Università degli Studi di Cagliari

DOTTORATO DI RICERCA IN

ECONOMIA

Ciclo XXVI

Essays on the Composition of Government Spending and Economic Growth

SSD SECS-P/01

Dottoranda: Stefania Marica

Coordinatore: Prof. Romano Piras

Tutor: Prof. Romano Piras

Esame finale anno accademico 2013 – 2014

Acknowledgements

Many people contributed to my thesis and to what I learned during my studies. First and foremost, I am grateful to my supervisor, Professor Romano Piras, for his support and guidance during all these years. As my postgraduate supervisor, he was who first introduced me to the fascinating research field. Without his help and continuous guidance this dissertation would have not been possible. I would also like to express my special gratitude to Professor Paolo Mattana for his patience and constructive feedback over the last four years.

I am indebted to the Department of Economics at the University of Cagliari for giving me the opportunity to complete my doctoral studies. In particular, I am particularly grateful to Professor Ivan Etzo, who kindly guided me in developing the methodology I applied in the second chapter of this thesis. I would also like to thank Professors Carla Massidda, Giovanni Masala, Giovanni Sulis, Alessio Moro, and Emanuela Marrocu for their valuable advice and the stimulating discussions.

I would also thank my fellow PhD students at University of Cagliari for being around and sharing this experience. Discussing ideas and opinions with them has made this endeavour more stimulating. In particular, I would like to thanks Massimo Pinna, Alejandra Alicia Vasquez, Tiziana Medda, Eleonora Corona, Alberto Nonnis and Farideh Tavazoee.

My final words of gratitude go to my family and my friends. I could have not completed this thesis without the support of my parents, their love and constant encouragement.

Thank you.

Contents

Chapter 3

List of Figures and Tables

Chapter 3

Alla mia famiglia

Introduction

"Public expenditure is the most powerful economic agent in all modern societies" (Arrow and Kurz, 1970).

My primary research interest lies in the relationship between government spending composition and economic growth, with particular attention to the Italian case. This dissertation comprises three academic papers, which have been into three corresponding chapters. In general, all three chapters address the same issue, but the level, scope of analysis and methodologies vary in each essay. The general scope of my research is to use both theoretical and econometric approaches to examine the influence and policy implications of different functions of government on economic growth.

Chapter 1 is titled **"Theoretical and Empirical Issues Related to Government Spending Composition and Growth: A Survey".** It discusses some theoretical and empirical aspects related to the influence of public spending on economic growth. From a theoretical point of view, prior to the endogenous growth models, no significant relationship was assumed to exist between economic growth and public expenditure. Since neoclassic growth models omit the factors that explain long-term growth, sometimes they are viewed as less useful and at worst inadequate. However, the recent argument in favour of the relevant relationship between public expenditure and long-run economic growth rests on the inclusion of fiscal policies into the endogenous growth models. This leads to the conclusion that public spending can affect long-run economic growth (Barro and Sala-i-Martin, 1992). Economic theory suggests several mechanisms by which government activity can affect growth, following both a linear and non-linear trend.

In this light, the first part of this chapter offers a literature review on the relationship between the size of government and economic growth to show how findings follow a contrasting pattern. In poor countries, public sectors are typically small, and the relationship between government size and growth is positive; in rich countries, where public sectors are typically large, the same relationship is less positive, and at times negative.

Generally speaking, there are many reasons to expect an inversely U-shaped relationship, which is also referred to as the Armey curve (Armey, 1995). At low levels of public expenditure, the Government cannot ensure they will respect private contracts and the property rights protection, thus determining a very low level of growth. Conversely, in case of very high levels of public expenditure, the citizens have not sufficient incentives to invest and produce because the amount of taxation necessary to finance this level of expenditure is excessively high. Either way, growth appears to be very low. It is reasonable to assume that an optimal level of expenditure exists. Beyond it, a further increase is likely to determine a fall in the level of output (with the consequent decrease of the growth rate).

The explosion of empirical studies on the endogenous growth led to the distinction of public expenditure into productive and consumption items (Barro, 1990; 1991). Henceforth, the second part of this chapter focuses on that more recent strand of the literature that attempts to evaluate the influence of functional breakdown of public spending on economic growth, thus going beyond the simple division between productive and unproductive expenditure. Studies that disaggregate public expenditures in healthcare, education, defence, infrastructures, housing sector and other expenditures categories show that the results change according to the specific countries under scrutiny, the analysed period and methodologies applied.

Chapter 2 is titled **"The Composition of Public Spending and Growth: Evidence from Italian Regions".** It examines the relationship between government spending composition and economic growth within an endogenous growth framework as developed by Ghosh and Gregoriou (2008) with two public goods, one being *a priori* more productive than the other. This theoretical model is an extension of Devarajan *et al.*'s. (1996) model in an optimal fiscal policy perspective. Put differently, this model addresses the fiscal policy issue in terms of the movements of the key endogenous fiscal variables being directly linked to the productivity parameters of the model. An important feature of the original model is that the generally assumed productive expenditure may become unproductive if the initial amount allocated to them is excessively large. The added value of this research project lies in its empirical analysis which is based on a panel of 19 Italian regions over the period 1996-2007. The dataset we use here is based on the Territorial Public Accounts (*Conti Pubblici Territoriali*) which contain economic data issued by the Italian Ministry of Economic Development (Dipartimento per lo Sviluppo e la Coesione Economica). These data provide the allocation of expenditures and revenues flows paid by/collected to each type of public administration within the 19 Italian regions under scrutiny. Our interest is to estimate the influence of economic and functional expenditure categories of the general government on real per capita GDP growth rate. The economic classification is based on the type or economic characteristics of expenditure (mainly capital and current expenditure). Conversely, the functional classification is based on the purpose or function towards which the expenditure is directed (e.g. expenditure on general public services, defence, economic affairs, healthcare, education and social protection). The functional breakdown of expenditures includes six components, which have been obtained

aggregating the thirty sectoral expenditure components on the basis of the available data. Furthermore, inside functional categories we distinguish between capital and current components. The reason for this further disaggregation resides in the fact that each functional expenditure component sum together of capital and current item. Hence, if one of the two has a significant growth effect but the other does not, the aggregate effect may be insignificant.
From a methodology standpoint, we opt to estimate the effects of fiscal policy by means the Generalized Method of Moments (GMM) dynamic panel estimators, as developed by Holtz-Eakin, Newey and Rosen (1990) and Arellano and Bond (1991). More specifically, we use the System-GMM approach suggested by Arellano and Bover (1995) and Blundell and Bond (1998) to tackle the finite sample biases caused by the employment of the difference-GMM estimators. These estimators allow us to handle the bias from unobserved country-specific effects, and to deal with potential endogeneity problems. This peculiar feature of our approach is relevant in this context due to the potential reverse causality that may exist between the shares of expenditure in total spending and economic growth. Preliminary results show only a weak effect of aggregate capital and current expenditure on economic growth when using System-GMM technique. In contrast, functional components seem not to have any significant effect on growth.
The results improve slightly when we take into account spatial correlation through a spatial lag model. Although there is no evidence of spatial autocorrelation in our specifications, the results show that the capital and current expenditure behaviour is driven by capital transfers and financial assets. In addition, it is also induced by current expenditure on personnel, purchases on goods and services, interest expense and other unclassified current expenditures. As for the functional components, the main result is given by capital expenditure on economic affairs, such as infrastructures, which plays an important role in augmenting the economic growth rate among Italian regions in the short period investigated here. Current expenditure on health, and capital and current expenditure on general public services had a negative and statistically significant effect on growth.

Chapter 3 is titled **“A Cointegration Analisys of Public Spending Composition for Italy: 1862-2007”.** It discusses the empirical investigation of the relationship between government spending composition and economic growth by using a historical time-series on the Italian case. Our aim is to estimate the effects of economic and functional components of government spending on economic growth both in the short- and long-run. As in our previous analyses, our theoretical reference framework is Ghosh and Gregorious’s (2008) model. In this chapter, we employ fiscal variables collected from the dataset of the Ministry of Economy (Ragioneria Generale dello Stato). To celebrate the 150th anniversary of the Italy’s Unification, this Ministry decided to collect and compile this database. The data is grouped according to capital and current expenditure (and their related sub-components). Another group is based on expenditures on defence, economic affairs, education and healthcare. The sample is divided as follows. One sample is limited to the period 1970-2007 due to the oil crisis occurred in 1970s and the availability of the private capital series (one of the endogenous key variables of the theoretical model) for that period only. We estimate this sample and its specifications are later used to estimate the remaining period (from 1862 to 1969), which has no private capital. After testing our series for unit roots with structural breaks, we can estimate the influence of the different components of public spending by means of an ARDL model. As for the first sample (1970-2007), the most surprising result is the negative effect of capital expenditure on economic growth, both in the short- and in the long-run. According to the theoretical model, the expenditures that are normally considered productive may became unproductive if an excessive amount of resources is devoted to them. In particular, capital expenditure appears to have been excessively high during the last forty years, thus resulting in an unproductive period at margin. On the other hand, current expenditure has an insignificant effect on economic growth both in the short- and in the long-run. Among functional components, expenditures on defence and economic affairs have a statistically significant effect on economic growth in the short-run. In contrast, the latter maintains a significant or even negative effect on real per capita GDP in the long-run only. As for the second sample period (1862-1969), we split it endogenously so as to establish two structural break dates. Overall, the results vary across sub-samples, but educational spending shows a positive and statistically influence on per capita GDP in the long-run.

Chapter 1

Theoretical and Empirical Issues Related to Government Spending Composition and Growth: A Survey

1. Introduction

A point of debate among economists is weather the public sector should or should not intervene to control the short-term fluctuations in economic activity. Classical and Keynesian economists have opposite views on such an approach. While classical economists believed that market forces were able to quickly bring economies to a long-run equilibrium, through adjustments in the labour market, the Keynesian school (Keynes, 1936) supports the fallibility of self-regulatory mechanisms, precisely because of the labour market rigidities. For this reason, the Keynesians evoke fiscal policies to support the economy during recession periods.

The link between fiscal policy and economic growth has raised a great deal of debate at both theoretical and empirical level. Public expenditure and national income have been the focus of public finance, since the amount of public expenditure has been increasing over time in almost all countries in the world.

Governments need to know the causal relationship between these two variables since the former play a significant role in the development of a country. The implication is that an increase in government expenditure could yield a positive or negative effect in the growth of a country's economy by increasing the national income.

From a theoretical standpoint, within the neoclassical framework, government policy, and particularly fiscal policy, has no role in determining the long-run economic growth rate[1], since this is determined by the exogenous population growth and technological progress rates. Due to the fact that neoclassical growth models omit those factors that explain long-un growth, sometimes the former are viewed as not particularly or, even worse, quite inadequate.

The explosion of works on endogenous growth, developed mainly since the early 1990s, has generated a number of models linking public spending to the economy's long term growth rate (Romer 1986, 1990; Lucas, 1988; Easterly, 1991; Barro, 1990; Barro and Sala-i-Martin, 1992, 2004, Cashin, 1995).

In endogenous growth models (cf. Romer, 1986, a forerunner in this sense), the production function is specified without diminishing returns. This implies that anything that affects the level of technology also affects the long-run per capita growth rate. From a fiscal policy perspective, this means that the growth effects of distortionary tax wedges are far greater than in neoclassical growth models. Thus, fiscal policies can be used to enhance efficient

[1] Government policy cannot affect growth except during the transition to the steady-state.

allocation of resources by correcting market failures and encourage higher human and physical capital productivity.

Barro (1990) offers a particularly simple version of endogenous growth models. His work, demonstrate to be a breaking point in the literature on the evolution of the role of public spending in growth theory. By allowing for productive public spending, i.e. public spending that increases private capital marginal productivity (e.g. infrastructures or property rights), Barro identifies the existence of a positive correlation between government spending and long-run economic growth. In this work, Barro models government spending (which is a flow variable in the economy's production function) in terms of public services and considers it to be complementary to private production.

The Barro (1990) model has been applied and developed by many. Barro and Sala-i-Martin (1992) are among those who tend to favour the application of the original model. They analyse the productive public good and its rivalry and excludability properties. Fisher and Turnovsky (1998) and Piras (2001) draw inspiration from this approach to study the congestion phenomenon. Moreover, Futagami, Morita and Shibata (1992) claim that public spending can be accumulated. Glomm and Ravikumar (1997) study the effects of productive spending financed by taxes on capital and/or labour. Agénor and Neanidis (2011) and Monteiro and Turnovsky (2013) combine productive public spending with human capital accumulation and study long-run growth effects.

Despite its apparent importance, the effects of public expenditure composition on growth have been rarely investigated, apart from few notable exceptions. These include theoretical works such as Barro (1990), who shows that when a government increases public consumption (utility enhancing) while reducing public spending (producing enhancing), growth rates fall regardless of the level of total spending. Devarajan *et al.* (1993, 1996) is an influent and more recent model focusing on least two component of public expenditure. These authors have developed a model that investigates two productive services (i.e. flow variables) in a CES production function. Out of these two variables of government expenditure, one is more productive than the other one. 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. Devarajan *et al.*'s model expresses the difference between the two types of expenditure by highlighting how a shift in the mix between the two alters the economy's long term growth rate. Ghosh and Gregoriou (2008) have extended this model within an optimal fiscal policy perspective.

Agénor (2010) show that reallocating expenditure from "unproductive" public spending to infrastructure spending would lead to a higher steady-state growth.

Much empirical work has been done to test the predictions of theoretical models, but the results differ greatly among studies. Some researcher find a positive relationship between government spending and economic growth (e.g. Niloy, 2003), while other studies (such as Romer, 1990; Folster and Henrekson, 1999) conclude that total government expenditures seem to have a negative effect on economic growth.

In his survey, Berg and Henrekson (2011) focus on the most recent papers that deal with the relationship between growth and government size. These authors conclude that the most recent studies typically find a negative correlation between total government size and economic growth.

Concerning the various categories of public expenditure, government expenditure on education and health care would raise labor productivity. Further, government expenditure on such infrastructure as roads and communications would also boost the rate of private domestic investment, which in turn fosters economic growth. Barro (1991) argues that "expenditures on education and defence are more like public investment than public consumption. In particular, these expenditures are likely to affect private sector productivity on property rights, which matters for private investment[2]". Anyway, the empirical evidence is mixed. For example, Baum and Lin (1993) find a positive and statistically significant impact of government expenditure on education and defence on economic growth, while Devarajan *et al.* (1996) find that these expenditures fail to produce such a positive effect. In a survey on the impact of government on long-run growth, Poot (2000) presents evidence of a positive link between growth and education spending, while the evidence on the negative growth impact of defence spending was moderately strong.

In this chapter, we review a wide body of the literature on the issues related to the empirical relationship between public spending, its composition and economic growth. Our survey shows in general that the influence of government spending composition is inconclusive, it varies across countries, time-span investigated and methodology employed.

The remainder of this chapter is organized as follows: Section 2 discusses the Wagner's Law and its empirical findings; Section 3 focuses on the application of the Armey Curve to investigate the non-linear relationship between government size and growth; Section 4 contains an empirical survey on the linear relationship between aggregate government spending and its components and economic growth; finally, Section 5 concludes this chapter.

[2] Barro (1991), pag. 430.

2. Causality Between Government Expenditure and Economic Growth: Wagner's Law

In terms of the relationship between public expenditure and growth, Wagnerians and Keynesians present two parallel views. According to the former, causality runs from growth of output to public expenditure whereas the latter postulate that causality runs from public expenditure to growth in times of recession.

Adolf H. Wagner, a German economist of the second half of the 19th century, first postulated a theory on the public expenditure increase that depends up the structural evolution of a society (Wagner, 1883). He conducted some research on the existence of a desirable limit regarding the size of the public sector, thus concluding that such a limit was impossible. In his opinion, the time path of public spending is essentially determined by the increase of national income such as the gross domestic product (GDP).

The empirical evidence concerning the relationship between national income and expenditure is based on the assessment of the elasticity of expenditure in relation to income. Only if such elasticity is significant, with a positive coefficient and greater than one, we may conclude that the link between the two variables exists and it is consistent with Wagner's hypothesis. It has been subjected to an empirical assessment by different researchers but the results obtained are contradictory and lead to conclude sometimes in favour of the existence of Wagner's Law, and sometimes against it. It essentially because the changing of countries analyzed, the temporal intervals considered and the methods applied.

Wagner's work is based on the empirical observations of Western industrializing countries. His main finding is that as the output increased in the past, public expenditure grew as well. Hence, his suggestion is not prescriptive, but rather explanatory in type. It does not contain any *a priori* assumption, but this idea encouraged a large number of researchers to study 'the law of increasing expansion of public expenditure' to find out whether it may empirically fit in industrializing countries.

While studying the causality between public expenditure and national income for India during the period 1950-1981, Singh and Sahni (1984) find that the effect of the growth of public expenditure on that of national income is relatively low if compared to its effect on the growth of expenditure income. The conclusion they reach is that public expenditure and national income are linked by a casual feedback mechanism, although empirical evidence suggests that such a causal relationship is neither of a Wagnerian nor a Keynesian type.

Ram (1986a, 1986b, 1987) tests the relationship between the share of public general expenditure and the per capita GDP in terms of elasticity. He does so by breaking the analysis down into two parts: time-series and cross-section. The time-series study is based 115 on countries, which have been analyzed over the period 1950-1980 showing low or modest differences between the various groups of countries. In addition, the ratio between results appears to be in line and in contrast to Wagner's hypothesis having an approximate 3:2 ratio. Out of the 115 countries under scrutiny, 41 display inferior to the unit elasticity; as for the remaining 75 countries, 54 of them feature a significant relationship at the 5% level. In the cross-section estimates, the time period is divided into three sub-periods: 1950-1960, 1961-1970 and 1971-1980 and into two sub-samples: developed and less developed countries. The results show that, in many cases, the elasticity of the government expenditure concerning the GDP is inferior to the unit. Hence, they do not seem to confirm Wagner's hypothesis.

Easterly and Rebelo (1993) find strong evidence in favour of Wagner's Law in the cross-section analysis relating to 115 countries during the period 1970-1988 and the analysis of 26 countries that considered the period from 1870 to 1988.

Henrekson (1993) notes how the crux of Wagner's Law originates from regressions to levels, and evokes Granger and Newbold's (1974) "causality test" in support of theses of erroneous inferences when variables are not steady. Indeed, Henrekson demonstrates how both income and the share of public expenditure on national product, even if correlated, are not cointegrated. To this end, he uses Sweden as his case study to carry out an empirical analysis on data in the historical series from 1861 to 1990. He ultimately concludes that correlations reported by other researchers are "spurious" in nature.

Koop and Poirier (1995) examine Wagner's hypothesis in terms of a long-term elasticity of the per capita government expenditure with regard to per capita income using a bivariate error-correction mechanism, which correspond to a co-integrated mechanism. Out of the 86 countries analysed, Wagner's hypothesis is supported by data in only one-third of them.

Chletsos and Kollias's (1997) study examines the validity of Wagner's law in the case of Greece by considering disaggregated public expenditure and using an error correction approach. The empirical findings suggest that Wagener's Law is valid only in the case of defence expenditure.

By comparing Latin America to OECD countries, Stein *et al.* (1998), show that the role of the public operator is more extensive in richest countries. In other words, those countries with a greater aggregate income tend to have wider public apparatus.

Islam (2001) re-examine the hypothesis at the basis of Wagner's law by means of advanced econometric techniques and find strong support for this law for the USA. Chang's (2002) study examines five different versions of Wagner's law for six countries and finds that, apart from one of this countries, all display long-run relationship between income and public expenditure.

Using a cross-country panel and random effects methods, Shelton (2007) regresses various measures of public expenditure on a vector of explanatory variables. He underlines that richest countries tend to have populations with a higher average age and this would force them to spend more in the area of social security and other forms of protection and public assistance. By calculating the fraction of population above 65 years old, he demonstrates that the countries with a greater national income would tend to have a larger state machine, which is in complete opposition to what Wagner' Law suggests. Put more simply, it may be the health and social expenditure that would lead the relationship between public expenditure and per capita income, which otherwise would not jointly increase.

A recent study by Lamartina and Zaghini (2011) on 23 OECD countries finds that the correlation between government activity and economic growth is higher in countries with low per-capita GDP, thus suggesting that the catching-up period is characterized by a stronger development of government activity with respect to economies in a more advanced state. This implies that, according to Wagner's hypothesis, the direct linkage between increasing state activity and economic growth might have a higher validity during early stages of development than at a later stage.

In order to shed some light on the coherence between the Wagner's Law and the development stage, Kuckuck (2012) uses historical data regarding five industrialized European countries, United Kingdom, Denmark, Sweden, Finland and Italy. He applies an advanced and vector error correction analysis and, in line with the Wagner's hypothesis, shows that the relationship between public spending and economic growth weakens due to the advanced stage of development.

Similarly, Magazzino (2010) aims to assess the empirical evidence of the Wagner's Law and applies it to Italy. By means of a time series approach, he studies the relationship between real GDP and five different items of real government spending, for the period 1960-2008. The results demonstrated to be not in much support of Wagner's Law, and the relationship between several items of government spending and national income appears to be more Keynesian than Wagnerian. Magazzino (2012) also examines the empirical evidence of Wagner's Law applying several time-series econometric techniques. This helps him to verify the correlation among variables, data stationary and cointegration so as to detect some possible spurious relationship and causality. He uses six alternative functional forms and applies them to data regarding the 27 European countries over the time period 1970-2009. Interestingly, the empirical evidence is in favour of the Wagnerian hypothesis.

Other studies that attempt to test Wagner's Law are mostly interested in the elasticity of public expenditure to community output. To this end, many scholars have developed several versions of the model to investigate and prove empirically what Wagner's Law suggests. Musgrave (1969), Goffman and Mahar (1971), Gupta (1967), Bird (1971), Gandhi (1971), and

Ganti and Kolluri (1979) examine the validity of Wagner's Law and they find elasticity to be greater than zero. In line with this, they claim that if the elasticity is greater than zero, then Wagner's Law is confirmed.

At the core of the Wagner's thesis is the interaction between the growth of the public sector and private activities. With the increase of economic development, exchanges intensify among operators and the network or relationships become more and more complicated and controversial. All this can be addressed through legislation and arrangement of new and heftier controls. Moreover, since the process of industrialization and urbanization creates external diseconomies, such as the congestion effect or the deterioration of the environment, the public sector has been called to face these challenges.

In contrast, the growth of social services can be explained by the general attempt to satisfy higher needs. A continuous expansion of social services is easily foreseeable and, since citizens finance such services with increasing shares of their resources, it would be senseless to set limits to these consumptions (Franco, 1993). Consequently, there is a limit to public sector growth. It may therefore follow a planned level of public expenditure (and a consequent predetermined relationship between this level and the national income) beyond which the community would not agree to give up increasing shares for private spending. Having reached this point, public spending should become fixed on a proportionally constant share of the general economic activity. It is possible, therefore, to highlight two distinct periods of development of expenditure. The first is distinguished by progressive growth, and its percentage variation of public expenditure turns out to be greater than the percentage variation of the aggregate income. Conversely, the second period is distinguished by proportional growth, when the percentage variation of public expenditure turns out to be equal to the percentage variation of the aggregate income.

3. A Non-Linear Relationship Between Government Size and Economic Growth: The Armey Curve

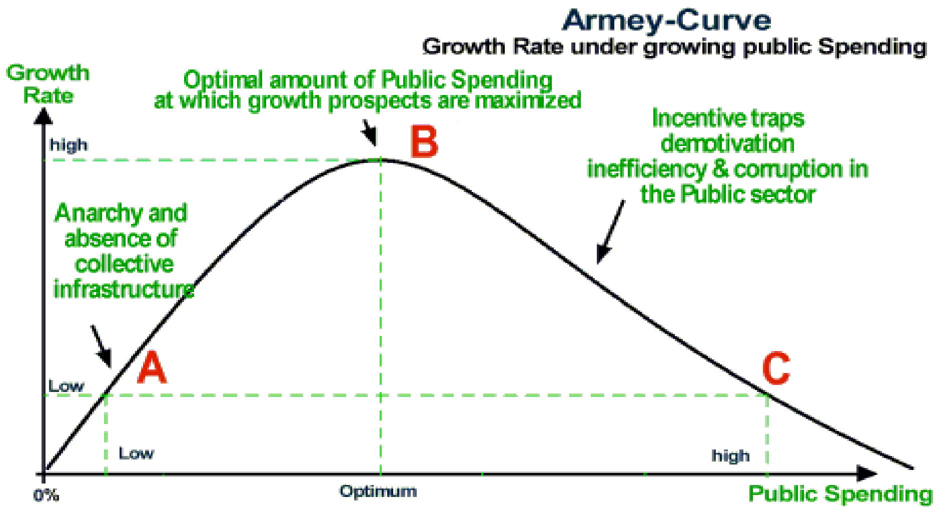
The economic growth provides different methods and tools to evaluate the role of the Government into the economic process. One of these is the Armey curve (1995), which takes its name from the Republican Senator Richard Armey, who first popularized it during a debate on the effects of public spending. This Curve correlates government expenditure and GDP growth rate, and has an inverse U shape. It is based on the fundamental law of diminishing returns, highlighting the government involvement's proportion into the economy (i.e. given by the ratio of government expenditure and GDP) and the real GDP growth rate. Armey suggested the idea that, in absence of a public sector, the economy produces a very low output (theoretically equal to zero). At low levels of public expenditure, the Government cannot guarantee it will respect private contracts and the property rights protection, thus determining a very low level of growth. Conversely, with very high levels of public expenditure, the citizens have not sufficient incentives to invest and produce because the amount of taxation necessary to finance this level of expenditure is too high. Once again, the growth appears to be extremely low. It is reasonable to assume that, starting with low levels, an increase of public expenditure is beneficial to growth. Similarly, starting with an extremely high level of expenditure and subsequently decreasing it leads to and increased GDP. However, those economic systems characterized by a mix of private and public decisions on the resource allocation display a higher and expected level of output.

As Figure 1 shows, increasing public expenditure also leads to an increase in the growth rate; this occurs faster in the descending portion of the curve, and more slowly after, thus reaching the maximum level of output in the B point, which represents an optimal level of expenditure[3]. After that point, a further increase in public spending determines a fall of the level of output (and consequently a slowing growth rate). Subsequently, the law of diminishing returns comes into play, which means that the higher level of public expenditure requires more taxes, thus discouraging the economic agents to produce and work. This implies the application of exist an optimal level of expenditure that is able to maximize the GDP growth rate.

Many models that explain why an excess of public expenditure can be negative for growth can be found in the literature. On the one hand, taxation generates a distortion in the economic agent behaviour, and therefore reduces efficiency. When spending to finance expenditures is high, taxation will be high as well, and distortion will be greater. On the other hand, from a dynamic point of view, a high tax burden on capital and labour income reduces growth and discourages physical and human capital accumulation. Furthermore, public spending can be beneficial to growth if it is complementary to private spending (consider for example the case of property rights protection), while if the latter replaces the former, private spending will slow down the growth rate.

[3] Optimum is defined as that point just before government becomes so large as to reduce the rate of economic growth and job creation. Governments are created to protect people and property. A government too small to establish the rule of law and protect people and their property from both foreign and domestic enemies is less than optimal.

Figure 1. Government spending size and economy growth

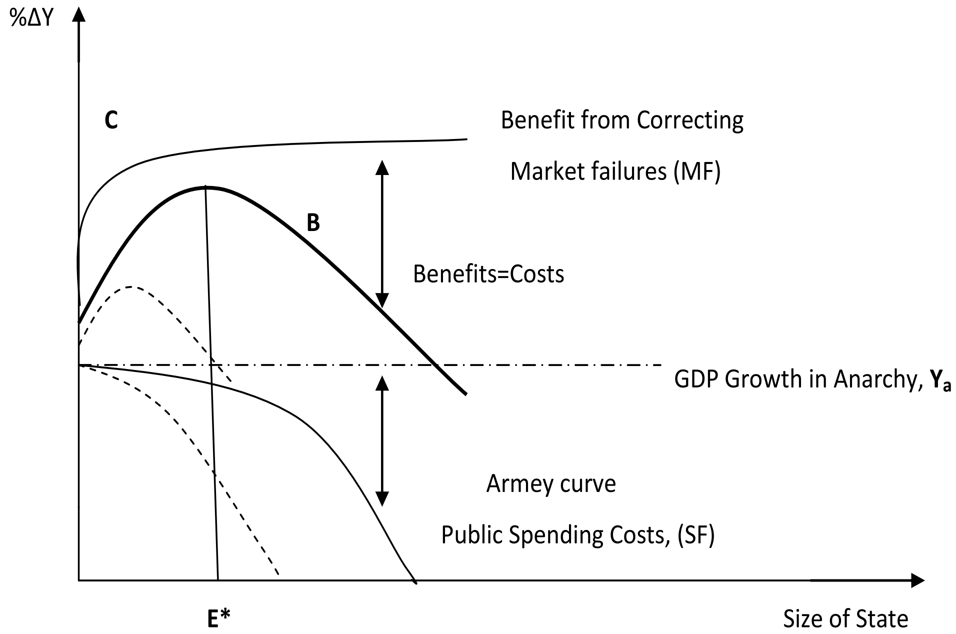


Source: Armey, 1995

Facchini and Melki (2011) further discuss the shape of the Armey curve by decomposing it into two curves that stand for the costs of the State failures and the benefits from correcting market failures. This enables to merge into a single theoretical framework, two sets of theories that are generally competing. The positive effect of public spending is explained by the benefits from correcting market failure, while the negative effect is explained by the costs inherent to State failure.

Figure 2 reports the MF curve that describes the positive effect of public spending with a decreasing marginal productivity, associated with the correction of market failures. Its slope is due to two different reasons: the law of diminishing returns due to the lack of market that however results in no market failures. Therefore, public spending has a positive impact on economic growth, but with a decreasing marginal effect. In contrast, the SF curve describes the negative effect of public spending, with decreasing marginal effects. The costs of public spending come from a crowding-out effect, effects of tax on market transaction costs, activities of rent seeking, political transaction costs and bureaucratic additional costs. The costs of public spending describe the declining part of the Armey curve, and the costs of public spending on economic growth increase at a steady rate. Facchini and Melki (2011) supply four reasons to explain the slope of the SF curve showed in Figure 2. First, the crowding-out effect increases more than proportionally with the size of government. This is due to the fact that, Welfare State affects entrepreneurs' productive activity by increasing its opportunity costs. Second, there is also a systematic crowding-out effect. Market prices solve the knowledge-dispersal problem since they convey already known information and contribute to the opinion forming process. Competition in market processes is a discovery procedure. Interestingly, the market inefficiency is not always a problem, because entrepreneurs perceive inefficiencies as opportunities to rearrange the pattern of input utilization or output consumption and to correct their expectation errors, i.e. they are opportunities for pure entrepreneurial profit.

Figure 2. Relationship between growth and government size: a decomposition of the Armey Curve



Source: Facchini and Melki (2011)

Public spending to correct market failures diminishes the numbers of solutions that market process can discover. We can therefore speak about systematic crowding-out effect because it can reduce both the economic knowledge available on the market and the number of participants. Third, the political transaction costs increase more than proportionally with the size of government because the displacement costs inside the public sector increase with the competition between the various interest groups. The intensity of competition increases with the size of government because public resources become scarce. The pro-education or the pro-safety groups spend more to obtain a marginal euro.

Fourth, the bureaucratic wastes rise more than proportionally with the size of government. It results from systematic crowding-out effect since they replace the price. There is no economic calculation. Nobody knows the value of goods and services. The structure of expenditure has no economic justification and it is only based on political reasons (Facchini and Melki, 2011).

So the U-inverted curve is the total effect of public spending, i.e. the combination of the benefits from correcting market failures (the MF curve in Figure 2) and the costs of State failure (the SF curve in Figure 2). Each country has its market and State culture. Public spending costs vary according to the level of bureaucratic inefficiency, the citizens' willingness to pay taxes and all those costs connected with the running and management of public institutions. Conversely, the more market price works, the lower the benefits from correcting its failures.

In Figure 2, E* is the optimal size of State. Before E*, the marginal benefits from correcting market failure are higher than the marginal costs. This means that, without government, the level of public spending is nil and the GDP growth rate would be Y_a. Beyond E*, the difference between benefits and costs decreases to become negative. Welfare enhancing through public spending is not necessarily desirable because public spending becomes too costly. These costs may exceed the benefits from correcting market failures. If the size of government remains at E*, the growth rate of GDP is maximized. Hence, the Armey curve theory is both positive and normative. It also supplies governments with an accurate size that can help them reach the highest production possibility frontier.

Facchini and Melki (2011) provide evidence of the existence of an inverted U-shaped relationship between government size and economic output using time-series data on France, a historical series from 1871 to 2008, and a quadratic model. Unlike many other studies, they also control for many exogenous factors. These authors find that the optimal size of the French Government (which was reached in the late 1940s), and measured as total spending as share of total GDP, would be 30 percent.

From an empirical point of view, many researchers attempted to determine the linear relationship between government spending and economic growth, while others sought to determine the level of public expenditure that maximizes growth rate. The threshold government size (which maximizes growth rate) is a point at which any rise in government spending that is lower than this value will have positive effects: in contrast, going over that value, will have negative effects on economic growth. Yet, results are still inconclusive. Sheehey (1993), Vedder and Gallaway (1998), and Chen and Lee (2005) point out that the inconsistency concerning the effect of government size on economic growth could be due to a non-linear rather than linear relationship.

Having analysed cross-countries data, Sheehey (1993) finds that government and economic growth have a positive relationship when government size (i.e. government consumption expenditure/GDP) is smaller than 15 percent. In contrast, the relationship is negative when government size becomes larger than 15 percent.

Karras (1996) estimates the optimal government size for several sets of economies by investigating the role of public services in the production process over the period 1960-1985. The empirical results suggest that government services are significantly productive and are overprovided in Africa, underprovided in Asia and optimally provided in America and Europe. Furthermore, the results show that the optimal government size is 23 percent for the average country, but ranges from 14 percent for the average OECD country to 33 percent in South America. Karras (1997) focuses on 20 European countries from 1950 to 1990 and estimates the optimal government size to be 16 percent and the marginal productivity of government services to be negatively related to government size. Consequently, the public sector may be more productive when small.

Vedder and Gallaway (1998) estimate the same relationship for the United States by means of the Armey Curve, over the period 1947-1997 and using five measurements for government size. They find evidence for the Armey Curve to be applicable only when "total government expenditures/GDP" or "net investment expenditure/GDP" are used as government size variables. The optimal size of federal expenditure for the data under scrutiny is equivalent to 17.45 percent of the US's GDP. They also find the optimum government size of other countries, including 21.37 percent in Canada (1854-1988), 26.14 percent in Denmark (1854-1988), 22.23 percent in Italy (1862-1988), 19.43 percent in Sweden (1881-1988), and 20.97 percent in the United Kingdom (1830-1988). However, these authors state that their results could be spurious because they do not take into account some factors that may affect the economic growth (as, for example, the innovation cycles).

Gwartney *et al.* (1998) find evidence that all different government size indicators have negative impact on economic growth.

Chao and Gruber (1998) estimate that, over the period 1929-1996, the optimum government spending size in Canada was about 27 percent. Tanzi and Schuknecht (1998) and Afonso, Schuknecht and Tanzi (2003) suggest that general government spending in excess of 30 percent of national output reduces economic growth.

Pevcin (2004) empirically verifies the existence of the relationship stated by Armey Curve for a sample of 12 European countries, over the period 1950-1996. The results suggest that the Armey Curve reaches its maximum point, meaning its optimal level of public expenditure, if it is at about 40 percent of the GDP. The results change slowly when using different estimation methods (the results range from 36.56 percent with Fixed Effect Model to 42.12 percent with Error Correction Model). In the sample under investigation, the total government expenditure in 1996 was on average 52.20 percent of the GDP. Therefore, the size of public sector was larger than the optimal level. Estimating the Armey Curve for a subsample of eight countries leads Pevcin to conclude that the optimal size is 42.90 percent for France, 38.98 percent for Finland, 45.96 percent for Sweden, 38.45 percent for Germany, 44.86 percent for the Netherlands, 42.28 percent for Ireland and 41.1 percent for Belgium. As for Italy, the total government expenditure (as share of GDP) in 1996 was 44.90 percent, while the optimal level of the Armey Curve was estimated to be equal to 37.09 percent, thus implying a potential reduction of about 18 percent.

Chen and Lee (2005) use a threshold regression approach for testing a non-linear relationship between government size and economic growth in Taiwan. They find different threshold values for different government sizes in Taiwan. Firstly, they explain that the threshold regime is 22.84 percent for "total government expenditure divided by GDP". This indicates that there is a non-linear relationship of the Armey Curve. In other words, when the government size is smaller than the regime, economic growth is promoted under expanding government expenditure. Conversely, if the government size is larger than the regime, then the economic growth decreases. Secondly, they point out that the threshold regime is equal to 7.30 percent when concerning the "government investment expenditure divided by GDP". Finally, they claimed that, when the variable "government consumption expenditure divided by GDP" is used as government size indicator, the threshold regime is 14.97 percent.

Chobanov and Mladenova (2009) examine the optimal size of government for a set of OECD countries. This optimal size is measured as overall government spending (i.e. a percentage of GDP) that maximizes economic growth. Overall, the results suggest that the optimal level of government spending is around 25 percent. However, these authors point out that, due to model and data limitations, the results seem to be biased upwards, and the "true" optimum government level is even smaller and also depends on the quality of government, not only by its size. Furthermore, they examine the relationship between general government consumption on final goods and services for a set of 81 countries and find that the optimal size of government consumption is 10.4 percent of GDP.

Mataşcu and Miloş (2009) take into consideration the real GDP growth and the total amount of public expenditures as percentage of GDP for the period 1999-2008. The main results point towards an optimum public size of 30.42 percent of GDP in EU-15 and a level of 27.46 percent of GDP in the EU-12 countries. The authors use a Pooled EGLS method (Period SUR) in both cases. De Witte and Moesen (2009) compute the optimal average government involvement in the 23 OECD countries and claim to amount to 41.22 percent of GDP.

Using the two-sector production function model developed by Ram (1986), Abounoori and Nademi (2010), estimate the threshold regression specification for Iran concerning the effect of government size on economic growth. They use three government size indicators to find out the different threshold points. The results show a non-linear relationship of the Armey Curve in Iran, where the threshold effects corresponding to total government expenditure share in GDP government consumption expenditure share in GDP, and government investment expenditure share in GDP are respectively 34.7 percent, 23.6 percent and 8 percent. This indicates that, when the government size is smaller than the regime, economic growth is promoted under expanding government expenditure, but if the government size is larger than the regime, then the economic growth decreases. Furthermore, the authors find that the results for government consumption, and especially government investment are over-expanding when, compared to their values observed over the period 1960-2006.

Herath (2010) applies an analytical framework based on time series and second degree polynomial regression. This approach confirms the possibility of constructing the Armey Curve for Sri Lanka from 1959 to 2003. She also estimates the optimal level of government expenditure to be approximately 27 per cent.

Nademi *et al.* (2010) applies the two-sector production function developed by Ram (1986) to estimate the threshold regression model for Islamic countries, thus following Armey's (1995) non-linear theory. Their empirical results confirm that, as far as the Islamic countries they examine are concerned, there is a non-linear relationship between government size and economic growth. Nademi *et al.* (2011) test the same relationship by following the same approach. Yet, for this study also adopt Hansen's (1996) heteroskedasticity-consistent Lagrange Multiplier (LM) approach by means of the bootstrapping method. They find that the Armey Curve is also applicable to the Iranian and Pakistani Economies.

The heterogeneous nature of the empirical results therefore seem to show that a unique optimal size of public spending in the economy that can hold for all countries cannot be found. Each country has their own optimal level, which depends on several factors and conditions, such as the economic development, the existence and efficiency of institutions in the economy market, the public sector efficiency, the state administration and the preferences of the population.

Overall, evidence shows that governments are generally larger than optimal. Yet, the ideal size of government cannot be plausibly determined. The data can realistically show that smaller governments are better, and suggest that the optimal size of government is smaller than what we observe today.

Furthermore, the optimum level obtained is shaped according to past data and it is likely that the periods analysed may affect the results of subsequent studies (Ekinci, 2011).

4. From Aggregate Public Spending to its Components

The empirical literature on the linear impact of government spending on economic growth may be subsumed under two main stands. One focuses on the effects of total government expenditures on economic growth (and it is therefore strongly related to the literature on the relationship between government size and growth). The other recognizes that different types of government expenditures may have different effects on growth.

4.1 Total government spending and economic growth

As for the first stand of the literature described above, several studies within it investigate the relationship between government spending and economic growth using different empirical methodologies, sample of countries and time spans. For instance, Cameron (1982) carries out a cross-country study that finds a negative bivariate correlation between the average percentages of GDP over the period 1960-1979. Cameron argues that the size of the effect is not very large, and notes that "a very dramatic increase in spending, in the range of 20 percentage points in GDP, a magnitude of increase that occurred in a few nations such as Sweden, the Netherlands and Denmark, would have reduced the rate of economic growth by only 1 percent".

The evidence obtained by early studies is typically restricted to cross-country regressions with no control variables. Agell *et al.* (2006) show how the negative bivariate correlation between government size and growth disappears when controlling for initial GDP and demography.

Landau (1983) examines 48 countries over the period 1961-1976 to find a negative relationship between public expenditure and growth. In the same vein, Marlow (1986) focusing on 19 industrialized countries over the period 1960-1980 and only controls for level and growth of social expenditure, thus supporting the view that public sector size retards overall economic growth.

Barro (1990) finds a significant negative relationship between government consumption share and the growth of real per capita GDP and determines insignificant positive effects of government investment.

Kneller *et al.* (1998) recognize that any study, which does not take into account both sides of the budget, suffers from relevant biases regarding the coefficient estimate. They maintain this further in Kneller *et al.* (1999) while examining a panel of 22 OECD countries over the period 1970-1975. In their research study, they find strong support for the Barro's (1990) model, according to which productive government expenditure enhances growth whilst non-productive expenditure does not. Other studies (such as Romer, 1990; Alexander, 1990; Folster and Henrekson, 1999) move in the same direction and conclude that total government expenditures have a negative effect on economic growth.

Folster and Henrekson (2001) investigate a panel of 22 rich OECD countries over the period 1970-1995 to find a robust and significant negative effect due to government expenditure and less robust negative effect due to total tax revenue. Agell *et al.* (2006) criticise Folster and Henrekson's (2001) study for the weakness of their results since including only OECD countries cannot be given a causal interpretation due to simultaneity. Agell *et al.* (2006) conclude that the correlation may be significantly less robust when only OECD countries are investigated.

Dar and Amirkhalkhali (2002) consider a panel of 19 OECD countries over the period 1971-1999 and find a significant negative relationship between total government expenditure and growth, either considering the entire period or taking the 1970s and 1980s separately (the 1990s do not seem to display significant effects). Furthermore, these authors also run country-specific regressions to find a significant negative effect for 16 out of the 19 countries under investigation. Agell *et al.* report a non significant relationship for the three out of those 19 countries. This relationship is negative but insignificant for Norway and Sweden and positive but insignificant for the USA.

Colombier (2009) examines the relationship between government size and economic growth for 21 OECD countries over the period 1970-2001. He finds a stable and positive, albeit small, growth effect of government size. In a thorough attempt to replicate this study, Bergh and Ohrn (2011) conclude that the results are not driven by the econometric method, but depend rather on the omission of time fixed effects and other control variables. Bargh and Ohrn demonstrate that adding time fixed effects produces a negative partial correlation in line with what other studies have found. Typically, adding controls for inflation, unemployment and economic openness does not change this, and often tends to increase the size of the negative coefficient on total tax revenue. Furthermore, using Colombier's data, they argue that direct taxation drives a negative correlation between taxes and growth.

Some other studies focus on a time-series dimension. For instance, Josaphat *et al*. (2000) investigate the impact of government spending on economic growth in Tanzania using time series data over the period 1965-1996 and find that increased productive expenditure (i.e. physical investment) has a negative effect on growth while consumption expenditure stimulates growth. Liu *et al.* (2008) examine the causal relationship between GDP and public expenditure for the United States data over the period 1947-2002. The results show that public spending raises the United States economic growth.

Dalena and Magazzino (2012) examine the long-run relationship between government expenditure and revenues for Italy over a historical time-series (1862-1993). By applying co-integration and causality techniques in the long- as well as in the short-run, they find that changes in government revenues (i.e. taxes) led to changes in government expenditures (the so called Tax-and-Spend hypothesis) during the period before World War I. In contrast, the interwar years were in line with the reverse relation according to which changes in government revenue respond to prior changes in government expenditures (displacement effect on Spend-and-Taxes hypothesis). Finally, the fiscal Synchronization hypothesis, which argues that expenditures and taxes are simultaneously adjusted, emerges in the republican age.

The literature on the relationship between government spending and economic growth is full of seemingly contradictory findings. Nonetheless, Bergh and Henrekson's (2011) survey concentrates on the most recent papers dealing with the relationship between growth and government size. This analysis shows that limiting the focus on studies regarding rich countries and considering measuring government size as total taxes or total expenditure relative to GDP and relying on panel data estimators with variation over time can help determine a more consistent picture. Research seems to be reaching general consensus regarding negative correlation. The negative sign seems not to be an unintended consequence of reverse causality in the sense that government generally expands during economic downturns.

Bergh and Henrekson (2011) find a significant negative correlation. Put differently, an increase in government size by 10 percentage points is associated with a 0.5 percent to 1 percent lower annual growth rate. The negative correlation has yet to be reconciled with the fact that big government is clearly correlated with higher levels of affluence. The aggregate correlation between government size and growth is also less relevant as far as policy concerned since political decisions are made on specific taxes and expenditure items, rather than aggregate. There are also strong theoretical reasons to expect different types of taxes and expenditures to have differential growth effects. However, it should be noted that this analysis mostly focuses on government expenditure effects rather than taxes on economic growth.

4.2 Public spending composition and growth

The development of endogenous growth models has allowed a new, the composition of public spending (and its components) that becoming increasingly relevant to growth. Only recently researchers started to evaluate the influence of public spending functional breakdown over economic growth. Consequently, the literature produced lately aims to estimate the elasticity of economic growth in relation to different items of government spending, using not only the distinction between productive and unproductive spending but also wide disaggregation.

Different functional spending components have been investigated in relation to economic growth, such as public infrastructure, healthcare and educational expenditures. For instance, starting from Aschauer's (1989) seminal contribution on United States data over the period 1949-1985, that shows a significant positive effect of investment expenditure on growth, other works with mixed empirical findings have subsequently followed.

Levine and Renelt (1992) use cross-country regressions to find a positive robust correlation between growth and the share of investment in GDP.

Baum and Lin (1993) examine the impact of three different types of government expenditures (i.e. defence, welfare and education) on the growth rate of per capita GDP using cross-section data from developed and developing countries over the period 1975-1985. They find that the growth rate of education and defence expenditure has positive effects on growth rate, while the growth rate of welfare expenditures has an insignificant negative effect on economic growth.

Acosta-Ormaechea and Morozumi (2013) study the effects of public expenditure reallocations on long-run growth. To this end, they compile a dataset comprising 56 countries (with different levels of income) for the period 1970-2010. Using dynamic panel GMM estimators, these authors find that a reallocation involving a rise in education spending has a positive and statistically robust effect on growth when the compensating factor remains unspecified or when this is associated with an offsetting reduction in social protection spending. Within social spending, the social protection component has often been assumed not to be productive (Kneller *et al.*, 1999), which could reflect the primary re-distributive nature of this type of outlay.

In general, in times of economic downturn, social expenditure provides stabilizers that automatically undermine the government's balanced budget. On the other hand, in boom years when growth rates are higher, fewer people will be unemployed, and public expenditure shares will be lower. Henceforth, a negative correlation between public expenditure and economic growth is to be expected in the short-run.

In the existing literature there is some evidence about the different effect of public spending expenditures on economic growth using a mix of developed and developing countries. It should be therefore assumed that studies evaluating the impact of public expenditure on growth should analyze both types of countries separately. Yet, findings are still controversial.

Devarajan *et al.* (1996) examine the relationship between government spending and composition and growth for a panel of 43 developing countries over the period 1970-1990. Using OLS and Fixed Effects models, they find that the share of current expenditure on total spending has a positive and statistically significant growth effect, while capital spending has a negative impact on growth. Furthermore, they also find a reverse relationship for a panel of 21 developed countries. The same result has been confirmed by Ghosh and Gregoriou (2008) who use a panel dataset for 15 developing countries over 28 years and apply a GMM technique. Gupta *et al.* (2005) assess the effects of fiscal consolidation and expenditure composition on economic growth in a sample of 39 low-income countries during the 1990s. The results (estimated by LSDV and GMM estimators) show that strong budgetary positions are generally associated with higher economic growth in both short and long terms. Gupta *et al.* find evidence that countries where spending is concentrated on wages tend to have lower growth, while those that allocate higher shares to capital and nonwage goods and services enjoy faster output expansion.

Niloy *et al.* (2003) examine growth effects of government expenditure for a panel of thirty developing countries over the period 1970-1980. They find that the share of government capital expenditure in GDP is positively and significantly correlated with economic growth, but current expenditure is insignificant.

Bose *et al.* (2007) obtain the same results using a panel of developing countries and including the complete specification of the government budget constraint. Moreover, they find that education is the key sector to which government should direct its resources in order to promote economic growth.

Easterly and Rebelo (1993) show that education spending is not always growth enhancing, pointing out that the promoting effects become statistically insignificant in some specifications. Likewise, Barro (2004), carries out a comprehensive study of growth determinants, also finds that an increase in public education spending does not have a statistically significant effect on growth. Barro also points out that defence spending can promote investment and thereby growth by enhancing entrepreneurs' property rights. Similarly, Agénor (2010) suggests that public health can influence growth by affecting labour productivity and individuals' discount factors.

Devarajan *et al.* (1996) find that expenditures on defence and education fail to produce a positive effect whereas and healthcare and transport and communication expenditures have positive effects on growth.

Hansson and Henrekson (1994) examine 14 rich countries over the period 1970-1987, and conclude that government transfers, consumption and total expenditure are consistently negatively related to growth of total factor productivity, whereas educational expenditure has a positive effect.

Romero-Avila and Strauch (2008) analyze data for 15 EU countries from 1960 to 2001. The results show a significant negative effect of government consumption and transfers, and a significant positive effect of government investment on growth. Furthermore, they find that direct taxes have negative and significant effects, but indirect taxes and social security contributions have no significant effects. These findings are in line with Widmalm (2001), who finds that taxes on personal income as a share of total tax revenue and more progressive taxes impede growth.

Afonso and Fuceri (2010) analyse using 28 OECD and EU countries during the period 1970-2004, to show how several revenue and expenditure sources, measured as a percentage of GDP and in terms of their business-cycle volatility, directly relate to growth. They demonstrate that indirect taxes, social contributions and government consumption have a sizable, negative and significant effect on growth, both in terms of size and volatility. As for subsidies, only their size influences growth, whereas only volatility matters for government investment. Thus, government investment is not bad for growth, but if it is highly volatile, growth on average suffers. Bottasso *et al.* (2013) evaluate the productive effect of public capital by estimating various production functions on a panel of 21 OECD countries over the period 1975-2002. The results show a positive long-run impact between public capital and output. The same authors do not find any relevant effect of public capital on GDP in the short-run, suggesting that public infrastructure investments might not be a powerful countercyclical policy instrument.

While analyzing time-series data on Switzerland from 1950 to 1994, Sing and Weber (1997) find that educational spending enhances economic growth. In contrast, health expenditure has the opposite impact. Furthermore, a negative effect of defence expenditure on growth has been observed in the short-run. Colombier (2009) draws the same conclusion while making use of Swiss data over the period 1950-2004.

Benos (2005) uses an unbalanced panel data set covering 16 OECD countries over the period 1970-1997 and decomposes public spending into various sub-categories and estimates the impact of each on economic growth. The results show that government spending on education, health and fuel-energy display a hump-shaped relationship with per capita growth, while public expenditures on housing-community amenities, social spending and transport and communication are characterized by a U-shaped relation with growth. Furthermore, the effect of public spending on education and social expenditures on growth are stronger the poorer a country is, while the opposite is true for expenditures on health. Akpan (2005) examines the effects of public spending composition and growth for Nigeria. The results show any significant relationship among variables. Nurudeen and Usman (2010) find different result using time-series data for Nigeria over the period 1970-2008. According to their analysis, capital, current and educational expenditures have a negative effect on growth, while health and transport and communication expenditures are growth enhancing.

Alshahrani and Alsadiq (2014) employ annual data for Saudi Arabia over the period 1969-2010 and find that, while private domestic and public investments, as well as healthcare expenditure, stimulate growth in the long-run, spending in the housing sector can also boost short-run production.

To the best of our knowledge, only few studies analyze the relationship between public spending composition and economic growth. Most studies focus on the impact of public stock of capital on production function. Picci's (1999) application of both Fixed and Ramdom Effects models, demonstrates a positive relationship between them. Nonetheless, the results are weaker when he adds some control variables to his experiment. De Stefanis and Sena (2005) also find a positive impact of public capital on total factor productivity (TFP). Bonaglia *et al.* (2000) find insignificant effects between public capital and productivity, while La Ferrara and Marcellino (2000) find a slight negative effect. Di Giacinto *et al.* (2012) make use of using different estimation methodologies over the period 1970-2001 and find that public capital enhances the Italian economic growth rate. These results show that the effect is higher when a VAR cointegration approach is employed.

Marrocu and Paci (2008) investigate the role played by public capital in increasing Italy's productivity levels. They examine a panel production function for all 20 Italian regions over the period 1996-2003 by using the Instrumental Variables (IV) method. The results show that public capital has a positive and significant effect on production, and the effects vary considerably between the two macro-areas of the country, namely Centre-North and Mezzogiorno (i.e. South of Italy). Furthermore, the disaggregation of the public capital stock into functional categories indicates a significant different impact within these two macro-areas. The most relevant outcome is that economic infrastructures are much more productive in the South, while the other type of public infrastructure (namely human capital infrastructures, social capital infrastructures and housing) seems to play a very limited role.

Grisorio and Prota (2013) examine the decentralization process effects on the share of different categories of public expenditures for the Italian regional administrations over the period 1996-2008. Using an economic and functional classification of expenditures, they show that the level of decentralization influences the expenditure composition. Grisorio and Prota (2015) also analyze the same relationship adopting a panel cointegration approach. The results reveal that the level of decentralization also influences the expenditure composition in the long-run. Indeed, it reduces welfare spending and has a positive effect on the share of expenditure to support productive activities.

5. Concluding Remarks

In this chapter, I have provided an overview of the literature regarding public spending, its functional breakdown and economic growth. Since Solow (1956) first proposed his neoclassical model, much research has concentrated on the absence of long-run economic growth. Subsequently, Romer's (1986) theoretical seemed to have shed some light on this topic, emphasizing the existence of an endogenous economic growth rate in the long-term. More recently, Barro's (1990) model has concentrated on productive public spending.

According to the endogenous growth models, fiscal policy affects the long-term growth rate through decisions on both taxes and expenditures. This happens because both of them can affect decisions by private firms about investing in human capital, knowledge or research and development, which constitute the engine of growth within the endogenous growth framework.

Bergh and Henrekson (2011) point out that, if productive government expenditures are characterized by decreasing returns, the negative effect of taxes to finance public expenditure may at some point dominate the positive effect of growth-promoting government activities. There are also reasons to expect the marginal negative effect of government size in increase absolute terms as government grows. For instance, in an attempt to finance rising expenditure, government may increase taxes and/or borrowing. Higher income taxation discourages individuals from working many hours or even seeking employment. This in turn reduces income and aggregate demand. Similarly, higher profit tax tends to increase production costs and reduce investment expenditure as well as profitability of firms.

Although different types of expenditure and taxes are likely to have different growth effects, I have started by describing studies that examine the aggregate correlation between total government size and growth.

From an empirical point of view, research seems to offer mixed and opposing results. On the one hand, scholars assert a linear positive or negative relationship between public spending and growth. Conversely, others assert the existence of a non-linear correlation between them. Despite the absence of unanimous consensus in the literature, existing evidence seem to confirm Barro's (1990) predictions, which maintain that, in poor countries, public sector are typically small, and the relationship between government size and growth is positive. In rich countries, public sectors are typically large, and the same relationship is less positive than in poor countries, and possibly negative.

Moreover, government expenditures on public and other goods with positive externalities play a crucial role as they can lead to higher economic growth.

Studies that disaggregate public expenditures in healthcare, education, defence, infrastructures, housing sector and other expenditures show that results change according to the methodology, sample and time span under investigation. For instance, the results differ if the sample under scrutiny comprises developed and developing countries. Moreover, they may also diverge if considering only one of these two typologies of countries. Although research in this field is progressing rapidly, further evidence is certainly much need.

References

Abounoouri, E. and Nademi, Y. (2010) "Government Size Threshold and Economic Growth in Iran", *International Journal of Business and Development Studies*, 2, pp. 95-108.

Acosta-Ormahcea, S. and Atsuyoshi, M. (2013) "Can a Government Enhance Long-Run Growth by Changing the Composition of Public Expenditure?" *International Monetary Fund* Working Paper, 13/162, Washington, DC.

Afonso, A. and Fuceri, D. (2010) "Government Size, Composition, Volatility and Economic Growth", *European Journal of Political Economy*, 26, pp. 517-532.

Afonso, A., Schuknecht, L. and Tanzi, V. (2003) "Public Sector Efficiency: An International Comparison", Working Paper No. 242, *European Central Bank*.

Agell, J. (1996) "Why Sweden's Welfare State needed Reform", *Economic Journal*, 106, pp. 1790-1771.

Agell, J., Lindh, T. and Ohlson, H. (1997) "Growth and the Public Sector: A Critical Review Essay", *European Journal of Political Economy*, 13, pp. 33-52.

Agell, J., Ohlsson, H. and Skogman Thoursie, P. (2006) "Growth Effects of Government Expenditure and Taxation in Rich Countries: A Comment", *European Economic Review*, 50, pp. 211-219.

Agénor, P. R. (2010) "A Theory of Infastructure-led development", *Journal of Economic Dynamics & Control*, 34, pp. 932-950.

Agénor, P. R. and Neanidis, K. C. (2011) "The Allocation of Public Expenditure and Economic Growth", *The Manchester School*, 79, pp. 899-931.

Alexander, W. R. J. (1990) "Growth: Some Combined Cross-Sectional and Time-Series Evidence from OECD Countries", *Applied Economics*, 22, pp. 1197-1204.

Alshahrani, S. A., and Alsadiq, A. J. (2014) "Economic Growth and Government Spending in Saudi Arabia: An Empirical Investigation", *International Monetary Fund (IMF)* Working Paper, WP/14/3.

Akpan, N. (2005) "Government Expenditure and Economic Growth in Nigeria: A Disaggregated Approach", *CBN Economic and Financial Review*, 43.

Armey, D., (1995), "The Freedom Revolution", Washington, Regnery Publishing Co.

Arrow, K. J. and Kurz, M., (1970) "Public Investment, the Rate of Return and Optimal Fiscal Policy, (*Johns Hopkins University,* Baltimore, MD).

Aschauer, D. (1989) "Is Government Spending Productive?", *Journal of Monetary Economics*, 23, pp. 177-200.

Barro, R. J., (1990) "Government Spending in a Simple Model of Endogenous Growth," *Journal of Political Economy*, 98, pp. s103-s125.

Barro, R. J. (1991) "Economic Growth in a Cross Section of Countries", *The Quarterly Journal of Economics*, CVI, pp. 407-443.

Barro, R. and Sala-i-Martin, X., (1992) "Public Finance in Models of Economic Growth", *Review of Economic Studies*, 59, pp. 645-661.

Barro, R. and Sala-i-Martin, X., (2004) "Economic Growth", *The MIT Press,* Cambridge, Massachusetts, London.

Baum, N. D. and Lin, S. (1993) “The Differential Effects on Economic Growth of Government Expenditures on Education, Welfare, and Defense”, *Journal of Economic Development*, 18, pp. 175-185.

Benos, N., (2005) “Fiscal Policy and Economic Growth: Empirical Evidence from OECD Countries”. *Discussion Paper 2005-01, University of Cyprus.*

Bergh, A. and Henrekson, M. (2011) “Government Size and Growth: A Survey and Interpretation of the Evidence”, *Journal of Economic Surveys*, 25, pp. 872-897.

Bergh, A. and Ohrn, N. (2011) “Growth Effects of Fiscal Policies: A Critical Appraisal of Colombier’s study”, IFN Working Paper 858, *Research Institute of Industrial Economics,* Stockholm*.*

Bird, R. M. (1971) “Wagner’s Law of Expanding State Activity”, *Public Finance*, 26, pp. 1-26.

Bonaglia, F., La Ferrara, E. and Marcellino, M. (2000) “Public Capital and Economic Performance: Evidence from Italy”, *Giornale degli Economisti e Annali di Economia*, 2.

Bose, N., Haque, M.E., and Osborn, D.R. (2007) “Public Expenditure and Economic Growth: A Disaggregated Analysis for Developing Countries”, *The Manchester School*, 75, pp. 533-56.

Bottasso, A., Castagnetti, C. and Conti, M. (2013) “And jet they Co-move! Public Capital and Productivity in OECD”, *Journal of Policy Modeling*, 35, pp. 713-729.

Cameron, D. (1982) “On the Limits of the Public Economy”, *Annals of the Academy of Political and Social Science*, 459, pp. 46-62.

Cashin, W. E. (1985) “Improving Lectures”, Idea Paper No. 14, Manhattan: *Kansas State University, Center for Faculty Evaluation and Development.*

Chao, J. C. P. and Grubel, H. (1998) “Optimal Levels of Spending and Taxation in Canada”, In Herbert Grubel, eds. *How to use the fiscal surplus Vancouver*: The Fraser Institute, pp. 53-68.

Chang, T. (2002) “An Econometric Test of Wagner’s Law for Six Countries based on Cointegration and Error Correction Modeling Techniques”, *Applied Economics*, 34, pp. 1157-1170.

Chen, S., and Lee, C. (2005) “Government Size and Economic Growth in Taiwan: A Threshold Regression Approach”, *Journal of Policy Modeling*, 27, pp. 1051-1066.

Chletsos, M. and Kollias, C. (1997) “Testing Wagner’s Law using Disaggregated Public Expenditure Data in the Case of Greece: 1958-1993”, *Applied Economics*, 29, pp. 371-377.

Chobanov, D. and Mladenova, A. (2009) “What is the Optimum Size of Government”, *Institute for Market Economics, Bulgaria.*

Colombier, C. (2009) “Growth Effects of Fiscal Policies: An Application of Robust Modified M-estimator”, *Applied Economics*, 41, pp. 899-912.

Dalena, M. and Magazzino, C. (2012) “Public Expenditure and Revenue in Italy, 1862-1993”, *Economic Notes by Banca Monte dei Paschi di Siena SpA*, 41, pp. 145-172.

Dar, A. A. and AmirKhalkhali, S. (2002) “Government Size, Factor Accumulation, and Economic Growth: Evidence from OECD Countries”, *Journal of Policy Modeling*, 24, pp. 679-692.

De Stefanis, S. and Sena, V. (2005) “Public Capital and Total Factor Productivity: New Evidence from the Italian Regions, 1970-1998”, *Regional Studies*, 39, pp.603-617.

Devarajan, S., Swaroop, V. and Zou, H. F., (1993) “ What Do Governments Buy? The Composition of Public Spending and Economic Performance”, *Working Papers 1082.*

Devarajan, S., Swaroop, V., and Zou, H. F., (1996) "The Composition of Public Expenditure and Economic Growth", *Journal of Monetary Economics*, 37, pp. 313-44.

De Witte, K. and Moesen, W. (2008) "The Performance of Government", *Review of Business and Economics*, 53, pp. 171-187.

Di Giacinto, V., Micucci, G. and Monatanaro, P. (2012) "Network Effects of Public Transport Infrastructure: Evidence on Italian Regions", *Papers in Regional Science*, 91, pp. 515-541.

Easterly, W. and Rebelo, S., (1993) "Fiscal Policy and Economic Growth", *Journal of Monetary Economics*, 32, pp. 417-458.

Ekinci, A., (2011) "What is the Optimum Size of Government: A Suggestion", *International Journal of Economics and Finance Studies*, 3, pp. 45-54.

Facchini, F. and Melki, M. (2011) "Optimal Government Size and Economic Growth in France (1871-2008): An Explanation by the State and Market Failures", *Documents de travail du Centre d'Economie de la Sorbonne, Université Panthéon-Sorbonne; Centre d'Economie de la Sorbonne*.

Feldstein, M. (2006) "The Effect of Taxes on Efficiency and Growth", *NBER Working Paper* No. 12201, May 2005.

Fisher, W. H. and Turnovsky, S. J. (1998) "Public Investment, Congestion, and Private Capital Accumulation", *Economic Journal*, 108, pp. 399-413.

Fölster S. and Henrekson M., (2001) "Growth Effects of Government Expenditure and Taxation in Rich Countries", *The European Economic Review*, 45, pp. 1501-1520.

Fölster, S. and Henrekson, M., (1999) "Growth and the Public Sector: A Critique of the Critics", *European Journal of Political Economy*, 15, pp. 337-358.

Franco, D. (1993) "L'Espansione della Spesa Pubblica in Italia", *Il Mulino*, Bologna.

Futagami, K., Morita, Y. and Shibata, A. (1993) "Dynamic Analysis of an Endogenous Growth Model with Public Capital", *Scandinavian Journal of Economics*, 95, pp. 607-625.

Gandhi, V. P. (1971) "Wagner's Law of Public Expenditure: Do Recent Cross-Section Studies Confirm It?, *Public Finance*, 26, pp. 44-56.

Ganti, S. and Kolluri, B. R. (1979) "Wagner's Law of Public Expenditures: Some Efficient Results for the United States", *Public Finance*, 34, pp. 225-233.

Ghosh, S. and Gregoriou, A., (2008) "The Impact of Government Expenditures on Growth: Empirical evidence from an Heterogeneous Panel", *Bulletin of Economic Research*, 61, pp. 95-102.

Glomm, G., and B. Ravikumar, (1997) "Productive Government Expenditures and Long-Run Growth", *Journal of Economic Dynamics and Control*, 21, pp. 183-204.

Goffman, I. J. and Mahar, D. J. (1971) "The Growth of Public Expenditure in Selected Developing Nations: Six Caribbean Countries", *Public Finance*, 26, pp. 57-74.

Granger C. W. J., Newbold, P. (1974) "Spurious Regressions in Econometrics", *Journal of Econometrics*, 2, pp. 111-120.

Grisorio, M. J. and Prota, F. (2013) "The Impact of Fiscal Decentralization on the Composition of Public Expenditure: Panel Data Evidence from Italy", *Regional Studies*.

Grisorio, M. J. and Prota, F. (2015) "The Short and the Long Run Relationship between Fiscal Decentralization and Public Expenditure Composition in Italy", *Economics Letters*, 130, pp. 113-116.

Gupta, S. P. (1967) "Public Expenditure and Economic Growth: A Time-Series Analysis", *Public Finance*, pp. 423-461.

Gupta, S., Clements, B., Baldacci, E. and Mulas-Granados, C. (2005) "Fiscal Policy, Expenditure Composition, and Growth in Low-Income Countries", *Journal of International Money and Finance*, 24, pp. 441-463.

Gwartney, J., D., Lawson, R. A. and Holcombe, R., G., (1998) "The Size and Function of Government and Economic Growth", *Washington, D.C.: Joint Economic Committee of the U.S. Congress.*

Hansson, P. and Henrekson, M., (1994) "A New Framework for Testing the Effect of Government Spending on Growth and Productivity", *Public Choice*, 81, pp. 381-401.

Henrekson, M. (1993) "Wagner's Law – A Spurious Relationship?" *Public Finance*, 46.

Herath, S. (2010) "The Size of the Government and Economic Growth: An Empirical Study of Sri Lanka", *SRE Discussion Papers*, 2010/05. WU Vienna University of Economics and Business, Vienna.

Islam, A. M. (2001) "Wagner's Law Revisited: Cointegration and Exogeneity Tests for USA", *Applied Economics*, 8, pp. 509-515.

Josaphat, P. K. and Oliver, M. (2000) "Government Spending and Economic Growth in Tanzania", 1965-1996: *CREDIT Research Paper* (University of Nottingham).

Karras, G., (1996) "The Optimal Government Size: Further International Evidence on the Productivity of Government Services", *Economic Inquiry*, pp. 193-203.

Karras, G., (1997) "On the Optimal Government Size in Europe: Theory and Empirical Evidence", *The Manchester School,* LXV, pp. 280-294.

Keynes, J. M. (1936) "The General Theory of Employment Interest and Money", *New York: Harcourt, Brace & World Inc.*

Kneller, R., Bleaney, M., and Gemmell, N., (1998) "Growth, Public Policy and the Government Budget Constraint: Evidence from OECD Countries", *School of Economics, Discussion paper n. 98/14. University of Nottingham.*

Kneller, R. A., Bleaney M. F. and Gemmell, N. (1999) "Fiscal Policy and Growth: Evidence from OECD Countries", *Journal of Public Economics*, 74, pp. 171-190.

Koop, G. and Poirier, D. J. (1995) "An Empirical Investigation of Wagner's Hypothesis by Using a Model Occurrence Framework", *Journal of the Royal Statistical Society*, Series A, 158, pp. 123-141.

Kormendi, R. C. and Meguire, P. C., (1985) "Macroeconomic Determinants of Growth: Cross-Country evidence", *Journal of Monetary Economics*, 16, pp. 141-164.

Kuckuck, J. (2012) "Testing Wagner's Law at Different Stages of Economic Development – An Historical Analysis of Five Western European Countries", *Institute of Empirical Economic Research*, Working Paper 91, Osnabrueck University, Germany.

La Ferrara, E. and Marcellino, M. (2000) "TFP, Costs, and Public Infrastructure: An Equivocal Relationship", *IGIER Working Paper*, n. 176.

Lamartina, S. and Zaghini, A. (2012) "Increasing Public Expenditure: Wagner's Law in OECD Countries", *German Economic Review*, 12, pp. 149-164.

Landau, D. (1983) "Government Expenditure and Economic Growth: A Cross-Country Study", *Southern Economic Journal*, 49, pp. 783-792.

Levine, R. and Renelt, D., (1992) "A Sensitivity Analysis of Cross-Country Growth Regression", *American Economic Review*, 82, pp. 942-963.

Liu, C. HL, Hsu, C., Younis, M. Z. (2008) "The Association Between Government Expenditure and Economic Growth: The Granger Causality Test of the US Data, 1974-2002", *Journal of Public Budgeting, Accounting and Financial Management*, 20, pp. 439-452.

Lucas, R. (1988) "On the Mechanics of Endogenous Growth", *Journal of Monetary Economics*, 22, pp. 3-42.

Magazzino, C. (2010) "Wagner's Law in Italy: Empirical Evidence from 1960 to 2008", *G. & L. E. R.*, 14, pp. 91-115.

Marlow, M. L. (1986) "Private Sector Shrinkage and the Growth of Industrialized Economies", *Public Choice*, 49, pp. 143-154.

Marrocu, E. and Paci, R. (2008) "The Effects of Public Capital on the Productivity on the Italian Regions", *Applied Economics*, pp. 1-14.

Monteiro, G. and Turnovsky, S. (2013) "Anticipated Consumption and its Impact on Capital Accumulation and Growth: Forward-Looking vs. Backward-Looking" Consumption Reference", *CESifo Working Paper* Series 4536, CESifo Group Munich.

Musgrave, R. A. (1969) "Fiscal Systems", *Yale University Press*, New Haven.

Mutascu, M. and Milos, M. C. (2009) "Optimal Size of Government Spending. The Case of European union Member States", *Annales Universitatis Apulensis Series Oeconomica*, pp. 1-11.

Nademi, A., Nademi, Y., Paghe, A.A., and Vaziri, H. (2011) "Does Armey Curve Exist in Pakistan and Iran Economies?", *Journal of Applied Sciences Research*, 7, pp. 562-565.

Nademi, Y., Samimi, A. J. and Zobeiri, H. (2010) "Government Size and Economic Growth: A Threshold Regression Approach in Selected Islamic Countries", *Australian Journal of Basic and Applied Sciences*, 4, pp. 2247-2249.

Niloy, B., Emranuel, M. H., and Denise, R. O. (2003) "Public Expenditure and Economic Growth: A Disaggregated Analysis for Developing Countries", *JEL*, Publications.

Nurudeen, A. and Usman, A. (2010) "Government Expenditure and economic Growth in Nigeria, 1970-2008: A Disaggregate Analysis", *Business and Economics Journal*, 4.

Pevcin, P., (2004) "Does Optimal Size of Government Exist?", Paper presented at the *EGPA (European Group of Public Administration)*, 2004 Annual Conference, 1-4 September, Ljubljana, Slovenia.

Picci, L. (1999) "Productivity and Infrastructure in the Italian Regions", *Giornale degli Economisti e Annali di Economia*, 58, pp. 329-353.

Piras, R. (2001) "Government Spending Composition in an Endogenous Growth Model with Congestion", *Metroeconomica*, 52, pp. 121-136.

Poot, J. (2000) "A Synthesis of Empirical Research on the Impact of Government on Long-Run Growth", *Growth and Change*, 31, pp. 516-546.

Ram, R. (1986a) “Government Size and Economic Growth: A New Framework and Some Evidence from Cross Sectional and Tim Series Data”, *American Economic Review*, 76, pp. 191-203.

Ram, R. (1986b) “Causality Between Income and Government Expenditure: A Broad International Prospective”, *Public Finance*, 41, pp.393-414.

Ram, R. (1987) “Wagner’s Hypothesis in Time-Series and Cross-Section Perspectives: Evidence from “Real” Data for 115 Countries”, *The Review of Economics and Statistics*, 69, pp. 194-204.

Romer, P.M. (1986) “Increasing Returns and Long-Run Growth”, *Journal of Political Economy*, 94, pp. 1002-1037.

Romer, P. (1990) “Endogenous Technological Change”, *Journal of Political Economy*, 98, pp. 71-102.

Romero-Avila, D. and Strauch, R. (2008) “ Public Finances and Long-Term Growth in Europe: Evidence from a Panel Data Analysis”, *European Journal of Political Economy*, 24, pp. 172-191.

Shelton, C. A. (2007) “The Size and Composition of Government Expenditure”, *Journal of Public Economics*, 91, pp. 2230-2260.

Singh, B., and Sahni, B. S. (1984) “Causality between Public Expenditure and National Income”, *Review of Economics and Statistics*, 56, pp. 630-644.

Singh, R. J. and Weber, R. (1997) “The Composition of Public Expenditure and Economic Growth: Can Anything be Learned from Swiss Data?”, *Schweizerische Zeitschrift fur Volkswirtschaft und Statistik*, 133, pp.617-634.

Solow, R. (1956) “A Contribution to the Theory of Economic Growth”, *Quarterly Journal of Economics*, 70, pp. 65-94.

Stein, E., Talvi, E. and Grisanti, A. (1998) “Institutional Arrangements and Fiscal Performance: the Latin American Experience”, *Inter-American Development Bank, Office of the Chief Economist*, Working Paper, 367, February.

Swan, T. W. (1956) “Economic Growth and Capital Accumulation”, *Economic Record*, 32, pp. 334-361.

Vedder, R. K. and Gallaway, L., (1998) “Government Size and Economic Growth”, *Paper presented for the Joint Economic Committee of the US Congress,* pp. 1-15.

Wagner, A. (1883) “Three extracts on Public Finance”, in R. A. Musgrave and A. T. Peacock (eds.), 1958, *Classic in the Theory of Public Finance*. London: Macmillan.

Widmalm, F. (2001) “Tax Structure and Growth: Are some Taxes Better than Others?”, *Public Choice*, 107, pp. 199-219.

Chapter 2

The Composition of Public Spending and Growth: Evidence from Italian Regions

1. Introduction

The role of fiscal policy in the long-run growth process has been central in macroeconomics especially since the birth of endogenous growth models. In a seminal paper, Barro (1990) models the productive government spending in terms of public services, a low variable, being in the economy's production function, instead Futagami *et al.* (1993) introduce public capital, as a stock variable. The theoretical relationship between the composition of government expenditure and growth is investigated by Devarajan *et al.* (1996), Ghosh and Roy (2004), Chen (2006) and Ghosh and Gregoriou (2008)[4].

Devarajan *et al.* (1996) have developed a model that defines two productive services as flow variables in a CES production function. Furthermore, one type of government expenditure is seen to be as more productive than the other. Consequently, 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. The model expresses the difference between the two types of expenditure by how a shift in the mix between the two alters the economy's long term growth rate. Ghosh and Gregoriou (2008) have extended Devarajan *et al.*'s (1996) theoretical model in an optimal fiscal policy perspective, rather than taking governmental decisions as a given.

Several researchers have attempted to analyze the aggregate public spending effects on economic growth. Yet their results have been thus far inconclusive and mixed. Some authors find that the impact of government expenditure on economic growth is negative or non significant (Landau, 1983; 1986; Kormendi and Meguire, 1985; Aschauer, 1989; Romer, 1990; Barro, 1990, 1991; Easterly and Rebelo, 1993; Grier and Tullock, 1999; Folster and Henrekson, 1999; 2001). Others find that the impact of government is positive and significant (Aschauer, 1989; Sàez and García, 2005).

Only recently researchers started to evaluate the influence of the composition of public spending on economic growth. With this objective in mind, scholars have aimed to estimate the elasticity of economic growth in reference to different items of government spending. They have made use of a wide disaggregation along with the pure distinction between productive and unproductive spending. A number of papers have specifically investigated how compositional changes in public spending affects economic growth by means of panel data

[4] Ghosh and Gregoriou's (2008) model consider two productive services as flow variables.

approaches (Devarajan *et al.*, 1993, 1996; Kneller *et al.*, 1999; Benos, 2005; Bose *et al.*, 2007; Ghosh and Gregoriou, 2008; Martins and Veiga, 2014; Acosta-Ormachea and Morozumi, 2013). It is broadly accepted that public spending on infrastructure such as roads, railways, bridges, telecommunications, expenditures on research and development, education and health are growth-enhancing in economy. Moreover, they are the most functional categories examined in the literature. It is generally assumed that to find a positive relationship between expenditures on education, health and growth, because they promote accumulation of human capital. Nonetheless, evidence appears not to be exhaustive. For instance, some works find a positive effect (e.g. Bose *et al.*, 2007; Acosta-Ormachea and Morozumi, 2013), while others find that an increase in public education spending has a negative or not statistically significant effect on growth (Devarajan *et al.*, 1996; Barro, 2004; Ghosh and Gregoriou, 2008). Benos (2009) finds a non-linear effect on growth. For instance, Barro and Sala-i-Martin (1995) and Hansson and Henrekson (1994b) find a significant positive effect on growth from educational spending and Aschauer (1989) found that public investment in infrastructure has had a positive effect on the growth rate in the United States. However, when government expenditure is increasingly channelled to transfer payments and taxes are raised, there are many theoretical reasons to believe that there is a point where higher government spending begins to have a negative effect on growth.

From an empirical point of view, most of existing works focus on developing and developed countries. It seems important to remark that the potential growth effects of public programs may have some implications in the selection procedure of countries for empirical testing. In particular, studies that mix rich and poor countries, or those that use OECD membership as a sample of rich countries may appear to be problematic (Folster and Henrekson, 1998).

Folster and Henrekson (1998) state that many empirical studies (such as Agell *et al.*, 1997) do not take into account the econometric problems that arise while studying the relationship between the rate of economic growth and the size of the public sector. They present evidence showing that, once a number of econometric issues are dealt with, the relationship between growth and public expenditure may be more robust than it first appears. Slemrod (1995) places greater emphasis on the econometric problems in most studies and concludes that "there is no persuasive evidence that the extent of government has either a positive or a negative impact on either the level of growth or the growth rate of income, largely because the fundamental problems of identification have not yet been adequately addressed". This approach creates a bias towards agnostic conclusions.

As for Italy the relation between composition of public spending and growth has sparsely been investigated. Grisorio and Prota (2013), for example, study the effects of the decentralization process in Italy on the share of different categories of public spending in total expenditure of the Italian regions over the period 1996-2008. They also use the economic and functional classification of public expenditures to show that the level of decentralization influences the expenditure composition. Grisorio and Prota (2015) also examine the relationship between fiscal decentralization and public expenditure composition of the Italian regional administrations in the long-run. The results demonstrate that the level of decentralization influences the expenditure composition. In other words, it reduces welfare spending, while having a positive effect on the share of expenditure for productive activities support.

In this chapter, we contribute to the literature on the growth impact of government spending composition in various ways. Firstly, we attempt to empirically examine the effects of government spending on growth based on Ghosh and Gregoriou's (2008) theoretical model. We examine a panel with 19 out of Italian regions (Valle d'Aosta is therefore not included in the sample) and we investigate this relationship in terms of both economic and functional classification. Secondly, our classification allows us to investigate six governmental functions and to consider capital and current expenditure items separately. The rationale behind this, is that some current spending items are crucial to promote the profitability of investments in some government functions such as education and health. Since these functional expenditures embody both capital and current expenditures, the aggregate effect estimated may be insignificant either of them has a significant growth effect. Third, we employ different checks of robustness of our results. In this context, we also apply alternative estimation methods and extent our analysis taking into account spatial dependence among the regions under scrutiny. The most relevant result is that implementing spatial lag models, some functional components that seemed do not influence economic growth gained significance, highlighting the importance to take into account spatial dependence among the units of our panel.

The remainder of this study is organized as follows. Section 2 provides the theoretical model used here; Section 3 describes the dataset we analyze; Section 4 discusses some issues relating to the methodology we employ; Section 5 is devoted to the regression analysis; Section 6 presents some concluding remarks.

2. Theoretical Model

2.1 Optimal Fiscal Policy

The endogenous growth literature seems to agree on that fiscal policy has potentially important effects on the long-run growth rate of the economy. In this context, the distinction between productive and unproductive government spending is crucial. In his seminal paper, Barro (1990) models the productive government spending in terms of public services. This is a flow variable, whitin the production function.of the economy. Devarajan *et al.* (1996) also investigates the relationship between the composition of government expenditure and growth. In their theoretical model, they consider two productive services (which are both flow variables) in a CES production function; one more productive than another. Importantly, they obtain that a shift in favour of an objectively more productive type of expenditure may not raise the growth rate, if its initial share is "excessively high". Devarajan *et al.* (1996) suggest that an attempt to study optimal fiscal policy, instead of taking the government's decision as a given, could be a fruitful extension of their model. Drawing on this, Ghosh and Gregoriou (2008) have attempted to extend the model. Within a decentralized economy set-up, these authors characterize the welfare-maximizing fiscal policy for a benevolent government (i.e. the second-best outcome). This government chooses the fiscal instruments at its disposal to maximize the representative agent's utility. Ghosh and Gregoriou's model solves the problems relating to the three key endogenous variables, which are the optimal expenditure shares of the two services, the optimal tax rate and the optimal growth rate. They do this by applying the key technological and behavioural parameters of the model. In Devarajan *et al.*'s (1996) model, the economy's growth rate is expressed in terms of the tax rate and expenditure shares, which are both exogenous; in Ghosh and Gregorious's (2008) model, the optimal growth rate is expressed in terms of optimal values of the same two variables.

The model start from a CES production function

$$y = f(k, g_1, g_2) = \left[\alpha k^{-\zeta} + \beta \mathrm{g}_1^{-\zeta} + \gamma \mathrm{g}_2^{-\zeta}\right] \tag{1}$$

where y is output, k is private capital, g_1, g_2 are two types of government spending, and $\alpha > 0, \beta \geq 0, \gamma \geq 0, \alpha + \beta + \gamma = 1, \zeta \geq -1$.

The government budget constraint is

$$g_1 + g_2 = \tau y \tag{2}$$

where τ is the (constant over time) income tax rate.

The shares of government expenditure that go towards $g_1(\phi)$ and $g_2(1-\phi)$ are given by

$$g_1 = \phi\tau y \quad and \quad g_2 = (1 - \phi\,)\tau y \tag{3}$$

where $0 \leq \phi \leq 1$.

The representative agent's utility function is isoelastic, utility is derived from private consumption (c) and is given by

$$U = \int_0^\infty \frac{c^{1-\sigma}-1}{1-\sigma} e^{-\rho t} dt \tag{4}$$

where $\rho\ (> 0)$ is the rate of time preference.

The agent's budget constraints is

$$\dot{k} = (1-\tau)y - c \tag{5}$$

Devarajan *et al.* (1996) derive an expression for the ratio, $\frac{g}{k}$, given by

$$\frac{g}{k} = \left[\frac{\tau^{\zeta} - \beta\phi^{-\zeta} - \gamma(\phi)^{-\zeta}}{\alpha}\right]^{\frac{1}{\zeta}} \tag{6}$$

and of the economy's (endogenous) growth rate, λ, given by

$$\lambda = \frac{\alpha(1-\tau)\{\alpha\tau^{\zeta}/[\tau^{\zeta} - \beta\phi^{-\zeta} - \gamma(1-\phi)^{-\zeta}]\}^{-(1+\zeta)/\zeta} - \rho}{\sigma} \tag{7}$$

The objective of this model is to characterize the optimal fiscal policy. Equations (1)-(5) are exactly as proposed by Devarajan *et al.* (1996). The representative agent's problem is to choose c and $\dot{k}$ to maximize utility, as given by equation (4), subject to the budget constraint (5), taking τ, g_1 and g_2, and also k_0 as a given. The first order condition gives rise to the Euler equation:

$$\lambda \equiv \frac{\dot{c}}{c} = (1-\tau)\frac{\partial y}{\partial k} - \rho \tag{8}$$

Thus, the consumption's growth rate is proportional to the difference between marginal productivity of capital, net of the tax rate, τ, and the rate of time preference, ρ.

The objective of the government in a decentralized economy is to run the public sector in the nation's interest, thus taking the private sector's choice as a given. In other words, the government's problem is to choose τ, g_1 and g_2 to maximize the representative agent's utility subject to (2), (5) and (8), and taking k_0 as given. The first order conditions with respect to τ, g_1 and g_2 respectively yield $\frac{\partial y}{\partial g_1} = \frac{\partial y}{\partial g_2} = 1$, from which we can obtain the optimal ratio of the two public goods when we have a benevolent government:

$$\left(\frac{g_1}{g_2}\right)^* = \left(\frac{\beta}{\gamma}\right)^{\frac{1}{\zeta+1}} \tag{9}$$

The value of $\frac{g}{k}$ is given in (6) above. Hence, using (9), we can obtain the individual values of $\frac{g_1}{k}$ and $\frac{g_2}{k}$:

$$\frac{g_1}{k} = \left[\frac{(\beta/\gamma)^{(1/(1+\zeta))}}{(\beta/\gamma)^{(1/(1+\zeta))}+1}\right] \cdot \left[\frac{\tau^{\zeta}-\beta\phi^{-\zeta}-\gamma(1-\phi)^{-\zeta}}{\alpha}\right]^{1/\zeta} \tag{10}$$

$$\frac{g_2}{k} = \left[\frac{1}{(\beta/\gamma)^{(1/(1+\zeta))}+1}\right] \cdot \left[\frac{\tau^{\zeta}-\beta\phi^{-\zeta}-\gamma(1-\phi)^{-\zeta}}{\alpha}\right]^{1/\zeta} \tag{11}$$

From $\frac{\partial y}{\partial g_1} = 1$, we obtain

$$g_1^* = \beta^{\frac{1}{1+\zeta}} \cdot y \tag{12}$$

and from $\frac{\partial y}{\partial g_2} = 1$, we obtain

$$g_2^* = \gamma^{\frac{1}{1+\zeta}} \cdot y \tag{13}$$

We are now in a position to find an expression for the optimal tax rate for the decentralized economy under a benevolent government. From the government budget constraint given by (2), and given the optimal shares (of output) of the two productive inputs given by (12) and (13) above, the optimal tax rate is given by

$$\tau^* = \beta^{\frac{1}{\zeta+1}} + \gamma^{\frac{1}{\zeta+1}} \tag{14}$$

Finally, the optimal share of the first public service from a welfare-maximizing point of view is obtained by combining equations (3), (12), and (14):

$$\phi^* = \frac{\beta^{1/(\zeta+1)}}{\beta^{1/(\zeta+1)}+\gamma^{1/(\zeta+1)}} \tag{15}$$

Clearly, the optimal share of the second public services obtained by combining equations (3), (13), and (14) is:

$$1-\phi^* = \frac{\gamma^{1/(\zeta+1)}}{\beta^{1/(\zeta+1)}+\gamma^{1/(\zeta+1)}} \tag{16}$$

Combining (9), (15) and (16), we obtain the following equation:

$$\left(\frac{g_1}{g_2}\right)^* = \frac{\phi^*}{1-\phi^*} = \left(\frac{\beta}{\gamma}\right)^{\frac{1}{\zeta+1}} \tag{17}$$

Finally, one can derive an expression for the growth rate that could be achieved in an economy where a benevolent government chooses its fiscal instruments, τ, g_1 and g_2, to maximize the welfare of the representative agent. This optimal growth rate expression can be obtained by combining equation (7) with equations (14), (15) and (16), and it is given by

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

$$= \frac{\alpha^{-1/\zeta}\left[1-\beta^{1/(\zeta+1)}-\gamma^{1/(\zeta+1)}\right]^{(1+2\zeta)/\zeta}-\rho}{\sigma} \tag{18}$$

Ghosh and Gregoriou (2008) have thus analytically characterized optimal fiscal policy in Devarajan *et al.*'s (1996) model. As it appears clear from equations (14)-(18) above, we obtain closed-form solutions of all the important fiscal variables in terms of the key technological and behavioural parameters of the model. The implications for policy are interesting in the case where the government formulates fiscal policy in the attempt to maximizing the welfare of the representative agent, rather than taking as "given" the tax rate and expenditure shares on the two public goods under scrutiny.

2.2 Comparative statics

In this section we investigate how the key variables respond to a change in the productivity parameter, β, where β is the share in the production function of the, a priori, more productive public good ($\beta > \gamma$). The variables are the optimal growth rate (λ^*), the optimal tax rate (τ^*), and the ratio of the optimal shares of the two public services $\left(\phi^*/(1-\phi^*)\right)$. First, from equation (18), $d\lambda^*/d\beta$:

$$\frac{d\lambda^*}{d\beta} = \frac{1}{\sigma}\cdot\frac{\alpha^{-1/\zeta}}{1+\zeta}\cdot\left(\frac{1+2\zeta}{\zeta}\right)\left[1-\beta^{1/(1+\zeta)}-\gamma^{1/(1+\zeta)}\right]^{(1+\zeta)/\zeta}\cdot\gamma^{-\zeta/(1+\zeta)}-\beta^{-\zeta/(1+\zeta)} \tag{19}$$

Clearly, $\frac{d\lambda^*}{d\beta} > 0 \ if \ \beta > \gamma$.

If $\beta = \gamma$ (the two components of public spending are equally productive), then a rise in β at the margin does not affect the optimal growth rate. Yet, if component (g_1) is more productive than (g_2) , then an increase in the productivity of that input will raise the growth rate (β is the input and the share of g_1 in the production function). Hence, it is important to identify which input is the more productive, as an increase in the share in the production function would bolster growth. Conversely, an increase in the share of the less productive input in the production function will have an adverse effect on growth.

Subsequently, from equation (14), $d\tau^*/d\beta$:

$$\frac{d\tau^*}{d\beta} = \frac{1}{1+\zeta}\left[\frac{1}{\beta^{\zeta/(1+\zeta)}} - \frac{1}{\gamma^{\zeta/(1+\zeta)}}\right] \tag{20}$$

Clearly, $\frac{d\tau^*}{d\beta} < 0 \ if \ \beta > \gamma$.

Again, if $\beta = \gamma$, the marginal effect of an increase in the productivity of one of the public goods will not make a difference to how the optimal tax rate behaves. However, if $\beta > \gamma$, then an increase in the share of the more productive input in the production function will reduce the optimal tax rate. This is due to higher productivity that translates into higher output. In turn, this generates higher tax revenues, which thereby require a lower tax rate to balance the government budget. Henceforth, from a welfare-maximizing perspective, an increase in the productivity of the more productive public good leads to a fall in the optimal tax rate.

Finally, from equation (17), we find $d\big(\phi^*/(1-\phi^*)\big)/d\beta$:

$$\frac{d\big(\phi^*/(1-\phi^*)\big)}{d\beta} = \frac{\frac{1}{1+\zeta}\left[\left(\beta^{-\zeta}\gamma\right)^{1/(1+\zeta)} + \left(\beta\gamma^{-\zeta}\right)^{1/(1+\zeta)}\right]}{\gamma^{2/(1+\zeta)}} \tag{21}$$

Clearly, $\frac{d\big(\phi^*/(1-\phi^*)\big)}{d\beta} \succ 0 \ if \ \beta + \gamma \succ 0$.

We know that $\alpha + \beta + \gamma = 1$, and $0 \prec \alpha \prec 1$. From this follows that $\beta + \gamma \succ 0 \Longrightarrow \Big(d\big(\phi^*/(1-\phi^*)\big)/d\beta\Big) \succ 0$.

3. Data

3.1 The Regional Public Accounts (RPAs)

In the early 1980s, Italy's faced the pressing need to fill the existing gap in public finance statistics. Moreover, many scholars engaged in a debate concerning the territorial distribution of public financial flows, which had been a common feature of all studies into the development of southern Italy.

Nowadays, the Regional Public Accounts (RPAs) is a sound, consolidated tool to allocate public sector cash flows to the different geographical area of the country. This tool supports the work of analysts and policymakers at both national and regional level. It has filled a longstanding gap regarding the sources of information available in Italy and concerning the regional distribution of revenues and expenditure, thus making it planning more knowledgeable and aware. At the same time, it has also played a prominent role in the theoretical debate and is the focus of considerable attention at international level. Relying on a sound understanding of the characteristics of government action as it unfolds, RPAs have brought the process of measuring the events and the effects of economic policy back to the heart of the decision-making process.

In the early 1990s, the development of a structural solution to the problem of the territorial distribution of government cash flows did not seem to be based on rational ground. The main issue was that it was not backed by adequate resources or political will, or supported by a well-developed methodological foundation. Rather, it was a stubborn decision (at times relying on volunteers effort) to create an information system that met the needs of territorial planning and analysis. Moreover, it was seen as a way to forge a network of data generating entities that could later support it.

The attempts to develop methodology skills and build information sources was made all the more challenging by the lack of a consolidated literature or empirical experience, either nationally or internationally. The institutional design of the data producers network was simultaneously weakened by an insufficient awareness of the tool's potential. Also, it suffered from the inconsistent level of administrative skills from region to region, which were mainly due to the numerous and persistent gaps in the Regional Teams network.

Therefore, developing an adequate methodology became a process of iterative approximations. Approximately, ten years after the project started, the government felt the need to completely revise the Regional Public Accounts time series. This helped systematize the various methodological decisions that, over time, had replaced the original approaches and significantly expanded the universe of entities involved.

The Department for the Development and Economic Cohesion (DPS – Dipartimento per lo Sviluppo e la Coesione Economica) invested a great deal an effort in the Regional Public Accounts project. They believed that the administrative and fiscal decentralization taking placeat the time in Italy could not ignore the need for an accurate qualification of the regional distribution of revenues and expenditure. Most importantly, the held the view that making decisions in the interests of society at large implied making assessments based on knowledge, and therefore accessible, timely, transparent and high-quality data.

3.2 The Reference Universe and the Nature of the Data

Consolidate public finance accounts refer to the aggregation of the revenues and expenditure flows of the various entities that make up a given reference universe, which are net of any flows between those entities. In measuring the cash flows of each individual region, the Regional Public Accounts generate data concerning the public sector universe. Selecting a different aggregate of entities requires a different approach to consolidating the data surveyed by the RPAs[5]. The public sector consists of general government and non-general government entities (at both the central and local/sub-regional level). They include entities under public control (i.e. public enterprises) that general government pixies to deliver certain public services to the public on a market services basis (e.g. telecommunications, electricity, and so on). The definition adopted for general government essentially coincides with that of the Italian National Accounts[6]. It includes those entities that prevalently provide non-market services. Also, they are funded primarily by various mandatory payments made by entities and parties in the private sector (e.g. taxes, duties, contributions, etc.) and/or those entities that perform a redistributive function. The number of entities that make up these two different universes, and the precise boundary between general government and non-general-government, can vary over time. Their number is also directly connected with the legal nature of the entities themselves and the laws that govern the various sectors of public action.

For each public sector entity, the RPAs database reconstructs expenditure and revenue flows at the regional level on the basis of the final accounts of the entity, but (in principle) without any reclassification. This helps the reconstruction of the accounts for each region. The RPAs

[5] In the RPAs database, each entity is considered as a final expenditure unit, using consolidation techniques to eliminate flows between the various levels of government. Particularly, in the transition from public sector to general government, the current account and capital transfers to public enterprises that are eliminated in the public sector consolidated accounts are included are in the general government consolidated accounts, given that the final expenditure of public enterprises is not included in the general government sub-universe.

[6] The definition adopted for the RPAs does not currently consider certain minor general government entities that are included in the ISTAT classification.

are therefore financial in nature: the flows measured are structured by item in a manner similar to that one used for the preparation of the financial statements of public entities that make use of “financial accounting”. Again, this allows reconstructing a complete framework of all transactions carried out by each entity that generate cash movements. Like the accounts of entities prepared on a financial accounting basis, the RPAs do not consider certain operations such as revaluations and writedowns of assets and liabilities or accruals to provisions and reserves. Financial accounting measures the financial effects of an entity’s activity and reports the revenues and expenditures that are expected to arise on the basis of the obligations assumed or rights acquired by the entity. The accounts compiled according to this procedure are termed assessments for revenues and commitments for expenditures. They are employed to ascertain (at either the budget or outturn stage) the ability of the entity to meet its funding requirements. Assessments and commitments are recognized when the legal entitlement accrues contracts or other legal instruments giving rise to the entitlement. This is due to the fact that they are generally determined on the basis of the statutory provisions. The RPAs uses cash accounting for its financial accounting. Cash accounting recognizes the cash settlements of the transactions, measuring monetary outlays (payments) and inflows (collections) at the time they occur rather than at the time the legal entitlement arises.

The selection of a cash accounting approach for the RPAs was prompted by the conviction that this is essential to delineating the context in which public action at the regional level takes place. Moreover, it was motivated by the fact that financial data are an integral part of the decision-making process and the formation and management of the public sector budget. In line with this approach, the RPAs project recognizes as a single account (for expenditure and revenues) both economic (broken down into current items and non-financial capital account items) and financial items (divided into items in respect of financial assets, receivables and equity investments, and financial liabilities, i.e. the entity’s debts). In addition, as regards to the budget outturns of the entities, the RPAs emphasize the recognition of transactions on a cash basis. Accordingly, data on revenues and expenditure are registered at the time the payments and collections occur.

However, the decision to select such a broad universe as the public sector makes it necessary to account for the fact that some entities use one form of accounting and others use the other[7]. This requires the application of a carefully thought-out methodology for converting the

[7] This refers not only to all public enterprises in the non-general-government segment of the public sector but it also involves certain public sector entities that, under regulations in force since the turn of the new millennium, also adopt accruals accounting (for example, ANAS, State Road Agency, and Patrimonio dello Stato SpA, state assets, at the central government level, local health authorities and chambers of commerce at the local level). The current debate suggests that in the future the public sector may adopt accruals accounting alongside financial accounting. Title III of Legislative Decree

accrual-basis accounts of entities in the RPA universe that use this approach to financial accounting. Within the landscape of the various sources of statistical information available in Italy, the RPAs therefore stand out if compared to other official data (such as those provided by the ISTAT's National Accounts). This happens precisely because of the nature of the data considered and the absence of reclassification. One of the special characteristics of this approach is the ability to use sectoral breakdowns of expenditure. Another special feature is the use of the cash accounting for the RPAs, which supplements and completes the information resources available to users, who can access data on an accrual basis for ISTAT and more extensive data regarding certain expenditure segments in the publications of other institutions. The RPAs data, together with their breakdown by economic items, are available for expenditure with a level of sectoral detail that identifies the main areas of action on the part of public entities by purpose.
The basic criterion of the territorial division of the expenditure in the Regional Public Accounts is mainly the location of the public's intervention in terms of financial flows as managed by the Italian regions.

3.3 Economic and Functional Classifications

The Regional Public Accounts (RPAs) classification of government expenditure follows two main lines: 1) the economic classification that is based on the type or economic characteristics of revenues and expenditures and, 2) the functional classification that is based on the purpose or the function towards which the expenditure is directed. The former is grouped according to of the type of outlay (Table A1 in Appendix): a) Capital Expenditure covers payments for the purchase or production of new or existing durable goods (i.e., goods of over one year life cycle), and b) Current or Recurrent Expenditure, which in turn includes wages and salaries, other goods and services, interest payments, and subsidies.
We estimate the effect of each economic component on the growth rate and then grouped the sub-categories of capital and current expenditures as follows:

- ***Capital expenditures*** *(*cap_exp*): capital account transfers (*cap_transf*), and financial and non-financial assets (*fin_assets *and* n_fin_assets*).*

The *cap_transf* variable includes capital transfers to households, private-sector companies and other social institutions; *fin_assets* and *n_fin_assets* comprise financial assets, which includes expenditures on real estate assets and works, movables, machinery, and other unclassified

279/97 charged the State Accountant General Office with introducing analytical accounting by cost centres in the public accounting system.

capital expenditures, as well as non-financial assets that covers expenditures on equity investment contributions and loans.

- ***Current expenditures*** *(*curr_exp*): current account transfers (*curr_transf*),* and *other current expenditures (*other_curr*).*

The *curr_transf* variable includes current transfers to households, private-sector companies and other social institutions, while *other_curr* includes expenditures on personnel, purchases of goods and services, items correcting and offsetting revenues, interest expenses and unclassified current expenditures.

The sector classification underlying the consolidated RPAs, broken down into 30[8] items that can be assembled with the Classification of the functions of Government (COFOG)[9], has been determined bearing two main objective in mind: on the one hand, it seeks to represent in a more detailed way the diversity of sectors of public intervention as a whole. On the other hand, it aims to take into account those items public budget, which sometimes may differ significantly. This is where RPAs data initially started.

Anyway, for the scope of this analysis, we aggregate the sectoral classification underlying the consolidated Territorial Public Accounts, into six types of public investment with economically distinct roles (cf. Table A2 in Appendix).

3.4 Dataset and Selection of Variables

For this study, we use an extremely well balanced panel data set covering 19 Italian regions[10], which accounts for the period 1996-2007. Choosing this period has been determined by the availability of the data[11].

The fiscal variables (namely the economic and functional components of government expenditure) are the key variables of the model. They have all been derived from the data issued by Department for the development and economic cohesion (*DPS – Dipartimento per lo Sviluppo e la Coesione Economica*). They are better explained in the next section.

---

[8] The 30 sectors under scrutiny and included in the functional classification are: General administration, Defence, Public order, Justice, Education, Training, Research and development, Culture and Recreational Services, Residential Building and Urban Development, Health, other social affairs (Support and Charity), Water, Sewers and Water Treatment, Environment, Waste Disposal, other health and sanitation services, Labour, Pensions and Wage Supplementation, Roads, other Transport, Telecommunications, Agriculture, Marine Fishing and Aquaculture, Tourism, Wholesale and Retail Distribution, Industry and Artisans, Energy, other public works, other economic sectors, unclassified expenditure.

[9] COFOG is the official classification of expenditures incurred by Public Administrations according to the purposes, set by the ONU and adopted by international institutions.

[10] In the empirical analysis, we exclude Valle d'Aosta because it is an outlier.

[11] We overlooked the economic crisis period (which started in 2008).

The economic and functional component of public expending are also expressed as a share of total government expenditure, while the total government spending is expressed as a share of GDP at constant prices (year 2005). An important feature of the present analysis is that this data set is strongly balanced. In the literature, many empirical works on the relationship between growth and components of government expenditure exist. However, most of them use an unbalanced data set. The dependent variable is chosen here as the per capita real GDP growth rate (natural log difference of GDP per capita in millions of euro, constant prices 2005).
Another important determinant of growth rate is the ratio of private stock and public capital ($private\_k$), which is derived from Ghosh and Gregoriou's (2008) theoretical model, as illustrated in Section 2. The data about capital stock have been kindly provided by Montanaro *et al.* (2012b). This variable is also expressed as a ratio of total government spending.
Our dataset also contains few macroeconomic variables, included as control variables. They seek to capture the factors affecting economic growth and have been obtained from the Italian National Institute of Statistics (ISTAT). One key control variable incorporates the percentage of population aged 24 to 35 having completed tertiary education. It is used in our reference regressions in order to take into account the growth effects of human capital in the researched regions. Thus, the estimated coefficients of the fiscal variables measure the growth impact of policies beyond their effect on physical and human capital accumulation. In addition, we also make use of the percentage of total population aged 65 and over as control. Another control used in our robustness checks includes the employment growth variable ($empl\_growth$) so as to control for business cycles effects on growth[12]. Most empirical panel data studies on growth existing in literature have been carried out for periods of approximately 30 years, with five-year averaged observations that help isolating business cycles influences on growth (Devarajan *et al.*, 1996, Kneller *et al.*, 1999, Ghosh and Gregoriou, 2008). However, this firstly this implies loss of information and efficiency of estimates. Secondly, the lack of synchronicity in country business cycles does not filter five-year averages from cyclical effects (Bassanini *et al.*, 2001).
We estimate the following equations, including the economic classification of public expenditures:

$$G_{it} = a_i + b_t + \beta_1 tot\_exp_{it} + \beta_2 cap\_exp_{it} + \beta_3 private\_k_{it} + \beta_4 human\_cap_{it} + \beta_5 pop\_65_{it} + e_{it} \quad (22)$$

[12] Benos (2009) also used this variable to determine the relationship between fiscal policy and economic growth.

$$G_{it} = a_i + b_t + \beta_1 tot\_exp_{it} + \beta_2 curr\_exp_{it} + \beta_3 private\_k_{it} + \beta_4 human\_cap_{it} + \beta_5 pop\_65_{it} + e_{it} \quad (23)$$

$$G_{it} = a_i + b_t + \beta_1 tot\_exp_{it} + \beta_2 cap\_transf_{it} + \beta_3\, fin\_assets_{it} + \beta_4 n\_fin\_assets_{it} + \beta_5 private\_k_{it} + \beta_6 human\_cap_{it} + \beta_7 pop\_65_{it} + e_{it} \quad (24)$$

$$G_{it} = a_i + b_t + \beta_1 tot\_exp_{it} + \beta_2\, curr\_transf_{it} + \beta_3 other\_curr_{it} + \beta_4 private\_k_{it} + \beta_5 human\_cap_{it} + \beta_6 pop\_65_{it} + e_{it} \quad (25)$$

where i and t denote the cross-sectional and time series dimensions respectively; a_i captures the time-invariant unobserved country-specific fixed effects, and b_t captures the unobservable individual-invariant time effects. G_{it} is the per capita real GDP growth rate, tot_exp_{it} is total government expenditure, cap_exp_{it} and $curr\_exp_{it}$ are public the capital and current expenditure shares, $private\_k_{it}$ is the private stock and $human\_cap_{it}$ and pop_65_{it} are the control variables, as already explained above.
Regarding functional classification, we estimate the following equations:

$$G_{it} = a_i + b_t + \beta_1 tot\_exp_{it} + \beta_2 cap\_gen\_p\_serv_{it} + \beta_3 cap\_defen_{it} + \beta_4 cap\_ec\_aff_{it} + \beta_5 cap\_health_{it} + \beta_6 cap\_educ_{it} + \beta_7 cap\_so\_prot_{it} + \beta_8 private\_k_{it} + \beta_9 human\_cap_{it} + \beta_{10} pop\_65_{it} + \varepsilon_{it} \quad (26)$$

$$G_{it} = a_i + b_t + \beta_1 tot\_exp_{it} + \beta_2 curr\_gen\_p\_serv_{it} + \beta_3 curr\_defen_{it} + \beta_4 curr\_ec\_aff_{it} + \beta_5 curr\_health_{it} + \beta_6 curr\_educ_{it} + \beta_7 curr\_so\_prot_{it} + \beta_8 private\_k_{it} + \beta_9 human\_cap_{it} + \beta_{10} pop\_65_{it} + \varepsilon_{it} \quad (27)$$

where gen_p_serv, $defen$, ec_aff, $health$, $educ$ and soc_prot are the capital and current shares of general public spending, defence, economic affairs, health, education and social protection expenditures. The remaining variables are as defined in the previous set.

3.5 Descriptive Analysis of Data

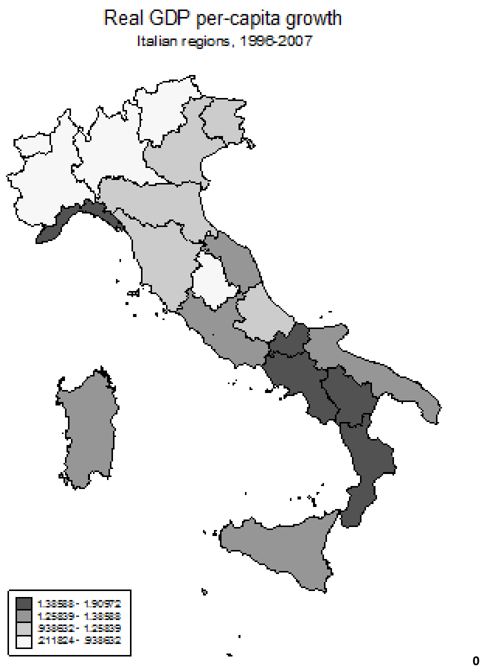
Before proceeding with a formal regression analysis on government expenditure composition and growth, it seems important to describe the dataset from various angles. Firstly, by pooling together all regions, we can examine the basic descriptive statistics, for the variables used in the estimations, as displayed in Table A4 in Appendix 1 and together with a spatial maps representation.

These maps show the real GDP pc growth rates and total government expenditure across Italian regions (average values, period 1996-2007). Figure 1, picture 1 shows that having a neighbouring country with particularly high level of GDP produces a positive spillover for the rich regions. During the period under consideration, the regions which grew at higher rates were located in the South of Italy (e.g. Molise, Campania, Basilicata, Calabria). Liguria demonstrates to be an exceptionto this as it scores high rates (on average) but is located in the North of Italy. As for the remainder of the regions analysed, the results seems to be coherent with the convergence hypothesis.

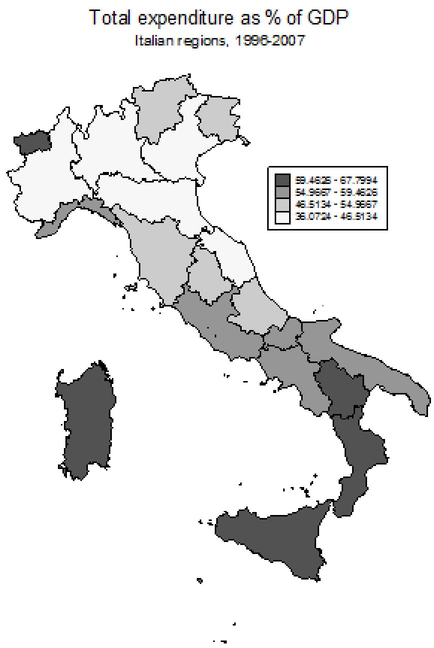
The regions with the lowest levels of GDP pc rate were Piedmont, Valle d'Aosta, Lombardy, Trentino Alto-Adige and Umbria (between 0.21 percent and 0.94 percent).

Total public spending as percentage of GDP registered a significant change across the Italian regions, but it is characterized by small variations in the period under consideration. The average size in Italian regions is about 53.24 percent of GDP, ranging between 34.50 percent in Veneto in 2007, and 75.26 percent in Calabria in 1996. Figure 1, picture 2 shows that, during the same period, Valle d'Aosta, Basilicata, Calabria, Sicily and Sardinia had the higher level of total expenditure as percentage of GDP (between 59.5 and 68 percent). The lowest levels of total expenditure were in Piemonte, Lombardy, Veneto, Emilia Romagna and Marche (between 36 and 46.5 percent).

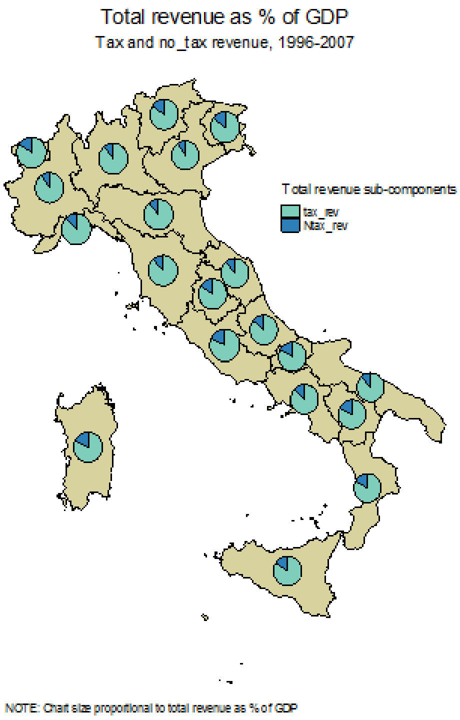
Figure 1. Regional distribution of main variables



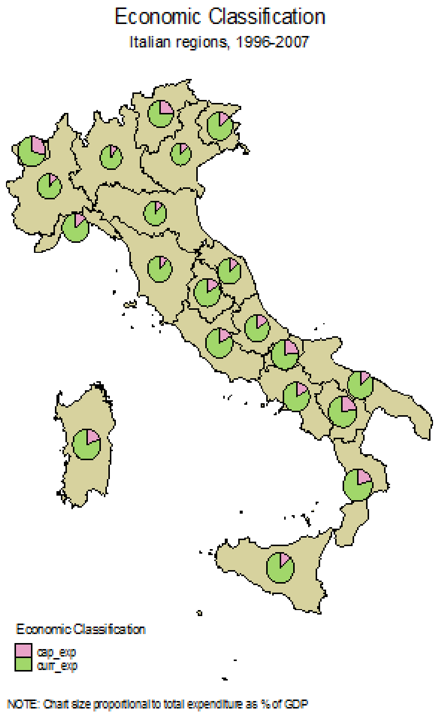
1.



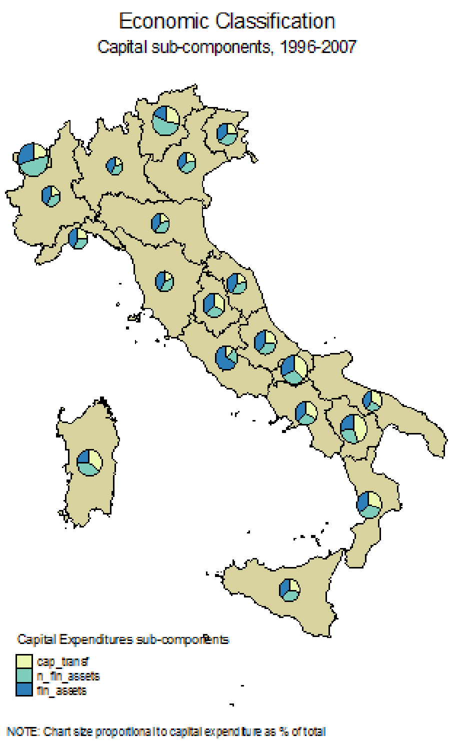
2.


Total revenue as % of GDP
Tax and no_tax revenue, 1996-2007
Total revenue sub-components
tax_rev
Ntax_rev
NOTE: Chart size proportional to total revenue as % of GDP

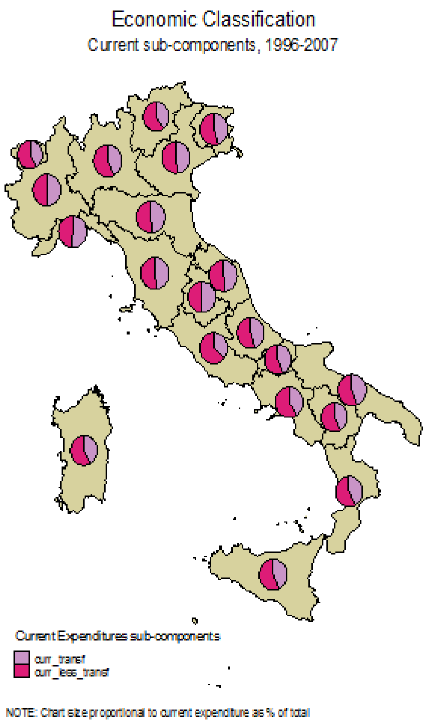
3.


Economic Classification
Italian regions, 1996-2007
Economic Classification
cap_exp
curr_exp
NOTE: Chart size proportional to total expenditure as % of GDP

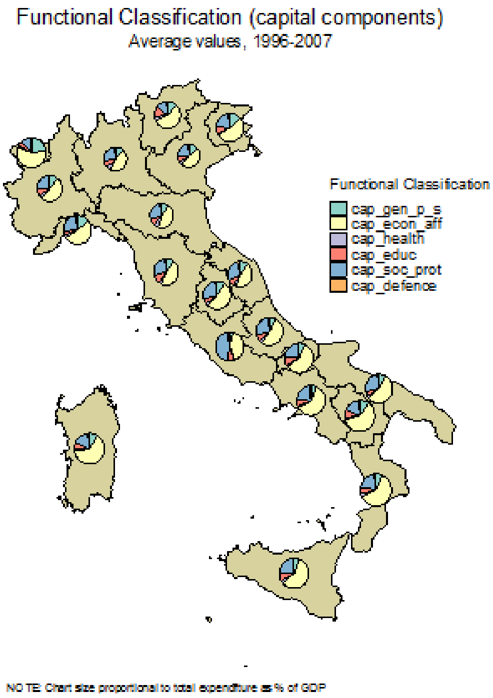
4.


Economic Classification
Capital sub-components, 1996-2007
Capital Expenditures sub-components
cap_transf
n_fin_assets
fin_assets
NOTE: Chart size proportional to capital expenditure as % of total

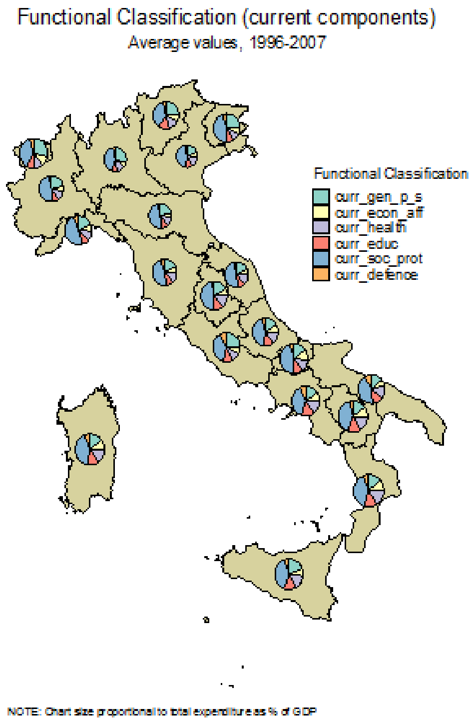
5.


Economic Classification
Current sub-components, 1996-2007
Current Expenditures sub-components
curr_transf
curr_less_transf
NOTE: Chart size proportional to current expenditure as % of total

6.



7.



8.

Notes: Average values 1996-2007. Expenditure on Economic and Functional Classifications are % shares on total expenditure.

The map reported in Figure 1, picture 3 shows the distribution of total revenues deriving from tax and no tax sources. Overall, revenues from taxation are higher than those from other sources of revenue in all regions (more than three-quarters of the total). The same steady-pattern of total spending is displayed by the two economic components, namely current and capital expenditure. Some variability can be found among regions, but during twelve years it has remained substantially unchanged. On average, the first component represents the 84 percent of total spending, and it ranges between 72 percent in Basilicata in 1996 and about 91 percent in Lombardy in 2007. The capital component is about the 16 percent of total spending. It ranges between 8 percent in Lombardy in 1997 and 28 percent in Basilicata in 1996. Figure 1, picture 4 shows the Economic Classification of total expenditure. Capital and current expenditures are expressed as percentages of total, and the diagram sizes are proportional to the total level of spending as percentage of GDP. All regions devote at least three-quarters of their public resources to current expenditure (e.g. compensation to employees, current transfers, interests on debt, etc.). Yet, the highest levels of capital expenditure are in Valle d'Aosta, Trentino Alto Adige, Molise, Basilicata, Calabria and Sardinia. Among the subcategories considered here, the greater shares of expenses are allocated to current transfers (about 38 percent of total spending) and other unclassified current expenditures, (47 percent of total spending). The last item examined here includes interest on debt (about 8 percent of total spending on average), compensation and other expenditures related to personnel working in service at public administrations along with purchases of goods and services. Regarding capital subcomponents, expenditures on real estate assets, movables and machinery (hence non-financial assets) absorb about 6 percent of total spending. Basilicata, Calabria, Molise, Trentino Alto Adige and Sardinia are the regions with the highest values. These regions also score the greatest levels of capital transfers (over 4 percent). Financial assets cover about 6 percent of total spending. The map reproduced in picture 5 highlights the capital expenditure sub-components as percentage of total spending. The map shows that the regions with biggest diagram size are those with highest level of capital expenditure.

As regards its composition, Valle d'Aosta and Trentino Alto Adige demonstrate to devote about fifty percent of capital resources on non-financial assets. The regions in the South part of Italy devote a good amount of capital spending to transfers to households, private-sector companies and other social institutions (especially Basilicata and Molise).

Furthermore, it seems interesting to note that Lazio is the only region with more than fifty percent of capital expenditure on financial assets (i.e. expenditures on equity investment contributions and loans). This seems to be related to the high number of interweaved subsidiaries in this region.

The maps reported in pictures 7 and 8 show the functional classification of government expenditure based on six items. They include capital and current shares, respectively. Among the capital components, expenditure on economic affairs absorbs the greater amount, which is about 8.5 percent of total spending. The smallest component is devoted to health spending (about 0.5 percent of total spending). Looking at picture 8, it becomes clear that, among the current components analysed, social protection takes the largest share, while almost all Italian regions devoted a smaller amount of resources to defence.

4. Methodology

In this section, we discuss the estimation strategy applied in our analysis. It contains two subsections: in Subsection 1, we report on the traditional estimation methodologies to capture the effects of public spending components and economic growth. To this end, we take into account the endogeneity issue. In Subsection 2, we analyses the spatial dependence issue in relation to the regions investigated here.

4.1 Traditional FE, IV-FD, Difference-GMM and System-GMM-Estimators

In order to estimate consistently the equation reported in (22) to (27), we must apply a panel technique. In the presence of unobserved heterogeneity, the pooled OLS model will be biased and inconsistent. When government revenue and expenditure shares are exogenously given, the effects of fiscal policy can be adequately captured by the OLS fixed effects model[13]. However, from an optimal fiscal policy perspective, the within estimates of the relationship will be biased. For this reason, a Generalized Method of Moments (IV-GMM) approach is needed to account for the endogeneity aspects.

The endogeneity problem derives directly from the theoretical model, which considers all fiscal variables as endogenous. Although Instrumental Variables (henceforth, IV) methods were first developed to cope with the problem of endogeneity in a simultaneous system, the correlation of regressor and error may also arise for other reasons. Generally speaking, the presence of measurement error in a regressor will cause the same correlation between regressor and error. Even if we assume that the magnitude of the measurement error is independent of the true value of the covariate (which has often demonstrated to be an inappropriate assumption), measurement error will cause biased and inconsistent parameter estimates of all parameters, not only for the mis-measured regressor. Another commonly encountered problem involves unobservable factors. Mathematically speaking, this is the same problem caused by endogeneity or measurement error.

Heteroskedasticity is a recurrent problem in empirical investigations. The conventional IV estimator (though consistent) is inefficient in the presence of heteroskedasticity. Nowadays, when facing unknown heteroshedasticity, scholars tend to use the Generalized Method of Moments (GMM), as introduced by Hansen (1982). The advantages of GMM over the IV approach are obvious. If heteroskedasticity is present, then the GMM estimator is more efficient than the simple IV estimator. Conversely, if heteroskedasticity is not present, the GMM estimator is asymptotically no worse than the IV estimator (Baum *et al.*, 2003).

We can consider the model:

$$y = X\beta + u, \qquad u \sim (0, \Omega) \tag{30}$$

[13] We also estimated the model by applying the random effects (RE) model. However, the Hausman specification test suggests that the fixed effects (FE) model is more appropriate for our case. The FE model is generally more appropriate than a RE approach for two reasons. Firstly, if the individual effects represent omitted variables, it is likely that these country-specific characteristics are correlated with the other regressors. Secondly, it is also likely that a typical macro panel will contain most countries of interest and, thus, is not likely to be a random sample from a much larger universe of countries. Judson and Owen (1999) show that with balanced panel data set, LSDV with Kiviet's (1995) correction can perform well. Yet, it requires a large time dimension of the panel (e.g. T=30) and all exogenous explanatory variables. With a smaller time dimension, LSDV does not dominate the alternatives for the GMM approach.

with $X(N \times K)$ and define a matrix $Z(N \times L)$ where $L \geq K$. This is the Generalized Method of Moments IV (IV-GMM) estimator. It is assumed here that the instruments Z are exogenous and can be expressed as $E(Z_i u_i) = 0$. The L instruments give rise to a set of L moments:

$$g_i(\hat{\beta}) = Z_i' \hat{u}_i = Z_i' \left(y_i - X_i \hat{\beta}\right), \qquad i = 1, \ldots\ldots, N \quad (31)$$

where each g_i is an L-vector. The method of moments approach considers each of the L moment equations as a sample moment, which we may estimate by averaging over N:

$$\bar{g}(\widehat{\beta}) = \frac{1}{N} \sum_{i=1}^{N} Z_i \left(y_i - X_i \hat{\beta}\right) = \frac{1}{N} Z' \hat{u} \quad (32)$$

The intuition behind the GMM approach is to choose an estimator for β that solves $\bar{g}\left(\hat{\beta}_{GMM}\right) = 0$.

If $L = K$, the equation to be estimated is said to be *exactly identified* by the order condition for identification. Put more simply, there as many excluded instruments as included right-hand endogenous variables. The problem of the method of moments is then K equations in K unknowns. A unique solution exists and it is equivalent to the standard IV estimator:

$$\hat{\beta}_{IV} = (Z' X)^{-1} Z' y \quad (33)$$

In the case of overidentification, we may define a set of K instruments:

$$\hat{X} = Z' (Z' Z)^{-1} Z' X = P_Z X \quad (34)$$

where P_Z is the projection matrix $Z(Z' Z)^{-1} Z'$, which gives rise to the two-stage least squares (2SLS) estimator

$$\hat{\beta}_{2SLS} = \left(\hat{X}' X\right)^{-1} \hat{X}' y = (X' P_Z X)^{-1} X' P_Z y \quad (35)$$

which, despite its name, is computed by this single matrix equation. In the 2SLS method with over-identification, the L available instruments "boil down" to the K needed to define the P_Z matrix. In the IV-GMM approach, that reduction is not necessary. All L instruments are used in the estimator. Furthermore, a *weighting matrix* is employed so that we may choose $\hat{\beta}_{GMM}$. Consequently, the elements of $\bar{g}\left(\hat{\beta}_{GMM}\right)$ are as close to zero as possible.

If the equation is overidentified (and $L > K$), we have more equations than we have unknowns. In general, it will not be possible to find a $\hat{\beta}$ that exactly sets all L sample moment conditions to zero. In this case, we take an $L \times L$ weighting matrix W and use it to construct a quadratic form in the moment conditions. In this case a criterion function that weights them appropriately is used to improve the efficiency of the estimator. The GMM estimator minimizes the criterion:

$$J(\hat{\beta}_{GMM}) = N\bar{g}(\hat{\beta}_{GMM})' W\bar{g}(\hat{\beta}_{GMM}) \tag{36}$$

where W is a $L \times L$ symmetric weighting matrix. Solving the set of FOCs, we derive the IV-GMM estimator of an overidentified equation:

$$\hat{\beta}_{GMM} = (X'ZWZ'X)^{-1}X'ZWZ'y \tag{37}$$

which will be identical for all W matrices that differ by a factor of proportionality. The *optimal weight matrix*, as Hansen (1982) shows, chooses $W = S^{-1}$ where S (an $L \times L$ matrix) is the covariance matrix of the moment conditions to produce the most *efficient* estimator:

$$S = E[Z'uu'Z] = lim_{N\to\infty} N^{-1}[Z'\Omega Z] \tag{38}$$

with a consistent estimator of S derived from 2SLS residuals, we define the efficient IV-GMM estimator as:

$$\hat{\beta}_{EGMM} = (X'ZS^{-1}Z'X)^{-1}X'ZS^{-1}Z'y \tag{39}$$

where $EGMM$ refers to the *efficient* GMM estimator with asymptotic variance

$$V(\hat{\beta}_{EGMM}) = \frac{1}{N}(Q'_{XZ}S^{-1}Q_{XZ})^{-1} \tag{40}$$

The derivation makes no mention of the form of Ω, which is the variance-covariance matrix (*vce*) of the error process u. However, the efficient GMM estimator is not yet a feasible estimator, because the matrix S is not known. To be able to implement the estimator, we need to estimate S. To do this, we need to make some assumptions about Ω.

The IV-GMM estimator is merely the standard IV (or 2SLS) estimator. In the presence of heteroskedasticity, the IV estimator is inefficient but consistent, whereas the standard estimated IV covariance matrix is inconsistent. Yet, asymptotically correct inference is still possible. In these circumstances the IV estimator is a GMM estimator with a suboptimal weighting matrix. Hence, the general formula for the asymptotic variance of a general GMM estimator still holds.

If there is heteroskedasticity of unknown form, we usually compute robust standard errors to derive the consistent estimate of the *vce*:

$$\hat{S} = \frac{1}{N}\sum_{i=1}^{N} \hat{u}_i^2 Z_i' Z_i \quad (41)$$

where $\hat{u}$ is the vector of residuals from any consistent estimator of β (e.g., the 2SLS residuals). For an overidentified equation, the IV-GMM estimates computed from this estimate of S will be more efficient than the 2SLS (Two Stage Least Square) estimates.

If we estimate that an overidentifying model allows for arbitrary heteroskedasticity by using the GMM two-step estimator, we will obtain different point estimates because we attempt to solve a different optimization problem. The problem is in the L-space of the instruments (and moment conditions) rather than in the K-space of the regressors, and $L > K$. We will also obtain different standard errors as the IV-GMM estimator is more efficient. This does not imply, however, that summary measures of fit will improve.

In the panel context, it may be reasonable to assume that observations on the same cluster in two different time periods are correlated, but observations on two different individuals are not.

If errors are considered to exhibit arbitrary intra-clusters in a dataset with M clusters, we may derive a cluster-robust IV-GMM estimator using

$$\hat{S} = \sum_{j=1}^{M} \hat{u}_j' \, \hat{u}_j \qquad where \qquad \hat{u}_j = \left(y_j - x_j \hat{\beta}\right) X' Z (Z' Z)^{-1} z_j \quad (42)$$

The IV-GMM estimates employing this estimate of S will be both robust to arbitrary heteroskedasticity and intra-cluster correlation.

The main problem regarding instrumental variables estimator is that we need to find variables (instruments) that, at the same time, are directly correlated with the explanatory variables and indirectly correlated with the dependent variable. "Good instruments" should be both relevant and valid. They should be correlated to the included endogenous regressors and at the same time orthogonal to the errors (i.e. namely, the excluded instruments must be distributed independently from the error process). To test the first assumption, we should consider the goodness-of-fit of the “first stage” regressions and relate each endogenous regressor to the entire set of instruments. Test of overidentifing restrictions address the second assumption. If and only if the equation is overidentified, a test should always be performed, which is known as Hansen-J test. It allows us to evaluate the validity of the instruments.

The ability of first differencing to remove unobserved heterogeneity also underlies the family of estimators that have been developed for Dynamic Panel Data (DPD) models. These models contain one or more lagged dependent variables, thus allowing for the modelling of a partial adjustment mechanism.

A serious difficulty arises with the one-way fixed effects model in the context of a dynamic panel data model, and particularly in the "*small* T and *large* N" context. As Nickell (1981) shows, the inconsistency of the within estimator is due to the correlation between the individual effect and the lagged dependent variable. By subtracting the mean of every variable, the error term becomes correlated to the lagged dependent variable. This means that the orthogonality condition between the regressor and the error term is violated. The resulting correlation creates a bias in the estimate of the coefficient of the lagged dependent variable which is not mitigated by increasing N, meaning the number of individual units. Furthermore, the inclusion of additional regressors does not remove this bias. Indeed, if to some extent, the regressors are correlated with the lagged dependent variable, their coefficient may be seriously biased as well. It is important to point out that this bias is not caused by an autocorrelated error process. The same bias arises even if the error process is i.i.d., and in that case, if the error process is autocorrelated, the problem is even more severe, given the difficulty of deriving a consistent estimate of the auto regressive parameters in that context. The same problem affects the random effects model. Interestingly, according to Nickell (1981) and Hsiao (1986), the correlation between the error term and the regressor in the simple OLS case produces an upward bias of the estimate; the opposite is true for the within group estimator. Therefore, as Bond *et al.* (2001) note, determining that the estimated parameters are between those extremes appears to be a reasonable test for the validity of results.

To overcome the violation of the orthogonality condition, an instrumental estimation in first difference was proposed by Arellano and Bond (1991) and applied to the growth context by Caselli *et al*. (1996). The general strategy is to instrument the differenced variable with its lagged levels. However, as shown by Bond *et al.* (2001), even this estimator in first differences is problematic within the context of growth models. Using the lagged levels as instruments for the first differences might cause a weak instruments problem. In particular, within the context of growth regressions, the time series are typically persistent and the number of time periods is small, which leads to a low correlation between the instruments and the instrumented variables. Instead, Bond et al. (2001) suggest applying a System-GMM approach.

The Arellano-Bond (1991) and Arellano-Bover (1995)/Blundell-Bond (1998) dynamic panel estimators are designed for situations with:

1. "small T, large N" panels, meaning few time periods and many individual units;
2. a linear functional relationship;
3. a single left-hand-side variable that is dynamic, depending on its past realizations;
4. independent variables that are not strictly exogenous, meaning correlated with past and possibly current realizations of the error;
5. fixed individual effects, implying unobserved heterogeneity;
6. heteroskedasticity and autocorrelation within individuals, but not across them.

Arellano-Bond estimation starts by transforming all regressors, usually by differencing, and uses the Generalized Method of Moments (Hansen, 1982), and so is called "difference GMM". The difference GMM method (Holtz-Eakin-Newey-Rosen, 1988 and Arellano-Bond, 1991) treats the model as a system of equations, one for each time period. The equations differ only in their instruments/moment condition sets. The predetermined and endogenous variables in first differences are instrumented with suitable lags of their own levels. Strictly exogenous regressors, as well as any other instruments, enter the instrument matrix in a conventional instrumental variables fashion: in first differences, with one column per instrument.

In standard 2SLS, including Anderson-Hsiao approach, the twice-lagged level appears in the instrument matrix as

$$Z_i = \begin{pmatrix} . \\ y_{i,1} \\ \vdots \\ y_{i,T-2} \end{pmatrix} \tag{43}$$

where the first row corresponds to $t = 2$, given that the first observation is lost in applying the first difference transformation. The missing value in the instrument for $t = 2$ causes that the observation for each panel unit be removed from the estimation.

If we also included the thrice-lagged level y_{t-3} as a second instrument in the Anderson-Hsiao approach, we would lose another observation per panel, so that:

$$Z_i = \begin{pmatrix} . & . \\ y_{i,1} & . \\ y_{i,2} & y_{i,1} \\ \vdots & \vdots \\ y_{i,T-2} & y_{i,T-3} \end{pmatrix} \tag{44}$$

So that the first observation available for the regression is that dated $t = 4$.

To avoid this loss of degrees of freedom, Holtz-Eakin *et al.* (1988) construct a set of instruments from the second lag of y, one instrument pertaining to each time period:

$$Z_i = \begin{pmatrix} 0 & 0 & \cdots & 0 \\ y_{i,1} & 0 & \cdots & 0 \\ 0 & y_{i,2} & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & y_{i,T-2} \end{pmatrix} \tag{45}$$

The inclusion of zeros in place of missing values prevents the loss of additional degrees of freedom, in that all observations dated $t = 2$ and later can now be included in the regression. Although the inclusion of zeros might seem arbitrary, the columns of the resulting instrument matrix will be orthogonal to the transformed errors. The resulting moment conditions correspond to an expectation that should hold:

$$E\left(y_{i,t-2}\varepsilon_{it}^{*}\right) = 0 \tag{46}$$

where ε^{*} refers to the first difference transformed errors.

It would also be valid to "collapse" the columns of this Z matrix into a single column, which embodies the same expectation, but conveys less information as it will only produce a single moment condition. In this context, the collapsed instrument set will be the same implied by standard IV, with a zero replacing the missing value in the first usable observation:

$$Z_i = \begin{pmatrix} 0 \\ y_{i,1} \\ \vdots \\ y_{i,T-2} \end{pmatrix} \tag{47}$$

Give this solution to the trade-off between lag length and sample length, we can adopt Holtz-Eakin *et al.*'s suggestion and include all available lags of the untransformed variables as instruments. For endogenous variables, lags 2 and higher are available. For predetermined variables that are not strictly exogenous, lag 1 is also valid, as its value is only correlated with errors dated $t - 2$ or earlier.

Using all available instruments gives rise to an instrument matrix such as

$$Z_i = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \cdots \\ y_{i,1} & 0 & 0 & 0 & 0 & 0 & \cdots \\ 0 & y_{i,2} & y_{i,1} & 0 & 0 & 0 & \cdots \\ 0 & 0 & 0 & y_{i,3} & y_{i,2} & y_{i,1} & \cdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \ddots \end{pmatrix} \quad (48)$$

In this setup, we have different numbers of instruments available for each time period: one for $t = 2$, two for $t = 3$, and so on. As we move to the later time periods in each panel's time series, additional orthogonality conditions become available, and taking these additional conditions into account improves the efficiency of the Arellano-Bond estimator. One disadvantage of this strategy should be apparent. The number of instruments produced will be quadratic in T, the length of the time series available. If $T < 10$, that may be a manageable number, but for a longer time series, it may be necessary to restrict the number of past lags used. As consequence, a proliferation of the number of instruments can results in a over-identification problem when time dimension is moderately large and relative to the number of regions[14].

However, while the GMM approach yields consistent estimators, the difference GMM method developed by Holtz-Eakin *et al.* (1988) and Arellano-Bond (1991) may suffer from finite sample biases. These biases arise if the time series are persistent, thus in turn letting instruments become weak. As Bond, Hoeffler and Temple (2001) point out, these biases are likely to be large in the context of empirical growth models since output tends to be a largely persistent variable. In this case, the authors recommend to use the alternative system-GMM estimators developed by Arellano-Bover (1995) and Blundell-Bond(1998).

The Arellano-Bover (1995)/Blundell-Bond (1998) estimator augments Arellano-Bond (2001) by making an additional assumption, that first differences of instrumenting variables are uncorrelated with the fixed effects. This allows the introduction of more instruments, and can dramatically reduce the imprecision associated to the single equation estimator and improve efficiency.

The System-GMM contains a level and a difference equation, so that the original equations in levels are added to the system. In the level equation, the lagged dependent variable is instrumented by the first difference, and the vice versa, in the difference equation, the first differences are instrumented by the lagged levels (Blundell and Bond, 1998). In these equations, predetermined and endogenous variables in levels are instrumented with the suitable lags of their own first differences. Instead of transforming the regressors to expunge the fixed effects, System-GMM differences the instruments to make them exogenous to the fixed effects. The main assumption is that the unobserved group effects are not correlated

[14] The rule of thumb is to keep the number of instruments less than or equal to the number of regions.

with changes in the instrumented variables; in other terms, the covariance between the two is consistent over time. Blundell and Bond (1998) show with simulations that the System-GMM has much greater precision in estimating autoregressive parameters using persistent time series. Therefore, the weak instruments problem can be minimized.

Bond *et al.* (2001) show that the System GMM estimator performs better than a range of other methods of moment estimators. Unfortunately, from a practical point of view, within the context of a dynamic panel data setting, a straightforward test of weak instruments is not available. For consistency, in the System-GMM approach, the relevant moment conditions must hold. Firstly, to ensure the validity of the lagged levels as instruments for the first differences, the error terms in the original level equation must be serially uncorrelated. Secondly, to allow the lagged differences to serve as instruments in the level equation, the initial condition (the deviations of the initial output from the steady-state) must not systematically correlate with the individual effects (Durlauf *et al.*, 2005).

Moreover, the System-GMM is also appropriate in our regional growth context because it allows other endogenous regressors to be included in the model (such as tax and no tax revenues, government expenditure components and private capital stock). The endogenous variables are instrumented using own lagged levels and differences. Hence, we can address not only the endogeneity related to the dependent variable but also those related to other crucial variables in the model.

The consistency of GMM estimators depends on whether the lagged values of the explanatory variables are a valid set of instruments and whether the error term is not serially correlated. We undertake the Sargan's instruments validity test (applicable to single equation GMM) and the Difference-Sargan test (applicable to System-GMM) to establish the validity of the instruments set.

Another important diagnostic is the AR test autocorrelation of the residuals. By construction, the residuals of the differenced equation should possess serial correlation, but if the assumption of serial independence in the original errors is warranted, the differenced residuals should not exhibit significant AR(2) behaviour. If a significant AR(2) statistic is encountered, the second lags of endogenous variables will not be appropriate instruments for their current values.

4.2 Spatial Dependence Models

Conventional regression models commonly used to analyze cross-section and panel data assume that units are independent of one another. This interdependence complicates the estimation of such models (Kelejian and Prucha, 1998). Within the last ten years, it has becomes standard to account for spatial dependence in empirical regional growth models (LeSage and Fischer, 2008). According to Anselin (1988), spatial dependence is defined as the "existence of a functional relationship between what happens at one point in space and what happens elsewhere".

Spatial regression methods allow us to account for dependence between observations, which often arises when observations are collected from points or regions located in space. The observations could represent income, employment or population levels, tax rates, and so on, for European Union regions delineated into NUTS regions, countries, postal or census regions. It is commonly observed that sample data collected for regions or points in space are not independent, but rather spatially dependent, which means that observations from one location tend to exhibit values similar to those from nearby locations.

There are different theoretical reasons for the observed dependence between nearby observations. Ertur and Koch (2007) use the notion of "spatial diffusion with friction" to provide a motivation for a spatial lag, which takes the form of an average of neighbouring regions. Another reason is that observed variation in the dependent variable may arise from unobserved or latent influence. Latent unobservable influences related to culture, infrastructure, recreational amenities and a host of other factors for which we have no available sample data that can be accounted for by relying on neighbouring values taken by the dependent variable. This happens when the latent influences change across regions. Furthermore, during last decades countries have experienced an economic and financial integration, which implies strong interdependencies between cross-sectional units.

There exist three ways through which taking into account for possible interaction effects among different units. The first model includes a spatially lagged dependent variable term, where its coefficient is called spatial autoregressive coefficient. This model is known as "spatial lag model" or "Spatial Autoregressive model" (SAR). According to Anselin *et al.* (2008), "the spatial lag model is typically considered as the formal specification for the equilibrium outcome of a spatial or social interaction process, in which the value of the dependent variable for one agent is jointly determined with that of the neighbouring agents". The second model, the spatial interaction effect is accounted not only for the spatially lagged dependent variable term, as the first model, but also by the inclusion of spatially lagged exogenous variables. Such last terms control for possible correlation among the dependent variable of a spatial unit with the level of explanatory variables in neighbouring units. For example, the dependent variable of a region might depend on its own specific covariates and by the neighbouring regions. When both interaction effects (the spatial autoregressive coefficient and the spatially lagged exogenous variables) are included in the model, the spatial econometric literature labels it as

“Spatial Durbin model” (SDM). The third model incorporates the spatial interaction effect by assuming that the error term is spatially autocorrelated. This model is used to handle spatial dependence due to omitted variables or errors in measurements through the error form.

According to LeSage and Pace (2009), “the cost of ignoring spatial dependence in the dependent variable and/or in the independent variables is relatively high since the econometrics literature has pointed out that if one or more relevant explanatory variable are omitted from a regression equation, the estimator of the coefficients for the remaining variables is biased and inconsistent. In contrast, ignoring spatial dependence in the disturbance, if present, will only cause a loss of efficiency; furthermore, the spatial Durbin model produces unbiased coefficient estimates, if the true data generation process is a spatial lag or a spatial error model. The SDM model does not ignore spatial dependence in the disturbance, but implies a different type of specification for error dependence from that in the true SAC”.

We decided to consider a spatial lag model that incorporates spatial dependence explicitly by adding a “spatial lagged” dependent variable on the right-hand side of the regression equation. This model goes by different names, Anselin (1988) calls this the *Spatial Autoregressive* model, and its main feature is the presence of a spatially lagged dependent variable among the covariates. The possible existence of residual spatial autocorrelation in the error term is checked by means of a series of tests. The spatially lagged y model is appropriate when we believe that the values of y in one unit i are directly influenced by the values of y found in i’s “neighbors”. This influence is above and beyond other covariates specific to i. Our broader interest here is in what influences economic growth and the spatial dependence among our units, not just estimating the association between of a region’s public spending components on its per capita GDP growth rate. If a region’s level of economic growth appears to be associated with its neighbour’s economic growth, this tell us something important about the distribution of per capita GDP growth rate itself and provides an opportunity for learning something about possible influences from spatial dependence on prospects and constraints on economic growth.

According to Anselin and Rey (1991) two basic types of spatial effects must be distinguished: a nuisance and a substantive. The first type typically stems from the arbitrariness of the administrative boundaries of spatial units. The problem of measurement errors arises in this context. In contrast, the second type refers to substantial spatial interactions between (neighbouring) locations. Here, economic factors or the economic outcome of one region exert an influence on the outcome in other locations.

Here, a more plausible and interesting approach is to consider the spatial association as a substantive feature of economic growth rather than as a statistical nuisance. The spatial association observed here (see Figure 1 in Section 3.3) suggests that we have dependence among observations such that the expected value of per capita GDP growth rate for a region i differs notably depending on the per capita GDP growth rate in neighbouring regions j. Instead of letting expected per capita GDP growth rate for a region i depend on just the expenditure components, we devise a model where the dependent variable is a function of both its own public spending components and the per capita GDP growth rate among neighbours, defined by $w_i y_i$ where the entries of the connectivity vector w_i (i.e., row i from matrix W) acquire nonzero values for all regions j that are defined as connected to i[15].

The general spatially lagged dependent variable model form is the following:

$$y_{i,t} = \alpha_i + \beta_1 tot\_exp_{i,t} + \sum_{m=1}^{s} \beta_s X_{i,m,t} + \sum_{n=1}^{p} \beta_p X_{i,n,t} + \rho W y_{i,t} + \theta_t + \varepsilon_{i,t} \tag{49}$$

where α_i are the regional fixed effects to account for common shocks affecting the pooled regions; Wy_{it} is the spatially lagged dependent variable with w the normalized weight matrix; θ_t are the time effects. Furthermore, X_{mt} is a vector of m public spending components and X_{nt} is a vector of n control variables.

A positive value for the parameter associated with the spatial lag (ρ) indicates that regions are expected to have higher per capita GDP growth rates if, on average, their neighbours have high per capita GDP growth rates.

In estimating this model we need to deal with an important issue: the endogeneity of the regessors, which comes from two sources. First of all, an "intrinsic" endogeneity of the spatially lagged term included into the model, which induces a two-way causality in the neighbour relation in space. Secondly, the endogeneity related to the explanatory variables, arising directly from the relationship we are analysing. If we need to take into account just the first kind of endogeneity, that arising from the inclusion of the spatial term, we can use the maximum likelihood method, two-stage least square (2SLS) or spatial Generalized Methods of Moments (GMM - Kapoor *et al.*, 2007; Elhorst *et al.*, 2010), based on the inclusion of instrumental variables, to get consistent estimators. In the growing empirical literature on spatial models great care has been devoted to tackling this problem, while the potential endogeneity of the explanatory variables has often been overlooked, particularly in the panel data context.

[15] The W connectivity or spatial matrix is row standardized so that each row in W sums to 1.

The impact of cross-sectional dependence in dynamic panel estimators is even more severe. In particular, Phillips and Sul (2003) show that if there is sufficient cross-sectional dependence in the data and it this ignored, the decrease in estimation efficiency can become large. Sarafidis and Robertson (2006) show that if there is cross-sectional dependence in the disturbances (specifically with short dynamic panel-data models), all estimation procedures that rely on IV and GMM (Generalized Methods of Moments, such as Anderson-Hsiao (1981), Arellano-Bond, (1991), and Blundell-Bond (1998) are inconsistent as N (cross-sectional dimension) grows large, for fixed T (the panel's time dimension). This outcome is important given that the desirable N-asymptotic properties of these estimators rely upon this assumption.

In comparison with traditional estimation methodologies, the spatial approach is better not because of the heuristics it produces alone, but because it specifies a plausible form of the feedback or dependency among observations.

The coefficient estimates have different interpretations. Because the effect of an increase of real GDP growth rate in region i disperses, in the first step, to the neighbouring regions and, in a second step, to the neighbours' neighbours and, therefore, back to the origin region, the initial increase of the dependent variable is only a part of the induced effects in the other regions $i \neq j$ as well as in the own region i. To account for these additional spatial spillovers when interpreting the parameters, we rely on the concepts developed by LeSage and Page (2009). Basically, LeSage and Page distinguish between the *direct* and *indirect* effect of changes in the variables. The direct effect measures the increase in the dependent variable y in the region i induced by an increase in the explanatory variables in region i. Note that this effect also includes feedback loops running via the initial impact of region i on its neighbour j followed by the return effect of region j on its neighbour i. The total effect includes the entire outcome of an increase of each explanatory variable in region i in this region and in region $i \neq j$. To calculate these measures, one must rely on the product of the parameter of interest and the spatial multiplier matrix $\beta_i * (I - W\rho)^{-1}$. The main diagonal of the matrix contains the direct effect for every region; the sample size standardized trace of the diagonal is a suitable measure of the direct effect. The other cells contain the indirect effects resulting from a change of β in i on the outcome in region j. The sample size standardized row sum of the matrix, therefore, can be interpreted as the total effect of a change in β in region i.

The presence of spatial dependence is formally tested by means of the cross-section dependence test proposed by Pesaran (2004) and the Moran's I test (1948). Although no direct test of spatial dependence in the context of a dynamic panel model is available, Pesaran (2004) designed a test for general forms of cross-section dependence (Pesaran CD test) in the case with many cross-sectional units and few time-series observations. Moscone and Tosetti (2009) state that, among a number of alternative tests, none perform better than Pesaran's CD test. To test for the presence of spatial autocorrelation we employ the following global Moran's Index (I^t) (1948) for each cross-section:

5. Estimation Results

5.1 Basic Models

In this section, we discuss the results of the relationship between economic and functional components of public spending and economic growth. Our first focus is on capital and current expenditures. Tables 1 to 6 display the results of the FE[16], IV-FD, Difference-GMM and System-GMM estimations, but not accounting for spatial effects. In general, the Generalized Method of Moments (GMM) performs quite poorly.

Table 1 shows that there is a positive relationship between capital component of government expenditure and economic growth. The result is also statistically significant with fixed effects and GMM-sys estimation, at five and ten percent respectively. It is coherent with expectation and with the existing literature on developed countries. Aschauer (1989) study examines the United States' situation to find that a unit increase on "core infrastructure" as streets, highways, airports, mass transit, and other public capital, is associated with an increase of 0.4 percentage points in the output level,thus favouring the costs reduction and promoting the private investment over a long run period. Devarajan *et al.* (1996) find the same result for a sample of 21 developed countries. In this analysis, we investigate 19 Italian regions, as they belong to a developed country. Hence, the expected results should be similar to Devarajan *et al.*'s (1996). It is worth noting that, our estimated coefficients cannot be interpreted as elasticities as the variables are not expressed in logarithms. The application of the Fixed Effects model demonstrates that there is an increase in the ratio of public capital to total public spending and per capita real GDP growth by 0.118 percentage points (cf. Table 1, specification 1). Using the IV-GMM, GMM-diff and GMM-sys techniques returns the same positive results, even though the coefficient size is larger.

As for to instrumentation, total expenditure, expenditure shares and stock of private capital are treated as endogenous when we implement GMM techniques are used. Therefore, the relative small number of regions implies a reduction in the maximum number of lags. This also

[16] We estimate the model with fixed and random effects. The application of the Hausman test helps us to strongly reject the null of no correlation between explanatory variables and individual effects. Another major advantageof using panel data is that it potentially helps to obtain consistent parameter estimates in the presence of this given type of unobserved heterogeneity. In this case, a first-differencing kind of transformation is required to eliminate the individual effects from the transformed equations, which in turns helps to obtain valid moment conditions (Bond, 2002).

helps to maintain the number of instruments at a minimum[17]. For the same reason, we also collapse the instrument set. According to this procedure, the number of instruments is slightly larger than the number of regions analysed by means of the GMM-sys approach. Unfortunately, there is no definitive answer to the question posed by Roodman (2009) "on how many instruments is too many". Empirical research has generally accepted to report the instrument count after estimates. Yet, Hansen specification test confirms that the instruments are valid for each case. Such a test cannot reject the null hypothesis of exogenous instruments. Furthermore, the Arellano-Bond test for second-order autocorrelation does not reject the null indicating that the error term is not serially correlated, thus supporting the use of the GMM technique. We further conduct two difference Hansen tests to verify on the validity of particular subsets of instruments. The first test examines the validity of the exogeneity of the extra instruments used in the level part of the system as a whole. The second difference test investigates the exogeneity of the lagged output used as an instrument in the level part. Roodman (2009a) proposed this type of testing while pointing out that a lagged dependent variable is often problematic among the sets of instruments used in the level part. Overall, the corresponding p-values validate the use of system as the preferred estimation strategy, rather than GMM-difference estimator[18].

All reported p-values are based on the standard errors corrected for the heteroskedatsicity; time dummies are included in each regression. Furthermore, both GMM-diff and GMM-sys are applied with the option "two step" as more efficient than one step estimator.

As for the estimation results, the theoretical model used here turns the optimal value of the ratio of private capital to public services, which is one of the key endogenous variables of the model (Ghosh and Gregoriou, 2008). We expect this optimal value to be positive, given that public services augment the productivity of the private capital. However, even if statistically significant at ten percent level, this sign is negative. Interestingly, human capital is never significant in all regressions.

The effect of total public spending to GDP is negative using all methodologies and in almost all specifications. It is statistically significant only when the Fixed Effects estimation is implemented. Ghosh and Gregoriou's theoretical model includes the share of total government spending in GDP[19] to control for level effects and to estimate the effects of

[17] The first lag is correlated with the current error term. Hence, a second lag is needed.

[18] As for the GMM-sys estimates, Bond et al. (2001, p. 18) claim that the two step estimator is more efficient than the one step estimator. However, they also observed that and in a finite sample, the associated standard errors are heavily biased downwards and unreliable as far as inference is concerned. Hence, we opted to run the same regressions using the one step option, thus getting very similar results.

[19] In Section 5.3, we analyse the revenue side of the government budget constraint in more detail by considering tax, no tax revenues and also the government budget deficit/surplus.

financing government expenditure on growth. Devarajan *et al.* (1996) find this share to be positive but insignificant. Conversely, Ghosh and Gregoriou (2008) find it to be positive and statistically significant. In general, the positive sign of this share is expected, since the desirable condition is that the productivity of public spending (which is financed by income taxes) exceeds the deadweight loss associated with distortionary taxation. Interestingly though, our case returns coefficients that are not statistically significant when both the IV and GMM methodologies are used. In contrast, the negative effect of total spending could not come as a surprise, considering the short-term under scrutiny.

TABLE 1

CAPITAL EXPENDITURE WITHOUT SPATIAL EFFECTS

Variable	Fixed Effects (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-SYS (4)
tot_exp	-0.253***	-1.316	-0.972	-0.158
	(0.001)	(0.437)	(0.142)	(0.263)
cap_exp	0.118**	0.233	0.371	0.371*
	(0.014)	(0.809)	(0.286)	(0.097)
private_k	-0.711*	-3.122	-2.328	-0.256
	(0.056)	(0.700)	(0.163)	(0.706)
human_cap	-0.051*	-0.001	-0.330	-0.063
	(0.080)	(0.987)	(0.157)	(0.473)
pop_65	-0.806**	-0.771	-3.892	-0.309
	(0.045)	(0.726)	(0.184)	(0.603)
Obs/No. of regions	228/19	171/19	209/19	228/19
No. of instruments			18	25
Lags dep. var			(2 3)	(2 3)
Lags endog. vars used as instruments			(2 2)	(2 2)
Endogeneity test (p-value)		1.481 (0.687)		
Arellano-Bond AR(1) (p-value)			-2.98 (0.003)	-3.23 (0.001)
Arellano-Bond AR(2) (p-value)			-0.53 (0.599)	0.28 (0.778)
Hansen J-test (p-value)		0.451 (0.798)	0.09 (0.958)	2.22 (0.973)
Diff. Hansen 1 for levels (p-value)				2.09 (0.911)
Diff. Hansen 2 for levels (p-value)				0.02 (0.999)

Notes: Dependent variable GDP per-capita growth rate at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown.

Table 2 shows the results regarding current public spending; the other variables remain generally unchanged (cf. Table 1). The coefficient of public spending is negative and statistically significant when analysed according to Fixed Effects and GMM-sys specifications. This means that, the Italian regions investigated here follow a trend similar to other developed countries. It essentially implies expenditures on personnel, purchases of goods and services along with interests on debt. As for the coefficient size of OLS Fixed Effects and IV-DIFF, it appears to be equal to the reported sizeof capital expenditure. This is hardly surprising since we are dealing with a balanced panel data set where both economic components (i.e. capital and current) count as one[20].

Tables 3 and 4 include capital and current expenditure shares respectively. The aim of this further disaggregation of capital and current public spending is to explore the effects of the main subcategories on per capita GDP growth rate. By doing so, we seek to investigate how sub-components influence the behaviour of capital and current expenditures. Again, the results are statistically significant when using the FE estimation. Conversely, results appear to be inconclusive when applying the GMM methodology, which allows us to detect endogeneity issues. These results reflect those previously found for aggregate capital and current expenditures.

The existing literature on the relationship between public spending composition and economic growth focuses on some functional components, but it does not distinguish between capital and current items (Devarajan *et al*., 1996; Ghosh and Greogiou, 2008; Acosta-Ormachea and Morozumi, 2013). Unlike previous empirical research, this work is different also from this point of view, as we analyzes the decomposition of expenditures in capital and current as we did for the economic ones. The driving reason in this case is that sectoral spending also includes expenditures on personnel along with other general expenses and investments. Overall, public capital and current expenditure may show a positive or negative relationship regarding growth, but some functional components may act differently when contributing to growth. This also avoids an *a priori* classification of the functional components of government spending as productive and unproductive. Although we have subsumed government sectoral expenditure under six categories, we have opted to focus on two of them, namely health and education expenditure (see tables 5 and 6). This helps us to reduce the otherwise high number of endogenous variables and instruments[21].

Again, the results obtained by means of the GMM approach are not significant. The only exception is the capital spending component of expenditure on education, which returns a positive and statistically significant sign when the Fixed Effects estimator is used. In general, it seems safe to conclude that, during the period under scrutiny, economic and functional components of public spending play no role in augmenting the economic growth of the Italian regions.

[20] Devarajan *et al.* (1996) find the same results. Not all empirical works on the relationship between government spending and growth return this result because they do not consider all expenditure items.

[21] As Roodman (2009a) states, large instrument collection can over-fit endogenous variables. We also estimate the same equations by means six functional components but the results have not been statistically significant.

TABLE 2

CURRENT EXPENDITURE WITHOUT SPATIAL EFFECTS

Variable	**Fixed Effects (1)**	**IV-DIFF (2)**	**GMM-DIFF (3)**	**GMM-SYS (4)**
tot_exp	-0.253***	-1.316	-0.972	-0.144
	(0.000)	(0.437)	(0.142)	(0.275)
curr_exp	-0.118**	-0.233	-0.371	0.359*
	(0.014)	(0.809)	(0.286)	(0.053)
private_k	-0.711*	-3.122	-2.328	-0.311
	(0.056)	(0.700)	(0.163)	(0.635)
human_cap	-0.051*	-0.001	-0.330	-0.057
	(0.080)	(0.987)	(0.157)	(0.440)
pop_65	-0.806**	-0.771	-3.892	-0.343
	(0.045)	(0.726)	(0.184)	(0.513)
Obs/No. of regions	228/19	171/19	209/19	228/19
No. of instruments			18	25
Lags dep. var			(2 3)	(2 3)
Lags endog. vars used as instruments			(2 2)	(2 2)
Endogeneity test (p-value)		1.481 (0.687)		
Arellano-Bond AR(1) (p-value)			-2.98 (0.003)	-3.23 (0.001)
Arellano-Bond AR(2) (p-value)			-0.53 (0.599)	0.30 (0.761)
Hansen J-test (p-value)		0.451 (0.798)	0.09 (0.958)	2.23 (0.973)
Diff. Hansen 1 for levels (p-value)				2.10 (0.910)
Diff. Hansen 2 for levels (p-value)				0.36 (0.948)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown.

TABLE 3

CAPITAL EXPENDITURE SUB-COMPONENTS WITHOUT SPATIAL EFFECTS

Variable	Fixed Effects (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-SYS (4)
tot_exp	-0.261***	-0.771	2.043	0.167
	(0.000)	(0.290)	(0.915)	(0.609)
cap_transf	0.113*	0.401	0.397	0.106
	(0.059)	(0.605)	(0.291)	(0.766)
n_fin_assets	0.064	0.384	6.141	1.314
	(0.482)	(0.541)	(0.867)	(0.750)
fin_assets	0.175**	-0.682	3.100	0.911
	(0.028)	(0.775)	(0.867)	(0.631)
private_k	-0.726*	-5.086	28.042	-0.807
	(0.052)	(0.496)	(0.889)	(0.726)
human_cap	-0.054*	0.043	-1.023	0.069
	(0.063)	(0.610)	(0.832)	(0.706)
pop_65	-0.824**	-1.608	25.469	0.121
	(0.047)	(0.549)	(0.897)	(0.909)
Obs/No. of regions	228/19	171/19	209/19	228/19
No. of instruments			20	28
Lags dep. var			(2 3)	(2 2)
Lags endog. vars used as instruments			(2 2)	(2 2)
Endogeneity test (p-value)		1.797 (0.876)		
Arellano-Bond AR(1) (p-value)			-0.22 (0.826)	-1.12 (0.263)
Arellano-Bond AR(2) (p-value)			-0.33 (0.742)	-0.27 (0.784)
Hansen J-test (p-value)		1.096 (0.578)	0.51 (0.775)	0.000 (1.000)
Diff. Hansen 1 for levels (p-value)				-0.22 (1.000)
Diff. Hansen 2 for levels (p-value)				0.000 (1.000)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown.

TABLE 4

CURRENT EXPENDITURE SUB-COMPONENTS WITHOUT SPATIAL EFFECTS

Variable	Fixed Effects (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-SYS (4)
tot_exp	-0.249***	-1.906	-0.990	-0.117
	(0.000)	(0.271)	(0.202)	(0.381)
curr_transf	-0.093	0.273	-0.143	-0.433
	(0.318)	(0.821)	(0.841)	(0.238)
other_curr	-0.121***	0.212	-0.417	-0.011
	(0.008)	(0.761)	(0.329)	(0.981)
private_k	-0.760*	-6.078	-2.570	2.533
	(0.057)	(0.495)	(0.128)	(0.402)
human_cap	-0.050*	-0.013	-0.341	-0.012
	(0.078)	(0.884)	(0.170)	(0.921)
pop_65	-0.826*	-1.578	-3.617	1.324
	(0.053)	(0.507)	(0.220)	(0.441)
Obs/No. of regions	228/19	171/19	209/19	228/19
No. of instruments			19	26
Lags dep. var.			(2 3)	(2 2)
Lags endog. vars used as instruments			(2 2)	(2 2)
Endogeneity test		3.823		
(p-value)		(0.430)		
Arellano-Bond AR(1) (p-value)			-3.16	-2.28
			(0.002)	(0.022)
Arellano-Bond AR(2)			-0.46	0.06
(p-value)			(0.643)	(0.952)
Hansen J-test		0.426	0.26	1.17
(p-value)		(0.808)	(0.879)	(0.997)
Diff. Hansen 1 for levels (p-value)				1.08
				(0.993)
Diff. Hansen 2 for levels (p-value)				-1.39
				(1.000)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown.

TABLE 5

FUNCTIONAL (CAPITAL) EXPENDITURE COMPONENTS WITHOUT SPATIAL EFFECTS

Variable	Fixed Effects (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-SYS (4)
tot_exp	-0.222***	-0.239	-1.230	0.247
	(0.001)	(0.595)	(0.423)	(0.481)
cap_health	-0.001	-0.738	-1.195	-1.877
	(0.996)	(0.403)	(0.462)	(0.960)
cap_educ	0.613***	2.974	3.533	3.693
	(0.001)	(0.126)	(0.438)	(0.839)
private_k	-0.606*	-0.818	-4.024	3.453
	(0.094)	(0.643)	(0.417)	(0.379)
human_cap	-0.039	-0.009	0.301	0.114
	(0.168)	(0.955)	(0.505)	(0.731)
pop_65	-0.924**	-1.173	-6.333	1.201
	(0.019)	(0.393)	(0.368)	(0.600)
Obs/No. of regions	228/19	171/19	209/19	228/19
No. of instruments			18	26
Lags dep. var.			(2 2)	(2 2)
Lags endog. vars used as instruments			(2 2)	(2 2)
Endogeneity test (p-value)		9.066 (0.170)		
Arellano-Bond AR(1) (p-value)			-2.29 (0.022)	-2.39 (0.017)
Arellano-Bond AR(2) (p-value)			-0.26 (0.792)	0.05 (0.959)
Hansen J-test (p-value)		5.581 (0.998)	0.07 (0.785)	0.32 (1.000)
Diff. Hansen 1 for levels (p-value)				0.12 (1.000)
Diff. Hansen 2 for levels (p-value)				0.04 (0.978)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown.

TABLE 6

FUNCTIONAL (CURRENT) EXPENDITURE COMPONENTS WITHOUT SPATIAL EFFECTS

Variable	Fixed Effects (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-SYS (4)
tot_exp	-0.197***	-0.682	-0.324	0.223
	(0.001)	(0.102)	(0.702)	(0.481)
curr_health	-0.033	0.509	-0.618	-0.009
	(0.763)	(0.262)	(0.569)	(0.984)
curr_educ	0.075	-0.389	0.648	2.032
	(0.683)	(0.567)	(0.621)	(0.264)
private_k	-0.530	-1.550	0.484	4.833*
	(0.119)	(0.391)	(0.816)	(0.062)
human_cap	-0.039	-0.038	-0.179	-0.287
	(0.112)	(0.765)	(0.620)	(0.291)
pop_65	-0.875**	-0.839	-1.757	2.881
	(0.013)	(0.554)	(0.439)	(0.147)
Obs/No. of regions	228/19	171/19	209/19	228/19
No. of instruments			19	26
Lags dep. var.			(2 3)	(2 2)
Lags endog. vars used as instruments			(2 2)	(2 2)
Endogeneity test		7.656		
(p-value)		(0.264)		
Arellano-Bond AR(1) (p-value)			-3.48	-2.16
			(0.001)	(0.031)
Arellano-Bond AR(2)			-0.42	-0.27
(p-value)			(0.674)	(0.789)
Hansen J-test		5.025	3.53	0.01
(p-value)		(0.999)	(0.171)	(1.000)
Diff. Hansen 1 for levels (p-value)				-1.19
				(1.000)
Diff. Hansen 2 for levels (p-value)				-2.20
				(1.000)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown.

5.2 Implementing Spatial Dependence

As a first step of the spatial empirical analysis, we have attempted toverify the general the assumption that the cross-section members' are independent. This condition is likely to be violated by units such as those in our panel data. We expect the Italian regions to be economically, fiscally and politically integrated. This idea is confirmed by the results reported in Table A16 in Appendix 3. The application of Pesaran's (2004) cross-dependence test to our data demonstrates that cross-sectional independence is rejected for all variables. This type of correlation may be due to common global shocks, which have a heterogeneous impact across regions- Alternatively, it can be the result of local spillover effects between them. Although no direct test of spatial dependence in the context of a dynamic panel model is available (Bouayad-Agha and Védrine, 2010), we employ the global and local Moran's Indices for the dependent variable. A global index of spatial autocorrelation expresses the overall degree of similarity between spatially close regions observed in a given area and in relation to a specific dependent variable (Pfeiffer *et al.*, 2008). Table A17 in Appendix 3 reports the results of global indices of spatial autocorrelations. The *Moran's I*[22] index is applied to each cross-section and the results show evidence of spatial global autocorrelation from 1997 to 2001 for real per capita GDP growth. This index summarizes the phenomenon investigated here according to a single value. Consequently, this index is not strictly intended identify specific spatial clusters, but to detect the possible presence of a general tendency of clustering within the sample. The greater the number of regions that are similar with respect to the variable under consideration are spatially close, the greater the value taken by the global index of spatial autocorrelation. In addition, we apply a local measure of spatial correlation to the dependent variable, which shows a different association among regions in different years (see Fig. A1, Appendix 3). Global and Local spatial autocorrelation tests on the dependent variable are unconditional, and therefore, represent only an indication about the spatial correlation that can be found in the estimations.

As for the spatial model, we estimate each specification by means of the Spatial Panel Arellano-Bond Linear Dinamic approaches: GMM-diff and GMM-sys. The GMM-diff specification tests are somehow less favourable and efficient than those carried out via the GMM-sys technique. We report both results, but our preferred approach is the GMM-sys. The tests for the absence of spatially correlated residuals and for the absence of general spatial autocorrelation cannot be rejected. The spatial lagged variable (the spatial autoregressive coefficient, ρ, in equation (49) above) have proved to be positive but not statistically significant in all regressions. Hence, this shows evidence of absence of spatial dependence among contiguous areas[23]. However, our results are slightly improved when compared the basic model.

Overall, the results seem to confirm our expectations. The capital spending has a positive effect on economic growth, while current spending has a negative and statistically significant sign when the GMM-sys approach is used at 10 percent level (see Table 7). Anyway, this effect vanishes when we introduce $empl\_growth$ as control variable. The significance of the estimates appears to be the same as that for the estimates reported in Tables 1 and 2, obtained without taking into account for spatial dependence. Among capital sub-components, capital transfer and financial assets expenditures have a positive and statistically significant influence on growth when GMM-sys is employed, at 5 and 10 percent level respectively.

[22] This test requires a weight matrix for capturing spatial interconnections among regions to be specified. We use a 19×19 row standardized distance matrix.

[23] It is worth noting that, if time dummies from 1997 to 2003 are included, spatial dependent variable gains statistical significance. Yet, the Sargan test does not allow rejecting the null hypothesis of validity for the Over Identification Restriction.

Among current sub-components, $other\_current$, that includes expenditures on personnel, purchases of goods and services, items correcting and offsetting revenues, interest expense and unclassified current expenditures, has a negative and statistically significant effect on economic growth at 5 percent level (see Table 8). These results are confirmed with the inclusion of the employment growth rate. They appears to be slightly different from those reported in Tables 3 and 4 above, without spatial interactions, where both capital and current sub-components seem not to have any influence on growth rate. Among functional expenditure, we include all six components because the results differ according to each variable (see Table 9). Both capital and current general public services have a negative effect on economic growth at 5 percent level. Some growth models state that these types of spending contribute to the protection of property rights increasing the probability that the citizens retain these rights to their goods and services[24]. Therefore, such models argue, the higher spending on public order-safety and defence are, the stronger the incentive agents have to accumulate human/physical capital and this enhances growth. In our estimated equations, expenditure on defence (which includes defence, public order-safety and justice) has a not significant influence on growth. Poot (2000) and Devarajan *et al.*(1996) report insignificant or negative influence of defence spending on growth. Conversely, Bleaney *et al.* (2001) find a positive and statistically significant effect. The capital component of public spending on economic affairs has a positive and statistically significant impact on growth. This is expected, since it includes among other outlays on transportation, communication, roads and energy. These kinds of spending imply positive externalities to private producers, which also raise their productivity, and therefore enhance economic growth according to the theoretical models (Barro, 1990). Our results are also consistent with evidence from Easterly and Rebelo (1992), Kneller *et al.* (1999), who found a positive correlation of this kind of expenditure with growth.

Concerning capital spending components on health and education, they do not seem to affect growth in a statistically significant way. These results are consistent with the difficulty of Devarajan *et al.* (1996) to obtain statistically significant estimates for health and education spending. Among current components, expenditure on health has a negative and statistically significant effect on growth.

The evidence regarding social spending show that this variables has no significant influence on growth. This is consistent with the mixed conclusions of both theoretical and empirical works on this subject. Specifically, many growth models predict that redistributive policies have a depressing effect on physical capital accumulation and growth (Feldstein, 1974), while others imply that social security expenditure may positively influence savings, the level and

[24] Defence expenditures are considered to contribute towards protection of property rights of a country's citizens as a whole.

productivity of physical and human capital investment, employment, international competitiveness and growth (Cashin, 1995, Lau *et al.* (2001) and Van Der Ploeg, 2003). Atkinson (1999) in a survey on the literature concluded that the evidence on the relationship between the size of the welfare state and growth is mixed and Kneller *et al.* (2001) including social expenditure in unproductive spending estimated an insignificant growth effect.

Equations 3 and 6 in Table 7, 8 and 9 include $empl\_growth$ as control variable. This is expected and controls for business cycles effects on growth, so we can be reasonably confident, that the estimated growth effects of the rest of the variables included in our model are not contaminated by short-run factors. Moreover, private capital is estimated to have not any significant effect on growth with GMM-sys. Concerning human capital, it has statistically insignificant growth impact in most cases, which is similar to results of other research (Sianesi-Van Reenen, 2003; Barro and Sala-i-Martin, 2004). This implausible finding theoretically (Lucas, 1988; Romer, 1990, Grossman-Helpan, 1991) can be explained in several ways. Human capital presents serious measurement problems (Krueger-Lindhal, 2000). Specifically, it embraces complex characteristics that are difficult to quantify accurately. Furthermore, educational measures are not often compatible across regions due to differences in schooling quality.

The choice of the spatial weighted matrix and its normalization are fundamental in spatial model estimation. Due to its economic, rather than pure statistical content, the normalization of the W matrix has recently received increasing interest from scholars in the field. We use a matrix which elements are the inverse of distance across regions. Firstly, we consider a W matrix normalized with respect to the largest eigenvalue. Unlike the roe standardization, this matrix allows preserving the symmetry of weights. Alternatively, as per the robustness check, we can consider a W row-standardized matrix where each row sums to unity. According to this procedure, the impact of all other regions on a particular region i is given by the weighted average of all regions' impacts. In addition, this implicitly implies that only relative rather than absolute distance matters (see next section).

TABLE 7

CAPITAL AND CURRENT ECONOMIC EXPENDITURE WITH SPATIAL EFFECTS

Variable	GMM-DIFF (1)	GMM-SYS (2)	GMM-SYS (3)	GMM-DIFF (4)	GMM-SYS (5)	GMM-SYS (6)
gdp_pc_growth(-1)	-0.050	0.015	0.001	-0.050	0.015	0.001
	(0.500)	(0.837)	(0.989)	(0.500)	(0.837)	(0.989)
tot_exp	-0.471***	-0.054	-0.041	-0.471***	-0.054	-0.041
	(0.000)	(0.235)	(0.361)	(0.000)	(0.235)	(0.361)
cap_exp	0.239***	0.143*	0.114			
	(0.003)	(0.063)	(0.134)			
curr_exp				-0.239***	-0.143*	-0.114
				(0.003)	(0.063)	(0.134)
dep. var. spatial lag	0.084	0.044	0.116	0.084	0.044	0.116
	(0.584)	(0.792)	(0.476)	(0.584)	(0.792)	(0.476)
private_k	-1.453***	0.183	0.234	-1.453***	0.183	0.234
	(0.005)	(0.565)	(0.448)	(0.005)	(0.565)	(0.448)
human_cap	-0.044	-0.001	-0.008	-0.044	-0.001	-0.008
	(0.218)	(0.997)	(0.815)	(0.218)	(0.997)	(0.815)
pop_65	-1.226**	-0.130	-0.099	-1.226**	-0.130	-0.099
	(0.027)	(0.576)	(0.663)	(0.027)	(0.576)	(0.663)
empl_growth			0.181**			0.181**
			(0.011)			(0.011)
Obs/No. of regions	209/19	209/19	209/19	209/19	209/19	209/19
Sargan Overid. Test	79.32	81.62	81.80	79.32	81.62	81.80
	(0.048)	(0.162)	(0.179)	(0.048)	(0.162)	(0.179)
LM test residual spatial autoc. (p-val)	0.096	0.494	0.005	0.096	0.494	0.005
	(0.757)	(0.482)	(0.942)	(0.757)	(0.482)	(0.942)
Global Moran's I test on Residuals (p-val)	0.019	0.042	0.004	0.019	0.042	0.004
	(0.667)	(0.387)	(0.865)	(0.667)	(0.387)	(0.865)
LM SAC (General Spatial Autoc.)	0.105	4.285	0.920	0.105	4.285	0.920
	(0.949)	(0.117)	(0.631)	(0.949)	(0.117)	(0.631)

Notes: Dependent variable is GDP per-capita growth at 2005 constant prices; p-values in parentheses *p<0.1, **p<0.5, ***p<0.01. Time dummies are included from 1997 to 2006. Lag dependent, spatial lag and all explanatory variables are treated as endogenous. Instruments are two lagged values of endogenous variables. An inverse distance matrix normalized with respect to the largest eigenvalue is used. Constant is not shown. All regressions run using the spregdpd routine for STATA.

TABLE 8

CAPITAL AND CURRENT ECONOMIC EXPENDITURE SUB-COMPONENTS WITH SPATIAL EFFECTS

Variable	GMM-DIFF (1)	GMM-SYS (2)	GMM-SYS (3)	GMM-DIFF (4)	GMM-SYS (5)	GMM-SYS (6)
gdp_pc_growth(-1)	-0.082	-0.009	-0.023	-0.040	0.007	-0.009
	(0.257)	(0.895)	(0.739)	(0.587)	(0.918)	(0.898)
tot_exp	-0.505***	-0.079*	-0.067	-0.476***	-0.049	-0.035
	(0.000)	(0.092)	(0.146)	(0.000)	(0.278)	(0.433)
cap_transf	0.319***	0.223**	0.198**			
	(0.002)	(0.029)	(0.046)			
n_fin_assets	-0.020	-0.079	-0.099			
	(0.888)	(0.599)	(0.497)			
fin_assets	0.323***	0.224*	0.193*			
	(0.007)	(0.059)	(0.098)			
curr_transf				-0.304**	-0.069	-0.022
				(0.017)	(0.530)	(0.838)
other_curr				-0.204**	-0.177**	-0.155*
				(0.016)	(0.041)	(0.068)
dep. var. spatial lag	0.065	0.024	0.090	0.084	0.065	0.144
	(0.662)	(0.881)	(0.575)	(0.583)	(0.693)	(0.376)
private_k	-1.626***	0.126	0.178	-1.250**	-0.071	-0.072
	(0.002)	(0.697)	(0.570)	(0.020)	(0.865)	(0.859)
human_cap	-0.056	-0.018	-0.025	-0.044	0.023	-0.006
	(0.112)	(0.615)	(0.482)	(0.224)	(0.946)	(0.866)
pop_65	-1.463***	-0.218	-0.186	-1.113**	-0.308	-0.315
	(0.008)	(0.352)	(0.415)	(0.050)	(0.303)	(0.280)
empl_growth			0.167**			0.190***
			(0.018)			(0.008)
Obs/No. of regions	209/19	209/19	209/19	209/19	209/19	209/19
Sargan Overid. Test	87.26	87.90	89.87	81.27	82.89	83.32
	(0.019)	(0.098)	(0.088)	(0.042)	(0.158)	(0.170)
LM test residual spatial autoc. (p-val)	0.000	0.212	0.017	0.009	0.577	0.016
	(0.996)	(0.645)	(0.897)	(0.925)	(0.447)	(0.901)
Global Moran's I test on Residuals (p-val)	-0.000	0.028	-0.008	0.006	0.046	0.008
	(0.933)	(0.547)	(0.955)	(0.847)	(0.351)	(0.820)
LM SAC (General Spatial Autoc.)	0.000	1.994	0.283	0.012	4.060	0.615
	(0.999)	(0.369)	(0.868)	(0.994)	(0.131)	(0.735)

Notes: Dependent variable is GDP per-capita growth at 2005 constant prices; p-values in parentheses *p<0.1, **p<0.5, ***p<0.01. Time dummies are included from 1997 to 2006. Lag dependent, spatial lag and all explanatory variables are treated as endogenous. Instruments are two lagged values of endogenous variables. An inverse distance matrix normalized with respect to the largest eigenvalue is used. Constant is not shown. All regressions run using the spregdpd routine for STATA.

TABLE 9

FUNCTIONAL (CAPITAL AND CURRENT) EXPENDITURE COMPONENTS WITH SPATIAL EFFECTS

Variable	GMM-DIFF (1)	GMM-SYS (2)	GMM-SYS (3)	GMM-DIFF (4)	GMM-SYS (5)	GMM-SYS (6)
gdp_pc_growth(-1)	-0.069	-0.018	-0.028	-0.066	0.004	-0.011
	(0.341)	(0.798)	(0.685)	(0.397)	(0.996)	(0.878)
tot_exp	-0.596***	-0.073	-0.060	-0.481***	-0.074	-0.040
	(0.000)	(0.137)	(0.215)	(0.000)	(0.210)	(0.490)
cap_gen_p_serv	-0.317	-0.459**	-0.466**			
	(0.109)	(0.023)	(0.019)			
cap_defen	0.114	-0.055	-0.013			
	(0.839)	(0.928)	(0.982)			
cap_ec_aff	0.251***	0.218**	0.191**			
	(0.004)	(0.013)	(0.027)			
cap_health	0.079	0.167	0.060			
	(0.853)	(0.710)	(0.890)			
cap_educ	0.390	0.048	0.084			
	(0.318)	(0.910)	(0.837)			
cap_soc_prot	-0.692**	-0.118	-0.129			
	(0.024)	(0.613)	(0.571)			
curr_gen_p_serv				-0.248***	-0.214**	-0.182**
				(0.004)	(0.015)	(0.034)
curr_defen				-0.304	0.020	-0.019
				(0.343)	(0.945)	(0.947)
curr_ec_aff				-0.048	-0.032	-0.029
				(0.782)	(0.862)	(0.869)
curr_health				-0.248*	-0.252*	-0.277**
				(0.057)	(0.068)	(0.040)
curr_educ				-0.237	-0.172	-0.158
				(0.209)	(0.383)	(0.409)
curr_soc_prot				-0.277*	-0.078	-0.001
				(0.066)	(0.572)	(0.995)
dep. var. spatial lag	0.091	-0.011	0.046	0.076	0.003	0.072
	(0.559)	(0.948)	(0.781)	(0.623)	(0.985)	(0.660)
private_k	-2.161***	-0.048	0.007	-1.501**	-0.299	-0.238
	(0.000)	(0.883)	(0.983)	(0.020)	(0.536)	(0.612)
human_cap	-0.015	0.021	0.013	-0.043	-0.008	-0.013
	(0.687)	(0.574)	(0.713)	(0.234)	(0.818)	(0.699)
pop_65	-1.760***	-0.295	-0.254	-0.948*	-0.264	-0.311
	(0.001)	(0.215)	(0.274)	(0.082)	(0.431)	(0.340)
empl_growth			0.161**			0.184**
			(0.022)			(0.012)
Obs/No. of regions	209/19	209/19	209/19	209/19	209/19	209/19
Sargan Overid. Test	80.46	86.79	86.17	90.14	86.24	86.71
	(0.094)	(0.166)	(0.199)	(0.021)	(0.176)	(0.188)
LM test residual spatial autoc. (p-val)	0.133 (0.716)	0.601 (0.438)	0.140 (0.708)	0.016 (0.898)	0.830 (0.362)	0.124 (0.725)
Global Moran's I test on Residuals (p-val)	-0.022 (0.746)	0.048 (0.333)	0.023 (0.607)	0.008 (0.815)	0.056 (0.262)	0.022 (0.624)
LM SAC (General Spatial Autoc.)	0.136 (0.934)	2.874 (0.238)	0.840 (0.657)	0.017 (0.991)	3.621 (0.164)	0.760 (0.684)

Notes: Dependent variable is GDP per-capita growth at 2005 constant prices; p-values in parentheses *p<0.1, **p<0.5, ***p<0.01. Time dummies are included from 1997 to 2006. Lag dependent, spatial lag and all explanatory variables are treated as endogenous. Instruments are two lagged values of endogenous variables. An inverse distance matrix normalized with respect to the largest eigenvalue is used. Constant is not shown. All regressions run using the spregdpd routine for STATA.

5.3 Robustness Check

To test the reliability of our results, we perform several estimations and apply different specifications. We first check the robustness of our results by adding the employment growth[25] as an extra control variable. This variable also captures the business cycles effects. As it is a potential determinant of growth, we threat this variable as endogenous (see tables A5-A7 in Appendix 2). Interestingly, the dynamic GMM framework allows us to deal with the additional endogeneity issues through internal instruments. Yet, by adding more endogenous controls would quickly make the estimation results unreliable if the number of instruments is large. Interestingly, the results are very similar to those reported in Section 5.1.

We further check the robustness of these results by changing the timing fiscal policy affects growth. We previously assumed previously that fiscal policy suffers not delay in affecting growth while simultaneously changing the steady state of the economy. However, one may instead assume that fiscal policy affects the economy only with lags. We run the same regressions to capture the potentially delayed effect of the public expenditure, also considering fiscal variables as having one lag (see tables A8-A10, Appendix 2) . Again, the results are consistent with those previously obtained.

Subsequently, we attempt to verify whether our empirical results change when including government revenues (see tables A11-A15, Appendix 2). From an empirical standpoint, we could choose not to incorporate fully the government budget constraint into the analysis. However, this could have resulted in obtaining parameter estimatesthat are similar to systematic omitted variable biases. The first part of our analysis focuses almost entirely on the expenditure rather than the revenue side of the government budget constraint. According to some researches (e.g., Kneller *et al.*, 1999 and Bose *et al.*, 2007), this could lead to biased coefficient estimates. Ideally, one simultaneously takes into account both the sources and the uses of funds when evaluating fiscal policy effects on growth. In order to achieve a more detailed understanding of the budget government constraint, we incorporate tax and no tax revenues, along with the government budget deficit/surplus, as also suggested in Ghosh and Gregoriou (2008). The final objective is to compare these results against our benchmark specification, where the ratio of total public spending on GDP (a proxy for the tax rate) was the only variable on the revenue side. We run these regressions for robustness check, although we are aware of the fact this may further extent the large number of instruments included in the GMM-sys specification. Once again, these estimations do not return any remarkable difference.

[25] We have estimated the same specifications by adding inflation as the control variable and found that the results remain unchanged.

In order to test the reliability of results obtained through spatial models, we attempt to verify the sensitivity of our analysis in relation to the spatial weights matrix used (see Appendix 3, Tables A18-A20). Rather than employing an inverse distance matrix normalized with respect to the largest eigenvalue, we implement a row standardized inverse distance matrix. Again, the modified specification does not affect results, at least in terms of coefficient size and statistical significance. A more detailed investigation of the residual test on each estimated regression reveals that, using the row standardized inverse distance matrix, residuals are still spatially autocorrelated. As a result, the residual specification tests are somehow less favourable.

6. Concluding Remarks

In this chapter, we have attempted to examine the relationship between composition of government spending and economic growth within an endogenous growth framework with two public goods, and one being *a priori* more productive than the other (Gosh and Gregoriou, 2008). The theoretical model is an extension of Devarajan *et al.*'s (1996) model in an optimal fiscal policy perspective. Consequently, the model addresses the fiscal policy issue in terms of the changes of the key endogenous fiscal variables being directly linked to the productivity parameters of the model. The added value of this work is mainly empirical, since it focuses on panel data regarding 19 Italian regions. It tries to understand which (and how) components of government spending affect economic growth rate. We have considered a double classification of government spending related to the public budget structure. The first classification is based on the type, or economic characterization, of expenditures. The second classification is based on the purpose or function expenditures have. We have grouped the thirty sectoral items of expenditure (based on the available data), into six main categories (i.e. general public services, defence, economic affairs, health, education and social protection), according to the Classification of the Functions of Government (COFOG). This work additionally contributes to distinguish between capital and current components among functional expenditures.

From a methodology point of view, the characterization of optimal fiscal policy (where theoretically all key variables are endogenously determined) can be captured by the Generalized Method of Moments (GMM) dynamic panel estimators, as developed by Holtz-Eakin, Newey and Rosen (1990) and Arellano and Bond (1991). Furthermore, we have used the GMM-sys approach, as proposed by Arellano and Bover (1995) and Blundell and Bond (1998), to tackle the finite sample biases caused by the use of difference-GMM estimators. These estimators help us to handle the bias from unobserved country-specific effects, and to deal with potential endogeneity problems. The property allowed by these estimators is important in this context as it entails potential reverse causality between the shares of each expenditure in total spending and economic growth.

In general, it is difficult to find statistically significant and robust associations of compositional changes in government expenditure with growth. Basic results show only a weak effect of aggregate capital and current expenditure on economic growth when using System-GMM technique. Conversely, functional components seem not to have any significant effect on growth. Results slightly improve when we have used a spatial lag model to account for spatial correlation. Although there is no evidence of spatial autocorrelation in our specifications, the results show that the capital and current expenditure behaviour is driven by capital transfers and financial assets. Also, it depends on current expenditure on personnel, purchases on goods and services, interest expense and other unclassified current expenditures. Among functional components, capital expenditure on economic affairs, such as infrastructures, play an important role in augmenting the economic growth rate of the Italian regions and within the short period under scrutiny. Current expenditure on health, and capital and current expenditure on general public services had a negative effect on growth. Other functional categories have no substantial effect on growth. Furthermore, diagnostic tests show evidence of absence of autocorrelation in the error term. Results are also robust regarding different specifications. These results have implications on how governments ought to allocate their expenditures on different types of public goods. If fiscal policies are pursued optimally, then expenditure shares are directly linked to the productivity of such goods. When statistically significant, the results generally confirm expectations and are coherent with existent empirical results on developed countries.

References

Acosta-Ormahcea, S. and Atsuyoshi, M. (2013) “Can a Government Enhance Long-Run Growth by Changing the Composition of Public Expenditure?”, *International Monetary Fund Working Paper*, 13/162, Washington, DC.

Adewara, S. O. and Oloni, E. F. (2012) “Composition of Public Expenditure and Economic Growth in Nigeria”, *Journal of Emerging Trends in Economics and Management Sciences*, 3.

Agbatogun, K. K. and Taiwo, A. S. (2011) “Government Expenditure in Nigeria: A Sine Qua Non for Economic Growth and Development”, *Journal of Research in National Development*, 9.

Agell, J., Lindh, T. and Ohlson, H. (1997) “Growth and the Public Sector: A Critical Review Essay”, European *Journal of Political Economy*, 13, pp. 33-52.

Agenor, P. R. and Neanidis, K. C. (2011) “The Allocation of Public Expenditure and Economic Growth”, *The Manchester School*, 79, pp. 899-931.

Anselin, L (1988) “Spatial Econometrics: Methods and Models”, Kluwer Academic, Dordrecht.

Anselin, L. and Rey, S.J. (1991) "Properties of tests for spatial dependence in linear regression models", *Geographical Analysis*, 23, pp. 112-131.

Anselin, L., Le Gallo, J., Jayet, H. (2008) “Spatial Panel Econometrics”, *Advanced Studies in Theoretical and Applied Econometrics*, 46, Part II, pp. 625-660

Arellano, M. and Bond, S. (1991) “Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations”, *Review of Economic Studies*, 68, pp. 29-52.

Arellano, M. and Bover, O. (1995) “Another Look at the instrumental-variable estimation of error-components models”, *Journal of Econometrics*, 58, pp. 277-297.

Arrow, K. J. and Kurz, M., (1970) “Public Investment, the Rate of Return and Optimal Fiscal Policy”, (Johns Hopkins University, Baltimore, MD).

Aschauer, D. (1989) “Is Government Spending Productive?”, *Journal of Monetary Economics*, 23, pp. 177-200.

Atkinson, A. B. (1999) “The Economic Consequences of Rolling Back the Welfare State”, *Munich lectures in Economics*, MIT Press.

Barro, R. J., (1990) “Government Spending in a Simple Model of Endogenous Growth,” *Journal of Political Economy*, 98, pp. s103-s25.

Barro, R. J. (1991) “Economic Growth in a Cross Section of Countries”, *The Quarterly Journal of Economics*, CVI, pp. 407-443.

Barro, R. and Sala-i-Martin, X., (1992) “Public Finance in Models of Economic Growth”, *Review of Economic Studies*, 59, pp. 645-661.

Barro, R. J. and Sala-i-Martin, X., (1995) “Economic Growth”, *McGraw-Hill*, New York.

Bassanini, A., Scarpetta S. and Hemmings, P., (2002) “Economic Growth: The Role of Policies and Institutions. Panel Data Evidence from OECD Countries”, *OECD Working paper* 283, pp. 1-68.

Benos, N., (2005) “Fiscal Policy and Economic Growth: Empirical Evidence from OECD Countries”. *Discussion Paper 2005-01, University of Cyprus.*

Benos, N., (2009) "Fiscal Policy and Economic Growth: Empirical Evidence from EU Countries", Mimeo, University of Ioannina.

Bleaney, M. F., Gemmel, N. and Kneller, R. (2001) "Testing the Endogeneous Growth Model: Public Expenditure, Taxation, and Growth Over the Long-Run", *Canadian Journal of Economics*, 34, pp. 36-57.

Blundell, R. and Bond, S. (1998) "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models", *Journal of Econometrics*, 87, pp. 115-143.

Bond, S., Hoeffler, A. and Temple, J. (2001) "GMM Estimation of Empirical Growth Models", *Discussion Paper No. 2084, Centre for Economic Policy Research.*

Bose, N., Haque, M.E., and Osborn, D.R. (2007) "Public Expenditure and Economic Growth: A Disaggregated Analysis for Developing Countries", *The Manchester School*, 75, pp. 533-56.

Bottasso, A., Castagnetti, C. and Conti, M. (2013) "And jet they Co-move! Public Capital and Productivity in OECD", *Journal of Policy Modeling*, 35, pp. 713-729.

Bouayad-Agha, S. and Védrine, L. (2010) "Estimation Strategies for a Spatial Dynamic Panel using GMM. A New Approach to the Convergence Issue of European Regions", *Spatial Economic Analysis*, 5, pp. 205-227.

Caselli, F., Esquivel, G. and Lefort, F. (1996) "Reopening the convergence debate: A new look at cross-country growth empirics", *Journal of Economic Growth*, 1, pp. 363-389.*

Cashin, P. (1995) "Government Spending, Taxes and Economic Growth", *IMF Staff Papers*, 42, pp. 237-269.

Chen, B., L., (2006) "Economic Growth with an Optimal Public Spending Composition", *Oxford Economic Papers*, 58, pp. 123-136.

Chen, S., and Lee, C. (2005) "Government Size and Economic Growth in Taiwan: A Threshold Regression Approach", *Journal of Policy Modeling*, 27, pp. 1051-1066.

De Castro F. and J., Gonzales Mìngues, (2008) "The Composition of Public Spending in Europe and Long-Term Growth", *Economic Bulletin*, Banco de España.

Devarajan, S., Swaroop, V. and Zou, H. F., (1993) " What Do Governments Buy? The Composition of Public Spending and Economic Performance", *Working Papers 1082.*

Devarajan, S., Swaroop, V., and Zou, H. F., (1996) "The Composition of Public Expenditure and Economic Growth", *Journal of Monetary Economics*, 37, pp. 313-44.

Durlauf, S., Johnson, P. and Temple, J. (2006) "Growth Economterics. In: Aghion, P.; Durlauf, S. (eds): Handbook of Economic Growth. Amsterdam, North Holland.

Easterly, W. and Rebelo, S., (1993) "Fiscal Policy and Economic Growth", Journal of Monetary Economics, 32, pp. 417-458.

Ekinci, A., (2011) "What is the Optimum Size of Government: A Suggestion", *International Journal of Economics and Finance Studies*, 3, pp. 45-54.

Elhorst, J. P. (2010) "Spatial Panel-Data Models". In M.M. Fischer & A. Gestis, eds., *Handbook of Applied Spatial Analysis*. Berlin: Springer, pp. 377-407.

Ertur, C. and Kock, W. (2007) "Growth, Technological interdependence and Spatial Externalities: Theory and Evidence", *Journal of Applied Econometrics*, 22, pp. 1033-1062.

Etsuro, S., (2001) "Public Capital and Economic Growth: A Convergence Approach", *Journal of Economic Growth*, 6, pp. 205-227.

Evans, P. and Karras, G., (1994) “Are Government Activities Productive? Evidence from a Panel of U.S. States”, *The Review of Economics and Statistics*, pp. 1-11.

Fan, S. and N., Rao, (2003) “Public Spending in Developing Countries: Trends, Determination and Impact”, *EPTD Discussion paper no. 99.*

Feldstein, M. (1974) “Social Security, Induced Retirement and Aggregate Capital Accumulation”, *Journal of Political Economy*, 82, pp. 905-926.

Fölster S. and Henrekson M., (2001) “Growth Effects of Government Expenditure and Taxation in Rich Countries”, *The European Economic Review*, 45, pp. 1501-1520.

Fölster, S. and Henrekson, M., (1999) “Growth and the Public Sector: A Critique of the Critics”, European Journal of Political Economy, 15, pp. 337-358.

Futagami, K., Morita, Y., and Shibata, A. (1993) “Dynamic Analysis of an Endogenous Growth Model with Public Capital”, *Scandinavian Journal of Economics*, 95, pp. 607-625.

Gemmell, N., Kneller, R. and Sanz, I. (2011) “The timing and persistence of fiscal policy impacts on growth: Evidence from OECD countries”, *Economic Journal*, 121, pp. F33-F58.

Ghosh, S. and Gregoriou, A., (2009) “The Composition of Government Spending and Growth: is Current or Capital Spending Better?”, *Oxford Economic Papers*, 60, pp. 484-516.

Ghosh, S. and Gregoriou, A., (2008) “The Impact of Government Expenditures on Growth: Empirical evidence from an Heterogeneous Panel”, *Bulletin of Economic Research*, 61, pp. 95-102.

Ghosh, S. and Roy, U. (2004) “Fiscal Policy, Long-Run Growth, and Welfare in a Stock-Flow Model of Public Goods”, *Canadian Journal of Economics*, 37, pp. 742-756

Glomm, G., and B. Ravikumar, (1997) “Productive Govenment Expenditures and Long-Run Growth,” *Journal of Economic Dynamics and Control*, 21, pp. 183-204.

Gray, C., Lane, T. and Varoudakis, A., (2007) “Fiscal Policy and Economic Growth. Lessons for Eastern Europe and Central Asia”, *The World Bank, Washington, DC.*

Grier, K. and Tullock, G., (1989) “An Empirical Analysis of Cross-Sectional Economic Growth, 1951-1980”, *Journal of Monetary Economics*, 24, pp. 259-276.

Grisorio, M. J. and Prota, F. (2013) “The Impact of Fiscal Decentralization on the Composition of Public Expenditure: Panel Data Evidence from Italy”, *Regional Studies*.

Grisorio, M. J. and Prota, F. (2015) “The Short and the Long Run Relationship between Fiscal Decentralization and Public Expenditure Composition in Italy”, *Economics Letters*, 130, pp. 113-116.

Grossman, G. M. And Helpman, E. (1991) “Innovation and Growth in a Global Economy”, *MIT Press, Cambridge*.

Gupta, S., Clements, B., Baldacci, E. and Mulas-Granados, C. (2005) “Fiscal Policy, Expenditure Composition, and Growth in Low-Income Countries”, *Journal of International Money and Finance*, 24, pp. 441-63.

Hanssen, P. and Henrekson, M., (1994) “A New Framework for Testing the Effect of Government Spending on Growth and Productivity”, *Public Choice*, 81, pp. 381-401.

Holtz-Eakin, D. W. Newey and Rosen, H. (1988) “Estimating Vector Autoregressions with Panel Data”, *Econometrica*, 56, pp. 1371-1395.

Holtz-Eakin, D., (1991) “Public-Sector Capital and the Productivity Puzzle”, Mimeo. *Syracuse University, Syracuse, NY.*

Hjerppe, R., Kiander, J., and Virén, M., (2005) “Are Government Expenditures Productive? Measuring the Effect on Private Sector Production”, *Vatt discussion papers, Government Institute for Economic Research, Helsinki.*

Hsiao, C. (1986) “*Analysis of Panel Data*”, Cambridge: Cambridge University.

Kapoor, M., Kelejian, H. H. and Prucha, I. R. (2007) “Panel Data Model with Spatially Correlated Error Components”, *Journal of Econometrics*, 140, pp. 97-130.

Kelejian, H.H. and Prucha, I.R. (1998) "A Generalized Spatial Two-Stage Least Squares Procedure for Estimating a Spatial Autoregressive Model with Autoregressive Disturbances", *Journal of Real Estate Finance and Economics*, 17, pp. 99-121.

Kneller, R., Bleaney, M., e Gemmell, N., (1998) “Growth, Public Policy and the Government Budget Constraint: Evidence from OECD Countries”, *School of economics, Discussion paper n. 98/14. University of Nottingham.*

Kneller, R. A., Bleaney M. F. e N. Gemmell, (1999) “Fiscal Policy and Growth: Evidence from OECD Countries”, *Journal of Public Economics*, 74, pp. 171-190.

Kormendi, R. C. e Meguire, P. C., (1985) “Macroeconomic Determinants of Growth: Cross-Country evidence, *Journal of Monetary Economics*, 16, pp. 141-164.

Krueger, A. and Lindhal, M. (2000) “Education for Growth: Why and for Whom?” *NBER Working Paper 7591.*

Landau, D. L., (1986) “Government and Economic Growth in the Less Developed Countries: An Empirical Study for 1960-1988”, *Economic Development and Cultural Change*, 35,pp. 35-75.

Landau, D. L., (1983) “Government Expenditure and Economic Growth: A Cross Country Study”, *Southern Economic Journal*, 49, pp. 783-792.

Lau, M. I. and Poutvaara, P. (2001) “Social Security Incentives and Human Capital Investment”, *CESIfo Working Paper*, 438.

Levine, R. and Renelt, D., (1992) “A Sensitivity Analysis of Cross-Country Growth Regression”, *American Economic Review*, 82 , pp. 942-963.

LeSage, J. and Fisher , M.M. (2008) "Spatial Growth Regressions: Model Specification, Estimation and Interpretation", *Spatial Econometric Analysis,* 3, pp. 275-304.

LeSage, J. and Pace, K. (2009) "Introduction to Spatial Econometrics", *Chapman and Hall/CRC*.

Lucas, R. E. (1988) “On the Mechanics of Economic Development”, *Journal of Monetary Economics*, 22, pp. 3-42.

Mankiw, N.G., Romer, D. and Weil, D.N. (1992) "AQ Contribution to the Empirics of Economic Growth", *Quarterly Journal of Economics*, 107, pp. 407-437.

Martins, S. and Veiga, F. J. (2014) “Government Size, Composition of Public Expenditure, and Economic Development”, International Tax and Public Finance, Springer, 21, pp. 578-597.

Moscone, F. and Tosetti, E. (2009) “A Review and Comparison of Tests of Cross-SectionIndependence in Panels”, *Journal of Economic Surveys*, Wiley Blackwell, 23, pp. 528-561.

Mutascu, M. and Milos, M. C. (2009) “Optimal Size of Government Spending. The Case of European union Member States”, *Annales Universitatis Apulensis Series Oeconomica*, pp. 1-11.

Nickell, S. (1981) “Biases in Dynamic Models with Fixed Effects”, *Econometrica*, 49, pp.417-426.

Pesaran, M. H. (2004) “General Diagnostic Tests for Cross Dependence in Panels, *CESifo Workig Papers, No. 1229.*

Pfeiffer, D., Robinson, T., Stevenson, M., Rogers, K. and Clements, A. (2008) “Spatial Analysis in Epidemiology”, *Oxford, Oxford University Press*.

Phillips, P. C. B. and Sul, D. (2003) “Dynamic Panel Estimation and Homogeneity Testing under Cross-Section Dependence”, *The Econometrics Journal*, 6, pp. 217-259.

Piras, R. (2001) “Government Spending Composition in an Endogenous Growth Model with Congestion”, *Metroeconomica*, 52, pp. 121-136.

Pisati, M. (2001) “Tools for Spatial Data Analysis”, *Stata Technical Bulletin*, 60, pp. 21-37. In *Stata Technical Bulletin Reprints*, 10, pp. 277-298. College Station, TX: Stata Press.

Poot, J. (2000) “A Synthesis of Empirical Research on the Impact of Government on Long-Run Growth”, *Growth and Change*, 31, pp. 516-546.

Roodman, D. (2009a) “How to do xtabond2: An Introduction to difference and system GMM in Stata”, *Stata Journal*, 9, pp. 86-136.

Roodman, D. (2009b) “A Note on the Theme of Too Many Instruments”, *Oxford Bulletin of Economics and Statistics*, 71, pp. 135-58.

Sàez, M., P. and García, S., Á., (2006) “Government Spending and Economic growth in the European Union Countries: an Empirical Approach”.

Sheeley, E. (1993) “The effect of Government Size on Economic Growth”, *Easter Economic Journal*, 19, pp. 321-328.

Shelton, C., A., (2007) “The Size and Composition of Government Expenditure”, *Journal of Public Economics*, 91, pp. 2230-2260.

Sianesi, B. and Van Reenen, J. (2003) “The Returns to Education: Macroeconomics”, *Journal of Economic Survey*, 17, pp. 158-200.

Van Der Ploeg, F. (2003) “Do Social Policies Harm Employment and Growth?”, *CESIfo Working Paper 886*, March, pp.1-28.

Appendix 1 – Further Data Description

Table A1. Classification of Expenditure by Economic Category

CURRENT EXPENDITURE	
Economic category	**Description**
Personnel	It includes gross compensation of personnel in service, i.e. net compensation, pension and social contributions charged to the institution, tax withholdings, overtime payments, special compensation, mission allowance, termination indemnity, contributions towards pension funds.
Social Security Contributions	This is one of the two specific items of the Personnel category as envisaged in the RPA survey schedule. It covers pension and social contributions charged to the entity. Since it can be treated as a transfer to social security institutions, the item is eliminated in consolidation. The data sources do not always report a breakdown of gross compensation that enables the separation of this item.
IRPEF Withholdings	This is the second of the two specific items for personnel expense, which can generally be extracted from the "transfer items" section in the accounts of public entities. The same measurement issues for social contributions apply here.
Purchases of Goods and Services	The item reports expenditure for purchases of goods and services used as input in the production process, but excluding those treated as fixed capital as they can be used in production for over one year.
Current Account Transfers Current account transfers to households and social institutions Current account transfers to private-sector companies Current account transfers to national public enterprises Current account transfers to public entities Current account transfers to the State Currents account transfers to other central government entities Current account transfers to regions and autonomous provinces Current account transfers to provinces and metropolitan cities Current account transfers to municipalities Current account transfers to local health authorities, hospitals and research hospitals Current account transfers to consortia and associations Current account transfers to firms, institutions, companies and foundations controlled by local authorities Current account transfers to mountain communities and other local authority unions Current account transfers to subordinate entities Current account transfers to other local government entities	This includes unilateral transfers, i.e. transfers with no direct corresponding performance, of a recurrent nature. They are not intended to support investments made towards other public or private entities. The recipients of the transfers are broken down into these categories in the RPA survey schedule.

Interest Expense	This covers all outlays for payment of interest on financial liabilities (i.e. loans, bonds and other securities and deposits, such as those issued by the State to those entities having deposits at the central treasury); it includes default interest for payments in arrears. In some statements, the “financial expense” item includes bank commissions, which should instead be reported under “Purchases of goods and services” if identifiable.
Items Correcting and Offsetting Revenues	These expenditures adjust the value of improperly registered revenues, or expenditures with corresponding revenues both in terms of the nature of the item and amount. However, these do not represent true transfer items. Where depreciation and amortization are included and specified, they are estimated as they are pure accounting entities. They are not computed in consolidated accounts.
Unclassified Current Expenditure	This category includes current expenditure items that cannot be allocated to one of the previous sections. They include, for example, payment of taxes and duties.
CAPITAL EXPENDITURE	
Economic Category	**Description**
Real Estate Assets and Works	The category includes expenditure on construction, extraordinary maintenance (e.g. refurbishment, completion, adaptation) or acquisition of buildings and other real estate assets, including civil engineering works (e.g. roads, ports, airports, reclamation works, land consolidation, etc.)
Movables, Machinery, etc.	This covers expenditure for the direct acquisition of movables (e.g. machinery and equipment, office machinery, communications devices, furnishings etc.) used by an entity to achieve investment goals, i.e. using them in the production process for one year. Movables included in this category must therefore be durable and hold the potential to generate income for a period beyond the fiscal year. Accordingly, such assets also include expenditure on software and scientific research. The acquisition of government or private sector securities that are not intended to provide financing to companies, entities or other organizations (which are recorded under equity investments) are included in this category . They do not give any ownership rights to their holders and do not represent interest-bearing financial instruments.
Capital Account Transfers Current account transfers to households and social institutions Current account transfers to private-sector companies Current account transfers to national public enterprises Current account transfers to public entities Current account transfers to the State Currents account transfers to other central government entities Current account transfers to regions and autonomous provinces Current account transfers to provinces and metropolitan cities	This category includes allocations, contributions and subsidies for the acquisition of movable assets or the execution of investment works. It also comprises all non-recurrent unilateral transfers, such as transfers to cover accumulated losses. The breakdown by beneficiary is the same as that for transfers on current account. Therefore, itincludes the items indicated to the left.

Current account transfers to municipalities Current account transfers to local health authorities, hospitals and research hospitals Current account transfers to consortia and associations Current account transfers to firms, institutions, companies and foundations controlled by local authorities Current account transfers to mountain communities and other local authority unions Current account transfers to subordinate entities Current account transfers to other local government entities	
Equity Investments and Contributions	Equity investments refer to the acquisition of portions of the capital of companies limited by shares, while contributions are equity holdings acquired by means of financial contributions to the capital or endowments of entities, companies and other enterprises. These instruments give rise to the right to share in the profits of the enterprises. Also, they receive a portion of the assets of such enterprises upon their liquidation.
Loans, etc.	This includes all expenditure relating to loans, advances and other financing procedures to be used by the recipients for investment purposes. In general, unlike bonds, shares and other securities, these instruments are not marketable.
Unclassified Capital Expenditure	Like the corresponding item under the Current Expenditure Category, this category includes capital expenditure that, owing to its specific features or cross-cutting nature, cannot be allocated to one of the previous categories. The analyst's skill demonstrated in their ability to limit the size of this item during consolidation.
REPAYMENT OF LOANS	
Economic Category	**Description**
Repayment of Loans	This comprises outlays regarding the repayments of the principal on loans, advances and other liabilities to third parties.

Source: Regional Public Accounts, UVAL (Public Investment Evaluation Unit) (DPS, Department for Development Policies)

Table A2. Classification of Expenditure by Functional Category

Aggregation	RPAs Classification
01 – General Public Services	General Administration Unclassified Expenditure
02 – Economic Affairs	Labour Other Transport Telecommunications Agriculture Marine Fishing and Aquaculture Tourism Wholesale and Retail Distribution Industry and Artisans Energy Other Public Works Other Economic Sectors Roads Sewers and Water Treatment Environment Waste Disposal Residential Building and Urban Development Water
03 – Health	Health Other Health and Sanitation Institutes
04 – Education	Education Training Research and Development Culture and Recreational Services
05 – Social protection	Pensions and Wage Supplementing Other Social Affairs (e.g. Suppport and Charity)
06 - Defence	Defence Public Order Justice

Table A3. Entities included in General Government for the Regional Public Accounts

GENERAL GOVERNMENT	***CENTRAL GOVERNMENT***
	State
	Patrimonio dello Stato SpA (State Assets)
	ANAS (State Road Agency)
	Social Security institutions
	Other central government entities
	REGIONAL GOVERNMENT
	Regions and Autonomous Provinces
	Entities subordinate to Regional Governments
	Local Health Authorities, Hospitals and Research Hospitals
	LOCAL GOVERNMENT
	Provinces and Metropolitan Cities
	City Councils
	Mountain Communities and other Local Authority Unions
	Chambers of Commerce
	Universities
	Entities subordinate to Local Governments
	Port Authorities and other Entities

Source: Regional Public Accounts, UVAL (DPS)

Description of variables used in the analysis

gdp_pc_growth: growth rate of real GDP per capital equal the natural log difference in millions of euro (constant prices 2005)
tot_exp: share of total spending (as % of GDP)
cap_exp: share of capital spending (as % of total spending)
cap_transf: share of expenditure on capital transfers (as % of total spending)
n_fin_assets: share of expenditure on non financial assets (as % of total spending)
fin_assets: share of expenditure on financial assets (as % of total spending)
curr_exp: share of current spending (as % of total spending)
curr_transf: share of expenditure on current transfers (as % of total spending)
other_curr: share of expenditure on other current (as % of total spending)
cap_gen_p_serv: capital share of expenditure on general public services (as % of total spending)
cap_defen: capital share of expenditure on defence (as % of total spending)
cap_ec_aff: capital share of expenditure on economic affairs (as % of total spending)
cap_health: capital share of expenditure on capital health (as % of total spending)
cap_educ: capital share of expenditure capital education (as % of total spending)
cap_soc_prot: capital share of expenditure on social protection (as % of total spending)
curr_gen_p_serv: current share of expenditure on general public services (as % of total spending)
curr_defen: current share of expenditure on defence (as % of total spending)
curr_ec_aff: current share of expenditure on economic affairs (as % of total spending)
curr_health: current share of expenditure on current health (as % of total spending)
curr_educ: current share of expenditure on current education (as % of total spending)
curr_soc_prot: current share of expenditure on social protection (as % of total spending)
private_k: private capital stock (as % of total spending)
human_cap: percentage population aged between 24 and 35 years old with high level of education
pop_65: percentage of population over 65 years old over the total
empl_growth: employment growth. Annual percentage change in total employed population
tax_rev: share of tax revenue (as % of GDP)
n_tax_rev: share of revenue not from taxation (as % of GDP)
def_surp: share of deficit/surplus (as % of GDP)

Table A4. Summary statistics

Variable	Mean	Std. Dev.	Minimum	Maximum
gdp_pc_growth	1.247	1.537	-3.018	5.372
tot_exp	53.243	8.881	34.501	75.263
cap_exp	15.652	4.521	8.098	27.948
curr_exp	84.348	4.521	72.052	91.902
cap_transf	4.440	2.579	1.346	14.658
n_fin_assets	5.502	2.244	2.624	15.032
fin_assets	5.710	1.879	2.918	15.584
curr_transf	37.761	4.787	26.759	47.394
other_curr	46.587	3.373	38.524	56.122
cap_gen_p_serv	1.439	0.745	0.193	5.481
cap_defen	0.265	0.180	0.056	1.655
cap_ec_aff	8.461	3.505	3.289	20.564
cap_health	0.485	0.292	0.099	2.276
cap_educ	1.251	0.560	0.451	3.528
cap_soc_prot	3.752	1.270	1.751	10.037
curr_gen_p_serv	15.926	5.040	9.011	34.302
curr_defen	4.631	1.432	2.265	8.585
curr_ec_aff	6.787	1.898	3.344	11.040
curr_health	11.350	1.999	6.448	16.506
curr_educ	9.508	1.792	5.924	13.542
curr_soc_prot	36.147	4.909	25.188	46.269
private_k	9.287	1.466	5.583	13.714
human_cap	37.137	12.073	17.68	82.69
pop_65	18.414	2.908	11.934	25.835
empl_growth	0.813	1.462	-3.142	4.288
tax_rev	42.454	3.097	34.905	51.883
n_tax_rev	7.022	1.692	3.933	13.668
def_surpl	-3.767	9.767	-32.514	20.191

Appendix 2 – Robustness Check without Spatial Effects

Robustness check with employment growth as additional control variable

TABLE A5

CAPITAL AND CURRENT ECONOMIC EXPENDITURE WITHOUT SPATIAL EFFECTS AND WITH EMPL_GROWTH

Variable	IV-DIFF (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-DIFF (4)	GMM-SYS (5)	GMM-SYS (6)
tot_exp	-0.595	-0.595	-0.949	-0.949	0.427	0.073
	(0.382)	(0.382)	(0.134)	(0.134)	(0.357)	(0.707)
cap_exp	0.635		0.302		-0.152	
	(0.281)		(0.499)		(0.717)	
curr_exp		-0.635		-0.302		-0.331
		(0.281)		(0.499)		(0.389)
private_k	-0.197	-0.197	-2.314	-2.314	-5.496	0.323
	(0.960)	(0.960)	(0.113)	(0.113)	(0.263)	(0.835)
human_cap	0.017	0.017	-0.324	-0.324	0.679	0.086
	(0.761)	(0.761)	(0.166)	(0.166)	(0.273)	(0.411)
pop_65	-0.287	-0.287	-3.945	-3.945	-3.467	0.118
	(0.844)	(0.844)	(0.142)	(0.142)	(0.229)	(0.882)
empl_growth	-0.152	-0.152	0.096	0.096	-0.883	-0.370
	(0.720)	(0.720)	(0.840)	(0.840)	(0.321)	(0.551)
Obs/No. of regions	171/19	171/19	209/19	209/19	228/19	228/19
No. of instruments			19	19	26	26
Lags dep. var			(2 3)	(2 3)	(2 2)	(2 2)
Lags endog. vars used as instr.			(2 2)	(2 2)	(2 2)	(2 2)
Endogeneity test	1.96	1.96				
(p-value)	(0.743)	(0.743)				
Arellano-Bond			-2.95	-2.95	1.92	-2.98
AR(1) (p-value)			(0.003)	(0.003)	(0.055)	(0.003)
Arellano-Bond			-0.50	-0.50	-0.37	-0.13
AR(2) (p-value)			(0.617)	(0.617)	(0.709)	(0.894)
Hansen J-test	0.87	0.875	0.05	0.05	0.00	0.03
(p-value)	(0.646)	(0.646)	(0.974)	(0.974)	(1.000)	(1.000)
Diff. Hansen 1 for					-0.42	-0.27
levels (p-val)					(1.000)	(1.000)
Diff. Hansen 2 for					-0.11	-0.23
levels (p-val)					(1.000)	(1.000)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown.

TABLE A6

CAPITAL AND CURRENT ECONOMIC EXPENDITURE SUB-COMPONENTS WITHOUT SPATIAL EFFECTS AND WITH EMPL_GROWTH

Variable	IV-DIFF (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-DIFF (4)	GMM-SYS (5)	GMM-SYS (6)
tot_exp	-0.724	-0.729	-0.223	-0.323	0.051	2.172
	(0.321)	(0.291)	(0.883)	(0.904)	(0.713)	(0.265)
cap_transf	0.409		0.149		0.007	
	(0.641)		(0.700)		(0.979)	
n_fin_assets	0.414		-0.055		-3.073	
	(0.617)		(0.977)		(0.315)	
fin_assets	-0.853		0.060		-1.692	
	(0.742)		(0.952)		(0.443)	
curr_transf		0.249		0.154		0.375
		(0.778)		(0.882)		(0.721)
other_curr		-0.003		0.270		3.861
		(0.995)		(0.895)		(0.229)
private_k	-5.455	-1.500	-0.070	0.681	2.447	2.768
	(0.511)	(0.750)	(0.995)	(0.950)	(0.314)	(0.516)
human_cap	0.053	0.021	-0.153	-0.204	0.358	1.607
	(0.557)	(0.759)	(0.523)	(0.796)	(0.435)	(0.224)
pop_65	-1.569	-0.918	-1.920	-2.817	-0.795	2.689
	(0.605)	(0.584)	(0.861)	(0.651)	(0.453)	(0.238)
empl_growth	0.016	0.310	0.268	0.306	-0.871	6.883
	(0.974)	(0.479)	(0.614)	(0.754)	(0.520)	(0.247)
Obs/No. of regions	171/19	171/19	209/19	209/19	228/19	228/19
No. of instruments			20	19	30	28
Lags dep. var			(2 2)	(2 3)	(2 2)	(2 2)
Lags endog. vars used as instr.			(2 2)	(2 2)	(2 2)	(2 2)
Endogeneity test (p-value)	2.15 (0.906)	2.82 (0.727)				
Arellano-Bond AR(1) (p-value)			-3.29 (0.001)	-2.87 (0.004)	-0.82 (0.414)	-0.65 (0.514)
Arellano-Bond AR(2) (p-value)			0.97 (0.334)	0.16 (0.872)	-0.84 (0.400)	.
Hansen J-test (p-value)	0.87 (0.646)	1.57 (0.457)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)
Diff. Hansen 1 for levels (p-val)					0.00 (1.000)	0.00 (1.000)
Diff. Hansen 2 for levels (p-val)					0.00 (1.000)	0.00 (1.000)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. The evidence related to the serial correlation of errors based on the AR(2) test is not available due to the insufficient number of panel periods. Constant is not shown.

TABLE A7

FUNCTIONAL (CAPITAL AND CURRENT) EXPENDITURE COMPONENTS WITHOUT SPATIAL EFFECTS AND WITH EMPL_GROWTH

Variable	IV-DIFF (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-DIFF (4)	GMM-SYS (5)	GMM-SYS (6)
tot_exp	-0.482	-0.589	-0.591	-4.128	0.672	0.279
	(0.252)	(0.247)	(0.716)	(0.659)	(0.343)	(0.159)
cap_health	-0.321		-1.759		26.794	
	(0.678)		(0.316)		(0.378)	
cap_educ	2.386		1.890		-11.325	
	(0.199)		(0.589)		(0.467)	
curr_health		0.538		-0.592		-1.937
		(0.349)		(0.900)		(0.394)
curr_educ		-0.410		3.701		-2.525
		(0.599)		(0.684)		(0.118)
private_k	-1.607	-1.285	-2.566	-5.610	-13.252	-1.319
	(0.336)	(0.527)	(0.478)	(0.762)	(0.512)	(0.530)
human_cap	-0.078	-0.038	-0.137	-1.711	0.982	0.704*
	(0.607)	(0.795)	(0.771)	(0.638)	(0.471)	(0.068)
pop_65	-1.394	-0.628	-3.849	-17.055	-6.041	-4.095
	(0.321)	(0.662)	(0.512)	(0.644)	(0.480)	(0.102)
empl_growth	0.486	-0.252	0.326	-0.630	0.949	-1.663
	(0.156)	(0.594)	(0.654)	(0.844)	(0.525)	(0.331)
Obs/No. of regions	171/19	171	209/19	209/19	228/19	228/19
No. of instruments			19	19	28	28
Lags dep. var.			(2 2)	(2 2)	(2 2)	(2 2)
Lags endog. vars used as instr.			(2 2)	(2 2)	(2 2)	(2 2)
Endogeneity test (p-value)	8.96 (0.255)	7.30 (0.399)				
Arellano-Bond AR(1) (p-value)			-2.47 (0.014)	-0.60 (0.546)	-0.52 (0.604)	-1.23 (0.217)
Arellano-Bond AR(2) (p-value)			-0.01 (0.995)	-0.52 (0.604)	-0.38 (0.705)	-
Hansen J-test (p-value)	4.83 (0.998)	3.71 (0.999)	0.02 (0.882)	0.02 (0.876)	0.000 (1.000)	0.000 (1.000)
Diff. Hansen 1 for levels (p-val)					0.00 (1.000)	0.00 (1.000)
Diff. Hansen 2 for levels (p-val)					0.00 (1.000)	0.00 (1.000)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown. The evidence related to the serial correlation of errors based on the AR(2) test is not available due to the insufficient number of panel periods.

Robustness check with lagged fiscal variables

TABLE A8

CAPITAL AND CURRENT ECONOMIC EXPENDITURE COMPONENTS WITHOUT SPATIAL EFFECTS AND WITH LAGGED VARIABLES

Variable	IV-DIFF (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-DIFF (4)	GMM-SYS (5)	GMM-SYS (6)
tot_exp(-1)	-0.406	-0.406	-0.604	-0.604	-0.026	-0.037
	(0.407)	(0.407)	(0.163)	(0.163)	(0.880)	(0.821)
cap_exp(-1)	0.270		0.496		0.003	
	(0.641)		(0.298)		(0.994)	
curr_exp(-1)		-0.270		-0.496		-0.751
		(0.641)		(0.298)		(0.994)
private_k	-2.744	-2.744	-2.869	-2.869	0.179	0.202
	(0.216)	(0.216)	(0.175)	(0.175)	(0.899)	(0.889)
human_cap	0.039	0.039	-0.159	-0.159	0.027	-0.011
	(0.571)	(0.571)	(0.476)	(0.476)	(0.716)	(0.902)
pop_65	0.028	0.028	-3.766	-3.766	-0.219	-0.075
	(0.986)	(0.986)	(0.172)	(0.172)	(0.601)	(0.892)
Obs/No. of regions	152/19	152/19	190/19	190/19	209/19	209/19
No. of instruments			17	17	23	23
Lags dep. var			(2 3)	(2 3)	(2 2)	(2 2)
Lags endog. vars used as instr.			(2 2)	(2 2)	(2 2)	(2 2)
Endogeneity test (p-value)	1.26 (0.739)	1.26 (0.739)				
Arellano-Bond AR(1) (p-value)			-2.01 (0.045)	-2.01 (0.045)	-2.68 (0.007)	-2.62 (0.009)
Arellano-Bond AR(2) (p-value)			1.30 (0.194)	1.30 (0.194)	0.72 (0.473)	0.51 (0.613)
Hansen J-test (p-value)	3.68 (0.159)	3.68 (0.159)	0.80 (0.670)	0.80 (0.670)	5.23 (0.632)	4.93 (0.668)
Diff. Hansen 1 for levels (p-value)					4.65 (0.590)	4.35 (0.630)
Diff. Hansen 2 for levels (p-value)					-1.33 (1.000)	-1.76 (1.000)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown.

TABLE A9

CAPITAL AND CURRENT ECONOMIC EXPENDITURE SUB-COMPONENTS WITHOUT SPATIAL EFFECTS AND WITH LAGGED VARIABLES

Variable	IV-DIFF (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-DIFF (4)	GMM-SYS (5)	GMM-SYS (6)
tot_exp(-1)	1.232*	1.589**	-0.418	-0.559	0.266	-0.066
	(0.071)	(0.019)	(0.408)	(0.467)	(0.579)	(0.842)
cap_transf(-1)	-1.569		0.345		0.124	
	(0.448)		(0.472)		(0.687)	
n_fin_assets(-1)	0.039		0.015		0.079	
	(0.965)		(0.995)		(0.809)	
fin_assets(-1)	-1.570		0.920		0.141	
	(0.138)		(0.639)		(0.882)	
curr_transf(-1)		2.195*		-0.481		-0.006
		(0.067)		(0.540)		(0.994)
other_curr(-1)		-0.110		-0.520		-0.135
		(0.845)		(0.281)		(0.767)
private_k	2.412	-1.637	-1.538	-2.780	-0.368	0.002
	(0.306)	(0.728)	(0.552)	(0.199)	(0.660)	(0.998)
human_cap	0.004	0.029	-0.133	-0.162	0.096	0.006
	(0.968)	(0.772)	(0.543)	(0.438)	(0.728)	(0.966)
pop_65	-2.401	-1.633	-1.330	-3.610	-0.353	-0.235
	(0.381)	(0.439)	(0.807)	(0.221)	(0.366)	(0.719)
Obs/No. of regions	152/19	152/19	190/19	190/19	209/19	209/19
No. of instruments			19	18	27	25
Lags dep. var			(2 3)	(2 3)	(2 2)	(2 2)
Lags endog. vars used as instr.			(2 2)	(2 2)	(2 2)	(2 2)
Endogeneity test (p-value)	9.36 (0.09)	6.84 (0.144)				
Arellano-Bond AR(1) (p-value)			-2.42 (0.016)	1.80 (0.072)	-1.90 (0.058)	-2.43 (0.015)
Arellano-Bond AR(2) (p-value)			0.08 (0.938)	1.27 (0.205)	-0.81 (0.421)	0.74 (0.460)
Hansen J-test (p-value)	3.83 (0.147)	3.08 (0.214)	1.14 (0.564)	0.97 (0.616)	0.09 (1.000)	5.75 (0.675)
Diff. Hansen 1 for levels (p-val)					-0.82 (1.000)	5.06 (0.653)
Diff. Hansen 2 for levels (p-val)					-0.47 (1.000)	0.72 (0.699)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown.

TABLE A10

FUNCTIONAL (CAPITAL AND CURRENT) EXPENDITURE COMPONENTS WITHOUT SPATIAL EFFECTS AND WITH LAGGED VARIABLES

Variable	IV-DIFF (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-DIFF (4)	GMM-SYS (5)	GMM-SYS (6)
tot_exp(-1)	0.086	0.332	-0.458	-0.684	0.271	-0.132
	(0.583)	(0.200)	(0.242)	(0.19)	(0.602)	(0.529)
cap_health(-1)	0.264		0.754		-0.844	
	(0.747)		(0.538)		(0.938)	
cap_educ(-1)	-1.523		0.921		1.217	
	(0.425)		(0.598)		(0.735)	
curr_health(-1)		-0.629		0.514		0.218
		(0.260)		(0.547)		(0.839)
curr_educ(-1)		0.886		-0.249		0.538
		(0.163)		(0.853)		(0.396)
private_k	2.782**		-2.109	-2.086	-0.500	-0.419
	(0.025)	3.640***	(0.297)	(0.409)	(0.368)	(0.856)
		(0.004)				
human_cap	-0.143	-0.195	-0.034	-0.064	0.177	0.030
	(0.312)	(0.272)	(0.818)	(0.766)	(0.277)	(0.824)
pop_65	0.665	0.310	-3.935*	-3.449	-0.615	-0.329
	(0.632)	(0.848)	(0.061)	(0.166)	(0.401)	(0.625)
Obs/No. of regions	152	152	190/19	190/19	209/19	209/19
No. of instruments			18	18	25	25
Lags dep. var.			(2 3)	(2 3)	(2 2)	(2 2)
Lags endog. vars used as instr.			(2 2)	(2 2)	(2 2)	(2 2)
Endogeneity test (p-value)	5.42	11.83				
	(0.491)	(0.066)				
Arellano-Bond AR(1) (p-value)			-2.16	-1.92	-1.84	-2.89
			(0.031)	(0.054)	(0.066)	(0.004)
Arellano-Bond AR(2) (p-value)			1.45	1.51	-0.80	0.89
			(0.148)	(0.130)	(0.426)	(0.373)
Hansen J-test (p-value)	10.47	8.59	2.29	1.30	2.85	2.33
	(0.915)	(0.968)	(0.319)	(0.523)	(0.943)	(0.969)
Diff. Hansen 1 for levels (p-val)					1.71	0.75
					(0.974)	(0.998)
Diff. Hansen 2 for levels (p-val)					-2.16	1.25
					(1.000)	(0.534)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown.

Robustness check with government budget constraint in full

TABLE A11

CAPITAL ECONOMIC EXPENDITURE WITHOUT SPATIAL EFFECTS AND WITH FULL BUDGET CONSTRAINT

Variable	FE (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-SYS (4)
tax_rev	-0.252***	0.658	0.411	2.300
	(0.005)	(0.608)	(0.570)	(0.526)
ntax_rev	-0.050	0.562	0.604	0.361
	(0.677)	(0.681)	(0.586)	(0.779)
def_surpl	0.251***	-0.069	0.036	-0.809
	(0.001)	(0.934)	(0.928)	(0.523)
cap_exp	0.120*	0.232	0.382	0.470
	(0.056)	(0.788)	(0.373)	(0.508)
private_k	-0.606	3.516	0.412	0.680
	(0.108)	(0.548)	(0.829)	(0.638)
human_cap	-0.047*	0.119	0.092	0.551
	(0.095)	(0.806)	(0.724)	(0.465)
pop_65	-0.692**	-0.331	-0.436	-0.489
	(0.045)	(0.871)	(0.898)	(0.625)
Obs/No. of regions	228/19	171/19	209/19	228/19
No. of instruments			19	28
Lags dep. var.			(2 2)	(2 2)
Lags endog. vars used as instruments			(2 2)	(2 2)
Endogeneity test p-value		3.04 (0.693)		
Arellano-Bond AR(1) p-value			-2.53 (0.011)	-1.14 (0.252)
Arellano-Bond AR(2) p-value			0.87 (0.385)	0.36 (0.722)
Hansen J-test p-value		0.43 (0.808)	0.10 (0.754)	0.000 (1.000)
Diff. Hansen 1 for levels (p-value)				-0.10 (1.000)
Diff. Hansen 2 for levels (p-value)				0.00 (1.000)

Note: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown.

TABLE A12

CURRENT ECONOMIC EXPENDITURE WITHOUT SPATIAL EFFECTS AND WITH FULL BUDGET CONSTRAINT

Variable	FE (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-SYS (4)
tax_rev	-0.252***	0.658	0.411	0.942*
	(0.005)	(0.608)	(0.570)	(0.067)
ntax_rev	-0.050	0.562	0.604	0.737
	(0.677)	(0.681)	(0.586)	(0.492)
def_surpl	0.251***	-0.069	0.036	-0.068
	(0.001)	(0.934)	(0.929)	(0.682)
curr_exp	-0.120*	-0.232	-0.382	-0.286
	(0.056)	(0.788)	(0.373)	(0.149)
private_k	-0.606	3.516	0.412	2.471
	(0.108)	(0.548)	(0.829)	(0.157)
human_cap	-0.047*	0.119	0.092	0.162
	(0.095)	(0.806)	(0.725)	(0.209)
pop_65	-0.692**	-0.331	-0.436	0.048
	(0.045)	(0.871)	(0.898)	(0.931)
Obs/No. of regions	228/19	171/19	209/19	228/19
No. of instruments			19	28
Lags dep. var.			(2 2)	(2 2)
Lags endog. vars used as instruments			(2 2)	(2 2)
Endogeneity test		3.04		
p-value		(0.693)		
Arellano-Bond AR(1) p-value			-2.53	-2.87
			(0.011)	(0.004)
Arellano-Bond AR(2)			0.87	1.17
p-value			(0.385)	(0.241)
Hansen J-test		0.43	0.10	0.000
p-value		(0.808)	(0.754)	(1.000)
Diff. Hansen 1 for levels (p-value)				-0.12
				(1.000)
Diff. Hansen 2 for levels (p-value)				0.00
				(1.000)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown.

TABLE A13

CAPITAL ECONOMIC EXPENDITURE SUB-COMPONENTS WITHOUT SPATIAL EFFECTS AND WITH FULL BUDGET CONTSTRAINT

Variable	FE (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-SYS (4)
tax_rev	-0.258***	1.265	0.395	0.011
	(0.004)	(0.674)	(0.913)	(0.956)
ntax_rev	-0.035	1.380	-1.379	0.001
	(0.780)	(0.669)	(0.963)	(1.000)
def_surpl	0.258***	-0.362	-0.147	-0.166
	(0.001)	(0.846)	(0.987)	(0.675)
cap_transf	0.143*	0.118	0.394	-0.122
	(0.062)	(0.943)	(0.968)	(0.864)
n_fin_assets	-0.007	-0.415	-1.649	-0.281
	(0.960)	(0.846)	(0.967)	(0.779)
fin_assets	0.163	-0.342	1.051	0.615
	(0.110)	(0.855)	(0.950)	(0.328)
private_k	-0.612	4.010	-1.758	-0.216
	(0.106)	(0.637)	(0.961)	(0.720)
human_cap	-0.049*	0.014	0.103	0.003
	(0.085)	(0.922)	(0.914)	(0.983)
pop_65	-0.698**	-0.928	-0.348	0.073
	(0.045)	(0.776)	(0.974)	(0.873)
Obs/No. of regions	228/19	171/19	209/19	228/19
No. of instruments			21	32
Lags dep. var.			(2 2)	(2 2)
Lags endog. vars used as instruments			(2 2)	(2 2)
Endogeneity test p-value		3.72 (0.811)		
Arellano-Bond AR(1) p-value			-0.12 (0.907)	2.26 (0.024)
Arellano-Bond AR(2) p-value			0.22 (0.824)	0.94 (0.347)
Hansen J-test p-value		0.27 (0.874)	0.000 (1.000)	0.000 (1.000)
Diff. Hansen 1 for levels (p-value)				0.00 (1.000)
Diff. Hansen 2 for levels (p-value)				0.00 (1.000)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown.

TABLE A14

CURRENT ECONOMIC EXPENDITURE SUB-COMPONENTS WITHOUT SPATIAL EFFECTS AND WITH FULL BUDGET CONSTRAINT

Variable	FE (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-SYS (4)
tax_rev	-0.201**	-0.849	0.809	-2.953
	(0.023)	(0.636)	(0.538)	(0.291)
ntax_rev	-0.009	-1.069	0.799	4.598
	(0.940)	(0.518)	(0.445)	(0.249)
def_surpl	0.193**	0.750	-0.399	2.064
	(0.011)	(0.460)	(0.786)	(0.226)
curr_transf	-0.008	-1.717	-0.212	1.996
	(0.938)	(0.303)	(0.803)	(0.146)
other_curr	-0.101	-1.575	0.274	0.711
	(0.103)	(0.342)	(0.901)	(0.422)
private_k	-0.679*	-0.504	4.068	9.808
	(0.088)	(0.947)	(0.722)	(0.164)
human_cap	0.048*	0.021	0.142	-0.127
	(0.086)	(0.778)	(0.629)	(0.143)
pop_65	-0.831**	0.632	0.623	3.366
	(0.016)	(0.787)	(0.892)	(0.164)
Obs/No. of regions	228/19	171/19	209/19	228/19
No. of instruments			20	30
Lags dep. var.			(2 2)	(2 2)
Lags endog. vars used as instruments			(2 2)	(2 2)
Endogeneity test p-value		4.84 (0.564)		
Arellano-Bond AR(1) p-value			-3.05 (0.002)	-0.53 (0.595)
Arellano-Bond AR(2) p-value			0.77 (0.442)	0.38 (0.704)
Hansen J-test p-value		0.27 (0.871)	0.000 (1.000)	0.000 (1.000)
Diff. Hansen 1 for levels (p-value)				0.00 (1.000)
Diff. Hansen 2 for levels (p-value)				0.00 (1.000)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. Constant is not shown.

TABLE A15

FUNCTIONAL (CAPITAL AND CURRENT) EXPENDITURE COMPONENTS WITHOUT SPATIAL EFFECTS AND FULL BUDGET CONSTRAINT

Variable	IV-DIFF (1)	IV-DIFF (2)	GMM-DIFF (3)	GMM-DIFF (4)	GMM-SYS (5)	GMM-SYS (6)
tax_rev	0.288	0.088	-1.373	1.772	0.057	-1.006*
	(0.550)	(0.865)	(0.822)	(0.817)	(0.925)	(0.096)
ntax_rev	0.448	0.241	-0.796	3.807	-0.784	5.498
	(0.487)	(0.755)	(0.870)	(0.631)	(0.681)	(0.164)
def_surpl	0.035	0.294	1.528	-0.971	-0.258	0.285*
	(0.941)	(0.562)	(0.756)	(0.882)	(0.621)	(0.058)
cap_health	0.191		-1.675		25.991	
	(0.901)		(0.466)		(0.226)	
cap_educ	2.524		3.550		-8.644	
	(0.281)		(0.465)		(0.219)	
curr_health		0.358		-1.719		-3.437
		(0.479)		(0.781)		(0.294)
curr_educ		-0.171		-0.968		-2.954
		(0.844)		(0.844)		(0.327)
private_k	0.018	-0.239	-5.309	9.338	0.691	7.318
	(0.993)	(0.925)	(0.780)	(0.539)	(0.562)	(0.229)
human_cap	0.086	0.021	-0.275	0.120	-0.066	-0.323
	(0.585)	(0.867)	(0.837)	(0.970)	(0.608)	(0.261)
pop_65	-1.466	-1.138	-7.719	1.124	-0.249	0.303
	(0.421)	(0.515)	(0.705)	(0.970)	(0.704)	(0.539)
Obs/No. of regions	171/19	171/19	190/19	209/19	228/19	228/19
No. of instruments			20	20	30	30
Lags dep. var.			(2 2)	(2 2)	(2 2)	(2 2)
Lags endog. vars used as instr.			(2 2)	(2 2)	(2 2)	(2 2)
Endogeneity test (p-value)	12.52 (0.129)	12.86 (0.117)				
Arellano-Bond AR(1) (p-value)			-1.36 (0.173)	-0.47 (0.638)	-1.83 (0.067)	-0.89 (0.376)
Arellano-Bond AR(2) (p-value)			0.29 (0.769)	0.09 (0.927)	-0.66 (0.510)	-
Hansen J-test (p-value)	2.84 (1.000)	3.93 (1.000)	0.00 (1.000)	0.00 (1.000)	0.00 (1.000)	0.00 (1.000)
Diff. Hansen 1 for levels (p-value)					0.00 (1.000)	0.00 (1.000)
Diff. Hansen 2 for levels (p-value)					0.00 (1.000)	0.00 (1.000)

Notes: Dependent variable GDP per-capita growth at 2005 constant prices. For IV/FD (all variables are at first difference). P-values in parenthesis. *p<0.1, **p<0.5, ***p<0.01. Time dummies are included. The evidence related to the serial correlation of errors based on the AR(2) test is not available due to the insufficient number of panel periods. Constant is not shown.

Appendix 3 – Robustness Check with Spatial Effects

Table A16. Cross dependence tests

Variables	CD test (p-value)
gdp_pc_gr_rate	24.62 (0.000)
tot_exp	23.45 (0.000)
cap_exp	13.11 (0.000)
curr_exp	13.11 (0.000)
cap_transf	9.79 (0.000)
n_fin_assets	21.85 (0.000)
fin_assets	24.80 (0.000)
curr_transf	20.97 (0.000)
others_curr	9.31 (0.000)
cap_gen_p_serv	7.37 (0.000)
cap_defen	10.84 (0.000)
cap_ec_aff	24.34 (0.000)
cap_health	7.56 (0.000)
cap_educ	19.10 (0.000)
cap_soc_prot	39.38 (0.000)
curr_gen_p_serv	14.77 (0.000)
curr_defen	21.32 (0.000)
curr_ec_aff	38.09 (0.000)
curr_health	30.76 (0.000)
curr_educ	26.41 (0.000)
curr_soc_prot	30.36 (0.000)

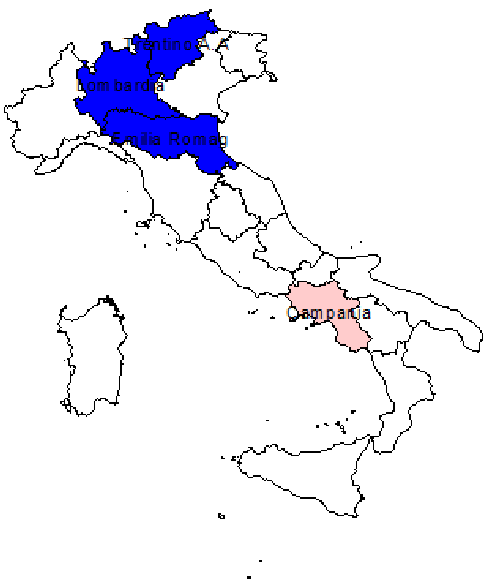
Note: CD reports Pesaran's (2004) cross-section dependence statistic that is distributed as a normal standard and tests the null hypothesis of cross-section independence.

Table A17. Global Moran's I test for gdp_pc_gr_rate

YEARS	Global Moran's I test (p-value)	
	Spatial weight matrix A	Spatial weight matrix B
1996	-0.141 (0.101)	-0.130 (0.513)
1997	0.060 (0.021)	0.201 (0.018)
1998	0.127 (0.000)	0.265 (0.002)
1999	0.112 (0.001)	0.196 (0.020)
2000	0.057 (0.027)	0.200 (0.020)
2001	0.036 (0.072)	0.107 (0.139)
2002	-0.005 (0.317)	0.003 (0.594)
2003	-0.031 (0.616)	0.033 (0.402)
2004	-0.131 (0.111)	-0.141 (0.404)
2005	-0.062 (0.899)	-0.180 (0.227)
2006	-0.010 (0.358)	0.047 (0.338)
2007	-0.111 (0.213)	-0.178 (0.205)

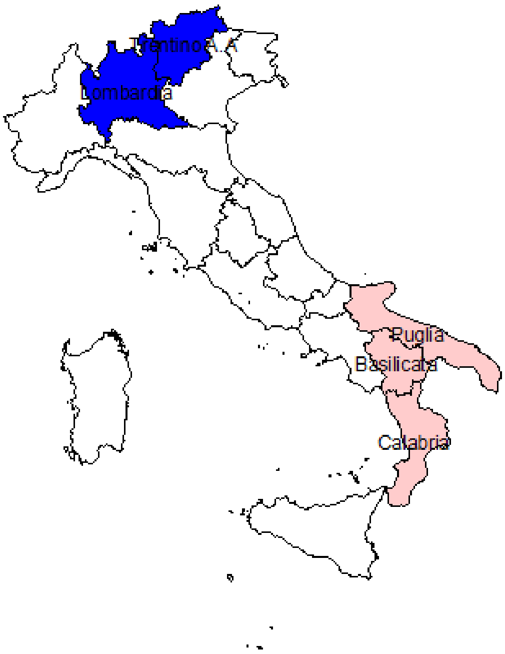
Note: The null hypothesis is no global autocorrelation. In the first column, we use a row standardized inverse distance matrix weighted by eigenvalues (spatial weight matrix A). In the second one, we use a row standardized inverse distance matrix (spatial weight matrix B).

Figure A1. Local Moran's I test for gdp_pc_gr_rate

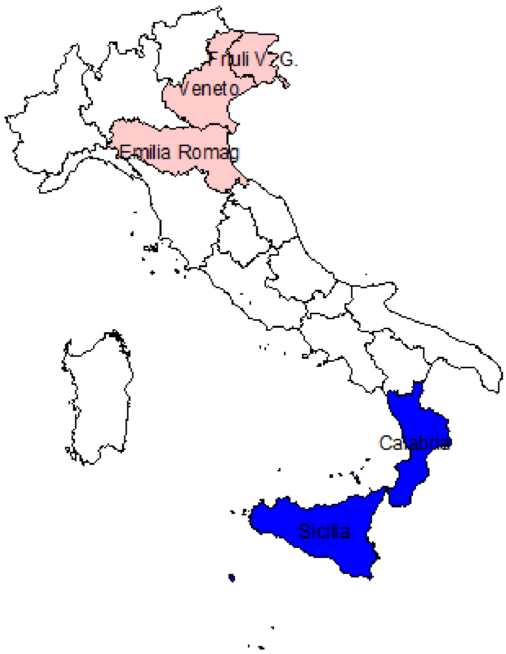


1.YEAR 1997

2.YEAR 1998



3.YEAR 1999



4. YEAR 2000

5. YEAR 2001

Notes: Local Moran's I is shown for years with spatial dependence across regions.

Robustness check with row standardized inverse distance weighted matrix

TABLE A18

CAPITAL AND CURRENT ECONOMIC EXPENDITURE WITH SPATIAL EFFECTS

Variable	GMM-DIFF (1)	GMM-SYS (2)	GMM-SYS (3)	GMM-DIFF (4)	GMM-SYS (5)	GMM-SYS (6)
gdp_pc_growth(-1)	-0.054	0.014	-0.007	-0.054	0.014	-0.007
	(0.447)	(0.842)	(0.918)	(0.447)	(0.842)	(0.918)
tot_exp	-0.462***	-0.053	-0.039	-0.462***	-0.053	-0.039
	(0.000)	(0.242)	(0.373)	(0.000)	(0.242)	(0.373)
cap_exp	0.250***	0.154**	0.124			
	(0.002)	(0.046)	(0.102)			
curr_exp				-0.250***	-0.154**	-0.124
				(0.002)	(0.046)	(0.102)
dep. var. spatial lag	0.121	0.079	0.128	0.121	0.079	0.128
	(0.564)	(0.731)	(0.569)	(0.564)	(0.731)	(0.569)
private_k	-1.440***	0.168	0.232	-1.440***	0.168	0.232
	(0.005)	(0.598)	(0.451)	(0.005)	(0.598)	(0.451)
human_cap	-0.040	0.004	-0.003	-0.040	0.004	-0.003
	(0.261)	(0.901)	(0.921)	(0.261)	(0.901)	(0.921)
pop_65	-1.243**	-0.124	-0.096	-1.243**	-0.124	-0.096
	(0.026)	(0.593)	(0.672)	(0.026)	(0.593)	(0.672)
empl_growth			0.171**			0.171**
			(0.016)			(0.016)
Obs/No. of regions	209/19	209/19	209/19	209/19	209/19	209/19
Sargan Overid. Test	78.34 (0.056)	80.35 (0.187)	82.06 (0.174)	78.34 (0.056)	80.35 (0.187)	82.06 (0.174)
LM test residual spatial autoc. (p-val)	0.221 (0.638)	0.026 (0.872)	0.467 (0.495)	0.221 (0.638)	0.026 (0.872)	0.467 (0.495)
Global Moran's I test on Residuals (p-val)	-0.019 (0.696)	-0.007 (0.962)	-0.028 (0.527)	-0.019 (0.696)	-0.007 (0.962)	-0.028 (0.527)
LM SAC (General Spatial Autoc.)	0.232 (0.890)	2.222 (0.329)	0.883 (0.643)	0.232 (0.890)	2.222 (0.329)	0.883 (0.643)

Notes: Dependent variable is GDP per-capita growth at 2005 constant prices; p-values in parentheses *p<0.1, **p<0.5, ***p<0.01. Time dummies are included from 1997 to 2006. Lag dependent, spatial lag and all explanatory variables are treated as endogenous. Instruments are two lagged values of endogenous variables. A row weighted standardized inverse distance matrix is used. Constant is not shown. All regressions run using the spregdpd routine for STATA.

TABLE A19

CAPITAL AND CURRENT ECONOMIC EXPENDITURE SUB-COMPONENTS WITH SPATIAL EFFECTS

Variable	GMM-DIFF (1)	GMM-SYS (2)	GMM-SYS (3)	GMM-DIFF (4)	GMM-SYS (5)	GMM-SYS (6)
gdp_pc_growth(-1)	-0.087 (0.219)	-0.010 (0.886)	-0.030 (0.652)	-0.044 (0.538)	0.006 (0.926)	-0.017 (0.798)
tot_exp	-0.498*** (0.000)	-0.080* (0.089)	-0.067 (0.147)	-0.470*** (0.000)	-0.048 (0.286)	-0.033 (0.448)
cap_transf	0.341*** (0.001)	0.245** (0.018)	0.214** (0.033)			
n_fin_assets	-0.028 (0.858)	-0.083 (0.581)	-0.097 (0.507)			
fin_assets	0.330*** (0.006)	0.231* (0.053)	0.203* (0.083)			
curr_transf				-0.325** (0.011)	-0.086 (0.429)	-0.038 (0.723)
other_curr				-0.213** (0.012)	-0.186** (0.033)	-0.163* (0.055)
dep. var. spatial lag	0.036 (0.862)	0.007 (0.975)	0.048 (0.829)	0.127 (0.547)	0.122 (0.597)	0.179 (0.426)
private_k	-1.628*** (0.002)	0.096 (0.767)	0.170 (0.588)	-1.223** (0.023)	-0.064 (0.879)	-0.056 (0.891)
human_cap	-0.050 (0.152)	-0.013 (0.714)	-0.019 (0.577)	-0.040 (0.267)	0.007 (0.841)	-0.001 (0.982)
pop_65	-1.446*** (0.008)	-0.214 (0.361)	-0.183 (0.422)	-1.118** (0.050)	-0.289 (0.336)	-0.301 (0.302)
empl_growth			0.155** (0.026)			0.179** (0.011)
Obs/No. of regions	209/19	209/19	209/19	209/19	209/19	209/19
Sargan Overid. Test	85.44 (0.026)	85.89 (0.126)	89.65 (0.090)	80.17 (0.051)	81.76 (0.180)	83.79 (0.162)
LM test residual spatial autoc. (p-val)	0.171 (0.679)	0.005 (0.943)	0.316 (0.574)	0.597 (0.440)	0.055 (0.815)	0.586 (0.440)
Global Moran's I test on Residuals (p-val)	-0.017 (0.739)	-0.003 (0.960)	-0.023 (0.615)	-0.032 (0.465)	-0.001 (0.896)	-0.032 (0.466)
LM SAC (General Spatial Autoc.)	0.188 (0.910)	0.494 (0.781)	0.886 (0.642)	0.630 (0.730)	0.643 (0.725)	4.029 (0.133)

Notes: Dependent variable is GDP per-capita growth at 2005 constant prices; p-values in parentheses *p<0.1, **p<0.5, ***p<0.01. Time dummies are included from 1997 to 2006. Lag dependent, spatial lag and all explanatory variables are treated as endogenous. Instruments are two lagged values of endogenous variables. A row weighted standardized inverse distance matrix is used. Constant is not shown. All regressions run using the spregdpd routine for STATA.

TABLE A20

FUNCTIONAL (CAPITAL AND CURRENT) EXPENDITURE COMPONENTS WITH SPATIAL EFFECTS

Variable	GMM-DIFF (1)	GMM-SYS (2)	GMM-SYS (3)	GMM-DIFF (4)	GMM-SYS (5)	GMM-SYS (6)
gdp_pc_growth(-1)	-0.073	-0.011	-0.027	-0.061	0.012	-0.089
	(0.306)	(0.872)	(0.691)	(0.428)	(0.867)	(0.899)
tot_exp	-0.572***	-0.071	-0.058	-0.470***	-0.074	-0.042
	(0.000)	(0.148)	(0.231)	(0.000)	(0.207)	(0.475)
cap_gen_p_serv	-0.307	-0.421**	-0.440**			
	(0.120)	(0.038)	(0.027)			
cap_defen	0.127	-0.102	-0.021			
	(0.819)	(0.868)	(0.971)			
cap_ec_aff	0.255***	0.221**	0.196**			
	(0.003)	(0.011)	(0.022)			
cap_health	0.063	0.146	0.041			
	(0.882)	(0.744)	(0.925)			
cap_educ	0.431	0.083	0.110			
	(0.272)	(0.843)	(0.788)			
cap_soc_prot	-0.607**	-0.089	-0.106			
	(0.047)	(0.705)	(0.643)			
curr_gen_p_serv				-0.252***	-0.219**	-0.191**
				(0.004)	(0.014)	(0.028)
curr_defen				-0.247	0.055	0.016
				(0.442)	(0.849)	(0.955)
curr_ec_aff				-0.060	-0.040	-0.034
				(0.728)	(0.827)	(0.847)
curr_health				-0.260**	-0.250*	-0.281**
				(0.046)	(0.068)	(0.036)
curr_educ				-0.286	-0.220	-0.192
				(0.136)	(0.271)	(0.321)
curr_soc_prot				-0.308**	-0.098	-0.022
				(0.041)	(0.480)	(0.875)
dep. var. spatial lag	0.122	0.058	0.096	0.081	0.100	0.130
	(0.555)	(0.799)	(0.669)	(0.707)	(0.672)	(0.571)
private_k	-2.107***	-0.055	0.002	-1.391**	-0.273	-0.218
	(0.000)	(0.866)	(0.995)	(0.032)	(0.576)	(0.645)
human_cap	-0.012	0.023	0.016	-0.037	-0.004	-0.009
	(0.740)	(0.530)	(0.658)	(0.310)	(0.918)	(0.793)
pop_65	-1.786***	-0.286	-0.247	-0.898	-0.246	-0.290
	(0.001)	(0.230)	(0.288)	(0.102)	(0.465)	(0.375)
empl_growth			0.157**			0.174**
			(0.024)			(0.017)
Obs/No. of regions	209/19	209/19	209/19	209/19	209/19	209/19
Sargan Overid. Test	79.59 (0.105)	84.76 (0.207)	84.88 (0.227)	87.21 (0.035)	83.77 (0.228)	85.72 (0.209)
LM test residual spatial autoc. (p-val)	0.835 (0.361)	0.024 (0.878)	0.210 (0.647)	0.212 (0.645)	0.049 (0.825)	0.377 (0.539)
Global Moran's I test on Residuals (p-val)	-0.038 (0.363)	-0.006 (0.965)	-0.019 (0.693)	-0.019 (0.694)	-0.009 (0.903)	-0.026 (0.567)
LM SAC (General Spatial Autoc.)	0.894 (0.639)	0.061 (0.970)	2.015 (0.365)	0.240 (0.887)	0.717 (0.699)	1.950 (0.377)

Notes: Dependent variable is GDP per-capita growth at 2005 constant prices; p-values in parentheses *p<0.1, **p<0.5, ***p<0.01. Time dummies are included from 1997 to 2006. Lag dependent, spatial lag and all explanatory variables are treated as endogenous. Instruments are two lagged values of endogenous variables. A row weighted standardized inverse distance matrix is used. Constant is not shown. All regressions run using the spregdpd routine for STATA.

Chapter 3

A Co-integration Analysis of Public Spending Composition for Italy: 1862-2007

1. Introduction

Whether increasing government expenditure promotes economic growth is a controversial topic in growth theory. Although public spending and its composition have been attracting the attention of many economists, especially interested in developing countries, the empirical evidence seems to be inconclusive. While some researchers have found that the impact of government expenditure on economic growth is positive and significant (Devarajan *et al.*, 1996; Liu, 2008; Ghosh and Gregoriou, 2007, 2008; Alshahrani and Alsadiq, 2014), others have found that the impact is negative or not significant (Landau, 1983; Alexander, 1990; Folster and Henrekson, 1999; Gupta *et al.*, 2005; Akpan, 2005; Mitchell, 2005; Acosta-Ormaechea and Morozumi, 2013). The reasons for these mixed results are multi-fold. For instance, in an attempt to finance rising expenditure, a government may increase taxes and/or borrowing. Higher income tax discourages individuals from working many hours a day, thus reducing income and aggregate demand. Moreover, if a government increases borrowing (especially from banks) in order to finance public expenditure, it will crowd-out the private sector, thus reducing private investment. On the other hand, government expenditure on education and health care would increase labour productivity. Education has been considered to be an independent factor of production that is indispensable to achieve high and sustainable economic growth rates. Government spending on health could lead to higher economic growth rates as long as it leads to higher levels of human capital, which is essential to growth. A healthy population is the wealth of a nation and healthy labour force enhances productivity and promotes economic growth. For instance, Barro (1991) argues that "expenditures on education and defence are more like public investment than public consumption; in particular, these expenditures are likely to affect private sector productivity or property rights, which matter for private investment". In addition, government expenditure on infrastructure as roads and communications would also boost the rate of private domestic investment, which in turn fosters economic growth.

Since the twentieth century, total government spending has considerably increased in all European and Extra-European countries, independently from institutional differences. Furthermore, the dynamic and the composition of public spending as a share of GDP have not been the same over time. In Italy, government spending represents most of the Public administrations' expenditures. The government's budget sets expenditures as per ministries, thus aiming to produce services for the community, support other sectors of the economy and finance other public administrations. The Ministry of Economy has published some statistics showing that in the last 150 years total government spending in Italy has increased rapidly and significantly. In 1862 total government spending (including repayment on loans) was approximately 183 euro per-capita (expressed at 2009 constant prices). In 2009 it reached 11.600 euro per-capita. Significant increases have occurred in the 1920s, in the 1930s and throughout the period between the 1960s and the 1990s. However, from the 1980s, there was an increase in the share of unproductive expenditure, namely the amount of spending devoted to repayment of loans, rather than to the production of services and investments. Over the last twenty years, total government spending (net of repayment of loans) has remained fairly stable at about 8000 euro per-capita.

In percentage of GDP, total government spending ranged from approximately 14% in 1870 to 50% in 2009.

Particularly important has also been the irregular pattern followed by capital spending: it was roughly 5% of total after Italy's Unification, with peaks of 10 percent and more than 20 percent between the 1940s and 1960s, to settle around 8 percent by the mid 1990s onwards.

The significant evolution of the amount of GDP highlights the growing role of the State in the economy and the society. In the 150 years since its political Unification, Italy has experienced approximately 20 business cycles of varying duration and amplitude. The cyclical behaviour exhibited by aggregate demand components conforms quite well to the evidence in the standard international business cycle literature, although some exceptions arise during the pre-World War II years (Clementi *et al.*, 2014).

Although several empirical studies have examined the relationship between government expenditure and economic growth in many countries (and especially developing countries) none of them has explored the relationship between different categories of government expenditures and economic growth for Italy.

Therefore, the main objective of this chapter is to examine empirically the impacts of different components of government expenditure on real per-capita GDP in Italy. To this end, we use an ARDL technique to co-integration to estimate the short- and long-run effects of these expenditures employing annual data over the period 1862-2007.

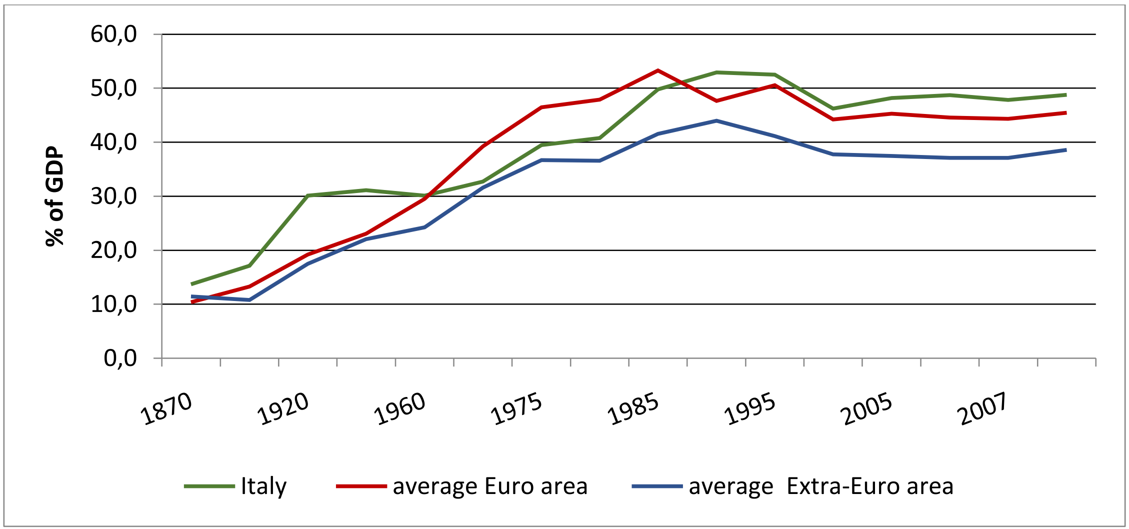
The remainder of the chapter is organized as follows. Section 2 provides a review of the literature. Section 3 gives a brief description of the existing historical data while Section 4 refers to the theoretical model and data used for this study. Section 5 offers a theoretical overview regarding the methodology and Section 6 presents the empirical results. Finally, Section 7 concludes this chapter.

2. Background

Given the importance of public expenditure in financing investment and consumption activities, Italy's fiscal policy plays a vital role in its economy. The government expenditures can be subsumed under an economic and a functional typology. The former includes capital and current expenditures. The latter includes expenditures by sector, such as defence, economic affairs, education, health, etc.

Figure 1 shows the historical path of total government expenditures in Italy in comparison to the Euro zone average and the Extra-Euro area average. As can be noted from the figure, total spending has increased considerably during the twentieth century in all European and Extra-European countries. The dynamics and the composition of total government spending as share of GDP have not been constant over time. Nonetheless, it is possible to capture the main patterns that occurred from Italy's Unification to 2009.

Figure 1. Total Government Expenditures: 1870-2009



Source: Ministry of Economy and Finance, the Italian Ragioneria Generale dello Stato, 2011.

On average, Extra-European countries show a ratio of total spending over GDP less significant than that of the European countries. Depending on the considered time period, Italy displays average values that are either equally distant from the averages of the two other groups or higher than that scored by the European countries.

From 1870 to 1913, total government spending has reached values under 20 per cent of GDP (especially, in 1870 we observe values of 13.7 per cent for Italy, 10.4 percent for the European countries average and 12.5 percent for the Extra-European countries average). In 1913, aggregate government spending in Italy was 17.5 percent of GDP. The weight of public spending on GDP was significant during the two world wars and the Great Depression periods, when expansionist fiscal policies were stimulated. In the 1920s the first social security system was introduced and during the 1930s (and before the World War II) some countries increased their military expenditures in response to the war threat. In 1937, aggregate public spending reached 31 percent of GDP, against 23 percent of the European countries average and 22 per cent of the Extra-European countries average. From the 1950s up to 1980, when the public sector played a major role in Italy's economy, the government allocated a large portion of its budget on aggregate spending to income distribution and cyclical stabilization. At that time, the welfare system contributed to increase and reinforce the new State's role. By 1980, total spending in Italy reached 40.6 percent of GDP against 30.1 percent in 1960; on average, the other European countries passed from 29.5 percent of GDP in 1960 to 46.8 per cent in 1980; the Extra-European countries passed from 24.2 per cent in 1960 to 35.2 per cent in 1980. Since the early 1990s, public spending has followed an irregular pattern due to institutional changes. In those years, many policies were promoted to attract private capitals to finance public infrastructures. Furthermore, many public authorities were created and many resources shifted from central to local government.

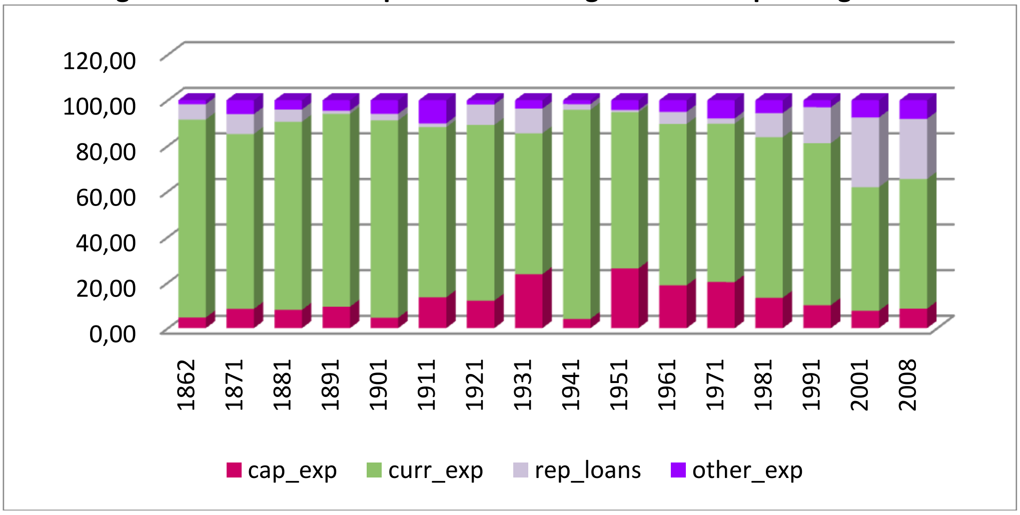
The composition of economic classification of government spending changed over the last century. The main changes are listed here. For instance, during the 150 years under consideration, the current spending, as total percentage, has always been higher than capital expenditure level (see Figure 2).

Since the end of the nineteen century, expenditure directly linked to the production of services declined significantly, thus ranging from 35-40 per cent during the 1960s to roughly 15 per cent in the last decade. Until the mid-1950s, a substantial stability can be noted about the share of personnel expenditure (i.e. salaries and wages; approximately between a half and two thirds of expenditure directly related to the production of services). The analysis shows that during World War I and II personnel expenditure was much lower. However, this sector cost 80 percent to 90 percent of all expenditure directly devoted to the production of services in more recent years. Capital expenditure accounted for 5 percent of the total expenditure over the years immediately following Italy's Unification. The data shows periods characterized by over 10 percent peaks, such as between 1882 and 1890, 1905 and 1915 and between 1924 and 1935; an over 20 percent peak can also be detected between mid-1940s and mid-1960s whereas starting from the mid-90s onwards the capital expenditure has settled at approximately eight percent. The Italian government allocated a large portion of its budget to expenditure on transfers to public administrations, households and businesses. Since the early twentieth century this budget was less than 15 percent of total expenditure; it subsequently followed a non linear trend to reach the World War II period. After that, it rose to levels between 40 and 55 percent until the beginning of the 1990s and then shrank on values ranging from 30 and 40 percent.

Expenditure on interest repayment accounted for one-third of the total expenditure during the first decades of Italy's Unification; values between 10 and 20 percent were reached in the period between World War I and II and they further decreased to 6 percent until the beginning of the 1970s. In the early 1990s, expenditure reached a quarter of total spending due to inflationary phenomena that also led to significant changes in nominal interest rates. Currently, expenditure has further shrunk to a significant, approximate 10 percent value.

The discontinuous trend in the share of expenditure for the repayment of loans in the first hundred years under scrutiny shows values greater than 20 or 30 percent only in some specific years. Yet, it began to grow steadily since the 1980s to reach the 25 percent of total spending in more recent years.

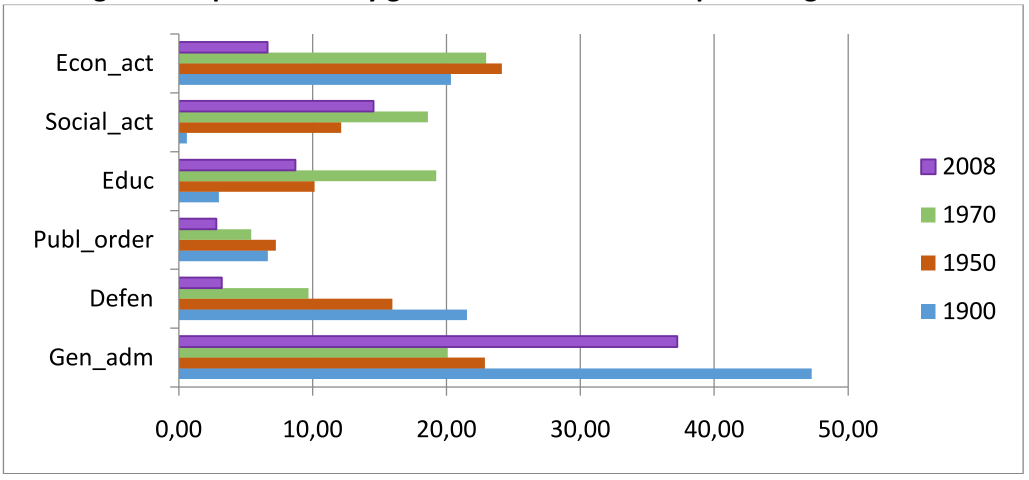
Figure 2. Economic components of total government spending



Source: This author's elaboration based on data provided by the Italian Ragioneria Generale dello Stato, 2011.

Interestingly, functional components of government spending also underwent important changes during the period under scrutiny (cf. Figure 3 that shows these main trends). It will be noted that the share of total spending on defence has significantly declined if compared to the years immediately following Italy's Unification. It represented over 30 percent of the total until 1866 and was constantly around 20 percent until World War II (peaking over 70 percent during World War I and over 50 percent during World War II). Starting from the 1980s, spending on defence settled around 3 percent. Expenditure on general administration showed a gradual decrease until the beginning of the 1970s (halving its share from about 40 to 20 percent of total spending). Later, it increased again reaching approximately 35 percent of total spending. As for expenditure on education, it accounted for less than 2 percent until the beginning of the twentieth century, but it subsequently reached 15 percent during the period between mid-1950s and mid-1960s before stabilizing around 8-9 percent. Expenditure on social activities (e.g. healthcare) amounted to less than 1 percent until the World War I. It grew rapidly to 30 percent of total spending in the mid-1980s and it nowadays counts approximately for 15 percent of total spending. The upward trend of the share of expenditure on economic affairs ranged between 10 and 30 percent of total until World War I and II. After that, this component of government spending grew again and reached around 8 percent of total until recently. The share of spending for justice and public order gradually decreased from values around 6 percent until the beginning of the 1970s to levels between 3 and 4 percent in more recent years.

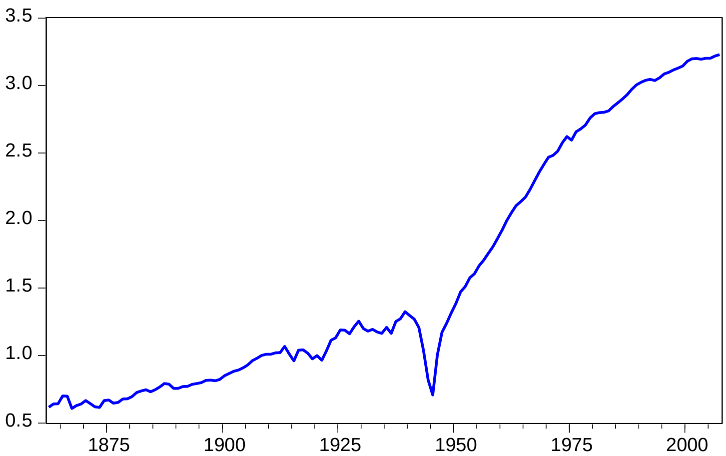
Figure 3. Expenditures by government functions as percentage of total



Source: This author's elaboration based on data provided by the Italian Ragioneria Generale dello Stato, 2011.

Figure 4 shows the series relating to GDP per capita at 2005 constant prices, which are expressed in natural logarithm. This analysis can be interpreted as an approximation of Italy's long-run growth since the time immediately subsequent its political unification in 1861. The non-linear trend characterizing the development process of the country over the period 1862-2007 emerges clearly from Figure 4. Since the end of World War II, Italian per capita GDP experienced an intense growth acceleration that began to decline in 1973 with the first oil crisis. Interestingly, during the previous ninety year (1862-1951) Italy had just doubled the initial GDP level, which reached its peak value only at the eve of the Italian involvement in World War II.

Figure 4. GDP per capita constant prices (1862-2007)



Notes: The X axis refers to years, the Y axis refers to per capita GDP in a logarithm scale (thousands of euros at constant 2005 prices).
Source: This author's elaboration based on data provided by the Baffigi (2011) dataset.

3. Literature Review

Within the framework of the neo-classical growth models, government fiscal policy does not have any effect on the growth of national output. Indeed, according to the Solow growth model (1956), public expenditure only relates to the equilibrium factor ratios and it assumes that public investment does not relate to long-run economic growth. Conversely, the Keynesian model argues that increase in government expenditure will lead to higher economic growth. Furthermore, the recent argument in favour of the significant relationship between long-run economic growth and public expenditures rests on the inclusion of fiscal policies into the endogenous growth models with the conclusion that public spending can affect the long-run economic growth (Barro and Sala-i-Martin, 1992). Fiscal policies can be used to enhance efficient allocation of resources by correcting market failures and thus encouraging higher human and physical capital productivity. Moreover, Barro and Sala-i-Martin (1992) classify expenditures as productive and unproductive and assume that the former has a direct impact on the rate of economic growth whereas the latter has an indirect or no effect. Although productive public expenditure is expected to boost the steady state growth rate, this argument depends on the composition of public spending. Consequently, a trade-off between consumption and productive public expenditure will ultimately determine the effects on the long-run growth (Kneller *et al.*, 1999). Devarajan *et al.* (1996) is to our knowledge the most comprehensive theoretical endogenous growth model. It has been subsequently extended by Ghosh and Gregoriou (2008). They have managed to reveal those conditions under which a change in the composition of public expenditure could enhance the higher steady state growth rate of the economy. They have therefore concluded that the generally assumed productive expenditures may become unproductive if the amount allocated to them is excessive. However, consensus yet in the literature has not yet been reached regarding to which expenditure components can be defined as productive or unproductive.

Empirical studies on the impact of government spending on economic growth may be grouped into two stands. One focuses on the effects of total government expenditures on economic progress, while the other recognizes that different types of government expenditures may have different effects on economic growth. In both cases, the type of analysis that scholars carry out differs in terms of empirical methodologies used, sample of countries and period analyzed. Hence, results demonstrate to be still inconclusive. Landau (1983) examines a sample of 96 countries and finds that an increase in the share of government expenditure's reduces the growth rate of per-capita real GDP. Furthermore, using data on developing countries over the period 1960-1980, he finds that government consumption expenditure has negative effects on the growth of per-capita output, while the other types of government expenditure have little effect on output growth. Barro (1989) finds a significant negative relationship between government consumption share and the growth of real per-capita GDP thus highlighting the insignificant effects of government investment. Romer (1990) stresses that total government spending has a negative impact on economic growth. Alexander (1990) and Folster and Henrekson (1999) have obtained similar results and reached the same conclusions.

Devarajan *et al.* (1996) examine the relationship between the composition of government spending and economic growth for a panel of 43 developing countries from 1970 to 1990. They find that the share of current expenditure on total spending has a positive and statistically significant growth effect, while capital spending has a negative impact on economic growth. They also find a reverse relationship for a panel of 21 developed countries. Furthermore, they find that government expenditures on health care, transportation and communication have positive effects on growth, while expenditures on defence and educations fail to produce such a positive impact.

Using Swiss data from 1950 to 1994, Sing and Weber (1997) find that expenditure on education enhances economic growth in the long-run, while expenditure on health has the opposite impact. They also observed that expenditure on defence has a negative effect on growth rate in the short-run. Colombier (2008) makes use of Swiss data considering the period 1950-2004 finds that education and transport infrastructures are positively and significantly related to economic growth. He also provides strong evidence for the negative relationship between health care expenditure and economic growth.

Niloy *et al.* (2003) examine growth effects of government expenditures for a panel of thirty developing countries over the period 1970-1980. They show that the share of government capital expenditure in GDP is positively and significantly correlated with economic growth, while current expenditure is insignificant.

In his study on Mexico covering 1955-1999, Ramirez (2004) concludes that expenditures on transport, communication, education and health (as grouped as a single public infrastructure category) can positively affect economic growth.

Akpan (2005) makes use of a disaggregated approach in order to determine the components of government expenditure that enhance growth in Nigeria. His research leads him to concludes that is no significant relationship between the components of government expenditure and growth.

Bose *et al.* (2007) examine the effects of government expenditure by sector on economic growth for a panel of thirty developing countries, paying attention to avoid the omission bias that may result from ignoring the full implications of the government budget constraint. They find that the share of government capital expenditure on GDP is positively and statistically correlated with economic growth, while the impact of recurrent expenditure is insignificant for the group of countries they investigate. Moreover, they find that education is the key sector towards which public expenditure should concentrate in order to promote economic growth. This result seems to oppose to the previous findings of negative and insignificant effects of education expenditure on economic growth for developing countries as put forward by Landau (1986) and Devarajan *et al.* (1996). Bose *et al.* also find that public expenditures on defence, transport and communication sectors has a significant impact on economic growth but becomes insignificant when they incorporate the government budget constraint and other sector expenditures into their analysis.

Olugbenga and Owoye (2007) investigate a sample of thirty countries over the period 1970-2005. Their findings confirm the existence of a long-run relationship between government expenditure and economic growth.

Liu *et al.* (2008) examine the causal relationship between GDP and public expenditure for the US data over the period 1947-2002. The results show that public expenditure raises the US economic growth.

In an analysis of panel data for 15 developing countries over 28 years and applying GMM techniques, Ghosh and Gregoriou (2008) find that current (capital) spending has positive (negative) and significant effects on the growth rate, thus confirming the Devarajan *et al.*'s

(1996) results. Furthermore, the results show evidence of a negative and significant effect of health and economic expenditures on economic growth rate.

Nurudeen and Usman (2010) analyze the impact of government expenditure on economic growth in Nigeria over the period 1970-2008. The results reveal that total capital expenditure, total recurrent expenditure and expenditure on education have negative effects on growth while expenditures on health, transport and communication are growth enhancing.

Alshahrani and Alsadiq (2014) empirically examine the effects of different types of government expenditures on economic growth in Saudi Arabia by employing annual data over the period 1969-2010. They find that healthcare expenditure stimulates growth in the long-run; moreover, spending in the housing sector can also boost short-run production.

As for the effects of government expenditures on economic growth in Italy, sparse empirical evidence can be found in the existing literature. For instance, Dalena and Magazzino (2012) examine the long-run equilibrium relationship between government expenditure and revenue in Italy from 1862 to 1993 by applying co-integration and causality techniques in the long and short-run. The results show that changes in government revenues (taxes) lead to changes in government expenditures (the so called Tax-and-Spend hypothesis); in contrast, the interwar years are in line with the reverse relation, according to which changes in government revenues (taxes) respond to prior changes in government expenditures (displacement effect or Spend-and-Taxes hypothesis). Finally, the Fiscal Synchronization hypothesis (which argues that expenditures and taxes are adjusted simultaneously) in Italy emerged when the Republic was established.

Grisorio and Prota (2015) show evidence of a long-run relationship between fiscal decentralization and expenditure composition. The results demonstrate that the level of decentralization influences the expenditure composition. Put more simply, it reduces welfare spending while it also has a positive effect on the share of expenditure that supports productive activities.

In this light, this study aims to fill the existing gap in the existing literature on Italy. The application of an ARDL technique allows us to capture the short-run dynamics and the long-run effects of government spending components and economic growth. Matter-of-factly, a very small amount of research has been devoted to the analysis of this relationship as far as Italy is concerned. Hence, this study examines the effect of public spending composition on economic growth in a very long period (1862-2007), using time-series methodologies on stationarity and co-integration. Furthermore, due to the significant length of the period under scrutiny, we do not take breaks as exogenous. We instead opted for splitting our sample and applying tests that could help us determine the breaks endogenously.

4. Model Specification

In this study, we estimate the effects of government expenditure on economic growth for Italy. As mentioned earlier, different types of government spending may have different effects. Thus, to incorporate this hypothesis in our analysis, we will disaggregate total government expenditure in economic (from specification (1) to (4)) and functional components (specification (5)). We will use different subsets of these components, both individually and simultaneously to better understand how each of them affects on growth. Like Devarajan *et al.* (1996) and Ghosh and Gregoriou (2008), we do not classify functional public expenditures as being productive and unproductive to begin with, but let the data "speak for itself". Furthermore, we will include trade openness as a control variable in our regressions to eliminate the effects of changes in trade policies.

The theoretical model follow is explained in more detail in Chapter two. In this section, we therefore estimate the following long-run growth specifications:

$$y_t = \beta_0 + \beta_1 tot\_exp_t + \beta_2 cap\_exp_t + \beta_3 private\_k_t + \beta_4 open_t + \varepsilon_t \quad (1)$$

$$y_t = \alpha_0 + \alpha_1 tot\_exp_t + \alpha_2 curr\_exp_t + \alpha_3 private\_k_t + \alpha_4 open_t + \varepsilon_t \quad (2)$$

$$y_t = \delta_0 + \delta_1 tot\_exp_t + \delta_2 cap\_serv\_exp_t + \delta_3 cap\_transf_t + \delta_4 private\_k_t + \delta_5 open_t + \varepsilon_t \quad (3)$$

$$y_t = \gamma_0 + \gamma_1 tot\_exp_t + \gamma_2 curr\_serv\_exp_t + \gamma_3 curr\_transf_t + \gamma_4 private\_k_t + \gamma_5 open_t + \varepsilon_t \quad (4)$$

$$y_t = \lambda_0 + \lambda_1 tot\_exp_t + \lambda_2 \mathrm{def}\_exp_t + \lambda_3 econ\_exp_t + \lambda_4 educ\_aff\_exp_t + \lambda_5 health\_exp_t + \lambda_6 private\_k_t + \lambda_7 open_t + \varepsilon_t \quad (5)$$

where y is the real per capita GDP (at 2005 constant prices), tot_exp is total government spending to GDP ratio, which is included in each specification in order to capture the level effect on per capita growth. In order to eliminate the effects of changes in trade policies, we include trade openness, $open$, as a control variable measured as the sum of exports and imports over the real GDP. A key endogenous variable is the ratio of private capital to public services, $private\_k$[1] (which derives directly from the theoretical model developed by Ghosh and Gregoriou, 2008); ε is the error term. The other fiscal variables are the economic and

[1] Unlike Devarajan *et al.* (1996), Ghosh ahd Gregoriou (2008) include private capital as a key determinant of the optimal growth rate.

functional components of government spending: cap_exp and $curr\_exp$[2] are aggregate capital and aggregate current spending, respectively; cap_serv_exp and $curr\_serv\_exp$ are capital and current components of total spending devoted to public services; cap_transf and $curr\_transf$ are capital and current transfers expenditure, respectively. The functional components are the following: def_exp is expenditure on defence, $econ\_aff\_exp$ is the expenditure on economic affairs (e.g. investments on infrastructures), $educ\_exp$ is expenditure on education and $health\_exp$ is expenditure on social affairs (e.g. social protection and healthcare spending). All variables are in natural logs and further explained in Appendix 1.

The notation can be simplified by writing the equations above in a generic form as:

$$y_t = \beta_0 + \beta_1 tot\_exp_t + \beta_2 private\_k_t + \beta_3 open_t + \sum_{i=1}^{m} \beta_i Exp_t^i + \varepsilon_t \qquad (6)$$

where Exp^i represents m different components of government expenditure (as also defined above)[3].

4.1 Data Source

In this study, we employ annual data covering the period 1862-2007. Drawing on the literature, we use the natural logarithm of real per-capita GDP for the long-run analysis and the growth rate of real per-capita GDP for the short-run analysis. We make use of Baffigi's (2011) dependent variable. The data on fiscal variables have been collected by analysis the material issued by the Italian Ministry of Economics and Finance – Ragioneria Generale dello Stato. These data are expressed as percentage shares of total spending, except for total government spending which is expressed as percentage of GDP. Openness to trade is measured as the ratio of sum of real exports and imports to the real GDP and it has been derived from the reports published by the Italian National Institute of Statistics (ISTAT). Private capital is expresses as share of real private capital on real total government spending, as Ghosh and Gregoriou's (2008) suggest. Capital private series have been provided by the Bank of Italy[4]. Data are converted into real terms by the GDP deflator (2005=100) and scaled using a natural

[2] Current expenditure is net of interest spending.

[3] It is worth remembering the different components of government expenditure: capital and current spending, capital and current service expenditure, capital and current transfers and expenditures on defence, economic affairs, education and health.

[4] Reconstruction of public and private capital series by Di Giacinto, Micucci and Montanaro (2012b), the Bank of Italy.

logarithm. Appendix 1 reports the trend of the variables used in the analysis for the periods 1862-1969 and 1970-2007, respectively.

5. Methodology

In recent literature, many claim that macroeconomic time series, and especially GDP, can be represented by stationary fluctuations around (deterministic) segmented trend. Hence, we follow Bai and Perron's (1998, 2003) suggestion to test for multiple structural breaks at unknown dates. Furthermore, we apply Clemente-Montañés-Reyes (1998) and Zivot and Andrews (1992) unit root tests with structural breaks to test for the presence of unit root in our series. These tests are further detailed in Sub-sections 5.1 and 5.2. Since we are interested in estimating the impact of government expenditures on economic growth in the short- and long-run, our preferred econometric method is the ARDL model. In the sub-section 5.3, we will therefore discuss some technical issues related to this methodology.

5.1 Endogenous Breaks Testing Procedure

Tests for parameters instability and structural change in regression models have been an important part of applied econometric work dating back to Chow (1960). He tested for regime change at *a priori* known dates using an F-statistic. In order to avoid such a constraint, Quandt (1960) modified Chow's framework and considered the F-statistic with the largest value and over all possible breakdates. Andrews (1993) and Andrews and Ploberger (1994) derived the limiting distribution of the Quandt and related test statistic. More recently, Bai (1997) and Bai and Perron (1998, 2003) provided theoretical computational results that further extend the Quandt-Andrews framework by allowing for multiple unknown breakpoints.

With regards to the dating of breaks, it is conventionally assumed that the dating of the potential break is an *a priori* known feature. Test statistics are then conducted by adding dummy variables representing different intercepts and slopes, thereby extending the standard Dickey-Fuller procedure. Perron's (1989) influential study tests a null hypothesis of unit root under the assumption of known (exogenous, pre-tested) break date in both null and alternative hypotheses. However, this standard approach has been criticized. For instance, Christiano (1992) argues that this approach invalidates the distribution theory underlying conventional testing. Since Perron's work, a number of studies have developed different methodologies to endogenously determine dates (cf. for example Zivot and Andrews (1992), Lumsdaine and Papell (1997), Vogelsand and Perron (1998) and Bai and Perron (2003)). All

these studies show that determining the time of the structural breaks endogenously, bias in the usual unit root tests can be reduced. As for our sample, the hypothesis of one unique structural break is too restrictive, due to the large time-span under scrutiny. We therefore need to apply a methodology that allows us to determine multiple structural breaks. To this end, we apply a multiple break point estimation as suggested by Bai and Perron (1998, 2003).
Bai and Perron (1998) developed a test for multiple structural changes. According to Lee and Strazicich (2003), the minimum Lagrange Multiplier (LM) unit root test assumes breaks in the null hypothesis and allows for more than one endogenous determined structural break in the unit root testing. Glynn *et al.* (2007) confirmed the LM test to be a superior estimation for structural breaks.
Bai and Perron (1998) propose an algorithm (which is based on the principle of dynamic programming) for the efficient global minimization of the sum of squared residuals, in which the dates, unknown *a priori*, of multiple breaks are estimated together with the parameters of the model. These dates correspond to the partition of the sample that minimizes the Bayesian Information Criterion (BIC) among all possible points of break that are characterized by a certain number of years.
Bai and Perron's (1998, 2003) approach (hereafter, the BP approach) to structural breaks considers a multiple linear regression with m breaks:

$$y_t = x_t^{'}\beta_j + \mu_t \qquad {\scriptstyle (t=T_{j-1}+1,\ldots\ldots,T_j)\ for\ j=1,\ldots\ldots,m+1} \tag{7}$$

where j is the segment index, y_t is the observed dependent variable at time t, $x_t(p \times 1)$ is a vector of covariates and β_j and is the corresponding vector of coefficients. μ_t is the stationary disturbance term which may have a different distribution across regimes. It is reasonable to assume that there are m breakpoints, where the coefficients shift from one stable regression relationship to a different one. $\{T_1, \ldots.., T_m\}$ denotes each $m-$partition. The break points $(T_1, \ldots.., T_m)$ are treated as unknown.
Given an $m-$partition $T_1, \ldots.., T_m$ the least square estimates for the β_j can easily be obtained by minimizing the sum of squared residuals:

$$RSS(T_1, \ldots, T_m) = \sum_{j=1}^{m+1} rss\left(T_{j-1}+1, T_j\right), \tag{8}$$

where $rss\left(T_{j-1}+1, T_j\right)$ is the usual minimal residual sum of squares in the jth segment. The problem of dating structural changes is to find the breakpoints $\hat{T}_1, \ldots, \hat{T}_m$ that minimize the objective function:

$$\left(\hat{T}_1, \dots, \hat{T}_m\right) = argmin_{(\mathrm{T}_1,\dots,\mathrm{T}_m)} RSS(T_1, \dots, T_m) \quad (9)$$

where the minimization is taken over all partitions $(T_1, \dots, T_m)$ such that $T_i - T_{i-1} \geq h \geq q$. Thus, the breakpoint estimators are global minimisers of the objective function. Finally, the regression parameter estimates are obtained using the associated least squares estimates at the estimated m −partition $\{\hat{T}_j\}$, i.e. $\hat{\beta} = \hat{\beta}\left(\{\hat{T}_j\}\right)$. Bai and Perron (2003a) offer an efficient algorithm to obtain global minimizers of the sum of squared residuals. It is based on the principle of dynamic programming. It is important to point out that, in general, h does not need not be set to q. Indeed, many instances show that trimming is a choice made independently of the number of regressors.

The main objective of this analysis is to determine the optimal number and location of the structural break points by minimizing the within-regime sums of squares[5].

In the case of various structural breaks, there are various ways to obtain the test statistics breaks:

i. Sequential $l + 1$ breaks versus l estimation of break points;
ii. A double maximum test (global l versus none), which tests a null hypothesis of no structural break against an alternative hypothesis of unknown number of breaks, given some upper bound;
iii. Test of l versus $l + 1$ breaks. This considers a null hypothesis of L breaks against an alternative that additional break exists, the breaks are obtained by global minimization of the sum of squared residuals;
iv. Global Information Criteria.

Bai (1997) describes an intuitive approach to detect more than one break. The procedure involves the sequential application of breakpoint tests including the full sample. It also requires the performance of a test of parameter constancy with unknown break. If the test rejects the null hypothesis of constancy, a new test should be carried out to determine the breakdate. This is done by dividing the sample into two sub-samples that will undergo individual unknown breakpoint tests. Each of these tests may be viewed as an a test of the null hypothesis of $l = 1$ breaks versus the alternative of $l + 1 = 2$. A breakpoint whenever a sub-sample null is rejected should be also added. The procedure can then be repeated until all of

[5] When implementing the BP procedure for structural change, the minimum fraction of observation ε (equivalent to the minimum number of observations h) is allocated to any regime over which the search for break points is conducted. This is a parameter each individual researcher should establish. As for our data, our search employs a parameter of $\varepsilon = 0.15$, corresponding to the minimal size of $h = 15$ yearly observations; this amounts allow simultaneous calculation for up to $m = 5$ breaks.

the subsamples do not reject the null hypothesis, or until the maximum number of breakpoints allowed or maximum subsample intervals to test is reached.

A single test of no breaks against an alternative of l breaks assumes that the alternative number of breakpoints l is pre-specified. In cases where l is unknown, we may test the null of no structural change against an unknown number of breaks. This type of testing is named *double maximum* since it involves the maximization of both a given l and across various values of the test statistic for l. The equal-weighted version of the test, called $UDmax$ chooses selects the alternative that maximizes the statistic across the number of breakpoints. An alternative approach, denoted $WDmax$ applies weights to the individual statistics so that the implied marginal p-values are equal prior to taking the maximum. The distribution of these test statistics are non-standard, but Bai and Perron (2003b) provide critical value and response surface computations for various trimming parameters (i.e. the minimum sample size for estimating a break), number of regressors, and number of breaks.

Bai and Perron (1998) describe a modified Bai (1997) approach in which the breakpoints under the null are obtained by global minimization of the sum of squared residuals at each step. This approach can be viewed as an $l + 1$ versus l test procedure that combines the global and sequential testing approaches.

The global information criteria is based on two different criteria: Bayesian Information Criterion (BIC) as suggested by Yao (1988) and a modified Schwarz criterion (LWZ) as suggested by Liu *et al.* (1997). Yao (1988) shows that under relatively strong conditions, the number of breaks that minimizes the Schwarz criterion is a consistent estimator of the true number of breaks in a breaking mean model. More generally, Liu, Wu and Zidek (1997) propose the use of the modified Schwarz criterion to determine the number of breaks in a regression framework. LWZ offer theoretical results showing consistency of the estimated number of breakpoints, and provide simulation results to guide the choice of the modified penalty criterion.

Overall, the sequential procedure works best in selecting the number of breaks (Bai and Perron, 2004). Nonetheless, Bay and Perron (2004) suggest that the performance of the sequential procedure can be improved. In this sense, a useful strategy is to first look at the $UDmax$ or $WDmax$ tests to see whether at least a break is present. The number of breaks can subsequently be decided on the basis of an examination of a test for l versus $l + 1$ breaks, which are constructed using estimates of the break dates obtained from a global minimization of the sum of squared residuals. According to Bai and Perron (2004), this is the preferred strategy.

We select a maximum of five breaks and use a trimming of 0.15 to apply break least square regression and multiple break points tests. We apply all four tests and then we choose the breaks based upon the test of l versus $l+1$ breaks. From the results reported in Table 1, it is possible to note that, the break points correspond to the periods when some major changes occurred in Italy. The main breaks are in correspondence of the great depression to the late nineteenth century, the economic crisis in 1921-22, the years around the economic miracle after World War II, the years of the oil crisis and the end of the 1980 when the public spending incidence has increased to 40-50% of GDP.

Our aim is to investigate the effectiveness of the government composition spending in sustaining output growth when different regimes are switching over time. This is because an explicit change in a law or in a policy would lead to a change in the behaviour of a series, at the time the new regime, comes into effect.

Table 1. Multiple breaks tests

	Sequential $l+1$ breaks vs l	**Global l breaks vs none**		**$l+1$ breaks vs global l**	**Global Information Criteria**	
		UDmax	**WDmax**		**Schwarz**	**LWZ**
Model 1	1896, 1923, 1953, 1973	1896, 1923, 1953, 1973	1896, 1923, 1953, 1973	1896, 1923, 1953, 1973	1896, 1923, 1953, 1973	1896, 1923, 1953, 1973
Model 2	1892, 1919, 1951, 1969, 1989	1892, 1919, 1951, 1970, 1989	1892, 1919, 1951, 1970, 1989	1891, 1927, 1958, 1988	1891, 1927, 1958, 1988	1891, 1927, 1958, 1988
Model 3	1896, 1923, 1953, 1973	1893, 1919, 1949, 1968, 1987	1893, 1919, 1949, 1968, 1987	1893, 1919, 1949, 1968, 1987	1898, 1949, 1968	1898, 1949, 1968
Model 4	1895, 1924, 1955, 1986	1892, 1919, 1949, 1968, 1989	1892, 1919, 1949, 1968, 1989	1895, 1927, 1958, 1988	1927, 1958, 1988	1927, 1958, 1988
Model 5	1881, 1920, 1953, 1984	1881, 1920, 1951, 1970, 1989	1881, 1920, 1951, 1970, 1989	1881, 1920, 1951, 1970, 1989	1951, 1984	1951, 1984

Note: The second column starting from the left reports Bai-Perron tests of $l+1$ vs l sequentially determined breaks; the second one reports the Bai-Perron tests of 1 to M globally determined breaks; the third one the Bai-Perron tests of $l+1$ vs l globally determined breaks; and the last one compare information criteria for 0 to M globally determined breaks. We have select the maximum number of 5 breaks for each test. Tests are based on the entire sample (1862-2007). We have excluded observations close to two World War I and II (i.e. intervals 1914-1918 and 1938-1948) to avoid having already known breaks.

5.2 Unit Roots Tests with Structural Breaks

Before testing whether the series are co-integrated, we have investigated the order of integration of each series by means of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. Table A7 and A8 summarize the results for both tests. Perron (1989, 1990) demonstrates that if a time-series exhibits stationary fluctuations around a trend or a level containing a structural break, then unit root tests will erroneously conclude that a unit root exists. Structural breaks occurs in many time series for any number of reasons, including economic crises, changes in institutional arrangements, policy changes and regime shifts. It can also be changed in economic policies or large economic shocks, such as World War I and II and the oil crisis in 1973. In our case, ADF and PP tests statistics may be misleading since several series have been subject to structural breaks over the sample period. A well-known weakness of the ADF unit root test is that it may fail to reject the unit root hypothesis if the series have a structural break[6]. The ADF test tends to have low power and, although not rejecting the null hypothesis, it does not always mean that the series is non-stationary (Perman and Byrne, 2006). For the series that are found to be I(1), they may be stationary around the structural break(s), I(0), but they are erroneously classified as I(1). This implies that a structural break can have a permanent effect on the pattern of the time series (Perman and Byrne, 2006). Testing the unit root hypothesis allowing for structural breaks has some advantages. Firstly, it prevents test results from becoming biased towards unit root. Secondly, it can identify when the possible break occurred. Perron (1989) proposes to allow for a known or exogenous structural break in the Augmented Dickey-Fuller (ADF) test. Following this development, many authors, including Zivot and Andrews (1992) and Perron (1997), propose to "endogenously" from the data determine the break point from the data.

Zivot and Andrews (1992) (henceforth, ZA) transforms Perron's unit root test (which is based upon an exogenously determined break date) into an unconditional unit root test. In other words, instead of treating the break date as fixed these authors purpose a test where the break date is estimated. This test allows for a single break in the intercept and the trend (slope) of the series. They suggest a sequential test using the full sample and a different dummy variable for each possible break date (Perman and Byrne, 2006). The estimated model takes the following form:

$$\Delta y_t = \mu + \alpha y_{t-1} + \beta t + \theta_1 DU_t + \gamma_1 DT_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \qquad (10)$$

Here, Δ is the first difference operator, ε_t is a white noise disturbance term with variance σ^2, and $t = 1, \dots, T$ is an index of time. The Δy_{t-j} term on the right hand side of the above equation allows for serial correlation and ensures that the disturbance term is white noise. Finally, DU_t is an indicator dummy variable for a mean shift occurring at time TB and DT_t is

[6] Perron (1989) argues that the power to reject unit root decreases when the stationary alternative is true and a structural break is ignored.

the corresponding trend shift variable, where $DU_t = 1$ and $DT_t = t - TB \; if \; t > TB$; 0 otherwise. As it conventionally occurs in these tests, a "trimming region" [0.15,0.85] is chosen and the break point is selected where the value of TB for which the ADF t-statistic is minimized. The null hypothesis here is that the series y_t, is an integrated process without a structural break. This goes against the alternative hypothesis that the series is trend stationary with a structural break in the trend function, which occurs at an unknown time.

The ZA strategy also relates to similar tests proposed by Perron-Vogelsang (1992). However, one obvious weakness is its inability to deal with more than one break in a time series. Addressing this problem, Clemente-Montañés-Reyes (1998) (henceforth, CMR) propose two tests that allow considering one and two events within the observed history of a time series. In these tests, the null hypothesis is that the series has a unit root with a structural break(s) against the alternative hypothesis that it is stationary with break(s). The null hypothesis is rejected if the calculated t statistic is grater in absolute value than the critical value. The advantage of these tests is that they do not require an *a priori* knowledge of the structural break dates. CMR (1998) unit root tests offer two models: (1) an additive outliers (AO), which captures a sudden change in the mean of a series; and (2) an innovational outliers (IO) model, which allows for a gradual shift in the mean of the series. This taxonomy of structural break follows from Perron and Vogelsang's (1992) work. The double break additive outlier AO model involves the estimation of the following specification:

$$y_t = \mu + \delta_1 DU_{1t} + \delta_2 DU_{2t} + \widetilde{y_t} \qquad (11)$$

where $DU_{mt} = 1$ for $t > T_{bm}$ and 0 otherwise, for $m = 1,2$. T_{b1} and T_{b2} are the breakpoints to be located by grid search. The residuals from this regression, $\widetilde{y_t}$, are then the dependent variable in the equation to be estimated. They are regressed on their lagged values, a number of lagged differences, and a set of dummy variables needed to make the distribution of the test statistic tractable:

$$\widetilde{y_t} = \sum_{i=1}^{k} \omega_{1i} DT_{b1,t-i} + \sum_{i=1}^{k} \omega_{2i} DT_{b2,t-i} + \alpha \tilde{y}_{t-i} + \sum_{i=1}^{k} \theta_i \Delta \tilde{y}_{t-i} + e_t \qquad (12)$$

where $DT_{bm,t} = 1$ for $t = T_{bm} + 1$ and 0 otherwise, for $m = 1, 2$. No intercept is necessary, as $\tilde{y}_t$ is mean zero. This regression is then estimated over feasible pairs of T_{b1} and T_{b2}, searching for the minimal t-ratio for the hypothesis $\alpha = 1$; that is, they are compared with the critical values provided by Perron and Vogelsang (1992) as they do not follow the standard Dickey-Fuller distribution.

The equivalent model for the innovational outlier (i.e. gradual change) model expresses the shocks to the series (the effects of δ_1, δ_2 above) as having the same ARMA representation as other shocks to the model, leading to the formulation:

$$y_t = \mu + \delta_1 DU_{1t} + \delta_2 DU_{2t} + \varphi_1 DT_{b1,t} + \varphi_2 DT_{b2,t} + \alpha y_{t-1} + \sum_{i=1}^{k} \theta_i \Delta y_{t-i} + e_t \qquad (13)$$

where again an estimate of α significantly less than unity will provide evidence against the I(1) null hypothesis. In each of these models, breakpoints T_{b1}, T_{b2} and the appropriate lag order k are unknown. The breakpoints are located by a two-dimensional grid search for the maximal (most negative) $t-$ statistic for the unit root hypothesis ($\alpha = 1$), while k is determined by a set of sequential $F-$tests.

These tests attempt to verify the null hypothesis H_0 against the alternative hypothesis H_1:

$$H_0: y_t = y_{t-1} + \delta_1 DTB_{1t} + \delta_2 DTB_{2t} + u_t \qquad (14)$$

$$H_1: y_t = u + d_1 DU_{1t} + d_2 DTB_{2t} + e_t \qquad (15)$$

In these equations, DTB_{it} is a pulse variable equal to one if $t = TB_i + 1$ and becomes zero otherwise. Further, $DU_{it} = 1\ if\ t > TB_1\ (i = 1,2)$ and zero otherwise. TB_1 and TB_2 represents the time periods when the mean is being modified. For simplicity, assume that $TB_i = \lambda_i T\ (i = 1,2)$ where $0 < \lambda_i < 1$ and $\lambda_2 > \lambda_1$ (Clemente *et al.*, 1998).

If the two breaks belong to the innovational outlier, one can test the unit root hypothesis by estimating the following model:

$$y_t = \mu + \rho y_{t-1} + \delta_1 DTB_{1t} + \delta_2 DTB_{2t} + d_1 DU_{1t} + d_2 DU_{2t} + \sum_{i=1}^{k} c_j\, \Delta y_{t-i} + e_t \qquad (16)$$

The minimum value of the simulated t-ratio is obtained from this estimation and this value can be used for testing whether the autoregressive parameter is 1 for all break time combinations. In order to derive the asymptotic distribution of this statistic, assume that $0 < \lambda_0 < \lambda_1$, $\lambda_2 < 1 - \lambda_0 < 1$. By implementing the largest possible window, λ_1 and λ_2 take values in the $\left(\frac{(t+2)}{T}, (T-1)/T\right)$ interval. Further, assume that $\lambda_2 > \lambda_1 + 1$ which implies that cases where the breaks occur in consecutive periods are eliminated (Clemente *et al.*, 1998).

If the shifts are better described as additive outliers, the unit root hypothesis can be tested through a two step procedure. First, eliminate the deterministic part of the variable by estimating the following model:

$$y_t = \mu + d_1 DU_{1t} + d_2 DU_{2t} + \tilde{y} \quad (17)$$

The second step involves taking out the test by searching for the minimal t-ratio for the hypothesis that $\rho = 1$ in the following model:

$$\tilde{y}_t = \sum_{i=0}^{k} \omega_{1i} DTB_{1t-i} + \sum_{i=0}^{k} \omega_{2i}\, DTB_{2t-i} + \rho \tilde{y}_{t-1} + \sum_{i=1}^{k} c_i \Delta \tilde{y}_{t-i} + e_t \quad (18)$$

The dummy variable DTB_{it} is included in this model to make sure that $\min t_{\hat{\rho}}^{AO}(\lambda_1, \lambda_2)$ converges to the distribution (Clemente *et al.*, 1998)[7]:

$$\min t_{\hat{\rho}}^{AO}(\lambda_1, \lambda_2) \longrightarrow inf_{\lambda=\Lambda} \frac{H}{[\lambda_1(\lambda_2-\lambda_1)(1-\lambda_2)]^{1/2} K^{1/2}} \quad (19)$$

According to Baum (2005), if the estimates of the CMR unit root tests provide evidence of significant additive or innovational outliers in the time series, the results derived from ADF and PP tests are doubtful, since this is evidence that the model excluding structural breaks is miss-specified. Therefore, in applying unit root tests in time series that exhibit structural breaks, only the results from the CMR unit root tests are considered. This occurs if the two structural breaks indicated by the respective tests are statistically significant at the 5% level. On the other hand, if the results of the CMR unit root tests show no evidence of two significant breaks in the series, the results from the CMR for one break, or Zivot and Andrews unit root tests are considered. If these tests show no evidence of a structural break, the ADF and PP tests can be considered.

5.3 The ARDL Estimation Approach

To test the long run relationship among our variables (equations (1)-(5) above), we use the robust econometric technique, Autoregressive Distributed Lag (ARDL or Bound testing) model originally introduced by Pesaran and Shin (1999) and further extended by Pesaran *et al.* (2001). We have decided to adopt this method for three reasons. Firstly, unlike other multivariate co-integration methods (e.g. Johansen and Juselius, 1990), the Bounds test is a simple technique that allows the co-integration relationship to estimated a single equation by OLS, once the lag order of the model is identified[8]. Secondly, in order to employ a valid standard co-integration

[7] For more technical information see Clemente, Montañés and Reyes (1998).

[8] It is worth noting that with the ARDL. Variables may have a different optimal number of lags, while Johansen's co-integration procedure does not allow it.

testing (such as those carried out by Engle and Granger, or Johansen), we need to ensure that all of the series are integrated according to the same order[9]. The Bounds test allows a mixture of I(0) and I(1) variables as regressors, which means that the order of integration of appropriate variables may not necessarily be the same[10]. Therefore, the ARDL technique has the advantage that it does not require a specific identification of the order of the underlying data. The first step to take in any co-integration technique is to determine the degree of integration of each variable in the model. However, this depends on which unit root test one uses. Moreover, different unit root tests could lead to contradictory results. Interestingly, the ARDL approach is useful as it helps avoiding these problems. Thirdly, this technique is also suitable for small or finite sample sizes (Pesaran *et al.*, 2001). The short and long-run coefficients of the model are estimated simultaneously and all variables of the model are assumed to be endogenous. Johansen's co-integration technique (which avoids the ARDL approach) entails a large set of choices to be taken into consideration. For instance, it involves decisions such as the number of endogenous and exogenous variables to be included, the treatment of deterministic elements, as well as the order of VAR and the optimal number of lags to be used. Most importantly, the estimation procedures are very sensitive to the method used to make these choices and take these decisions (Pesaran and Smith, 1998).

According to Pesaran and Pesaran (1997), the ARDL approach requires the following two steps. In the first step, the existence of any long-run relationship among the variables of interest is determined using an F-test. The second step of the analysis is to estimate the coefficients of the long-run relationship and determine their values. This is followed by the estimation of the short-run elasticity of the variables with the error correction representation of the ARDL model.

The unrestricted error correction (UECM) versions of the ARDL model of the functional forms explained in the section above are given below:

$$\Delta y_t = \rho_0 + \rho_1 y_{t-1} + \rho_2 tot\_exp_{t-1} + \rho_3 k\_private_{t-1} + \rho_4 open_{t-1} + \sum_{i=1}^{m} \rho_i \, Exp_{t-1}^{i} + \eta_1 \Delta y_{t-j} + \eta_2 \Delta tot\_exp_{t-j} + \eta_3 \Delta private\_k_{t-j} + \eta_4 \Delta open_{t-j} + \sum_{i \in \theta} \eta_i \Delta Exp_{t-j}^{i} + \varepsilon_t \quad (20)$$

where j is the optimal number of lags; all variables are as defined above and in the Appendix 1. Exp^i represents m different components of government expenditure (as defined above in section IV). Furthermore, ρ_0 is drift component and ε_t represents the white noise.

[9] Two or more variables are said to be integrated if they contain a stable long-run linkage. Greene (2003) elaborates co-integration as pre-test for the avoidance of spurious regression analysis, and explains that the integration order of all variables should be the same or greater than I(0); this also mean series should be non-stationary at level form.

[10] It is important that the series are not I(2).

Equation (20) indicates that economic growth tends to be influenced and explained by its past values. The structural lags are established by using minimum Schwarz Bayesian Information Criteria (SBC)[11].

After each regression, the Wald test (F-statistic) is computed to differentiate the long-run relationship between the concerned variables. The Wald test can be carried out by imposing restrictions on the estimated long-run coefficients. The null and alternative hypotheses (according to which all coefficients are jointly equal to zero) are as follows:

$$H_0: \rho_1 = \rho_2 = \rho_3 = \rho_4 = \rho_i = 0 \tag{21}$$

i.e., there is no co-integration among variables.

$$H_1: \rho_1 \neq \rho_2 \neq \rho_3 \neq \rho_4 \neq \rho_i \neq 0 \tag{22}$$

i.e., there is co-integration among variables.

The asymptotic distribution of the Wald-test is non-standard under the null hypothesis of no co-integration among variables. Consequently, the computed F-statistic value will be evaluated with the critical values tabulated in Tables CI of Pesaran *et al.* (2001). These critical values are calculated for different regressors and whether the model contains an intercept and/or a trend. According to these authors, the lower bound critical values assume that the explanatory variables are integrated of order zero, or I(0), while the upper bound critical values assume that the same variables are integrated of order one, or I(1).

The two sets of critical values provide critical value bounds for all classifications of the regressors into purely I(1), purely I(0) or mutually cointegrated. However, these critical values are generated for sample size of 500 and 1000 observations and 20000 and 40000 replications respectively. Narayan (2004a) and Narayan (2005) argue that existing critical values, due to their large sample sizes, cannot be used for small sample sizes[12]. For this reason, we rely on those values reported in Narayan (2005), which calculated for sample sizes ranging from 30-80 observations.

Therefore, if the computed F-statistic is smaller than the lower bound value, then the null hypothesis is not rejected and we can conclude that there is no long-run relationship between economic growth and its determinants. Conversely, if the computed F-statistic is greater than

[11] Pesaran and Smith (1998) argue that the SBC should be used in preference to other model specification criteria because it often has more parsimonious specifications.

[12] For instance, Narayan (2005) compares the critical values generated with 31 observations and the critical values reported in Pesaran *et al.* (2001). He finds that the upper bound critical value at the 5% significance level for 31 observations with four regressors is 4.13 while the corresponding critical value for 1000 observations is 3.49, which is 18.3% lower than the critical value for 31 observations.

the upper bound value, then capital expenditure and economic growth share a long-run level relationship. On the other hand, if the computed F-statistic falls between the lower and the upper bound values, then the results are inconclusive.

In order to find out the short run coefficients, we make use of the following equation (which represents the final version of the estimated model):

$$\Delta y_t = \rho_0 + \eta_1 \Delta y_{t-j} + \eta_2 \Delta tot\_exp_{t-j} + \eta_3 \Delta private_{k\,t-j} + \eta_4 \Delta open_{t-j} + \sum_{i \in \theta} \eta_i \Delta Exp^i_{t-j} + \omega ECT_{t-1} + \mu_t \quad (23)$$

where the ηs are the short-run dynamic elasticities of the model's convergence to long-run equilibrium and ω is the speed of adjustment. Δ represents the first differences operator and the EC_{t-1} refers to the one period lagged error correction term. The coefficient of ECT provides the speed with which variables returns to their equilibrium position in the long-run, in the event of shocks to the system. The sign of ECT should be negative and statistically significant. In each equation, changes in the endogenous variables are caused not only by their lags, but also by the previous period's disequilibrium in level.

In the final step, we apply Hendry and Ericson's (1991) general-to-specific modelling technique to select the preferred ECM. This procedure first estimates the ECM with different lag lengths for the differences terms. Subsequently, it simplifies the representation by eliminating the lags with insignificant parameters. A correctly indicated ECM model has to pass a series of diagnostic tests. These include the Autoregressive LM (Lagrange Multiplier) test and/or the Durbin Watson test for serial correlation in residuals and the Jarcque-Bera test for normality distribution of residuals. In this study, we also apply the Ramsey RESET specification test. In summary, these tests have been conducted to ensure the reliability of results. Stability tests, such as CUSUM and CUSUMSQ are also employed to check the stability of the estimated coefficients over the time periods.

6. Empirical Results

6.1 Unit Roots Tests

While the presence of a long run relationship among variables remains critical to valid estimation and inference, Pesaran *et al.* (2001) suggest that the ARDL approach remains valid regardless of the order of integration of the explanatory variables. The ARDL methodology thus has the advantage of not requiring a precise identification of the order of integration of the underlying data. The ARDL approach to co-integration does not require the pre-testing of the variables (which are included in the model) for unit root, unlike other techniques such as Johansen's approach (Pesaran *et al.* (2001)). However, we test for unit roots to eliminate the possibility of I(2) variables. In the presence of such variables the computed F-statistics provided by Pesaran *et al.* (2001) are no longer valid because they are based on the assumption that the variables are I(0) or I(1).

To verify the order of integration, this work applies the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) unit root tests[13] (see Tables A3, A7 and A8 in Appendix 1[14]). The ADF and PP unit root tests suggest that each variable is integrated of order one I(1) and stationary I(0). However, this analysis is not concerned with the implications of structural breaks on unit roots. Given the inability of standard ADF and PP to capture the impact of structural breaks, we firstly report the CMR two structural breaks test (see Tables A4, A9 and A11 in Appendix 1). In the entire period, most of the variables used in the analysis exhibit two statistically significant structural breaks. Total capital spending (in AO and IO models)[15] has only one statistically significant break. Henceforth, we also test the variables by means of CMR with one structural break and ZA tests. Despite the breaks in many of the series under consideration, the null hypothesis cannot be rejected in the AO model. The CMR test with two structural breaks, allows to reject the null in many cases, solely in the IO model. In general, the breaks are in correspondence to the years between World War I and II, or around the 1970s (i.e. during the years of the oil crisis years)[16]. The CMR (Clemente-Montañés-Reyes) test with one structural break allows us rejecting the null in both cases, namely the AO and the IO models. It means that in some years the changes took place gradually and in other years they were faster. Furthermore, the results of the CMR test with one structural break and the ZA test are very similar in terms of rejection of the null. Similar conclusions can be drawn for the sub-sample period 1862-1969.

Regarding the sub-sample period 1970-2007, the AO model with the CMR test with one structural break seems to be more appropriate for the variables as they all appear to have sudden structural changes rather than gradual shifts. Given the mix in the order of integration

[13] Unless otherwise stated, the tests are based on the default setting of lag length for ADF and bandwidth for PP.

[14] We test for unit roots for the entire sample (1862-2007), and for the two sub-samples under analysis: 1862-1969 and 1970-2007.

[15] Bear in mind that in the AO model changes are assumed to take place rapidly, while in the IO model changes are assumed to take place gradually.

[16] These results confirm those found during the multiple breakpoint tests. It is worth noting that the unit root test with structural break can be applied only to the series without any missing observation or jump. For this reason and in order to apply CMR and ZA tests, we also consider the years during World War I and II.

of the variables, we have opted to estimate our model specifications by means of an ARDL co-integration technique.

6.2 Co-integration (sample period 1970-2007)

Since we are interested in estimating the impact of government expenditures on economic growth in the short- and long-run simultaneously, the ARDL model becomes our preferred econometric method. We apply the ADRL co-integration approach to each specification. The empirical results from the estimated ARDL model are presented from table 2 to 5. In the first stage, the order of lag length is obtained from an unrestricted vector autoregressive model (VAR) through the Schwartz Bayesian Criteria (SBC). The order of lag length appears to be different for each specification. Following Pesaran *et al.*'s (1997) procedure, we first estimate an OLS regression for the first differences part of the unrestricted equation and test for the joint significance of the parameters of the lagged level variables when added to the first regression. According to Pesaran *et al.* (1997), "this OLS regression in first differences are of no direct interest" to the bounds co-integration test. The F-statistic tests the joint null hypothesis that the coefficients of the lagged level variables are zero (i.e. they do not share any long-run relationship). The results for the computed Wald tests (F-statistics), reported in the last row of each table, reveal that the calculated F-statistics is higher than the upper bound critical value in all specifications[17]. As per these results, we can safely conclude that a level long-run co-integration relationship exists for the estimated ARDL models.

6.3 Long-run Analysis

Once the existence of a long-run relationship has been established, equations (1)-(11) can be estimated using the ARDL model. Tables 2 and 3 show the long-run estimated coefficients respectively for the economic and functional components. On an aggregate level, total government expenditure has played a positive role in augmenting real per capita GDP in Italy. This is the level effect of total government spending on per capita GDP. Interestingly, Devarajan *et al.* (1996) have found it to be positive but insignificant; in contrast, Ghosh and Gregoriou (2008) have found it to be positive and statistically significant. The result is intuitive and coherent with the optimal fiscal policy perspective. Put differently, in order to finance a higher level of government spending, higher distortionary taxes are needed. The steady-state

[17] According to Narayan (2005), the existing critical values reported in Pesaran *et al.* (2001) cannot be used for small sample size because they are based on large sample sizes. Narayan (2005) provides a set of critical values for sample sizes ranging from 30 to 80 observations.

GDP growth will increase only if the productivity of that government spending exceeds the deadweight loss associated with the taxes required to pay it. This result is robust in all specifications.

The estimated coefficients of the long-run relationship show that there is a negative and statistically significant relationship between the capital component of public expenditure and real per capita GDP, contrary to the a priori theoretical expectation of a positive sign. A similar negative relation is obtained by Devarajan *et al.* (1996) and Ghosh and Gregoriou (2008) for developing countries. Barro (1990, 1991) finds that consumption expenditure (i.e. current expenditure less education and defence expenditure) is associated with lower per-capita growth. Public expenditure on capital goods is supposed to add to the country's physical capital (e.g. infrastructure, roads, bridges, dams, ports, etc). Thus, the stock of infrastructure capital would complement private-sector productivity and, consequently, have favourable effects on growth. To understand better the negative effect of capital spending, we also estimate the capital spending sub-components and examine which of them had driven this negative effect. As demonstrated in equation (2) in Table 2, we replace capital spending with its sub-components, which are capital services and capital transfers expenditures. The results show that the first item in the long-run has not significant effects, while the second one has a negative and statistically significant effect on the real per-capita GDP. As shown in the theoretical model, an increase in the share devoted to the expenditures that are traditionally considered to be productive does not need to raise the economic growth. The initial shares could be such that this kind of expenditure is there is already too large and its increase becomes counterproductive[18]. Italy may be one of such cases that devote too much resources expenditures on capital transfers. Consequently, a unit increase in the ratio of capital transfers to total public spending decreases per capita real GDP by 18 percent.

Equation (4) in Table 2 shows the results for the regression of current public spending to total public spending. In the long-run, the coefficient is insignificant. This is also confirmed when its sub-components are considered (i.e. current services and current transfers expenditures).

Both theory and intuition suggest that expenditure ratios and per capita GDP might have a nonlinear relationship. From the theoretical model we know that productive expenditures can be positively associated with growth when their shares in the budget are low; however, this relationship becomes negative when the shares are large. The intuition is that as the share keeps rising, decreasing return to scale set in and, eventually, the relationship between the two variables turns negative. Equations (3) and (6) in Table 2 report the nonlinear regression models respectively with capital and current expenditure. Neither linear nor the squared terms

[18] See Devarajan *et al.* (1996) pg. 330.

are now statistically significant in both cases (i.e. capital and current expenditures). The results are basically unchanged for current spending, while it is likely that the linear relationship will give a better result for the capital component. Regarding functional components of expenditure in the long-run, the only positive significant effect stems from the health spending, but only at 10 percent level. Yet, it disappears when the same component is estimated without other functional components. The other factors that contribute significantly to GDP in Italy are economic affairs and education expenditures. The former has a negative effect both in isolation (eq. (9) in Table 3) and when considered with other variables (eq. (7) in Table 3). Following Ghosh and Gregoriou (2008), this could be associated to the corruption in investment projects. When included with other variables, a negative long-run relation is also observed between the dependent variable and expenditure in education.

This results is extremely puzzling. However, it does not seem to be robust because, when considering this component alone (cf. eq. (10) in Table 3), its sign becomes positive, even though not statistically significant. Devarajan *et al.* (1996) also find a negative and statistically significant relation between education and GDP growth rate for developed countries. Alshahrani and Alsadiq (2014) find the same results in the long-run for Saudi Arabia. They attribute this result to the lack of emphasis on education in the period under consideration, rather than to a negative effect of education on per-capita GDP in the long-run. A key endogenous variable of the theoretical model is the ratio of private capital to public services. The coefficient of this variable is positive and statistically significant in all equations, thus meaning that as expected, public services augment the productivity of private capital. Furthermore, openness to trade has not a significant effect on output in the long-run.

Table 2. Long –run coefficients for Economic Classification (1970-2007)

Variables	Economic Classification					
	Long-run coefficients					
	(1)	(2)	(3)	(4)	(5)	(6)
const	-2.019*** (0.571)	-1.883** (0.715)	-1.814** (0.759)	-5.491*** (0.986)	-3.789*** (1.315)	-0.211 (3.668)
tot_exp	1.437*** (0.102)	1.388*** (0.122)	1.423*** (0.125)	2.152*** (0.229)	1.917*** (0.183)	2.195*** (0.241)
cap_exp	-0.192*** (0.050)		-0.301 (0.370)			
cap_serv_exp		-0.039 (0.036)				
cap_transf		-0.181*** (0.051)				
cap_exp^2			0.022 (0.077)			
curr_exp				0.018 (0.091)		-2.846 (2.135)
curr_serv_exp					-0.202 (0.210)	
curr_transf					0.052 (0.079)	
curr_exp^2						0.373 (0.278)
private_k	1.229*** (0.102)	1.215*** (0.088)	1.203*** (0.156)	1.940*** (0.281)	1.840*** (0.186)	1.942*** (0.283)
open	-0.007 (0.081)	-0.009 (0.083)	-0.012 (0.070)	0.045 (0.082)	-0.047 (0.139)	0.061 (0.089)

Notes: The dependent variable is the real per capita GDP, gdp_pc. Robust standard errors in parentheses. ***, **, * indicate statistical significance respectively at 1%, 5% and 10% levels.

Table 3. Long –run Coefficients for Functional Classification (1970-2007)

Variables	Functional Classification				
	Long-run coefficients				
	(7)	(8)	(9)	(10)	(11)
const	-2.731** (1.229)	-4.865*** (0.647)	-2.867*** (0.737)	-5.684*** (0.731)	-6.048*** (1.116)
tot_exp	1.531*** (0.250)	2.069*** (0.109)	1.567*** (0.177)	2.172*** (0.181)	2.254*** (0.276)
def_exp	0.051 (0.112)	-0.070 (0.131)			
econ_aff_exp	-0.124*** (0.038)		-0.095*** (0.033)		
educ_exp	-0.175** (0.073)			0.080 (0.120)	
health_exp	0.091* (0.053)				0.063 (0.065)
private_k	1.443*** (0.030)	1.947*** (0.270)	1.319*** (0.179)	1.883*** (0.272)	2.087*** (0.377)
open	0.074 (0.122)	0.002 (0.136)	0.036 (0.089)	0.050 (0.090)	0.061 (0.073)

Notes: The dependent variable is the real per capita GDP, gdp_pc. Robust standard errors in parentheses. ***, **, * indicate statistical significance respectively at 1%, 5% and 10% levels.

6.4 Short-run Analysis

The signs of the short-run dynamic impacts changed little if compared to those in the long-run (see tables 4 and 5). When statistically significant, total expenditure is negatively associated with economic growth. With regard to detailed economic components of expenditure, capital and current aggregate expenditures confirm the same effect as that detected in the long-run. Capital spending still has a negative effect, even if its impact is significantly less than those of the long-run (i.e. a unit increase in this share of spending decreases economic growth by 2%, in eq. (1) table 4, whereas it is 18% in the long-run). The same result is found for capital transfers expenditure. Current expenditure does not play any role in the short-run. Among the sub-components, current services expenditure plays a negative role on determining the economic growth in the short-run. As for the non-linear relationship, the results confirm theory and the intuition: the economic growth is an increasing function of the share of capital expenditure and a decreasing function of the square term.

Among the functional components, defence expenditure has a negative effect on the dependent variable in the short-run, both in isolation and when considered with other variables. Economic affairs expenditure is currently positive (cf. eq. (7) in Table 5), but it shows a different effect on economic growth if different years are considered[19]. Education is again negative in the short-run when it is included with other variables. Yet, it turns not to be significant when considered in isolation. Finally, health care expenditure is not significant when considered with other variables, but it turns to be negatively in relation to economic growth when considered in isolation, as shown in eq. (11) in Table 5.

Devarajan *et al.* (1996) find a negative but not significant relationship between expenditure on defence and growth rate, a negative and statistically significant relationship between education spending and growth rate; however, they do not display any difference between short- and long-run.

The estimated coefficient for the error correction term is negative and statistically significant in all estimated equations. This means that real GDP in Italy functions according to an automatic mechanism that responds to deviations from equilibrium in a balanced manner. The value of 0.13 (cf. eq. (1) in Table 4) for the ECM coefficient suggests an adjustment slow speed strategy, which is roughly equal to 13%.

[19] This is not surprising since we are considering at the change from one year to another one in the short-run. It is therefore valid for each series.

Table 4. Short –run Coefficients for Economic Classification based on the ARDL model

Variables	Economic Classification					
	Short-run coefficients					
	(1)	(2)	(3)	(4)	(5)	(6)
const	0.010***	-0.004	0.011**	0.038***	-0.016*	0.021**
	(0.004)	(0.004)	(0.004)	(0.010)	(0.009)	(0.008)
Δgdp_p_{t-1}	0.439***	0.873***	0.498***	-0.067	0.248*	0.392
	(0.119)	(0.141)	(0.045)	(0.292)	(0.127)	(0.279)
Δtot_exp_{t}						0.060**
						(0.023)
Δtot_exp_{t-1}		0.830***	0.016	-0.870**		-0.475
		(0.154)	(0.023)	(0.383)		(0.403)
Δtot_exp_{t-2}				-0.745***	0.755*	-0.719***
				(0.200)	(0.379)	(0.106)
Δtot_exp_{t-3}				-0.442**	-0.708***	-0.365***
				(0.200)	(0.168)	(0.085)
$\Delta cap\_exp\_tot_{t-1}$			0.287***			
			(0.095)			
$\Delta cap\_exp\_tot_{t-2}$	-0.022**		0.197*			
	(0.010)		(0.106)			
$\Delta curr\_exp\_tot_{t-1}$				-0.058**		1.024
				(0.025)		(0.622)
$\Delta cap\_serv\_exp_{t-1}$		0.001				
		(0.013)				
Δcap_transf_{t-2}		-0.017***				
		(0.005)				
$\Delta curr\_serv\_exp\_{t-3}$					-0.128**	
					(0.048)	
$\Delta curr\_transf_{t-1}$					0.015	
					(0.026)	
$\Delta cap\_exp\_tot^\wedge 2_{t-1}$			-0.057***			
			(0.018)			
$\Delta cap\_exp\_tot^\wedge 2_{t-2}$			-0.044**			
			(0.020)			
$\Delta curr\_exp\_tot^\wedge 2_{t-1}$						-0.140
						(0.081)
$\Delta private\_k_{t}$	-0.087***	-0.077***	-0.065**			
	(0.024)	(0.017)	(0.024)			
$\Delta private\_k_{t-1}$		0.807***		-0.939**		-0.446
		(0.148)		(0.384)		(0.396)
$\Delta private\_k_{t-2}$				-0.793***	0.904**	-0.701***
				(0.198)	(0.412)	(0.111)
$\Delta private\_k_{t-3}$				-0.417*	-0.524***	-0.360***
				(0.200)	(0.149)	(0.092)
$\Delta open_{t}$	0.142***	0.088***	0.115***			0.139***
	(0.034)	(0.023)	(0.036)			(0.030)
$\Delta open_{t-1}$	-0.095***	-0.014		0.101**	0.132***	
	(0.029)	(0.040)		(0.035)	(0.029)	
$\Delta open_{t-3}$				-0.034	-0.087**	
				(0.030)	(0.040)	
ECM_{t-1}	-0.126***	-0.127***	-0.141***	-0.316***	-0.313***	-0.365***
	(0.044)	(0.034)	(0.045)	(0.079)	(0.048)	(0.061)
No. of obs	35	35	35	33	33	34
R-sq	0.71	0.91	0.82	0.94	0.87	0.85
Adj. R-sq	0.63	0.82	0.70	0.82	0.73	0.73
JB Test	0.280 (0.870)	0.215 (0.898)	0.003 (0.998)	3.051 (0.217)	1.236 (0.539)	1.481 (0.477)
Ser. Corr LM1	2.291 (0.130)	0.290 (0.590)	1.511 (0.219)	0.073 (0.787)	1.347 (0.246)	0.280 (0.597)
Ser. Corr LM2	3.610 (0.165)	2.844 (0.241)	4.539 (0.103)	0.433 (0.805)	3.471 (0.176)	0.433 (0.806)
Ramsey-Reset	0.709 (0.407)	0.057 (0.814)	0.087 (0.772)	0.213 (0.654)	3.691 (0.074)	0.221 (0.644)
Bound test	7.8603***	5.1644**	4.82636**	9.1262***	5.2362**	6.7802***
ARDL order	(1, 1, 2, 0, 1)	(1, 1, 1, 2, 1, 1)	(1, 1, 2, 2, 0, 0)	(3, 4, 4, 4, 4)	(2, 4, 4, 2, 4, 4)	(1, 3, 1, 1, 3, 0)

Notes: The dependent variable in the long-run equations, is the real per capita GDP. In the short-run specifications, the dependent variable is Δgdp_pc. Robust standard errors in parentheses. ***, **, * indicate statistical significance respectively at 1%, 5% and 10% levels. The ARDL order is selected on the bases of the SBC. The relevant critical value bounds are obtained from Table case III (with unrestricted intercept and no trend) in Narayan (2005). They are 4.590 – 6.368 at 1% level, 3.276 – 4.630 at 5% level, 2.696 – 3.898 at 10% level (for 35 observations and 4 regressors) and 4.257 – 6.040 at 1% level, 3.037 – 4.443 at 5% level, 2.508 – 3.763 at 10% level (for 35 observations and 5 regressors). ***denotes F-statistic falling above the 99% upper bound, **above the 95% upper bound, and *above the 90% upper bound. Dummy variables for some years are also included in each regression.

This means that approximately 13% discrepancy for the previous year is adjusted to the current year, i.e. 13% of disequilibria from the previous year's shock converge forward to the long-run equilibrium in the current year. This is due to the fact that the present value of the dependent variable is lower than that found in the long-run.

All the regressions for the underling ARDL models passed the diagnostic tests. We test for the presence of any autocorrelation (i.e. serial correlation LM test) in the residuals of our estimations. It is well known that the absence of autocorrelation in residuals is a crucial assumption for the accuracy of ARDL estimations. We also test for the normality (i.e. Jarque-Bera test) of the residuals and for the correct functional form (i.e. Ramsey-Reset test) of our model specifications.

According to Pesaran and Shin (1999), the stability of the estimated coefficient of the error correction model should also be graphically investigated. The stability of the long-run coefficients is used to form the error-correction term in conjunction with the short-run dynamics. Some of the problems of instability could stem from inadequate modelling of the short-run dynamics characterizing departures from the long-run relationship. Hence, it is expedient to incorporate the short-run dynamics for the constancy of long-run parameters. To this end, we apply the CUSUM and CUSUMSQ tests as developed by Brown *et al.* (1975). The CUSUM test is based on the cumulative sum of recursive residuals based on the first set of n observations. It is updated recursively and plotted against the break points. If the plot of CUSUM statistic stays within the 5% significance level, the estimated coefficients are said to be stable. A similar procedure is used to carry out the CUSUMSQ test which is based on the squared recursive residuals. A graphical presentation of these two tests is provided in Figures 5 and 6 below. The cumulative sum of the squares is within the 5% significance lines, thus suggesting that the residuals variance is somehow stable.

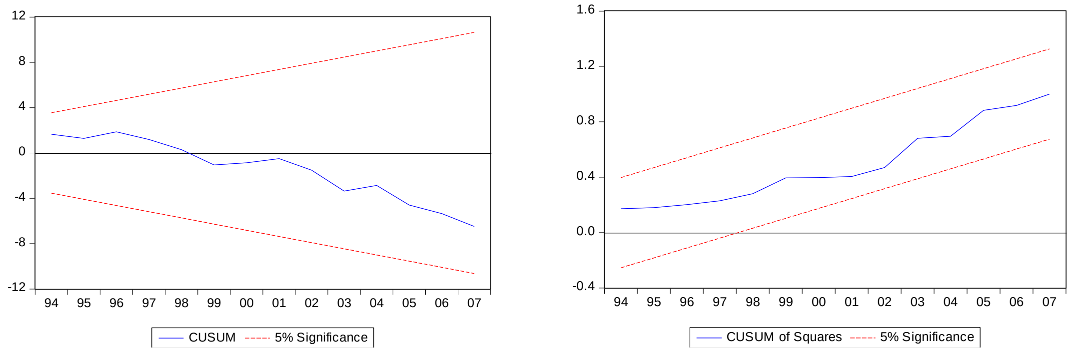
Table 5. Short–run coefficients for Functional Classification based on the ARDL model

Variables	Functional Classification				
	Short-run coefficients				
	(7)	**(8)**	**(9)**	**(10)**	**(11)**
const	0.007	0.282***	0.386***	0.018***	0.038***
	(0.008)	(0.049)	(0.021)	(0.003)	(0.009)
Δgdp_p_{t-1}	-0.442	-1.175***		0.313***	-1.318**
	(0.334)	(0.316)		(0.083)	(0.456)
Δgdp_p_{t-2}	1.491***				
	(0.368)				
Δgdp_p_{t-3}			0.167**		1.324***
			(0.059)		(0.144)
Δtot_exp_{t}				-0.698***	
				(0.145)	
Δtot_exp_{t-1}	-0.924**	-2.062***	-1.122***		-2.082***
	(0.353)	(0.320)	(0.066)		(0.556)
Δtot_exp_{t-2}	0.712**	-0.642***	-0.493***		-0.960***
	(0.287)	(0.150)	(0.078)		(0.087)
Δdef_exp_{t-1}	-0.075**	-0.026**			
	(0.026)	(0.011)			
$\Delta econ\_aff\_exp_{t-1}$	0.018		0.029***		
	(0.011)		(0.003)		
$\Delta econ\_aff\_exp_{t-2}$	0.036***				
	(0.007)				
$\Delta econ\_aff\_exp_{t-3}$			-0.040***		
			(0.003)		
$\Delta econ\_aff\_exp_{t-4}$			-0.059***		
			(0.004)		
$\Delta educ\_exp_{t}$				0.008	
				(0.016)	
$\Delta educ\_exp_{t-2}$	-0.097***				
	(0.021)				
$\Delta health\_exp_{t-1}$	-0.008				-0.047***
	(0.012)				(0.014)
$\Delta health\_exp_{t-2}$					-0.041***
					(0.010)
$\Delta private\_k_{t}$				-0.722***	
				(0.141)	
$\Delta private\_k_{t-1}$	-0.821**	-2.017***	-0.936***		-2.125***
	(0.364)	(0.323)	(0.067)		(0.561)
$\Delta private\_k_{t-2}$	0.740**	-0.670***	-0.304***		-1.045***
	(0.302)	(0.143)	(0.074)		(0.088)
$\Delta private\_k_{t-3}$	-0.510***	-0.765***	0.091***		
	(0.136)	(0.104)	(0.010)		
$\Delta open_{t}$	0.090***		0.210***	0.019	
	(0.023)		(0.010)	(0.016)	
$\Delta open_{t-1}$	0.044		-0.234***		0.151***
	(0.028)		(0.009)		(0.031)
$\Delta open_{t-2}$		0.084***			0.067**
		(0.025)			(0.022)
ECM_{t-1}	-0.245***	-0.420***	-0.213***	-0.062**	-0.531***
	(0.056)	(0.033)	(0.020)	(0.024)	(0.041)
Obs	34	33	33	36	33
R-sq	0.94	0.95	0.99	0.93	0.94
Adj. R-sq	0.86	0.88	0.97	0.89	0.86
JB Test	0.335 (0.846)	0.596 (0.742)	4.949 (0.084)	2.726 (0.256)	2.861 (0.239)
Ser. Corr LM1	0.046 (0.830)	0.138 (0.710)	2.998 (0.083)	0.408 (0.523)	4.381 (0.036)
Ser. Corr LM2	1.200 (0.549)	1.936 (0.380)	3.582 (0.167)	3.078 (0.215)	4.387 (0.112)
Ramsey-Reset	1.599 (0.230)	0.710 (0.415)	3.484 (0.095)	1.714 (0.203)	0.625 (0.445)
Bound test	4.04167*	18.0313***	31.6027***	12.7751***	155.6359***
ARDL order	(3, 3, 1, 3, 2, 2, 3, 3)	(1, 4, 1, 4, 4)	(4, 2, 4, 3, 4)	(1, 0, 0, 0, 1)	(4, 4, 3, 4, 4)

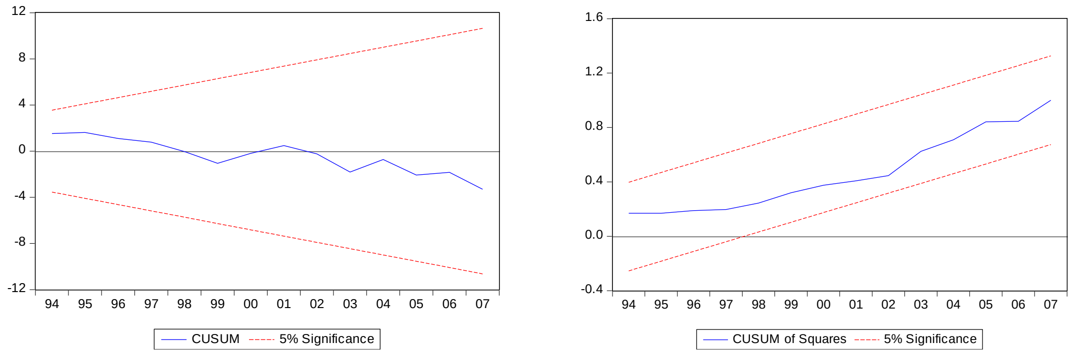
Notes: The dependent variable, in the long-run equations, is the real per capita GDP. In the short-run specifications, the dependent variable is Δgdp_pc. Robust standard errors in parentheses. ***, **, * indicate statistical significance respectively at 1 %, 5% and 10% levels. The ARDL order is selected on the basis of the SBC. The relevant critical value bounds are obtained from Table case III (with unrestricted intercept and no trend) in Narayan (2005). They are 3.841 – 5.686 at 1% level, 2.753 – 4.209 at 5% level, 2.300 – 3.606 at 10% level (for 35 observations and 7 regressors) and 4.590 – 6.368 at 1% level, 3.276 – 4.630 at 5% level, 2.696 – 3.898 at 10% level (for 35 observations and 4 regressors). ***denotes F-statistic falling above the 99% upper bound, **above the 95% upper bound, and *above the 90% upper bound. Dummy variables for some years are also included in each regression.

Figure 5. Stability test for equations 1-6 (Economic components)

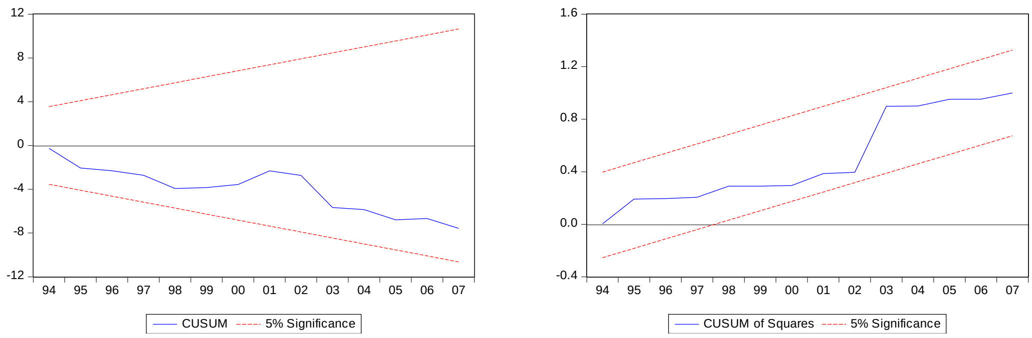
Equation (1)



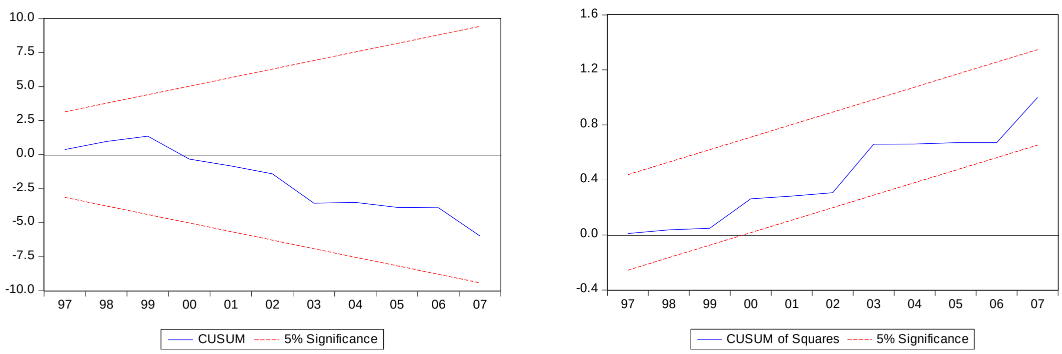
Equation (2)



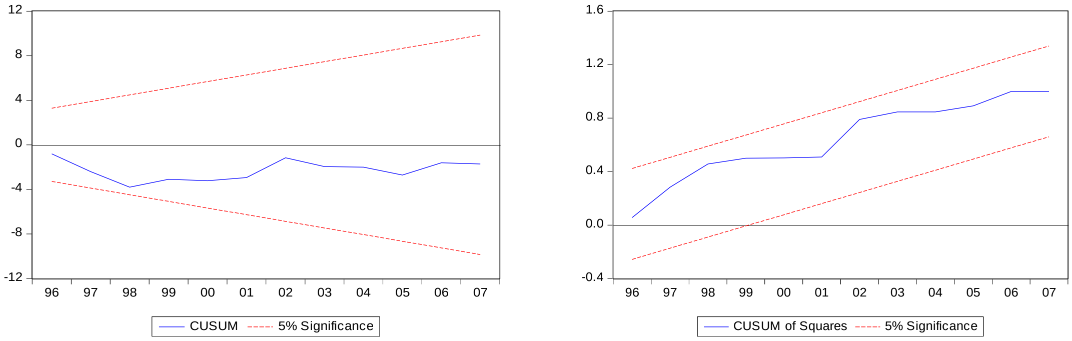
Equation (3)



Equation (4)



Equation (5)



Equation (6)

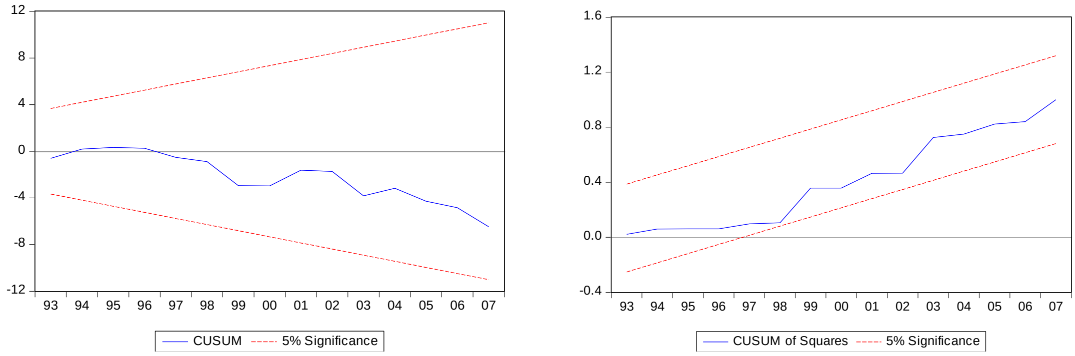
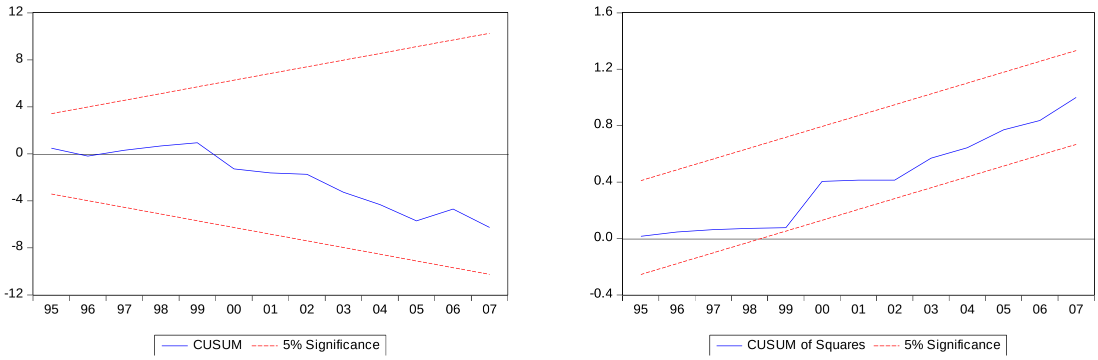
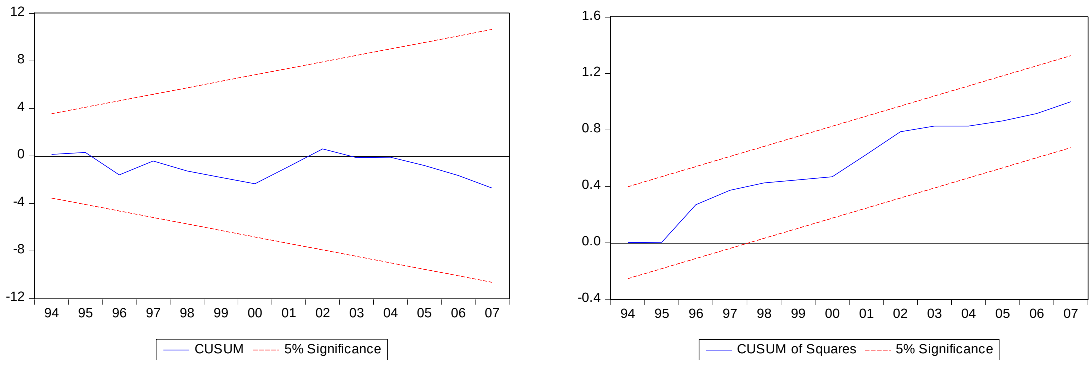


Figure 6. Stability test for equations 7-11 (Functional components)

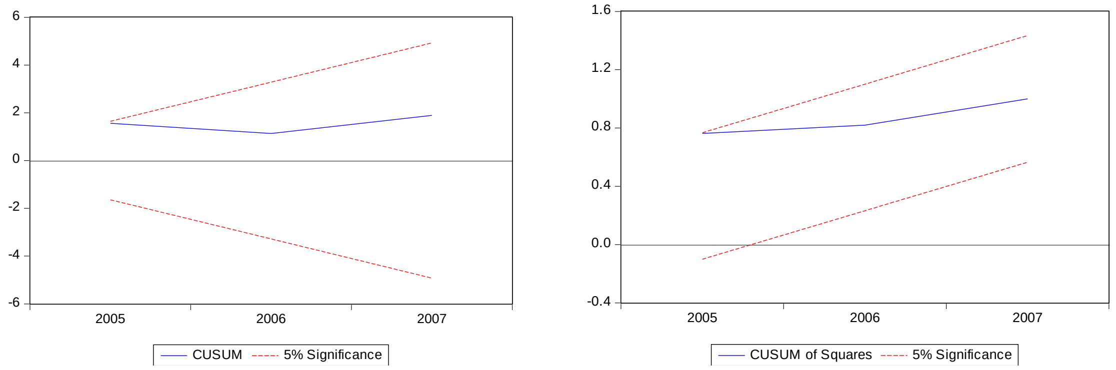
Equation (7)



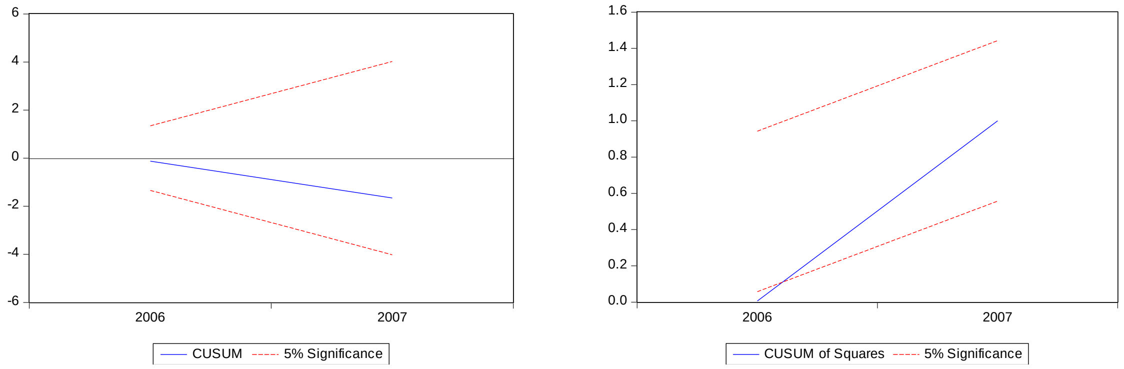
Equation (8)



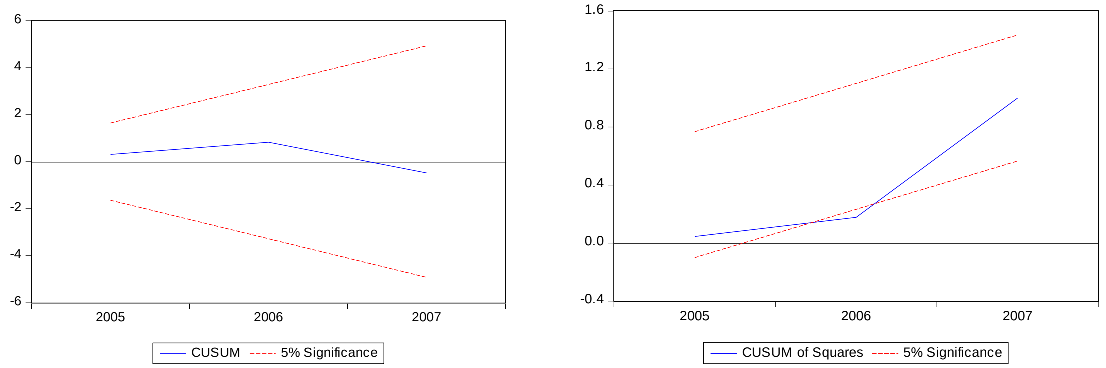
Equation (9)



Equation (10)



Equation (11)



We also estimate equations from (1) to (11). This is done without including private capital (see Tables A13-A16 in Appendix 2). The aim of this sensitivity analysis is to highlight the differences in the results given by the private capital series. Since the results do not show significant difference between the two analyses, we also estimate the same relationships for the remaining sample period 1862-1969, for which data are available. The results for the computed Wald test (F-statistics), reported in the last row of each table and reveal that a long-run co-integration relationship still exists for 8 out 11 estimated[20] specification. This also confirms the robustness of our results[21].

6.5 Co-integration (sample period 1862-1969)

In this section we estimate the relationship between economic and functional components of government spending, as well as real per-capita GDP during the period 1862-1969 (for which all variables are available, apart from the series for private capital[22]). Firstly, we estimate our models for the entire period, although the results do not show evidence for error correction mechanism. The reason for this could be the many events occurred in Italy during this long period. Hence, we decide to endogenously split our sample, thus involving a multiple breakpoint test. It is worth noting that we eliminate those observations in correspondence to the World War I and II, namely the years from 1914 to 1918 and from 1943 to 1946.

Table 6 shows the dates for two, three and five structural breakpoints. The breaks basically coincide with the main historical events occurred in Italy, even if they are different depending on the estimated specification. This is not surprising since the multiple breakpoint test searches for a break in the residual of the regression.

The first break corresponds to the end of the nineteenth century, when Italy was hit by a great depression, or to the years between World War I and II. These years were characterized by many crises that culminated in the Wall Street crash in 1929. The second main break occurred after World War II, around the 1950s. In 1953, the so called “Economic Miracle” began and lasted until the first half of the 1960s.

In this light, we are interested in dividing our sample into three sub-samples. This can help us avoid any samples with few observations. Unfortunately, our third sub-sample does not contain more than 19 observations; consequently, results should be cautiously interpreted.

---

[20] In three specifications it was not possible estimate the long- and short-run relations because residuals were not stationary (see Appendix 2). Yet, this is also due to the fact that private capital has a statistically significance effect on economic growth so it contributes to the long-run relationship.

[21] To investigate the determinants of short- and long-run economic growth simultaneously, we have also estimated a VECM specification for the real per capita GDP. In this case, we have considered only the ADF and PP test results, from which all variables are integrated of the same order. In spite of the presence of multiple independent variables, the Johansen test identifies no more than two co-integrating vectors. Overall, the results are extremely similar to those obtained by means of the ARDL approach. The signs of the series are coherent with the ARDL estimation results.

[22] We can now refer to Devarajan et al. (1996) theoretical model.

Table 6. Multiple breaks test with $l+1$ breaks vs global l BP test (1862-1969)

	2 structural breaks		3 structural breaks		5 structural breaks	
Specification1	1897, 1953	1862-1896 (35) 1897-1952 (47) 1953-1969 (17)	1896, 1923, 1953	1862-1895 (34) 1896-1922 (22) 1923-1952 (26) 1953-1969 (17)	1879, 1893, 1920, 1935, 1953	1862-1878 (17) 1879-1892 (14) 1893-1919 (22) 1920-1934 (15) 1935-1952 (14) 1953-1969 (17)
Specification2	1919, 1953	1862-1918 (52) 1919-1952 (30) 1953-1969 (17)	1893, 1923, 1953	1862-1892 (31) 1893-1922 (25) 1923-1952 (26) 1953-1969 (17)	1882, 1904, 1923, 1937, 1955	1862-1881 (20) 1882-1903 (22) 1904-1922 (14) 1923-1936 (14) 1937-1954 (14) 1955-1969 (15)
Specification3	1898, 1951	1862-1897 (36) 1898-1950 (44) 1951-1969 (19)	1896, 1923, 1953	1862-1895 (34) 1896-1922 (22) 1923-1952 (26) 1953-1969 (17)	1878, 1896, 1923, 1938, 1956	1862-1877 (16) 1878-1895 (18) 1896-1922 (22) 1923-1937 (15) 1938-1955 (14) 1956-1969 (14)
Specification4	1927, 1953	1862-1926 (60) 1927-1952 (22) 1953-1969 (17)	1895, 1927, 1953	1862-1894 (33) 1895-1926 (27) 1927-1952 (22) 1953-1969 (17)	1880, 1901, 1921, 1935, 1953	1862-1879 (18) 1880-1900 (21) 1901-1920 (15) 1921-1934 (14) 1935-1952 (14) 1953-1969 (17)
Specification5	1922, 1951	1862-1921 (55) 1922-1950 (25) 1951-1969 (19)	1882, 1922, 1951	1862-1881 (20) 1882-1921 (35) 1922-1950 (25) 1951-1969 (19)	1882, 1901, 1922, 1937, 1955	1862-1881 (20) 1882-1900 (19) 1901-1921 (16) 1922-1936 (15) 1937-1954 (14) 1955-1969 (15)

Notes: Results obtained from OLS breakpoint test estimation on the 1862-1969 sample. We have omitted any observations for those years close to World War I and II (i.e. from 1914 to 1918 and from 1943 to 1946) to avoid already known breaks. Number of observations are provided in parenthesis. Specification 1 and 3 include capital and current expenditure, specification 2 and 4 include their sub-components and specification 5 includes functional expenditure components.

After finding the integration order of all variables, our equations have been estimated via the ARDL co-integration technique. In the first stage, the individual lag length order (which is different for each series) is obtained from an unrestricted vector autoregressive model (VAR), which has been selected through the minimum value of the Schwartz Bayesian Criteria (SBC). Finally, the F-statistics is estimated on the basis of the Wald-test. The results of the test are reported in the last row of each table. The results obtained by means of the Bound testing approach show that the calculated F-statistics are statistically significant for our estimated equations. In addition, they are higher than the upper bound critical value, thus implying that there is co-integration among the variables in the models. Long- and short-run results are reported in the same table. Table 7 shows the estimated relationship between capital expenditure and real per-capita GDP in the three sub-samples. In the long-run and on an aggregate level, total spending plays a positive and statistically significant role on augmenting the real per-capita GDP in Italy, within entire period under consideration. Capital spending has a positive and significant effect only during the period 1897-1952 (eq. (3a)), while the results do not show any evidence for the no linear relationship. It is interesting to note that, as far as capital sub-components are concerned, as estimated in Table 8, the breaks date is are almost the same. This positive effect of capital spending is driven by both capital services spending and capital transfers. The signs of the long-run dynamic impacts for capital expenditure are also maintained in the short-run for the first and the third sub-samples (1953-1969), but they are not in the second sub-sample (1897-1952). Furthermore, the period 1862-1897 shows evidence of a short-run no-linear relationship between capital expenditure and economic growth. Table 9 shows the results of the current expenditure for sub-samples 1862-1918 and 1953-1969. During the period 1919-1952, there is no evidence of long-run relationship among our variables since residuals were not stationary. In the first sub-sample (1862-1918), there is evidence of no-linear relationship between current expenditure and real per-capita GDP. Once again, these results must be cautiously interpreted due to the weak significance (at 10% level) of the bound test. In the short-run, evidence of linear and negative relationship can be found. Also, for current sub-components expenditure, as reported in Table 10, the breaks are very similar to those found for total current spending. The positive effect found in the first sub-sample seems to be driven by current transfers. In the period 1953-1969, a significant relationship among our variables cannot be found. Hence, it seems safe to conclude that the long-run relationship is given by the positive role played by openness to real per-capita GDP.

Table 11 shows the results of the functional expenditure components in all three different sub-samples. Overall, the results for each period are slightly different. In the short-run, defence, economic affairs and health expenditures have a negative effect on economic growth in the period 1862-1921.

The period that spans from Italy’s political Unification to the post World War I years demonstrate that expenditures on defence, economic affairs, education and healthcare played a positive role in augmenting real per-capita GDP in the long-run. This effect is confirmed for expenditure on education in all three sub-samples, which means that this functional component contributed significantly to the Italian GDP during the period 1862-1969.

Table 7. ARDL capital expenditure (1862-1969)

Variables	1862-1896		1897-1952		1953-1969	
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)
			Long-run coefficients			
Const	0.153	0.095	0.111	0.561	-5.030***	-12.206
	(0.162)	(0.173)	(0.318)	(0.383)	(0.505)	(8.173)
tot_exp	0.427***	0.443***	0.261***	0.225***	1.183*	1.188*
	(0.045)	(0.047)	(0.051)	(0.048)	(0.618)	(0.643)
cap_exp	0.002	0.068	0.163***	-0.069	-0.332	4.432
	(0.012)	(0.044)	(0.034)	(0.211)	(0.301)	(5.199)
cap_exp^2		-0.020		0.057		-0.790
		(0.016)		(0.050)		(0.871)
open	-0.190***	-0.201***	-0.050	-0.098	1.514***	1.513***
	(0.066)	(0.066)	(0.058)	(0.061)	(0.353)	(0.363)
			Short-run coefficients			
Const	0.007***	-0.005***	-0.029	-0.035	0.010**	0.008
	(0.002)	(0.001)	(0.021)	(0.025)	(0.003)	(0.010)
Δgdp_p_{t-1}	1.105***	0.910***	0.394**	0.218	0.765***	0.750***
	(0.139)	(0.101)	(0.146)	(0.153)	(0.058)	(0.183)
Δgdp_p_{t-3}		0.486***				
		(0.116)				
Δtot_exp_{t}			-0.013			
			(0.033)			
Δtot_exp_{t-1}	-0.290***	-0.215***		-0.064**	0.095***	0.084
	(0.028)	(0.018)		(0.028)	(0.014)	(0.043)
Δcap_exp_{t}					0.118***	0.103**
					(0.014)	(0.027)
Δcap_exp_{t-1}	0.033***	0.034***	0.018	0.025		
	(0.004)	(0.003)	(0.017)	(0.100)		
Δcap_exp_{t-2}	0.007	0.069***				
	(0.006)	(0.015)				
Δcap_exp_{t-4}	-0.039***					
	(0.004)					
$\Delta cap\_exp^2_{t-1}$				-0.003		0.002
				(0.022)		(0.006)
$\Delta cap\_exp^2_{t-2}$		-0.020***				
		(0.005)				
$\Delta cap\_exp^2_{t-4}$		-0.006***				
		(0.001)				
$\Delta open_{t}$			0.068	0.076***	-0.010	0.050
			(0.051)	(0.027)	(0.010)	(0.043)
$\Delta open_{t-1}$	0.159***	0.096***			0.080***	
	(0.020)	(0.008)			(0.017)	
ECM_{t-1}	-0.440***	-0.145**	-0.201***	-0.205**	-0.081***	-0.106**
	(0.078)	(0.060)	(0.069)	(0.089)	(0.009)	(0.038)
Obs	30	30	38	38	15	15
R2	0.94	0.98	0.61	0.64	0.99	0.82
Adj. R-sq	0.91	0.96	0.46	0.46	0.96	0.51
JB Test	0.362 (0.835)	2.718 (0.257)	0.823 (0.663)	0.537 (0.765)	4.848 (0.089)	2.315 (0.314)
Ser. Corr LM1	0.067 (0.796)	0.926 (0.336)	1.560 (0.212)	0.001 (0.975)	0.619 (0.431)	0.948 (0.330)
Ser. Corr LM2	1.005 (0.605)	1.273 (0.529)	1.562 (0.458)	0.364 (0.834)	1.816 (0.403)	1.938 (0.379)
Ramsey-Reset	0.706 (0.413)	6.263 (0.029)	0.352 (0.558)	1.302 (0.265)	0.168 (0.710)	0.786 (0.426)
Bound test	9.9810***	46.9247***	12.5061***	5.3244**	1259.830***	4.61483*
ARDL order	(1, 2, 4, 2)	(4, 4, 3, 4, 3)	(2, 0, 1, 0)	(2, 1, 1, 1, 0)	(1, 1, 0, 1)	(1, 1, 0, 1, 0)

Notes: The dependent variable in the long-run equations is the real per capita GDP. In the short-run specifications, the dependent variable is Δgdp_pc. We have omitted observations for those years close to World War I and II (i.e. from 1914 to 1918 and from 1943 to 1946) to avoid already known breaks. Robust standard errors in parentheses. ***, **, * indicate statistical significance respectively at 1%, 5% and 10% levels. The ARDL order is selected on the basis of the SBC. The relevant critical value bounds are obtained from Table case III (with unrestricted intercept and no trend) in Narayan (2005). They are 5.333 – 7.063 at 1% level, 3.710 – 5.018 at 5% level and 3.008 – 4.150 at 10% level (for 30 observations and 3 regressors). They are 4.768 – 6.670 at 1% level, 3.354 – 4.774 at 5% level and 2.752 – 3.994 at 10% level (for 30 observations and 4 regressors). They are 5.018 – 6.610 at 1% level, 3.548 – 4.803 at 5% level and 2.933 – 4.020 at 10% level (for 40 observations and 3 regressors). Equation (4a) includes unrestricted intercept and unrestricted trend, so critical values from table case V are: 5.376 – 7.092 at 1% level, 3.958 – 5.226 at 5% level and 3.334 – 4.438 at 10% level (for 40 observations and 4 regressors). ***denotes that the F-statistic falls above the 99% upper bound, **above the 95% upper bound, and *above the 90% upper bound. Dummy variables for some years are also included in each regression.

Table 8. ARDL capital expenditure components (1862-1969)

Variables	1862-1897 (1b)	1898-1950 (2b)	1951-1969 (3b)
	Long-run coefficients		
Const	-0.007 (0.255)	0.553 (0.334)	-0.455*** (0.832)
tot_exp	0.473*** (0.059)	0.206*** (0.051)	1.716*** (0.493)
cap_serv_exp	-0.025 (0.025)	0.126*** (0.039)	-0.295** (0.115)
cap_transf	0.008* (0.005)	0.055*** (0.020)	-0.538** (0.242)
Open	-0.161* (0.085)	-0.113 (0.068)	1.127*** (0.376)
	Short-run coefficients		
Const	-0.019*** (0.005)	0.008 (0.005)	0.004 (0.004)
Δgdp_p_{t-1}	1.303*** (0.292)	-0.148 (0.117)	0.935*** (0.070)
Δgdp_p_{t-3}	0.572*** (0.165)		
Δtot_exp_{t}			0.180** (0.048)
Δtot_exp_{t-1}	-0.302*** (0.029)	-0.081 (0.046)	
Δtot_exp_{t-2}	-0.103*** (0.020)		
$\Delta cap\_serv\_exp_{t-1}$	0.046*** (0.008)	0.041 (0.031)	0.053*** (0.011)
$\Delta cap\_serv\_exp_{t-2}$	0.009 (0.006)	-0.091*** (0.026)	
$\Delta cap\_serv\_exp_{t-3}$	0.014** (0.005)	0.098*** (0.016)	
$\Delta cap\_serv\_exp_{t-4}$	-0.019** (0.008)		
Δcap_transf_{t}			0.024** (0.009)
Δcap_transf_{t-1}	0.003** (0.001)	0.012* (0.006)	
$\Delta open_{t-1}$	0.105*** (0.010)	0.062 (0.040)	-0.042* (0.019)
$\Delta open_{t-2}$	0.046* (0.025)	-0.024 (0.037)	
ECM_{t-1}	-0.506*** (0.154)	0.215*** (0.069)	-0.295*** (0.061)
Obs	31	32	17
R2	0.96	0.85	0.96
Adj. R-sq	0.91	0.72	0.87
JB Test	1.356 (0.508)	1.142 (0.565)	1.418 (0.492)
Ser. Corr LM1	1.137 (0.286)	0.001 (0.979)	1.243 (0.265)
Ser. Corr LM2	4.045 (0.132)	0.548 (0.760)	1.759 (0.415)
Ramsey-Reset	0.001 (0.982)	1.606 (0.224)	0.954 (0.384)
Bound test	10.5478***	4.96038**	4.7611*
ARDL order	(4, 2, 4, 2, 3)	(1, 1, 3, 3, 2)	(1, 0, 1, 0, 1)

Notes: The dependent variable in the long-run equations, is the real per capita GDP. In the short-run specifications, the dependent variable is Δgdp_pc. Robust standard errors in parentheses. ***, **, * indicate statistical significance respectively at 1%, 5% and 10% levels. The ARDL order is selected on the basis of the SBC. Equation (1b) includes unrestricted intercept and unrestricted trend, so critical values from table case V in Narayan (2005) are: 5.856 – 7.578 at 1% level, 4.154 – 5.540 at 5% level and 3.430 – 4.624 at 10% level (for 30 observations and 4 regressors). The relevant critical value bounds for equations (2b) and (3b) are obtained from Table case III (with unrestricted intercept and no trend) in Narayan (2005). They are 4.768 – 6.670 at 1% level, 3.354 – 4.774 at 5% level and 2.752 – 3.994 at 10% level (for 30 observations and 4 regressors). ***denotes F-statistic falling above the 99% upper bound, **above the 95% upper bound, and *above the 90% upper bound. We delete observations in correspondence to the two world wars, namely: years from 1914 to 1918 and from 1943 to 1946.

Table 9. ARDL current expenditure components (1862-1969)

Variables	1862-1918		1953-1969	
	(1c)	(2c)	(3c)	(4c)
Long-run coefficients				
Const	-1.872***	-30.221***	-5.162*	-33.344
	(0.507)	(10.138)	(2.791)	(115.86)
tot_exp	-0.047	0.116	0.738*	0.762
	(0.092)	(0.123)	(0.368)	(0.428)
curr_exp	0.289*	14.262***	0.012	13.464
	(0.158)	(5.200)	(0.496)	(55.761)
curr_exp^2		-1.743**		-1.606
		(0.654)		(6.691)
Open	0.542***	0.532***	1.640***	1.626***
	(0.139)	(0.105)	(0.358)	(0.410)
Short-run coefficients				
Const	-0.021***	-0.012***	0.044***	0.042***
	(0.007)	(0.004)	(0.009)	(0.013)
Δgdp_p_{t-1}	0.015	0.121	0.153	0.245
	(0.066)	(0.078)	(0.193)	(0.230)
Δgdp_p_{t-2}	-0.196***	-0.075		
	(0067)	(0.076)		
Δgdp_p_{t-3}	-0.254***	-0.230***		
	(0.060)	(0.074)		
Δtot_exp_{t}				-0.055
				(0.022)
Δtot_exp_{t-1}	-0.087***	-0.078***	-0.001	
	(0.023)	(0.017)	(0.030)	
$\Delta curr\_exp_{t}$	-0.084***		-0.156*	2.105
	(0.024)		(0.071)	(3.870)
$\Delta curr\_exp_{t-1}$		0.441		
		(0.823)		
$\Delta curr\_exp\text{^}2_{t}$				-0.281
				(0.469)
$\Delta curr\_exp\text{^}2_{t-1}$		-0.066		
		(0.103)		
$\Delta open_{t}$		-0.001	0.186**	0.267***
		(0.024)	(0.068)	(0.071)
$\Delta open_{t-1}$	-0.021			
	(0.023)			
ECM_{t-1}	-0.197***	-0.133***	-0.162**	-0.143**
	(0.049)	(0.036)	(0.050)	(0.045)
Obs	48	47	15	15
R2	0.82	0.88	0.77	0.89
Adj. R-sq	0.76	0.83	0.46	0.69
JB Test	0.503 (0.778)	0.662 (0.718)	0.176	1.343 (0.511)
Ser. Corr LM1	1.925 (0.165)	0.424 (0.515)	1.324 (0.250)	0.002 (0.964)
Ser. Corr LM2	2.201 (0.333)	2.302 (0.316)	3.398 (0.183)	3.214 (0.200)
Ramsey-Reset	0.195 (0.662)	0.004 (0.951)	2.196 (0.199)	0.399 (0.562)
Bound test	13.5885***	4.5046*	12.9804***	9.1763***
ARDL order	(3, 2, 1, 1)	(3, 1, 1, 1, 0)	(1, 1, 0, 0)	(1, 0, 0, 0)

Notes: Table 9 above does not show the estimated results for the period 1919-1952 because over that period residuals from the long-run relationship were not stationary. It means that there is not long-run relationship among these variables. We delete observations in correspondence to the two world wars, namely: years from 1914 to 1918. Equations (1c) and (2c) include unrestricted intercept and unrestricted trend, so the critical values from table case V in Narayan (2005) are: 5.995 – 7.335 at 1% level, 4.368 – 5.545 at 5% level and 3.673 – 4.715 at 10% level (for 50 observations and 3 regressors). They are 5.184 – 6.684 at 1% level, 3.834 – 5.064 at 5% level and 3.240 – 4.350 at 10% level (for 50 observations and 4 regressors). The relevant critical value bounds for equations (3c) and (4c) are obtained from Table case III (with unrestricted intercept and no trend) in Narayan (2005). They are 5.333 – 7.063 at 1% level, 3.710 – 5.018 at 5% level and 3.008 – 4.150 at 10% level (for 30 observations and 3 regressors). They are 4.768 – 6.670 at 1% level, 3.354 – 4.774 at 5% level and 2.752 – 3.994 at 10% level (for 30 observations and 4 regressors). ***denotes F-statistic falling above the 99% upper bound, **above the 95% upper bound, and *above the 90% upper bound. Dummy variables for some years are also included in each regression.

Table 10. ARDL current expenditure components (1862-1969)

Variables	1862-1926	1953-1969
	Long-run coefficients	
	(1d)	**(2d)**
Const	-1.770*** (0.347)	-3.857 (3.582)
tot_exp	-0.015 (0.054)	0.670 (0.385)
curr_serv_exp	0.115 (0.073)	-0.427 (0.696)
curr_transf	0.267*** (0.031)	0.217 (0.289)
Open	0.516*** (0.094)	1.553*** (0.362)
	Short-run coefficients	
Const	-0.014*** (0.004)	0.047* (0.019)
Δgdp_p_{t-1}		0.150 (0.322)
Δgdp_p_{t-2}	0.072 (0.087)	
Δgdp_p_{t-3}	-0.475*** (0.083)	
Δtot_exp_{t}		0.253*** (0.068)
Δtot_exp_{t-1}	-0.047** (0.018)	
Δtot_exp_{t-2}	0.036* (0.013)	
Δtot_exp_{t-3}	0.110*** (0.024)	
$\Delta curr\_serv\_exp_{t}$		-0.146 (0.073)
$\Delta curr\_serv\_exp_{t-1}$	-0.092*** (0.020)	
$\Delta curr\_transf_{t}$	-0.020 (0.012)	
$\Delta curr\_transf_{t-1}$		-0.048 (0.037)
$\Delta open_{t-1}$		-0.157** (0.051)
ECM_{t-1}	-0.119*** (0.028)	-0.427** (0.101)
Obs	48	15
R2	0.77	0.88
Adj. R-sq	0.69	0.57
JB Test	0.584 (0.747)	0.346 (0.841)
Ser. Corr LM1	0.144 (0.705)	0.008 (0.929)
Ser. Corr LM2	2.168 (0.338)	0.068 (0.967)
Ramsey-Reset	0.400 (0.531)	0.015 (0.911)
Bound test	6.6458***	2879.211***
ARDL order	(3, 5, 1, 0, 0)	(1, 0, 0, 1, 1)

Notes: The dependent variable in the long-run equations, is the real per capita GDP. In the short-run specifications, the dependent variable is Δgdp_pc. Robust standard errors in parentheses. ***, **, * indicate statistical significance respectively at 1%, 5% and 10% levels. The ARDL order has been selected on the basis of the SBC. Table 10 does not show the estimated results for the period 1927-1952 because in that period the residuals from the long run relationship were not stationary. It means that there is not long-run relationship among our variables. Equations (1d) includes unrestricted intercept and unrestricted trend, so critical values from table case V in Narayan (2005) are: 4.306 – 5.874 at 1% level, 3.136 – 4.416 at 5% level and 2.614 – 3.746 at 10% level (for 50 observations and 4 regressors). The relevant critical value bounds for equation (2d) are obtained from Table CI(i) (with no intercept and no trend) in Pesaran *et al.* (2001) because they are not available in Narayan (2005). They are 3.07 – 4.44 at 1% level, 2.26 – 3.48 at 5% level and 1.90 – 3.01 at 10% level (4 regressors). ***denotes F-statistic falling above the 99% upper bound, **above the 95% upper bound, and *above the 90% upper bound. We delete observations in correspondence to the two world wars, namely: years from 1914 to 1918 and from 1943 to 1946.

Furthermore, this result is coherent with both theoretical expectations and the signs of short-run dynamics maintained in relation to the long-run. Apart from defence spending, all other components lost significance in the period starting from 1922 to 2007. Interestingly, defence spending turns to be negative and statistically significant in the long-run period 1951-1969. Devarajan *et al.* (1996) find public spending in defence negatively related to the per-capita growth for developing countries and statistically insignificant for developed countries. As for Italy, we attribute this effect to the substantial resources devoted to defence spending during World War II[23] so that an increase in this share was ultimately counterproductive.

The error correction term indicates the speed of the equilibrium restoring adjustment in the dynamic models. The ECM coefficient shows how variables return to equilibrium, thus having a negative and statistically significant impact. Bannerje *et al.* (1998) holds that a highly significant error correction term is further proof of the existence of a stable long-term relationship. All statistically significant error correction adjustment coefficients are negative, thus implying the convergence to the long-run equilibrium in each specification. Each table in this chapter also presents results for several post-estimation diagnostic tests.

[23] During the World War II expenditure on defence reached more than 50% of total spending.

Table 11. ARDL functional components (1862-1969)

Variables	1862-1921	1922-1950	1951-1969
	Long-run coefficients		
	(1e)	(2e)	(3e)
const	-0.477*** (0.169)	-1.042* (0.547)	2.407*** (0.693)
tot_exp	0.049 (0.035)	0.293*** (0.089)	-0.011 (0.128)
def_exp	0.079** (0.036)	0.107 (0.071)	-0.746*** (0.086)
econ_aff_exp	0.119** (0.046)	-0.074 (0.043)	-0.056 (0.040)
educ_exp	0.178*** (0.039)	0.380*** (0.062)	0.702*** (0.090)
health_exp	0.023*** (0.008)	0.029 (0.054)	-0.048 (0.065)
open	0.135*** (0.038)	0.181** (0.068)	-0.016 (0.130)
	Short-run coefficients		
const	-0.018*** (0.004)	-0.009* (0.005)	0.013 (0.019)
Δgdp_p_{t-1}	0.469*** (0.078)	0.866*** (0.197)	0.492 (0.327)
Δtot_exp_{t}		0.045 (0.117)	-0.441** (0.126)
Δtot_exp_{t-3}	0.086*** (0.018)		
Δdef_exp_{t}		0.219*** (0.056)	-0.386** (0.119)
Δdef_exp_{t-1}	-0.080*** (0.010)		
Δdef_exp_{t-2}	-0.047*** (0.013)		
$\Delta econ\_aff\_exp_{t-1}$		-0.150** (0.054)	0.118** (0.037)
$\Delta econ\_aff\_exp_{t-2}$	-0.037*** (0.009)		
$\Delta econ\_aff\_exp_{t-3}$	-0.041*** (0.011)		
$\Delta educ\_exp_{t}$		0.195** (0.065)	
$\Delta educ\_exp_{t-1}$	0.108*** (0.019)		0.151 (0.097)
$\Delta educ\_exp_{t-2}$	0.070** (0.023)		
$\Delta health\_exp_{t}$		-0.100 (0.067)	-0.013 (0.035)
$\Delta health\_exp_{t-1}$	-0.018*** (0.006)		
$\Delta health\_exp_{t-2}$	-0.023*** (0.007)		
$\Delta open_{t}$		0.151* (0.068)	-0.030 (0.032)
$\Delta open_{t-2}$	0.036* (0.018)		
$\Delta open_{t-4}$	0.040** (0.021)		
ECM_{t-1}	-0.329*** (0.081)	-1.584*** (0.223)	-0.344* (0.149)
Obs	46	21	17
R2	0.93	0.91	0.68
Adj. R-sq	0.87	0.75	0.13
JB Test	0.072 (0.965)	0.933 (0.627)	0.180 (0.914)
Ser. Corr LM1	2.222 (0.136)	0.008 (0.929)	0.082 (0.774)
Ser. Corr LM2	2.279 (0.256)	0.085 (0.958)	3.929 (0.140)
Ramsey-Reset	1.431 (0.243)	0.284 (0.613)	0.196 (0.676)
Bound test	6.3996***	4297.574***	269.0789***
ARDL order	(1, 4, 4, 4, 4, 3, 4)	(1, 0, 0, 1, 0, 0, 0)	(1, 0, 0, 1, 1, 0, 0)

Notes: The dependent variable in the long-run equations, is the real per capita GDP. In the short-run specifications, the dependent variable is Δgdp_pc. Robust standard errors in parentheses. ***, **, * indicate statistical significance respectively at 1%, 5% and 10% levels. The ARDL order on the bases of the SBC. Equation (1e) includes unrestricted intercept and unrestricted trend, so critical values from table case V in Narayan (2005) are: 4.310 – 5.881 at 1% level, 3.229 – 4.536 at 5% level and 2.750 – 3.944 at 10% level (for 50 observations and 6 regressors). The relevant critical value bounds for equations (2e) and (3e) are obtained from Table case III (with no intercept and no trend) in Narayan (2005). They are 4.270 – 6.211 at 1% level, 2.970 – 4.499 at 5% level and 2.457 – 3.797 at 10% level (with 30 observations and 6 regressors). ***denotes F-statistic falling above the 99% upper bound, **above the 95% upper bound, and *above the 90% upper bound. We delete observations in correspondence to the two world wars, namely: years from 1914 to 1918 and from 1943 to 1946.

7. Concluding Remarks

The main objective of this chapter has been to explore the relationship between government spending and economic growth in Italy from 1862 to 2007 by using Devarajan *et al.*'s (1996) and Ghosh and Gregoriou's (2008) extended version. This model can derive the conditions under which a change in the mix of public spending may lead to a higher steady-state growth rate for the economy. The conditions depend not only on the physical productivity of different components of public spending but also on the shares of government expenditure allocated to them. Our key explanatory fiscal variables are grouped into two main categories: economic and functional components. The former classification includes capital and current expenditures (and related sub-components), while the latter includes expenditures on defence, economic affairs, education and health care.

Given the size of our sample, we decided to segment it according to the following criteria. We took into account the oil crisis of the 1970s (which is a break also confirmed by the multiple breakpoint test). Moreover, we considered the availability of private capital series for the period 1970-2007 and separated this sample from the period 1862-1969. The main contribution of this analysis is the investigation of the series for unit root with structural breaks to ascertain the order of integration of them. We employed an ARDL approach in order to disentangle the effects of economic and functional components of public spending in the short- and long-run.

Overall, the effect of each fiscal variable differs according to the sub-sample under scrutiny. On the basis of the theoretical model used, our empirical results suggest that expenditures that are normally considered productive may become unproductive if an excessive amount of resources is devoted to them. As for Italy, this is the case of capital expenditure during the period 81970-2007, both in the short- and long-run. In particular, capital expenditure may have been excessive in Italy during last 40 years, thus rendering them unproductive at the margin. A more accurate analysis demonstrated that the negative effect of capital spending was essentially driven by capital transfers during the same period. On the other hand, current expenditure had an insignificant effect on economic growth in the short- and long-run. Among functional components, both defence and economic affairs had a significant effect (respectively, negative and both negative and positive) on economic growth in the short-run. In the long-run, only economic affairs expenditure maintained a significant and negative effect on real per-capita GDP. On an aggregate level, total government spending had a negative effect on economic growth in the short-run. Conversely, it had a positive effect in the long-run. In this light, we endogenously divided this sample by taking into account two structural breaks. We also estimated the same models without private capital for the sample period 1862-1969 by applying the ARDL technique. In general, the most significant results are from the first sub-samples because they show a greater number of observations. That said, the results of this study must be cautiously since the data are based on a historical reconstruction and they may not be perfectly homogeneous.

As for capital expenditure, during the period between the Italy's Unification and the end of the nineteenth century, the results obtained by our analysis reveal a positive no linear effect on economic growth in the short-run. Conversely, they show a positive effect in the long-run during World War I and II. This effect has been driven by the positive impact of both capital services and capital transfers expenditures. Current expenditure does not show significant effects on economic growth for the period 1862 to 1969. Among functional components, the co-integration analysis showed that the main driving force behind short- and long-run growth is spending on education, which includes human capital.

The lessons policy that can be learnt from these results is that Italy needs to facilitate private investment and put more emphasis on the productive components of government spending. This can be done by increasing health care and education spending as well as generally increasing the efficiency of expenditure on infrastructures and economic affairs. All in all, this study advocates the allocation of government spending so as to maintain existing infrastructures and social projects. Moreover, the government should carefully evaluate the possibility to take action and start new investment projects.

References

Acosta-Ormahcea, S. and Atsuyoshi, M. (2013) "Can a Government Enhance Long-Run Growth by Changing the Composition of Public Expenditure?" IMF Working Paper, 13/162, International Monetary Fund, Washington, DC.

Alexander, W. R. J. (1990) "Growth: Some Combined Cross-Sectional and Time-Series Evidence from OECD Countries", *Applied Economics*, 22, pp. 1197-1204.

Alshahrani, S. A., and Alsadiq, A. J. (2014) "Economic Growth and Government Spending in Saudi Arabia: An Empirical Investigation", International Monetary Fund (IMF) Working Paper, WP/14/3.

Andrews, D. W. K. (1993) "Tests for Parameter Instability and Structural Change With Unknown Change Point", *Econometrica*, 61, pp. 821-856.

Andrews, D. W. K. and Ploberger, W. (1994) "Optimal Tests When a Nuisance Parameter is Present Only Under the Alternative", *Econometrica*, 62, pp. 1383-1414.

Akpan, N. (2005) "Government Expenditure and Economic Growth in Nigeria: A Disaggregated Approach", *CBN Economic and Financial Review*, 43.

Arrow, K. J. and Kurz, M., (1970) "Public Investment, the Rate of Return and Optimal Fiscal Policy, (Johns Hopkins University, Baltimore, MD).

Baffigi, A. (2011), *Italian National Accounts (1861-2011)*, Banca d'Italia – Quaderni di Storia Economica, n. 18.

Bai, J. (1997a) "Estimation of a Change Point in Multiple Regression Models", *Review of Economics and Statistics*, 79, pp. 551-563.

Bai, J. (1997b) "Estimating Multiple Breaks one at a Time", *Econometric Theory*, 13, pp. 315-352.

Bai, J. and Perron, P. (1998) "Estimating and Testing Linear Models with Multiple Structural Changes", *Econometrica*, 66, pp. 47-78.

Bai, J. and Perron, P. (2003a) "Computation and Analysis of Multiple Structural Changes Models", *Journal of Applied Econometrics*, 18, pp. 1-22.

Bai, J. and Perron, P. (2003b) "Critical Values for Multiple Structural Changes Tests", *Econometric Journal,* 1, pp. 1-7.

Bai, J. and Perron, P. (2004) "Multiple Structural Changes Models: A Simulation Analysis", in Corbea, D. Durlauf, S., Hansen, B. E. (Eds.), *Econometric Essays*, Cambridge University Press.

Banerjee, A., Dolado, J. J. and Mestre, R. (1998) "Error-Correction Mechanism Tests for Cointegration in a Single-Equation Framework", *Journal of Time Series Analysis*, 19, pp. 267-283.

Barro, R. J., (1990) "Government Spending in a Simple Model of Endogenous Growth," *Journal of Political Economy*, 98, pp. s103-s25.

Barro, R. J. (1991) "Economic Growth in a Cross Section of Countries", The Quarterly Journal of Economics, CVI, pp. 407-443.

Barro, R. and Sala-i-Martin, X., (1992) "Public Finance in Models of Economic Growth", Review of Economic Studies, 59 (4), pp. 645-661.

Baum, C. F. (2005) “Stata: The Language of Choice for Time-Series Analysis?”, *The Stata Journal*, 5, pp. 46-63.

Bose, N., Haque, M.E., and Osborn, D.R. (2007) “Public Expenditure and Economic Growth: A Disaggregated Analysis for Developing Countries”, *The Manchester School*, 75, pp. 533-56.

Chow, G. C. (1960) “Test of Equality Between Sets of Coefficients in Two Linear Regressions”, *Econometrica*, 28, pp. 591-605.

Clemente, J., Montanés, A. and Reyes, M. (1998) “Testing for a Unit Root in Variables with a Double Change in the Mean”, *Economic Letters*, 59, pp. 175-182.

Clementi, F., Gallegati, M. And Gallegati, M. (2014) “Growth and Cycles of the Italian Economy Since 1861: The New Evidence”, *Italian Economic Journal*.

Colombier, C. (2008) “Government and Growth”, Group of Economic Advisors, *Swiss Federal Finance Administration*, Working Paper, No. 4.

Christiano, L. J. (1992) “Searching for a Break in GNP”, *Journal of Business and Economic Statistics*, 10, pp. 237-250.

Dalena, M. and Magazzino, C. (2012) “Public Expenditure and Revenue in Italy, 1862-1993”, *Economic Notes by Banca Monte dei Paschi di Siena S.p.A.*, 41, pp. 145-172.

Devarajan, S., Swaroop, V., and Zou, H. F., (1996) “The Composition of Public Expenditure and Economic Growth”, *Journal of Monetary Economics*, 37, pp. 313-44.

Dickey, D. A. and W. A. Fuller (1979) “Distribution of the Estimators for Autoregressive Time Series with a Unit Root”, *Journal of the American Statistical Association*, 74, pp. 427-431.

Dickey, D. A. and W. A. Fuller (1981) “Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root”, *Econometrica*, 49, pp. 1057-1072.

Easterly, W. and Rebelo, S., (1993) “Fiscal Policy and Economic Growth”, *Journal of Monetary Economics*, 32 (3), pp. 417-458.

Fölster, S. and Henrekson, M., (1999) “Growth and the Public Sector: A Critique of the Critics”, European *Journal of Political Economy*, 15, pp. 337-358.

Ghosh, S. and Gregoriou, A., (2008) “The Composition of Government Spending and Growth: is Current or Capital Spending Better?”, *Oxford Economic Papers*, 60, pp. 484-516.

Ghosh, S. and Gregoriou, A., (2007) “The Impact of Government Expenditures on Growth: Empirical evidence from an Heterogeneous Panel”, *Bulletin of Economic Research*, 61, pp. 95-102.

Glynn, J., Perera, N. and Verma, R. (2007) “Unit Root Tests and Structural Breaks: A survey with Applications”, *Revista de Methods Cuantitativos Para la Economia y la Empresa*, 3, pp. 63-79.

Greene, W. (2003) “Econometric Analysis” 3th ed. EnglewoodCliffs, N. J., Prentice Hall.

Grisorio, M. J. and Prota, F. (2015) “The Short and the Long Run Relationship between Fiscal Decentralization and Public Expenditure Composition in Italy”, Economics Letters, 130, pp. 113-116.

Gupta, S., Clements, B., Baldacci, E. and Mulas-Granados, C. (2005) “Fiscal Policy, Expenditure Composition, and Growth in Low-Income Countreis”, *Journal of Money and Finance*, 24, pp. 441-463.

Hartshorne, K. B. (1985) “Education and Development in the South African Context”, *Development Southern Africa*, 2.

Liu, J., Wu, S. and Zidek, J. V. (1997) “On Segmented Multivariate Regressions”, *Statistica Sinica*, 7, pp. 497-525.

Lumsdaine, R. and Papell, D. (1997) “Multiple Trend Breaks and the Unit Root Hypothesis, *Review of Economics and Statistics*, 79, pp. 212-218.

Johansen, S. and Juselius, K. (1990) “Maximum Likelihood Estimation and Inference on Cointegration with Applications to Money Demand”, *Oxford Bulletin of Economics and Statistics*, 52, pp. 169-210.

Johansen, S. (1988) “Statistical Analysis of Cointegration Vectors”, *Journal of Economic Dynamics and Control*, 12, pp. 231-254.

Johansen, S. (1992) “*Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*”, Oxford University Press, Oxford.

Johansen, S. (1995) “Cointegration in Partial Systems and the Efficiency of Single-Equation Analysis”, *Journal of Econometrics*, 52, pp. 389-402.

Landau, D. L., (1986) “Government and Economic Growth in the Less Developed Countries: An Empirical Study for 1960-1988”, *Economic Development and Cultural Change*, 35,pp. 35-75.

Landau, D. L., (1983) “Government Expenditure and Economic Growth: A Cross Country Study”, *Southern Economic Journal*, 49, pp. 783-792.

Lee, J. and Strazicich, M. C. (2003) “Minimum Lagrange Multiplier Unit Root Test with Two Structural Breaks”, *Review of Economics and Statistics*, 85, pp. 1082-1089.

Le Infrastrutture in Italia: dotazione, programmazione, realizzazione, Banca d’Italia, Workshops and Conderences, No. 7, April 2011.

Liu, C. HL., Hsu, C. and Younis, M. Z. (2008) “The Association Between Government Expenditure and economic Growth: The Granger Causality Test of the US Data, 1974-2002”, *Journal of Public Budgeting, Accounting and Financial Management*, 20, pp. 439-452.

Narayan, P. K. (2004a) “Reformulating Critical Values for the Bounds F-Statistics Approach to Cointegration: An Application to the Tourism Demand Model for Fiji”, Department of Economics Discussion Papers No. 02/04, Monash University, Melbourne, Australia.

Narayan, P. K. (2005) “The Saving and Investment Nexus for China: Evidence from Cointegration Tests”, *Applied Economics*, 37, pp. 1979-1990.

Niloy, B., and Emranul, M. H. and Denise, R. O. (2003) “Public Expenditure and Economic Growth: A Disaggregated Analysis for Developing Countries”, *JEL*, Publications.

Nurudeen, A. Usman, A. (2010) “Government Expenditure and economic Growth in Nigeria, 1970-2008: A Disaggregate Analysis”, *Business and Economics Journal*, 4.

Perman, R. and Byrne, J. P. (2006) “*Unit Roots and Structural Breaks: A Survey of the Literature*”, Department of Economics, University of Glasgow, Glasgow.

Perron, P. (1989) “The Great Crash, the Oil Price Stock and the Unit Root Hypothesis”, *Econometrica*, 57, pp. 1361-1401.

Perron, P. (1997) “Further Evidence on Breaking Trend Functions in Macroeconomic Variables”, *Journal of Econometrics*, 80, pp. 355-385.

Pesaran, H. M. and Pesaran, B. (1997) "Working with Microfit 4.0: Interactive Econometric Analysis" , *Oxford University Press*, Oxford.

Pesaran, H. M. and Shin, Y. (1999) "An *Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis*", in Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium, (Ed.) S. Storm, Cambridge University Press, Cambridge, pp. 1-33.

Pesaran, M. H., Shin, Y. and Smith, R. (2001) "Bound Testing Approaches to the Analysis of Level Relationships", *Journal of Applied Econometrics*, 16, 289-326.

Perron, P. and Vogelsand, T. J. (1992) "Nonstationarity and level Shifts with an Application to Purchasing Power Parity", *Journal of Business & Economic Statistics*, 10, pp. 301-320.

Quandt, R. E. (1960) "Tests of the Hypothesis that a Linear Regression Obeys Two Separate Regimes", *Journal of the American Statistical Association*, 55, pp. 324-330.

Ragioneria Generale dello Stato, *La Spesa dello Stato dall'Unità d'Italia: Anni 1862-2009*.

Ramirez, M. D. (2004) "Is Public Infrastructure Spending Productive in the Mexican case? A Vector Error Correction Analysis", *Journal of International Trade and Economic Development*, 13, pp. 159-178.

Romer, P. M. (1990) " Endogenous Technological Change", *Journal of Political Economy*, 98, pp. 71-102.

Singh, R. J. and Weber, R. (1997) "The Composition of Public Expenditure and Economic Growth: Can anything be learned from Swiss data?", *Swiss Journal of Economics and Statistics*, 33, pp. 617-634.

Solow, R. M. (1956) "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics*, 70, pp. 65-94.

Yao, Y. C. (1998) "Estimating the Number of Change-Points via Schwarz' Criterion", *Statistics and Probability Letters*, 6, pp.181-189.

Vogelsand, T. J. and Perron, P. (1998) "Additional Tests for a Unit Root allowing for a Break in the Trend Function at an Unknown Time", *International Economic Review*, pp. 1073-1100.

Zivot, E. and Andrews, D. W. K. (1992) "Further Evidence of the Great Crash, the Oil Price Shock and the Unit-Root Hypothesis", *Journal of Business and Economic Statistics*, 10, pp. 251-270.

Appendix 1 – Further Information on Variables

Definitions of the variables

The definitions of all variables used in this study are provided below. All the variables have been expressed in logarithms and converted in real terms by the GDP deflator (2005=100).

gdp_pc: per capita GDP (thousands of euros)

tot_exp: total government spending as share of GDP

cap_exp: capital government spending as share of total

curr_exp: current government spending as share of total

cap_serv_exp: capital services government spending as share of total

cap_transf: capital transfers government spending as share of total

curr_serv_exp: current services and personnel expenditures as share of total

curr_transf: current transfers government spending as share of total

defen_exp: government spending on defence as share of total

econ_aff_exp: government spending on economic affairs as share of total

educ_exp: government spending on education as share of total

health_exp: government spending on social activities as share of total

private_k: private capital, the ratio of real private capital and total real government spending

open: openness to trade, the ratio of sum of real exports and imports to the real GDP

Table A1. Descriptive statistics of variables involved in the analysis (1862-1969)

Variables	Mean	Standard deviation	Min	Max
gdp_pc	3.394	2.031	1.837	11.200
tot_exp	18.525	7.990	10.47	44.96
cap_exp	11.876	6.750	1.00	29.25
curr_exp	59.218	11.341	40.99	88.22
cap_serv_exp	4.911	2.573	0.53	11.94
cap_transf	6.965	6.063	0.08	23.64
curr_serv_exp	42.956	9.844	32.25	74.32
curr_transf	16.262	9.324	5.47	54.01
defen_exp	23.563	13.235	9.07	74.37
econ_aff_exp	19.059	6.110	4.21	35.39
educ_exp	5.483	4.894	1.12	19.14
health_exp	5.071	5.231	0.13	16.02
open_gdp	20.316	4.705	9.27	34.84

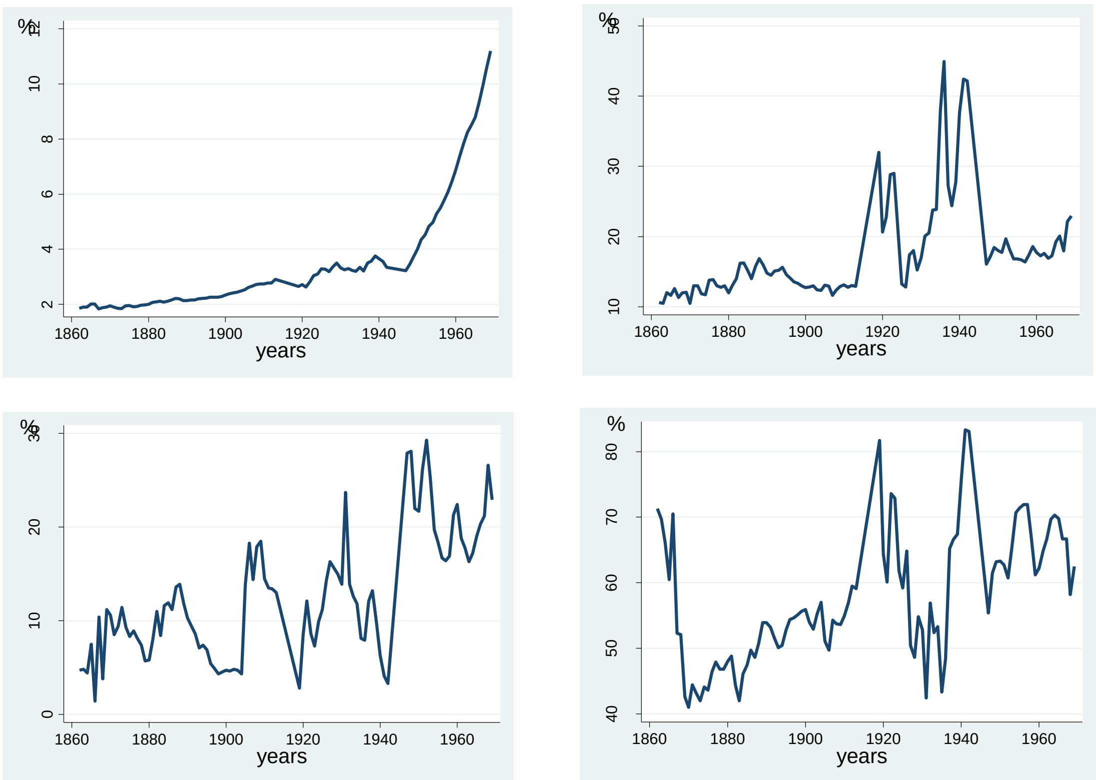
Notes: Statistics are based on series not expressed in logarithm form.

Table A2. Descriptive statistics of variables involved in the analysis (1970-2007)

Variables	Mean	Standard deviation	Min	Max
gdp_pc	19.144	4.267	11.815	25.243
tot_exp	40.149	9.646	20.79	51.38
cap_exp	13.041	5.028	6.14	24.00
curr_exp	51.549	9.205	35.95	70.19
cap_serv_exp	1.001	0.650	0.51	3.71
cap_transf	12.041	4.646	5.54	22.44
curr_serv_exp	20.451	6.355	13.77	36.78
curr_transf	31.099	5.049	19.48	42.74
defen_exp	4.136	2.099	2.1	9.94
econ_aff_exp	21.426	10.295	8.12	38.75
educ_exp	10.544	3.292	7.16	19.24
health_exp	17.751	4.074	11.82	29.06
private_k	1.205	0.300	0.910	1.940
open_gdp	36.053	5.379	25.7	47.49

Notes: Statistics are based on series not expressed in logarithm form.

Figure A1. Economic and Functional expenditure components (1862-1969)



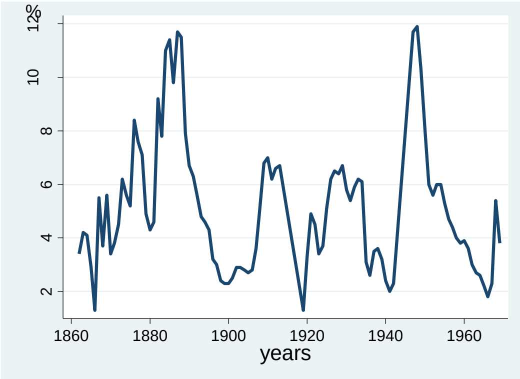
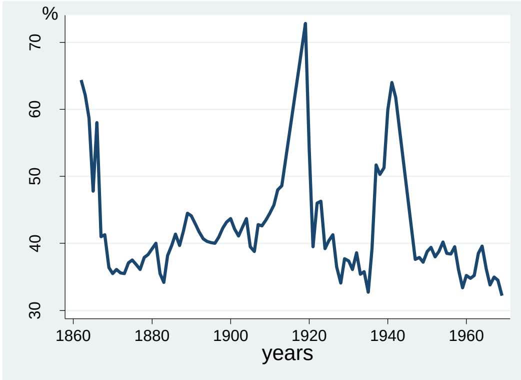
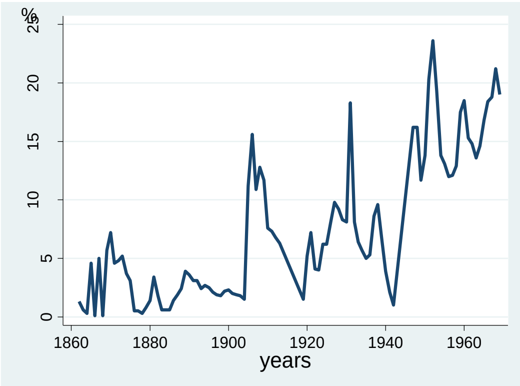
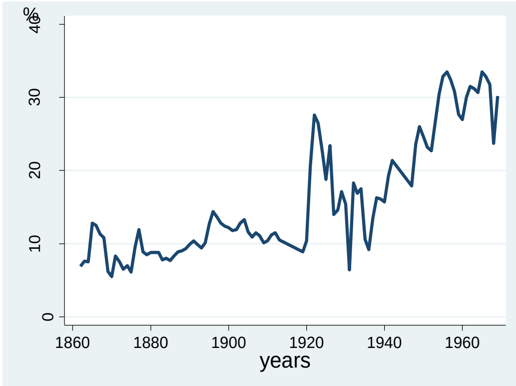
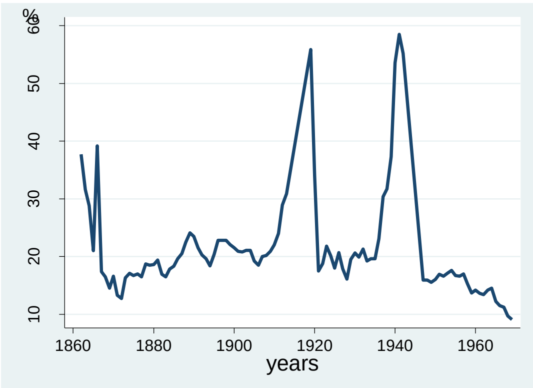
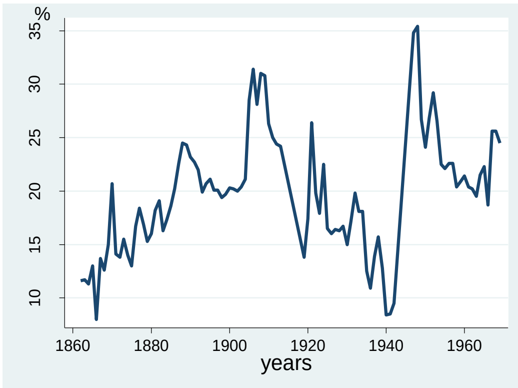
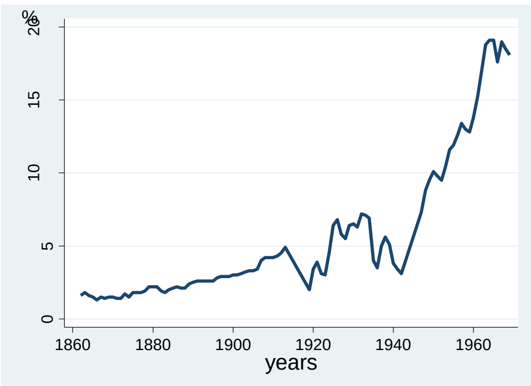
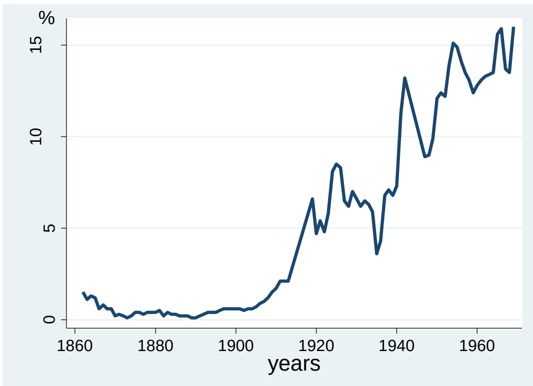
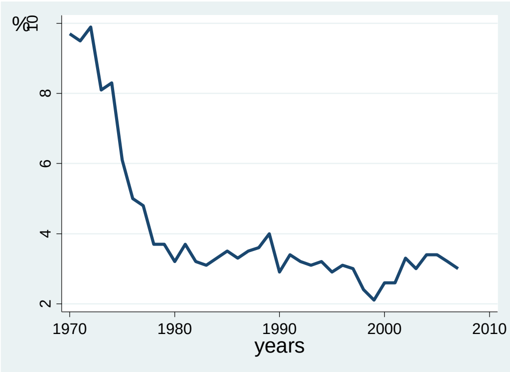
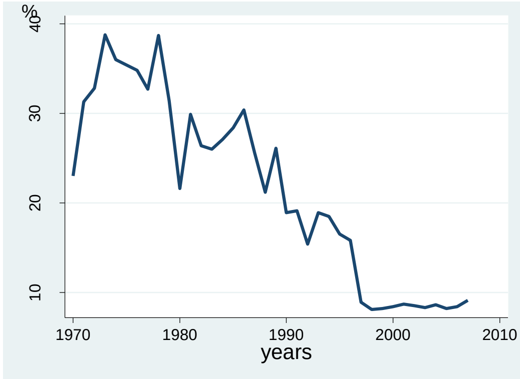
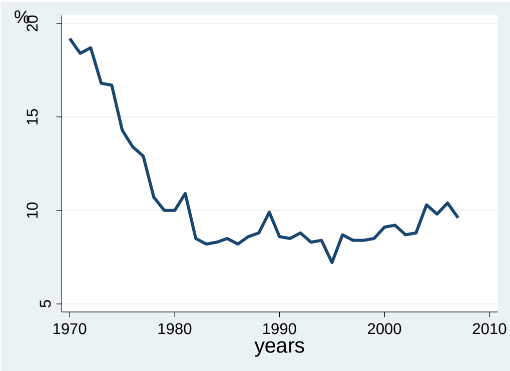
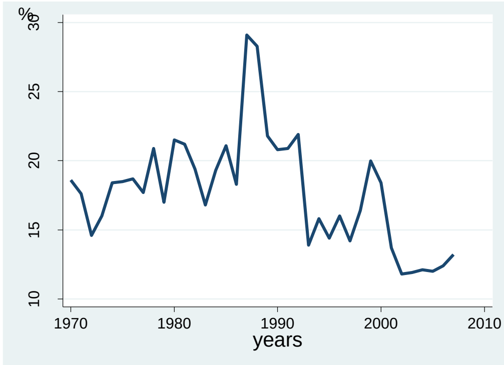

%
12
10
8
6
4
2
1860
1880
1900
1920
1940
1960
years

%
70
60
50
40
30
1860
1880
1900
1920
1940
1960
years

%
25
20
15
10
5
0
1860
1880
1900
1920
1940
1960
years

%
40
30
20
10
0
1860
1880
1900
1920
1940
1960
years

%
60
50
40
30
20
10
1860
1880
1900
1920
1940
1960
years

%
35
30
25
20
15
10
1860
1880
1900
1920
1940
1960
years

%
20
15
10
5
0
1860
1880
1900
1920
1940
1960
years

%
15
10
5
0
1860
1880
1900
1920
1940
1960
years

Figure A2. Economic and Functional expenditure components (1970-2007)









Unit Root Tests

Table A3. Unit Root Tests (1862-2007)

Variables	ADF		PP	
	Level	First Difference	Level	First Difference
gdp_pc	-1.847600	-7.876961***	-1.557297	-7.657295***
tot_exp	-2.963293	-9.689738***	-3.140807	-9.134906***
cap_exp	-3.503649**	-14.20430***	-4.238182***	-16.02742***
curr_exp	-3.100122	-10.20637***	-3.152249*	-12.71576***
cap_serv_exp	-3.373604*	-10.62233***	-3.205166*	-10.71358***
cap_transf	-3.715175**	-9.294539***	-6.621785***	
curr_serv_exp	-2.067533	-11.76771***	-2.243830	-11.76537***
curr_transf	-5.027205***		-4.942673***	
def_exp	-1.779233	-11.32473***	-1.992467	-11.45300***
econ_aff_exp	-3.385575*	-10.50136***	-2.879624	-11.58290***
educ_exp	-2.515558	-8.438854***	-2.400324	-7.705078***
health_exp	-2.619550	-12.29436***	-2.587602	-12.29436***
open	-1.035303	-13.23646***	-0.667490	-13.41806***

Notes: This author's elaboration based on the entire 1862-2007 sample.
***,**,* implied significance is respectively at the 1%, 5% and 10% level. The lag length for the ADF test has been selected using the Schwarz Bayesian Information Criterion (SBIC). Under the null hypothesis the series has a unit root, while under the alternative the series is stationary.

Table A4. Clemente-Montañés-Reyes's Unit Root Tests with Two Structural Breaks

1862-2007						
	Additive Outliers (AO)			**Innovational Outliers (IO)**		
Variables	**t-stat**	**TB1**	**TB2**	**t-stat**	**TB1**	**TB2**
gdp_pc	-2.341	1952***	1969***	-9.219**	1942***	1944***
tot_exp	-4.492	1911***	1979***	-6.224**	1912***	1976***
cap_exp	-4.753	1929	1942**	-5.687**	1916	1943***
curr_exp	-2.244	1933***	1972***	-5.082	1934***	1973***
cap_serv_exp	-3.169	1968***	1979***	-4.175	1887**	1967***
cap_transf	-3.194	1906***	1942***	-6.347**	1903***	1943***
curr_serv_exp	-4.316	1946***	1979***	-4.694	1942**	1973***
curr_transf	-3.139	1918***	1941***	-6.801**	1919***	1942***
def_exp	-3.656	1948***	1977***	-3.979	1942***	1971***
econ_aff_exp	-3.081	1914***	1948***	-3.985	1912*	1943*
educ_exp	-1.966	1927***	1949***	-5.179	1916***	1943***
health_exp	-4.479	1898***	1920***	-5.622**	1889***	1915***

Notes: This author's elaboration based on the entire 1862-2007 sample. TB1 and TB2 denote the structural break dates suggested by the tests. The t-stat value is the minimum calculated t-statistics. 5% critical value for both breaks: -5.490. Under the null hypothesis the series has a unit root with two structural breaks, while under the alternative the series is stationary with two structural breaks. For TB ***,**,* implied significance is respectively at the 1%, 5% and 10% level.

Table A5. Clemente-Montañés-Reyes's Unit Root Tests with One Structural Break

1862-2007				
	Additive Outliers (AO)		**Innovational Outliers (IO)**	
Variable	**t-stat**	**TB**	**t-stat**	**TB**
gdp_pc	-2.743	1964***	-6.113**	1944***
tot_exp	-2.985	1979***	-2.433	1912**
cap_exp	-3.895**	1915***	-5.437**	1943***
curr_exp	-2.473	1985***	-2.664	1934
cap_serv_exp	-4.614**	1974***	-3.747	1967***
cap_transf	-3.830**	1942***	-4.515**	1943***
curr_serv_exp	-4.025**	1979***	-4.171	1971***
curr_transf	-3.160	1939***	-3.491	1939***
def_exp	-3.663**	1970***	-2.908	1963***
econ_aff_exp	-1.475	1984***	-3.634	1943
educ_exp	-2.325	1927***	-3.749	1943***
health_exp	-4.384**	1914***	-3.893	1915***

Notes: This author's elaboration based on the entire 1862-2007 sample. TB denotes the structural break date suggested by the tests. Critical levels at 5% are respectively: -3.560 for the AO model and -4.270 for the IO model. Under the null hypothesis the series has a unit root with one structural break, while under the alternative the series is stationary with a single structural break. For TB ***,**,* implied significance is respectively at the 1%, 5% and 10% level.

Table A6. Zivot and Andrews's Unit Root Tests with One Structural Break

1862-2007			
Variable	**TB**	**K**	**t-stat**
gdp_pc	1953	2	-3.203
tot_exp	1945	2	-4.255
cap_exp	1945	2	-6.305***
curr_exp	1937	0	-5.030**
cap_serv_exp	1945	3	-4.450
cap_transf	1945	2	-6.035***
curr_serv_exp	1936	0	-4.447
curr_transf	1941	2	-5.459**
def_exp	1936	2	-4.570
econ_aff_exp	1971	1	-4.983
educ_exp	1945	3	-4.211
health_exp	1917	0	-5.471**

Notes: This author's elaboration based on the entire 1862-2007 sample. The critical values are respectively at 1% and 5% are -5.58 and -5.08. The null of the Zivot and Andrews test is unit root (without break) while, under the alternative, the series is stationary (with one break).

Table A7. Unit Root Tests (1862-1969)

Variables	ADF				PP			
	Intercept and trend		Intercept only		Intercept and trend		Intercept only	
	Level	First Diff	Level	First Diff	Level	First Diff	Level	First Diff
gdp_pc	-1.01	-6.80***	1.03	-6.51***	-0.34	-6.43***	1.75	-6.38***
tot_exp	-2.72	-8.70***	-2.30	-8.74***	-2.97	-7.67***	-2.53	-7.54***
cap_exp	-3.44*	-11.9***	-2.99**	-12.0***	-4.11***		-3.57***	
curr_exp	-3.87**	-8.86***	-2.88*	-8.88***	-3.91**	-10.7***	-2.98**	-10.74***
cap_serv_exp	-3.89**	-6.49***	-3.85***		-3.55**	-8.86***	-3.55***	
cap_transf	-3.77**	-18.16***	-2.61*	-18.25***	-6.50***		-4.28***	
curr_serv_exp	-3.23*	-7.51***	-3.21**	-7.55***	-3.38*	-9.50***	-3.39**	-9.55***
curr_transf	-4.92***		-2.50	-9.76***	-4.94***		-2.50	-14.69***
0def_exp	-2.31	-9.21***	-2.28	-9.24***	-2.71	-9.35***	-2.68*	-9.38***
econ_aff_exp	-4.20***		-4.14***		-3.28*	-10.10***	-3.23**	-10.18***
educ_exp	-3.05	-7.64***	-0.85	-7.66***	-2.84	-7.43***	-0.46	-6.76***
health_exp	-3.49**	-10.41***	-0.57	-10.40***	-3.50**	-10.41***	-0.56	-10.40***
open	-1.58	-11.42***	-1.56	-11.47***	-1.30	-11.72***	-1.29	-11.77***

Notes: This author's elaboration based on the entire 1862-1969 sample.
***,**,* implied significance is respectively at the 1%, 5% and 10% level. The lag length for the ADF test has been selected by using the Schwarz Bayesian Information Criterion (SBIC).

Table A8. ADF and PP Unit Root Tests (1970-2007)

Variables	ADF				PP			
	Intercept and trend		Intercept only		Intercept and trend		Intercept only	
	Level	First Diff	Level	First Diff	Level	First Diff	Level	First Diff
gdp_pc	-1.34	-5.25***	-3.05**	-5.31***	-0.81	-6.79***	-3.93***	
tot_exp	-1.28	-8.71***	-2.31	-7.61***	-1.28	-8.71***	-2.45	-7.46***
cap_exp	-5.45***		-0.80	-9.55***	-5.42***		-1.09	-24.84***
curr_exp	-2.18	-6.71***	-1.81	-7.00***	-2.26	-6.76***	-1.74	-7.02***
cap_serv_exp	-2.40	-8.92***	-3.50**	-7.86***	-2.27	-11.32***	-3.83***	
cap_transf	-5.278***		-0.63	-9.59***	-5.25***		-0.89	-19.23***
curr_serv_exp	-2.01	-8.09***	-1.94	-7.62***	-1.79	-8.20***	-2.00	-7.55***
curr_transf	-2.49	-6.49***	-2.28	-6.58***	-2.49	-6.60***	-2.28	-6.71***
def_exp	-1.93	-7.95***	-2.52	-7.25***	-1.80	-7.95***	-2.63*	-7.12***
econ_aff_exp	-3.72**	-7.27***	-0.53	-7.37***	-3.72**	-7.37***	-0.42	-7.48***
educ_exp	-1.65	-8.19***	-2.63*	-7.09***	-1.38	-11.00***	-2.98**	-7.06***
health_exp	-2.72	-7.18***	-2.17	-7.24***	-2.68	-10.72***	-2.17	-8.70***
private_k	-1.24	-8.61***	-2.11	-7.55***	-0.97	-8.79***	-2.11	-7.36***
open	-2.02	-6.06***	-1.78	-6.14***	-2.04	-6.06***	-1.78	-6.14***

Notes: This author's elaboration based on the entire 1970-2007 sample.
***,**,* implied significance is respectively at the 1%, 5%, and 10% level. The lag length for the ADF test has been selected by using the Schwarz Bayesian Information Criterion (SBIC).

Table A9. Clemente-Montañés-Reyes's Unit Root Tests with Two Structural Breaks

1862-1969						
	Additive Outliers (AO)			Innovational Outliers (IO)		
Variables	**t-stat**	**TB1**	**TB2**	**t-stat**	**TB1**	**TB2**
gdp_pc	-2.698	1907***	1950***	-3.489	1902	1944***
tot_exp	-2.684	1916***	1921***	-5.301	1912***	1944***
cap_exp	-4.732	1929	1942***	-6.411**	1916	1943***
curr_exp	-1.618	1913***	1933	-6.111**	1908***	1934
cap_serv_exp	-4.207	1894***	1947	-4.408	1891*	1943
cap_transf	-3.148	1906***	1942***	-5.868**	1903***	1943***
curr_serv_exp	-2.431	1911***	1922***	-5.474	1912***	1918***
curr_transf	-2.777	1918***	1942***	-6.018**	1919***	1943***
def_exp	-1.315	1913***	1922***	-3.248	1912***	1918***
econ_aff_exp	-4.635	1914***	1948***	-5.729**	1912***	1943***
educ_exp	-1.739	1927***	1949***	-3.641	1922**	1943***
health_exp	-4.438	1901***	1919***	-5.207	1893***	1915***

Notes: This author's elaboration based on the entire 1862-1969 sample. TB1 and TB2 denote the structural break dates suggested by the tests. t-stat value is the minimum calculated t-statistics. 5% critical value for both breaks: -5.490. Under the null hypothesis the series has a unit root with two structural breaks, while under the alternative the series is stationary with two structural breaks. For TB ***,**,* implied significance is respectively at the 1%, 5% and 10% level.

Table A10. Clemente-Montañés-Reyes's Unit Root Tests with One Structural Break

1862-1969				
	Additive Outliers (AO)		Innovational Outliers (IO)	
Variable	t-stat	TB	t-stat	TB
gdp_pc	-1.437	1952***	-3.221	1944***
tot_exp	-3.935**	1911***	-5.438**	1912***
cap_exp	-4.621**	1942***	-6.034**	1943***
curr_exp	-5.098**	1908***	-4.506**	1934***
cap_serv_exp	-4.221**	1915**	-2.607	1943
cap_transf	-4.415**	1942***	-4.290**	1943***
curr_serv_exp	-3.454	1946***	-3.722	1942**
curr_transf	-2.586	1939***	-2.737	1919***
def_exp	-3.697**	1950***	-3.674	1942***
econ_aff_exp	-3.707**	1914	-4.916**	1943**
educ_exp	-2.048	1949***	-1.589	1922*
health_exp	-3.965**	1914***	-3.094	1915***

Notes: This author's elaboration based on the entire 1862-1969 sample. TB denotes the structural break date suggested by the tests. Critical levels at 5% are respectively: -3.560 for the AO model and -4.270 for the IO model. Under the null hypothesis the series has a unit root with one structural break, while under the alternative the series is stationary with a single structural break. For TB ***,**,* implied significance is respectively at the 1%, 5% and 10% level.

Table A11. Clemente-Montañés-Reyes's Unit Root Tests with Two Structural Breaks

1970-2007						
	Additive Outliers (AO)			Innovational Outliers (IO)		
Variables	t-stat	TB1	TB2	t-stat	TB1	TB2
gdp_pc	-2.791	1985***	1995***	-2.549	1983*	1993
tot_exp	-4.265	1979***	1999	-3.594	1977	1980*
cap_exp	-3.431	1987***	1995***	-0.933	1977	1988
curr_exp	-3.058	1980***	1992***	-4.480	1981	1991***
cap_serv_exp	-3.869	1979***	1989	-4.255	1976**	1981
cap_transf	-2.737	1987***	1997***	-0.129	1977	1988
curr_serv_exp	-3.521	1979***	1995***	-3.034	1976	1993
curr_transf	-2.041	1985	1992***	-3.769	1982	1991***
def_exp	-2.891	1987***	1997	-2.255	1988	1996
econ_aff_exp	-2.304	1987***	1994***	-6.005	1986***	1995***
educ_exp	-3.900	1979***	1993	-3.520	1976*	1980
health_exp	-1.742	1986***	1990***	-0.320	1985	1991***
private_k	-3.480	1979***	1988*	-3.464	1977***	1996
open	-2.984	1985	1996***	-0.710	1984***	1993***

Notes: This author's elaboration based on the entire 1970-2007 sample. TB1 and TB2 denote the structural break dates suggested by the tests. t-stat value is the minimum calculated t-statistics. 5% critical value for both breaks: -5.490. Under the null hypothesis the series has a unit root with two structural breaks, while under the alternative, the series is stationary with two structural breaks. For TB ***,**,* implied significance is respectively at the 1%, 5% and 10% level.

Table A12. Clemente-Montañés-Reyes's Unit Root Tests with <u>One</u> Structural Break

1970-2007				
	Additive Outliers (AO)		**Innovational Outliers (IO)**	
Variable	**t-stat**	**TB**	**t-stat**	**TB**
gdp_pc	-2.335	1990***	-1.989	1999
tot_exp	-4.482**	1977***	-4.049	1976***
cap_exp	-3.420	1992***	-0.933	1988
curr_exp	-2.668	1992***	-3.506	1991***
cap_serv_exp	-4.008**	1979***	-4.207	1976***
cap_transf	-3.486	1992***	-0.129	1988
curr_serv_exp	-2.811	1979***	-3.034	1993
curr_transf	-1.548	1990***	-3.266	1991**
def_exp	-4.020**	1976***	-2.316	1996
econ_aff_exp	-3.118	1993***	-2.725	1995**
educ_exp	-3.784**	1976***	-3.530	1976**
health_exp	-3.436	1998***	-0.054	1991***
private_k	-0.010	1976***	-2.218	1977
open	-2.752	1996***	-2.611	1998*

Notes: This author's elaboration based on the entire 1970-2007 sample. TB denotes the structural break date suggested by the tests. Critical levels at 5% are respectively: -3.560 for the AO model and -4.270 for the IO model. Under the null hypothesis the series has a unit root with one structural break, while under the alternative the series is stationary with a single structural break. For TB ***,**,* implied significance is respectively at the 1%, 5% and 10% level.

Appendix 2 – Robustness Check Estimations

Table A13. Long –run coefficients for Economic Classification (1970-2007 without private capital)

Variables	**Economic Classification**					
	Long-run coefficients					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
const	2.604*** (0.669)	2.765*** (0.870)	3.499*** (0.920)	-	7.817** (3.175)	-
tot_exp	0.318*** (0.065)	0.251** (0.122)	0.398*** (0.071)	-	-0.237 (0.395)	-
cap_exp	-0.384*** (0.065)		-1.255** (0.533)			
cap_exp_serv		-0.074 (0.057)				
cap_transf		-0.359*** (0.062)				
cap_exp^2			0.181 (0.107)			
curr_exp				-		-
curr_exp_serv					-1.077** (0.464)	
curr_transf					-0.034 (0.134)	
curr_exp^2						-
open	0.033 (0.105)	0.028 (0.109)	-0.015 (0.100)	-	-0.197 (0.251)	-

Notes: The dependent variable is the real per capita GDP, gdp_pc. Robust standard errors in parentheses. ***, **, * indicate statistical significance respectively at 1%, 5% and 10% levels. This table does not show estimated coefficients for current expenditure because residuals are not stationary.

Table A14. Short –run Coefficients for Economic Classification based on the ARDL model (without private capital)

Variables	Economic Classification					
	Short-run coefficients					
	(1)	(2)	(3)	(4)	(5)	(6)
const	0.009** (0.003)	0.006* (0.003)	0.011*** (0.003)	-	0.012*** (0.004)	-
Δgdp_p_{t-1}	0.472*** (0.126)	0.458*** (0.109)	0.571*** (0.129)	-	0.436*** (0.130)	-
Δgdp_p_{t-2}		0.190** (0.068)				
Δtot_exp_{t}	-0.007 (0.025)	-0.003 (0.015)	-0.009 (0.018)			
Δtot_exp_{t-1}					-0.007 (0.018)	
$\Delta cap\_exp\_tot_{t-1}$	-0.056*** (0.008)		0.242*** (0.053)			
$\Delta curr\_exp\_tot_{t-1}$				-		-
$\Delta cap\_serv\_exp_{t-1}$		-0.011 (0.009)				
Δcap_transf_{t}		-0.044*** (0.010)				
Δcap_transf_{t-1}		0.009 (0.014)				
Δcap_transf_{t-2}		0.016 (0.013)				
Δcap_transf_{t-3}		0.017* (0.009)				
$\Delta curr\_serv\_exp_{t}$					0.007 (0.025)	
$\Delta curr\_transf_{t}$					0.009 (0.010)	
$\Delta cap\_exp\_tot\text{^}2_{t-1}$			-0.043*** (0.010)			
$\Delta cap\_exp\_tot\text{^}2_{t-2}$			0.004 (0.003)			
$\Delta cap\_exp\_tot\text{^}2_{t-3}$			0.005* (0.002)			
$\Delta curr\_exp\_tot\text{^}2_{t-1}$						-
$\Delta open_{t}$	0.032 (0.033)	0.039 (0.029)	0.060 (0.036)		0.060 (0.037)	
$\Delta open_{t-1}$	-0.044* (0.025)	-0.026 (0.031)			-0.021 (0.023)	
ECM_{t-1}	-0.098*** (0.029)	-0.101*** (0.026)	-0.062** (0.028)		-0.039** (0.014)	
Obs	36	34	34	-	36	-
R-sq	0.86	0.89	0.89		0.88	
Adj. R-sq	0.80	0.82	0.80		0.79	
JB Test	0.387 (0.824)	1.849 (0.397)	0.274 (0.872)		0.904 (0.636)	
Ser. Corr LM1	0.679 (0.410)	0.730 (0.393)	3.005 (0.083)		0.674 (0.412)	
Ser. Corr LM2	0.738 (0.691)	0.911 (0.634)	3.039 (0.219)		1.436 (0.488)	
Ramsey-Reset	0.898 (0.353)	1.552 (0.229)	1.834 (0.507)		0.508 (0.485)	
Bound test	5.1297***	4.0702*	7.5039***	--	6.1676***	-
ARDL order	(1, 0, 0, 1)	(2, 0, 1, 3, 1)	(1, 0, 1, 3, 0)		(1, 1, 0, 0, 1)	

Notes: The dependent variable is Δgdp_pc. Robust standard errors in parentheses. ***, **, * indicate statistical significance respectively at 1%, 5% and 10% levels. The ARDL order is selected on the basis of SBC. The relevant critical value bounds for equations (1), (3) and (5) are obtained from Table CI(i) (with no intercept and no trend) in Pesaran *et al.* (2001) because they are not available in Narayan (2005). They are 3.42 – 4.84 at 1% level, 2.45 – 3.63 at 5% level and 2.01 – 3.10 at 10% level (3 regressors). They are 3.07 – 4.44 at 1% level, 2.26 – 3.48 at 5% level and 1.90 – 3.01 at 10% level (4 regressors). The relevant critical value bounds for equation (2) are obtained from Table case III (with unrestricted intercept and no trend) in Narayan (2005). They are 4.590 – 6.368 at 1% level, 3.276 – 4.630 at 5% level, 2.696 – 3.898 at 10% level (for 35 observations and 4 regressors). ***denotes F-statistic falling above the 99% upper bound, **above the 95% upper bound, and *above the 90% upper bound. This table does not show estimated coefficients of current expenditure in equations (4) and (6) because residuals are not stationary.

Table A15. Long –run coefficients for Functional Classification (1970-2007 without private capital)

Variables	Functional Classification				
	Long-run coefficients				
	(7)	(8)	(9)	(10)	(11)
const	2.291*	-	1.723***	-3.961*	0.940*
	(1.692)		(0.623)	(1.984)	(0.551)
tot_exp	0.240	-	0.405***	1.142***	0.648***
	(0.247)		(0.077)	(0.272)	(0.064)
def_exp	0.131	-			
	(0.100)				
econ_aff_exp	-0.251***		-0.226***		
	(0.061)		(0.041)		
educ_exp	-0.332**			0.596*	
	(0.146)			(0.337)	
health_exp	-0.015				-0.315***
	(0.063)				(0.086)
open	0.139	-	0.108	0.372**	0.144
	(0.140)		(0.116)	(0.161)	(0.143)

Notes: The dependent variable is the real per capita GDP, gdp_pc. Robust standard errors in parentheses. ***, **, * indicate statistical significance respectively at 1%, 5% and 10% levels. This table does not show estimated coefficients for defence in equation (8) because residuals are not stationary.

Table A16. Short –run Coefficients for Functional Classification based on the ARDL model (without private capital)

Variables	Functional Classification Short-run coefficients (7)	(8)	(9)	(10)	(11)
const	0.020*** (0.003)	-	0.013*** (0.003)	0.011*** (0.004)	0.006 (0.004)
Δgdp_p_{t-1}	0.149 (0.122)	-	0.379*** (0.079)	0.294** (0.112)	0.470*** (0.085)
Δgdp_p_{t-2}					0.320*** (0.079)
Δgdp_p_{t-3}					0.052 (0.081)
Δgdp_p_{t-4}					-0.147 (0.093)
Δtot_exp_{t}	-0.001 (0.015)			0.007 (0.019)	
Δtot_exp_{t-1}			-0.001 (0.013)		0.013 (0.025)
Δdef_exp_{t-1}	-0.067*** (0.020)	-			
Δdef_exp_{t-2}	-0.082*** (0.018)	-			
$\Delta econ\_aff\_exp_{t}$	-0.035*** (0.007)				
$\Delta econ\_aff\_exp_{t-1}$	0.030*** (0.009)	-	0.016** (0.007)		
$\Delta econ\_aff\_exp_{t-2}$	0.053*** (0.013)				
$\Delta educ\_exp_{t}$				0.014 (0.020)	
$\Delta educ\_exp_{t-1}$	0.099** (0.045)				
$\Delta educ\_exp_{t-2}$	0.104*** (0.027)				
$\Delta health\_exp_{t}$					
$\Delta health\_exp_{t-1}$	0.030 (0.011)				0.019 (0.014)
$\Delta open_{t}$	0.028 (0.019)	-	0.053 (0.032)	0.107*** (0.026)	0.114** (0.048)
$\Delta open_{t-3}$	-0.103*** (0.015)	-			
ECM_{t-1}	-0.104*** (0.032)	-	-0.047*** (0.015)	-0.037** (0.011)	-0.054*** (0.012)
Obs	34	-	36	36	33
R-sq	0.94	-	0.91	0.89	0.86
Adj. R-sq	0.85		0.84	0.83	0.77
JB Test	1.853 (0.396)		0.963 (0.618)	0.206 (0.902)	0.118 (0.943)
Ser. Corr LM1	1.635 (0.201)		0.064 (0.800)	2.007 (0.157)	0.777 (0.378)
Ser. Corr LM2	2.483 (0.289)		1.906 (0.386)	2.300 (0.317)	0.969 (0.616)
Ramsey-Reset	0.966 (0.345)		0.187 (0.671)	2.839 (0.107)	0.109 (0.745)
Bound test	8.6326***	-	14.3276***	8.1715***	4.9678**
ARDL order	(1, 0, 2, 3, 2, 1, 3)		(1, 1, 1, 0)	(1, 0, 0, 1)	(4, 1, 1, 0)

Notes: The dependent variable is Δgdp_pc. Robust standard errors in parentheses. ***, **, * indicate statistical significance respectively at 1%, 5% and 10% levels. The ARDL order is selected on the basis of SBC. The relevant critical value bounds for equations (7), (9), (10) are obtained from Table CI(i) (with no intercept and no trend) in Pesaran *et al.* (2001) because they are not available in Narayan (2005). They are 3.42 – 4.84 at 1% level, 2.45 – 3.63 at 5% level and 2.01 – 3.10 at 10% level (3 regressors). They are 2.54 -3.91 at 1% level, 1.97 – 3.18 at 5% level and 1.70 – 2.83 at 10% level (7 regressors). The relevant critical value bounds for equation (11) are obtained from Table case III (with unrestricted intercept and no trend) in Narayan (2005). They are 5.198 – 6.845 at 1% level, 3.615 – 4.913 at 5% level and 2.958 – 4.100 at 10% level (for 35 observations and 3 regressors). ***denotes F-statistic falling above the 99% upper bound, **above the 95% upper bound, and *above the 90% upper bound. This table does not show estimated coefficients of defence expenditure in equation (8) because residuals are not stationary.[24]