Optimal Government Size and Economic Growth in France (1871-2008): An Explanation by the State and Market Failures[1]

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Abstract: This paper analyses the effect of public expenditure on economic growth from both a theoretical and an empirical point of view. Given that the economic literature supplies numerous and conflicting views on the topic, the article offers a framework combining both theories of market failures and State failures to account for an inverted U-shaped relation between government size and GDP growth. The empirical contribution is to provide evidence through a long time-series analysis of the existence of such a relation on the period 1871-2008 for France, which offers one of the longest stable democratic periods to analyse.

Key words: Public Spending, Public Expenditure, Government Size, BARS Curve, Armey Curve, Economic Growth, Market Failure, State failure, France.

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1. Introduction

The relation between public expenditure and economic growth has traditionally been a topic of considerable interest for economists and more recently for political leaders. Indeed, the topic is currently of burning importance especially in the United States and European Union because most countries have been confronted with an increasing public debt and a drop in their economic growth since 2007. Faced with the crisis, governments, like the American Congress, chose to support economic activity with reflationary policies *i.e.* public spending, thus increasing public deficit and public debt. This choice seems to have been justified by the Keynesian paradigm, based on a virtuous cycle of public spending through the multiplier effect. As a result, for instance in France in 2010, the total public spending represented 56.60%[2] of the French GDP and the ratio of public debt to GDP is expected to be 91%[3] in 2013. Thus the economic policies in France and in most other OECD countries seem to have marked, at least in the crisis's first stages, the "comeback" of the golden rules of the Keynesian policy (Keynes 1936; Barrère 1983; Creel et al. 2005).

Nevertheless the actual effect of public spending on economic growth is both theoretically and empirically debated. Traditionally, the theory of market failures has justified State interventionism while the theory of State failures has rather insisted on the possible harmful effect of the State's activity and expansion. The theoretical debate has given rise to a plethoric empirical literature and contradictory findings (Nijkamp and 2004) concerning the effect of government size, defined as the public expenditure as a share of total GDP, on economic growth. The relationship was initially studied in the framework of a linear model through a Cobb Douglas production function first developed by Feder (1982) and adapted by Ram (1986) (Dalamagas 2000, p.278). According to the area and the period studied, these studies and the following ones found opposite clear-cut effects, either positive or negative. But, in the wake of Grossman (1987, 1988), the empirical literature investigated the possibility of a non-linear relationship, assuming that government size has a positive effect on growth but only to a certain extent. Similarly to the Laffer curve, this literature emphasized the existence of an inverted U-shaped curve between government size and GDP growth, sometimes called the Armey Curve (Armey et al. 1995), the Rahn Curve (Rahn 1999) or also the "BARS curve" referring to Barro (1989), Armey et al. (1995), Rahn (1996) and Scully (1994). The top of the

[2] Public debt corresponds to the whole public loans contracted by all public administrations. It encloses State debt, local community debt and social administrations' debt (social security).
[3] Source: INSEE.

curve would supply the “optimal” government size in the sense of the size that maximizes GDP growth.

Therefore, the debate shifted from the sign of the relation between government size and growth (either positive or negative) to the determination of the optimal government size. In the latter perspective, we tackle two main questions. First, how can we theoretically explain a non linear relationship between State size and economic growth? Second, is there a single State size that would maximize growth for all countries or a diversity of optimal sizes, depending on national and institutional determinants (Mueller 2003, p.546)? Concerning the first question, the literature on the Armey Curve suffers from a theoretical lack since no work provides a comprehensive explanation of the inverted U relationship between government size and economic growth. Most often, to justify the existence of an optimal State size, they merely refer to the theory of market failures that would clearly define the State’s prerogatives (natural monopoly, externalities…). As far as governments stick to their prerogatives, State size would be efficient, but beyond it, it would turn to be harmful for economic growth. However this explanation of government size optimality cannot properly account for the existence of State failures *per se*, which makes public intervention costly even within the frame of its prerogatives. That led us to propose a theoretical explanation of the Armey curve and State optimality applying the remediableness criterion (Williamson 2005), thus combining the costs (State failures) and the benefits (from correcting market failures) of public spending.

Concerning the second question related to the diversity of the Armey curves, the latest empirical studies did not allow to provide a clear answer. They did not supply comparable results, mainly due to the fact that their observation periods widely diverged. While the studies on US, mainly on relative long periods, found an optimal size of around 20% (Grossman 1987, 1988; Peden 1991; Carlstrom et al. 1991; Scully 1994; Vedder et al 1998), the studies over other countries and especially European countries focused on very recent periods and established optimal rates closer to 30% (Chao and Gruber 1998; Afonso et al. 2003; Pevcin 2004; Davis 2009; Forte and Magazzino 2010). These seemingly contrasting findings can hardly be compared because of too different observation periods. Indeed, the optimal rate seems to depend on the observation period and that is all the more true that the observation period is short (Mavrov 2007, p.59). Therefore it turns out to be necessary to have studies on long periods over other countries than US to know if their optimal State sizes, if

they exist, converge towards similar rates or if national disparities exist. The French case appeared to be much relevant for such a study because it provided one of the longest stable democratic periods to analyze, since the establishment of the Third republic in 1870.

The main contribution of the present article is to provide a framework, through an accurate analysis of the existing literature and an articulation of the theories of State and market failures, for a better understanding of the inverted U-shape relationship between government size and GDP growth. This framework enables to account for the diversity of the optimal State sizes that would depend on both the market cultures and State (in)efficiency of the countries. The thesis of a diversity of the Armey curves is also supported by our empirical findings. Indeed, we first found robust evidence of the existence of a non-linear relationship between government activity and economic performance in France on one of the longest periods studied within this literature, 1871-2008. Then we empirically determine that the optimal State size on this period was 34% as a share of GDP, that is to say, much higher than the optimal level found in comparable long-time series studies on US.

The rest of the article is structured as follows. Section 2 explores the literature on the impact of public expenditure on economic performance. Section 3 develops a theoretical framework by articulating the theories of market failures and State failures to account for the existence of an inverted U-shaped relationship between government activity and GDP growth. Section 4 provides empirical findings of the existence of such a relationship in France over long periods (1871-2008). Section 5 concludes.

2. Empirical literature

The issue of the effect of government activity on economic outcomes has given rise to a plethoric empirical literature. The studies took many forms, testing the effect of total public expenditure or in a specific field (defense, education, infrastructure…), (marginal) tax rates or public debt on different economic outcomes such as GDP or GNP growth, total factor productivity or unemployment. Nijkamp and Poot (2004) provide a rather comprehensive meta-analysis of 93 studies performed until 1998 on the effects of total and specific public expenditure and tax rates on economic growth. They conclude that if the positive influence of public spending in education and public infrastructure is confirmed, it is much more difficult to reach an agreement on the effect of fiscal policy and total public spending as a percentage of the GDP. We propose here to focus on the effect of the latter kind of studies by providing a

thorough analysis of the 41 articles of the meta-analysis dealing only with the effect of government size and by completing it with 23 extra studies on the topic, most often published after 1998 (Table 1 and 2). For a better understanding of the contradictory effects of government size on economic outcomes according to the different studies, we propose an in-depth analysis of the periods and the panels of countries considered in each study. We also suggest to examine more deeply the form of the estimated model (linear or non-linear). Indeed, Nijkamp and Poot (2004) merely provided the sign (positive, negative or inconclusive) of the relationship without specifying the form of the equation that is tested. Thus, they could classify a study as inconclusive when it provided no evidence of a linear relationship but a strong non-linear relationship between government size and economic growth, as for Grossman (1987). Therefore, in our analysis, we add a fourth possible effect besides positive, negative and inconclusive, which is a non-linear one, which would describe an inverted U-shaped curve.

Among the 64 studies of our sample, the huge majority, namely 47, tested only a linear relationship between government size and growth (table 1), while 17 tested a non-linear model (table 2). As we can see in table 1 that presents the results of the former kind of studies, 64% (30) of them found a negative effect of government size, while only 11% (5) found the opposite effect and 25% (12) were inconclusive. This convergence towards a negative influence of government size becomes even more obvious when considering the studies, whether in cross-section or in time-series, which focused on developed, OECD countries. In fact 70% (19) of the studies upheld a negative effect, while only 7% (2) established a positive effect and 23% (6) found no relationship. The negative effect seems to be slightly less prominent for developing countries and in the studies that gather both kinds of countries. Indeed, concerning the developing countries, we list 60% (6) of the sample articles showing a negative effect, 20% (2) a negative one and 20% (2) an inconclusive effect. Likewise the cross-countries studies that focus on both developing and developed countries provided evidence of a negative effect in 50% (5) of the cases and a positive one in 10% (1) and no effect in 40% (4) of the articles. From these raw statistics, we can first suppose that the effects of a same government size slightly differ according to the development of the countries considered.

insert Table 1 here

As all the 64 studies focused on a relatively recent period, namely the second half of the 20th century, except Ahmed (1986) whose observation period is 1908-1980. Thus we can assume that this apparent negative effect is valid only for this recent period. As this period corresponds to relatively high scope of government size, especially for the developed countries, we can also assume that this seemingly negative effect is true for relatively high share of public expenditure in national income. It is exactly what the small literature on the optimal size of government tends to show. We collected 17 papers estimating a non-linear relationship between government activity and its performance (table 2). According to the studies, the optimal size of government can vary from around 20% to 40% of GDP. The bulk of these studies are on the United-States and they tend to converge towards a 20% ratio (Grossman 1987, 1988; Peden 1991; Carlstrom et al. 1991; Scully 1994; Vedder et al 1998). Regarding other countries, the studies found most often higher optimal sizes such as 27% for Canada (Chao and Gruber 1998), 35% for 23 OECD countries (Afonso et al 2003), 40% in low-income countries (Davis 2009), around 40% for European countries (Forte and Magazzino 2010, p.1[4]; Pevcin 2004, p.10[5]) and especially between 40% (Forte and Magazzino 2010, p.23) and 43% (Pevcin 2004, p.10) for France.

These studies tend to comfort the global negative effect of government size in the second half of the 20th century, found in the "linear-relationship studies". Indeed, most of the countries would be on the downward sloping portion of their inverted U-shaped curves during this period. This effect would be all the more negative as the study is on rich, OECD countries because they would have a lower optimal size. Table 2 also shows that the different studies on as specific country converge more or less toward similar but not identical optimal sizes. Even though the optimal sizes provided by the various studies can hardly be compared because of significant methodological differences, such as the models to assess and the observation periods, table 2 supplies us with a second indication. There would be a diversity of Armey curves specific to each country. However neither the inverted U curve, nor the diversity of the curves is theoretically justified in the literature. That is what we propose in the next section.

insert Table 2 here

[4] Forte and Magazzino (2010, p.23) found a 37% average optimal State size for Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and UK.
[5] Pevcin (2004) found a 36-43% optimal government size for 8 EU countries: Italy, France, Finland, Sweden, Germany, Ireland, Netherlands, and Belgium.

3. An Approach of the Optimal Government Size based on the State and Market Failures

The inverted-U relationship between government activity and GDP Growth neither suggest that "all government is bad", nor that "all government is good". Government can have a positive influence on economic growth until a certain scope and beyond it, it can become harmful. Thus, an optimal size of government would exist (figure 1, G*).

insert figure 1 here

Formally, the inverted-U relationship between public spending and economic growth can be represented as follows:

$$GDP\ GROWTH = a + b\,G - c\,G^2, \text{ with } b \text{ and } c > 0 \qquad (1)$$

GDP GROWTH represents the real gross domestic product and *G* the size of government. The positive sign on the *G* term shows the beneficial effects of government spending on output (Vedder and Gallaway 1998, p.4). It refers to the positive effect from correcting market failures. On the contrary, the negative coefficient associated with the G^2 term measures the adverse effects of an increase in government size. Beyond the optimal state size, *G**, the squared term (cG^2) increases in value faster than the linear term (bG). In other words, a low level of public expenditure as share of GDP has a positive effect on economic growth, while high rates of public expenditure have a negative effect.

Traditionally, the inverted-U relationship between government size and economic growth is explained by the combination of the theories of State and market failures (Grosman 1988, p.195, Vedder and Gallaway 1998, p.2) that account for both the positive and negative effects of government activity. The positive effect of public spending is explained by the benefits from correcting market failure (Coase 1960, p.16; Arrow 1970, p.69; Cullis and Jones 1987; Williamson 2005; Hillman 2009, pp.16-23) (Table 3). The negative effect is explained by the costs inherent to State failure (Wolf 1979, 1988; Krueger 1990; Le Grand 1991; Evangelopoulos 2007; Brady et al. 1995; Boettke et al. 2007; Munger 2008). Our first contribution to the theory of inverted-U shaped relationship is to show that the Armey Curve or BARS Curve is the combination of two curves related to the market and the states failures (Figure 2, MF and SF curves).

Insert Table 3

The *MF curve* describes the positive effect of public spending with a decreasing marginal productivity (Figure 2). The positive effect of public spending is the gains associated with the correction of market failures. The law of diminishing returns explains its slope. The slope is also explained by the fact that when there is no more market, there are no longer market failures. This double effect explains the shape of the curve of the benefits from correcting the market failures. Therefore public spending has a positive impact on economic growth, but with a decreasing marginal effect. The benefits from correcting market failures explain the rising phase of the Armey curve.

The theory of market failures is a theory of the optimal size and structure of public spending because, like in the Adam Smith's minimal State (Smith 1737/1937, Book, IV, Chapter X, p.651), the theory of public goods, externalities, natural monopoly and asymmetric information, precisely gives the natures and the qualities of public goods that should be provided to achieve the first best optimum, that is to say the optimal allocations of scarce resources. Thus why not to stick to this explanation of the optimal size and why is the Armey Curve not always increasing? The answer is to be found on the side of the two definitions of the concept of State failure.

The SF curve describes the negative effect of public spending with an increasing marginal effect (Figure 2). The theory of State failure explains both the non optimality of government size and the negative effect of public spending on GDP growth rate. We can first speak about State failures when the public choice resulting from the democratic process does not manage to optimally correct market failures, on the one hand, because the preferences of the median voter are different from the optimal level and, on the other hand, because of the existence of complex agency relationship between voters, politicians and bureaucrats (Imai 2009; Downs 1960; Hillman 2009, p.84-89, Table 1).

There are also State failures *per se*, since, as Williamson and a part of the public choice theory put it, the benefits and the costs of every public choice should always be compared according to the remediableness criterion (Williamson 2005). The costs of public spending come from crowding-out effect (Bastiat 1983, p.93), effects of tax on market transaction costs, activities

of rent seeking (Hillman 2009, pp.84-100), political transaction costs (Dixit 1998) and bureaucratic additional costs (Dunleavy 1991; Sarte 2001; Ayal and Karras 1996). The political transaction costs describe the displacement costs, for instance, of one euro in private safety to public education. One euro in public education is desirable because it enhances welfare and the productivity of inputs (positive externality). Nevertheless, under certain conditions, the gains from displacements may not compensate its costs i.e. the political transaction costs. Government cannot spend money without extracting money from someone. There exists political transaction costs because political contracts are rarely between two clearly identifiable contractors; they have multiple parties (voters or lobbyists) and contract can rarely be as efficient as on market (Dixit 1998, pp.48-49). Political transaction costs are the cost of organizing a pressure group, lobbying, contributing to campaign, seeking votes and paying bribes (Benson 1984, p.390). Political exchange like voluntary exchange is costly. In addition to these two costs from correcting market failures, there is a relative inefficiency. Therefore the costs of public spending describe the declining part of the Armey curve.

However the fact that the costs of public spending on economic growth increase at an increasing rate is more original in view of the related literature (Figure 2, SF curve). We supply here four reasons to explain the slope of the SF curve (Figure 2).

-1- The Crowding-out effect increases more than proportionally with the size of government, because Welfare State affects the entrepreneurs' productive activity by increasing its opportunity cost (Lippman and al. 2005, p.23).

-2- There is also a systemic crowding-out effect. Market prices solve the knowledge-dispersal problem. They transmit already known information and contribute to the process of the formation of opinion (Hayek 1949, pp. 96-106; Kirzner 1984, p.204). Then competition in market process is a discovery procedure. The inefficiency of market is not always a problem, because entrepreneurs perceive in the inefficiencies the opportunities to rearrange the pattern of input utilization or output consumption and to correct their expectation errors (Kirzner 1978, 1985, p.138) i.e. the opportunities for pure entrepreneurial profit. Public spending to correct market failures deprives the members of solutions that market process would have discovered. We can speak about a systemic crowding-out effect because it can reduce both economic knowledge available on the market and the number of participants.

-3- 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 scare. The pro-education groups or the pro-safety ones spend more to obtain the marginal euro.

-4- The bureaucratic wastes rise more than proportionally with the size of government. It results from systemic crowding-out effect since the tax replaces the price. There is no economic calculation. Nobody knows the value of goods and services. The structure of expenditure has no economic justification but is only based on political reasons.

So the U-inverted curve is the total effect of public spending, i.e. the combination of the benefits from correcting market failures (Figure 2, *Curve MF*) and the costs of State failure (Figure 2, *Curve SF*). Figure 2 summarizes our theoretical justification of the non-linear relationship between economic growth and government scope.

insert figure 2 here

Before G*, the marginal benefits from correcting market failure are higher than the marginal costs. In a world without government, the level of public spending is nil and the GDP growth rate would be Y_a (Figure 2). GDP growth rate is not necessarily nil. In some cases, anarchy could be sustainable (Friedman 1989; Stringham 2005; Leeson 2007). When the State emerges, the monopoly of violence creates both social peace and a risk of legal predation (North, Wallis and Weingast 2005, p.10). In a world without any government, output per capita is low because there is no rule of law (North and Thomas 1973; Cowen 1992). Anarchy is the order of violence in which everyone can steal the assets of weaker persons with impunity. In this world, there is little incentive to save and to invest in productive activities. The skills move towards unproductive activities because the threat of predation is credible and constant. Without government, "*predatory groups will impose themselves on people by force and create government to extract income and wealth*" (Holcombe 2004, p.326). Without a government monopoly over the use of violence, competing groups can cooperate and collude to exercise coercion, giving birth to a collusive anarchy (Cowen 1992, p.261). Public spending appears here and has a positive effect on economic growth. The theory of market

failure and more generally of anarchy failure (Cowen 1992) explains why between 0 and *G**, public spending has a positive effect at an increasing rate (Figure 2, C).

Beyond G*, 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 remained at G*, the growth rate of GDP is maximized. So the Armey curve theory is both positive and normative. It also supplies governments with an accurate size if they want to reach the highest production possibility frontier.

Finally our decomposition of the Armey curve can be presented as a synthesis of the whole theoretical works on the effects of public expenditure on growth and more generally on the consequences of public intervention. This decomposition also enables us to provide some possible explanations of the diversity of the Armey Curves, *via* the shapes of the benefits (*MF curve*) and costs curves (*SF curve*). Each country has its market and State cultures. The public spending costs vary according to the level of bureaucratic inefficiency, the willingness to pay tax and the institutions *via* their consequences on the level of political transaction costs. Inversely, the more market price works, the lower the benefits from correcting its failures.

4. Empirical evidence of the optimal government size in France (1871-2008)

4.1 Economic growth and government size in France: an historical background

In the empirical section, we try to determine the nature of the relationship between government size and GDP growth in France since 1871. The French case is particularly interesting because, since the establishment of the Third Republic in 1870 and the Constituent Assembly election one year later, France adopted a stable republican regime, except for WWII, with a relatively high permanence of its political institutions. Therefore it offers a long period relevant for a time-series analysis. Since 1871, the French GDP growth presented numerous variations (see figure 3) marked by production long cycles and the different wars, against Prussia (1870-1871), World War 1 and World War 2 (table 4) (See the endnote for more information on the French growth)[i].

insert Figure 3 here

insert Table 3 here

During the same period, the government followed a general upward trend from 1871 to 2008 except a brief decrease between 1917 and 1930 (see figure 4 and table 5). A closer look enables us to confirm Florio and Colautti (2005, p.379) who observed that the French government size followed an S-shaped curve over the whole period (figure 4). But while they found that the stabilisation period occurred during the 1970s, our data shows that public expenditure as a share of GDP has remained stable since only the early 1990s. In spite of this recent period of stabilisation, France has one of the highest ratio of expenditure over national income among the OECD countries (55.8% in 2009). The ratio stood at around 15% in the first decade of the 19th century. In the early 1990s, public spending represented more than the half of the national wealth produced in a year (Figure 4).

insert Figure 4 here

insert Table 5 here

The main driver of this increase has been the rapid growth in social protection spending (*Social Security*) due to structural factors, especially population ageing: this latter trend is expected to continue, looking to 2050 (Beynet and Naerhuysen 2007, p.1). The debt service charge has also increased in line with the rise of public debt. Operating expenses have remained stable as a percentage of GDP (Beynet and Naerhuysen 2007, p.2).

The point is now to estimate the relationship between government size and economic growth. The raw data yields a first look into this question. Indeed, by performing a basic regression of the average growth rate by decade on the average size of the government by decade from 1930, when public spending started to steadily increase, we can observe a inverted U curve with an optimal size located between 35% and 40% (Figure 5). However, this insight could be entirely spurious.

insert Figure 5 here

4.2 Empirical strategy and test

4.2.1 Data. This first stylised fact needs a deeper examination through an appropriate econometric approach. We chose to assess an alternative model between the traditional one of a Cobb Douglas production function and the basic model of the empirical literature on the Armey Curve. The former presents the advantage of being comprehensive but considers only a linear relationship and includes variables that can depend on government activity such as capital or labour investments. Moreover it is said to present important limitations (Bairam 1990, p. 1427; Chobanov and Mladenova 2009; Hill 2008). The latter, while allowing to assess a non-linear relationship, is suspiciously free from control variables. That is why we went for a quadratic model with the standard variables of the literature on the effect of public expenditure.

In our model, the dependant variable is the annual French GDP (*GDP_FR*) provided by Maddison's website[6]. The main dependant variable is the size of government (*GSIZE*), expressed by the share of total public expenditure (Central State, social protection and local public authorities) as a share of total GDP. This variable was built by linking the series of Bourguignon and Levy-Leboyer (1985) and André and Delorme (1983, 1993). The possibility of exogenous chock is taken into account with the external growth that is approximated in our case by the annual GDP of 11 European traditional trade partners (*GDP_EU*) stemming from Maddison's website[7]. As a complement, we add a traditional explicative variable of the literature on the growth-expenditure relationship (Bairam 1990; Dalamagas 2000), which is the degree of openness of the economy (*OPEN*) that corresponds to the share of the exportation plus the importation as a percentage of total GDP, coming from Asselain and Blancheton (2005). We also consider the national level of employment (*EMPLOY*) supposed to control for economic cycles, according to Grossman (1987) and Vedder and Gallaway (1998) who control for unemployment rate. This variable, stemming from Bourlies et al. (2010), measures the average number of workers per year in France. We also include in our model a variable measuring the level of total tax rate (*TAX*), available on Piketty's website[8], enabling to look at the effect on growth of a change in expenditure holding taxes constant. Finally, we include a standard variable measuring the French total population (*POP*), coming

[6] Maddison's website (http://www.ggdc.net/MADDISON/oriindex.htm): Historical Statistics of the World Economy: 1-2008 AD- Table 2: GDP levels-France GDP in million 1990 International Geary-Khamis dollars

[7] Maddison's website (http://www.ggdc.net/MADDISON/oriindex.htm): Historical Statistics of the World Economy: 1-2008 AD- Table 2: GDP levels-GDP Total 11 Western Europe (Austria, Belgium, Denmark, Finland, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, United-Kingdom), million 1990 International Geary-Khamis dollars.

[8] Piketty's website (http://piketty.pse.ens.fr/fichiers/public/Grasset2001/Livre/TabChap1.xls)

from Maddison's website[9]. The presentation of the variables is given in appendix with tables A.1 (definition and source), A.2 (descriptive statistics) and A.3 (correlation matrix) in appendix.

In a first step, we estimate with an OLS method a linear model through the following equation by excluding two periods, [1914-1919] and [1939-1946], which correspond to the war periods and for which the data on public expenditure are not available. This model is given by equation (2). Then, to test an inverted U-shaped relationship between government size and GDP growth, we estimate a quadratic model represented by equation (3), by adding the squared variable of government size into equation (2):

$$Ln(GDP\_FR_t) = C + a_1\, Ln(GSIZE_t) + a_2\, Ln(GDP\_EU_t) + a_3\, Ln(OPEN_t) + a_4\, Ln(EMPLOY_t) + a_5\, Ln(TAX_t) + a_6\, Ln(POP_t) + \varepsilon_t \quad (2)$$

$$Ln(GDP\_FR_t) = C + \alpha_1\, Ln(GSIZE_t) + \alpha_2\, Ln(GSIZE_t)^2 + \alpha_3\, Ln(GDP\_EU_t) + \alpha_4\, Ln(OPEN_t) + \alpha_5\, Ln(EMPLOY_t) + \alpha_6\, Ln(TAX_t) + \alpha_7\, Ln(POP_t) + \varepsilon_t \quad (3)$$

With *GDP_FR* representing the French annual GDP, *GSIZE* the annual size of government, *GDP_EU* the European annual GDP, *OPEN* the annual degree of openness of the national economy, *EMPLOY* the annual level of total employment, *TAX* the average annual level of tax rate, *POP* the total population, ε an error term, *C* a constant.

4.2.2 Preliminary Tests. As we deal with macroeconomic variables over time, the possibility of spurious regression results due to common trends or nonstationarity of the data arises. First, supposing that all the variables are I(1), we first tested for cointegration between *Ln(GDP_FR), Ln(GSIZE) and Ln(GSIZE)²*, by regressing the former on the latters. But the residuals of this regression did not turn out be stationary, what indicates the absence of a long-term relationship. Then, we make sure of the stationarity of our series and, in case of non-

[9] Maddison's website (http://www.ggdc.net/MADDISON/oriindex.htm): Historical Statistics of the World Economy: 1-2008 AD- Table 1.

stationarity, remove the deterministic component from the series. After having implemented Augmented Dickey-Fuller and Phillips-Perron unit root tests on the logarithm of our variables, we found that all of them are integrated of order 1, I(1) except *Ln(GSIZE)* that is I(0). Therefore we took in the following regressions the first differences of our variables except the latter.

Secondly we accounted for the possibility that public expenditure takes time to translate into economic growth rates when using the lag structure. We included separately in the baseline regression the lagged variables of *GSIZE* and we kept the lag length that minimizes the Akaike's Information Criterion, which turned out to be the *t-1* lagged variable. Moreover, t-tests require normality of the error terms. If normality does not hold, the t-distribution does not apply. Therefore, all the following regressions include annual dummies to control for the outliers and to allow to pass the Jarque-Bera test. In table 5, 6 and 7, we report the Jarque-Bera test statistics and p-values for the residuals series. Finally, a Box-Pierce test is also systematically performed to make sure of the absence of serious auto-correlation of the error terms. For indication, we also report the Durbin-Watson (DW) test statistics in the tables.

4.2.3 Causality. Although we use the lagged variable of government size, we do not totally get rid of the difficulty inherent to the literature on the expenditure-growth relation, to identify the sense of the causality. It is supposed to be especially the case of cross-section analyses because of "*pooled estimates of the effects of government size on economic growth*" (Ghali 1999). Indeed, a significant coefficient can be interpreted as causality from economic growth to government size, according to the Wagner's Law that supposes that as a society becomes more developed, the proportion of public spending to total output tends to rise. However, in our case, after having performed Granger Causality tests, we found a clear one-way effect from our variable of government size to GDP growth. Indeed, the tests show that we cannot reject the hypothesis that "GDP Growth does not Granger cause Government Size" while we can reject the hypothesis according to which "Government Size does not Granger cause GDP Growth"[10].

4.3 Results

[10] The test shows that we cannot reject the hypothesis that "GDP Growth does not Granger cause Government Size" (F-stat = 0.39) while we can reject the hypothesis according to which "Government Size does not Granger cause GDP Growth" (F-stat' = 1.95). When increasing the lag length, for instance with 8 lags, the causality becomes even more obvious with (F-stat = 1.36; F-stat' = 3.97).

In a first battery of tests, we estimate with an OLS method a linear relationship between French growth and government size, namely equation (2). The results are given in table 6. We estimate this relation in two steps: by first adding the control variables related to the European growth and the economy openness, available on the whole period 1871-2008, and then by including the other variables concerning the level of employment, tax rates and population, available on shorter periods. The Box-Pierce test indicates the presence of autocorrelation, up to a maximum lag, only for the first regression (column 1). Indeed, at the 0.95 confidence level, the null hypothesis (no serial correlation) cannot be accepted. Therefore we reestimate it by including a first-order autoregressive disturbance term (AR1).

insert Table 6 here

We first notice from table 6 that the control variables have overall the expected effects when they reach significance. The variable approximating the European growth appears as the most significant variable to explain French growth, being systematically significant at 1% level, while the degree of openness of France is neither significant on the whole period studied (column 1) nor when including other control variables (column 3). Concerning the government size variable, it turns out to have a significant and positive effect on economic growth on the whole period (column 1) but the relationship is not stable as showed by a Cusum of Squares Test (see figure A.1 in appendix). It appears obvious when performing the same regression on a shorter period 1896-2008 (column 2) and when including additional control variables (column 3), since government size stops being significant. Therefore estimating a linear model does not enable us to uphold the thesis of a relationship between public spending and economic growth.

Our theoretical prediction leads us to estimate in a second battery of regressions a quadratic model in which we add the squared variable of government size. The results are supplied in table 7 and speak volume. Indeed, the variable representing government size has a positive and significant impact on economic growth while the squared value has a significant and negative effect in the four regressions of table 6. This result is valid with the short version of our model on the whole period 1871-2008 (column 1) and also when adding, one by one, the other control variables of the whole model on the shorter period 1896-2008 (columns 2, 3 and 4). Therefore this second set of tests gives credit to our hypothesis of an inverted U-shaped relationship between the size of government and economic growth on long periods in France.

In other words, the Armey curve is verified for France since 1871. That enables us to decompose the total and marginal effects of government activity.

insert Table 7 here

If we first focus on the total effect, the coefficients of table 8 allow to say that government expenditure has globally had a positive impact on economic activity in France. In fact, a 1% increase in public spending as a share of GDP has entailed in average a 0.17% point increase in GDP growth on the whole period studied (calculation based on the coefficients, α_1 and α_2, of LN_GSIZE(t-1) and LN_GSIZE(t-1)² of column 1 table 6)[11]. However if we look into the marginal effect of government activity, the conclusion is more contrasted. It appears from the coefficients of the four regressions of table 7 that the maximizing GDP growth government size is around 29-30% (exp $(-\alpha_1/2\alpha_2)$) and has been continuously exceeded since 1947. Therefore, the marginal effect of an increase in government size was positive until the end of WW2 and became negative since 1950 when the actual ratio was higher than 30% on an ongoing basis. Therefore our empirical finding provides us with good reasons to uphold that government size in 2008 was higher by around 20% point than the growth maximizing size. It also appears that, like most other industrialized nations, France would be on the downward sloping portion of its inverted U-shaped curve. If France would have kept a government size close to the ratio of 30%, it would have experienced in average for the period 2000-2008, an annual growth rate of 3.23% instead of the 1.93% actual rate, which represents a significant loss of 1.9% point of growth per year.

We also performed a set of robustness checks by mainly controlling for the effect of political variables in the restrained model on the whole period and in the whole model on the shorter period 1896-2008. The results are supplied in table 8. We first control for the change in the political institutions inherent to each Republic[12], by including dummy variables the 3rd, 4th

[11] If we consider the coefficients α_1 and α_2 of columns 2, 3 and 4 of tables 7, the increase seems to have been higher, from 0.20% to 0.23% point.

[12] France adopted de facto in September 1870 a stable parliamentary republic with the third Republic (1870-1940), during which the National Assembly is split in an Upper Chamber, the Senate and a Lower Chamber, the House of Deputies, the sole institution elected by direct universal suffrage. This bicameralism system characterizes the working of the French democracy until now, except a brief interruption with the Vichy Regime (1940-1944). The Fourth Republic (1946-1958) is in the continuation of the previous Republic with roughly the same working of institutions while under the Fifth Republic (since 1958), the Parliament is composed of the National Assembly that becomes the Lower Chamber and the Senate, moreover a president is elected by universal suffrage.

and 5th Republics. That has no impact on the relationship between government activity and economic growth (column 1 and 4). Then, to consider the potential effect of electoral cycles, we include a dummy variable coded 1 for all the election years of the lower Chamber of the Parliament because during the majority of our observation period, it is the sole institution elected by direct universal suffrage. But this variable leaves the coefficients of the government size variable unchanged (column 2 and 5). Finally we use a variable of political ideology of Facchini and Melki (2011) which measures the share of left-wing seats in parliament. While this variable does not reach significance, its introduction noticeably decreases the coefficients and significance of both government size variables (column 3). According to Facchini and Melki (2011), that can be explained by the fact that political ideology has an indirect effect on GDP through public spending. Therefore the former and the latter are correlated, as we can see on table A.3. But, the inverted U-relationship between government size and economic growth proves to be robust and an optimal size between 28 and 29% can be confirmed.

insert Table 8 here

4.4 Discussion

Rather than merely supplying yet another evidence of the existence of the Armey curve for an additional country or period, it is interesting to know if our result is consistent with the related empirical literature. The aim is actually to understand, in the light of our finding, the diversity of sometimes contradictory results of the studies on the relationship between government size and economic performance. We can first notice that our finding of a 30% growth maximizing ratio is oddly significantly higher than the usual 20% ratio found in the studies on US (Grossman 1987, 1988; Peden 1991; Carlstrom and Gokhaie 1991; Scully 1994; Vedder and Gallaway 1998). It also appears that the French State reached its optimal scope later than in US, around 15 years later. Indeed, for instance, Grossman (1987) located the reversal point in the mid-1930s, compared to the late 1940s for France. That leads us to wonder whether these differences are due to a methodological bias or at least methodological divergences among the studies or rather to a French or an European originality.

A first possibility is that the optimal point of government scope is underestimated in the studies on US because of too short observations periods that do not contain many observations with a government size below the optimal one found. Indeed, by starting the

study after the 1930s, *i.e.* after the occurrence of the optimal point, as is the case for Vedder and Gallaway (1998) who started their study in 1947, or only a few years before, in 1929, as is the case for Grossman (1987), Peden (1991) and Scully (1994), not enough observations before the optimal size are taken into account. Mueller (2003, p.546) already emphasized that "some caution must be exercised in accepting Peden's [*and others'*] estimate of optimal government size, given the very few observations [they] had when the government was smaller than 17 % of national income." By contrast, in our study, the government size is systematically under its optimal size until at least the end of WW1, what gives serious grounds for thinking that the French optimal government size would be around 30%.

However a second possibility is that it does exist a diversity of Armey curves and thus of optimal State sizes according to the countries considered or more generally the institutional patterns. Indeed, while, the studies on US, whether biased or not, tend to reach a consensus on a low optimal size, the studies on other countries, with similar biases, tend to converge towards much higher sizes. Indeed, our finding is consistent with the studies on different panels of countries (Chao and Gruber 1998; Tanzi and Schuknecht 1996; Afonso et al 2003; Davis 2009) and especially on the EU countries whose optimal size would be between 37% (Forte and Magazzino 2010, p.1)[13] and around 40% (Pevcin 2004, p.10)[14] and more precisely on France with an optimal ratio between 40% (Forte and Magazzino 2010, p.23) and 43% (Pevcin 2004, p.10). Therefore it does appear that a relatively high optimal government size would be a European specific feature compared to US and does not result only from different observation periods.

However our result of a 30% ratio also contrasts with the above 40% ratio of the other studies on France. But, in this case too, this divergence probably stems from the shorter observation periods of the other studies. Indeed, Forte and Magazzino (2010) start their analysis in 1970, that is to say around 20 years after the occurrence of the optimal size, while Pevcin (2004) starts its in 1950, thus having a very few observations before the peak of the Armey curve. With our long time-series analysis, we can reasonably be confident in a 30% optimal size for the French State. It turns out that the shorter the observation period, the more the optimal point is sensible to the inclusion or exclusion of observations. It is for instance the case in the

[13] Forte and Magazzino (2010, p.23) found a 37% average optimal State size for Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and UK.
[14] Pevcin (2004) found a 36-43% optimal government size for 8 EU countries: Italy, France, Finland, Sweden, Germany, Ireland, Netherlands, and Belgium.

study of Mavrov (2007, p.58) who estimates that the optimal size for the Bulgarian State is 21% on the very short period 1990-2004[15].

In spite of the potential biases inherent to the various observation periods, the convergence of the empirical findings on different optimal State sizes according to the county studied tends to invalidate the thesis of a single inverted U-shaped relationship between government size and growth for all countries. Besides the consensus of the empirical findings of a relatively low optimal ratio in US, close to 20%, it emerges another trend of the empirical literature towards a higher optimal ratio of at least 30% for Europe. The stakes are now to know what the determinants of the optimal government size are. A first intuition was that the variety of government activity effects and optimal scales in terms of economic growth was probably due to "different political environments, different spending histories, and different patterns of change in non-observable variables, such as the pace and pattern of innovation" (Vedder and Gallaway 1998; Mueller 2003, p.549). But the literature also provided observable factors such as the level of economic development (Mueller 2003, p.549; Forte and Magazzino 2010, p.23[16]) and more particularly prerequisite in terms of literacy and education, political institutions (political instability, distortionary regulation) and cultural environments (Barro 1990). In one of the latest advancements on the Armey Curve, Forte and Magazzino (2010, p.39) investigated two potential determinants could be the national tradition of Welfare State and the flexibility of the labour market[17]. But the most important determinant of the shape of the Armey curve stays the national economic development. As a proof, in a comprehensive study with cross-country and time-series analyses for 115 "market economies" on the period 1960-1980, Ram (1986, p.191) found an overall positive effect of government size on

[15] Mavrov (2007, p.59): "For example, 2 years smaller period increase optimal size to 22,5% and 3 years – to 25%. The same result is possible under increasing the period."

[16] Forte and Magazzino (2010, p.23): "It is also interesting to note that the level of the peak of the BARS curve, on balance, increases with the increase of the per capita GDP, confirming the theoretical thesis that for countries who are in the former stages of economic development, the ratio of public expenditure to GDP needs to be higher than for the countries with high per capita GDP, because of the presence of indivisibilities in the supply of public goods."

[17] Forte and Magazzino (2010, p.38): "It is quite interesting to note that for the Western Continental European countries – that have a common tradition of welfare state and complex labor institutions – the peak of the BARS curve is at a much lower level than for the Anglo-Saxon countries, which, at least from Thatcher's reforms […], have a much more flexible labor market."

growth[18] but a closer look reveals that this effect does not empirically hold for the 8 most developed countries[19] of his panel.

The fact remains, however, that a better understanding of the Armey Curve and its determinants allows to ensure (a bit) consistency among the numerous and contradictory studies on the effect of public expenditure on economic activity. The existence of an Armey curve that would be peculiar to each country or each institutional design enables us to understand why the empirical findings depend much on both the observation period and the counties studied. The period is decisive because, by focusing on a rather short one, the huge majority of the studies focus either on the rising or the declining portion of the curve, most often on the declining one since they study recent periods. By the way, they can account for a global negative effect with a linear model. But the studies often omit to specify that the effect they find is valid only for a narrow specific size of government contrary to Peden and Bradley (1989, p.242) who specify that "*the negative relationship between government scale and productivity that [they] find is relevant for current ratios of government spending (about 35%) […and] not inconsistent with the argument that there may be an "optimal" size of government*". The panel studied, is at least as decisive because, in view of the literature, the effect of government scale seems to deeply depend on economic, cultural and political institutions. Therefore it turns out to be very informative to perform long time-series analyses for a single country.

5. Conclusion

The objective of this study was to investigate both theoretically and empirically the relationship between government size and economic growth. Its theoretical originality was to resort to both theories of State and market failures to account for a non-linear, inverted U-shaped relationship between government activity and economic performance. That turned out to be useful to specify the shape of the Armey curve by decomposing it into two curves standing for the costs of the State failures and the benefits from correcting market failures. It enabled us to unify in a single theoretical framework two sets of theories that generally are in completion or at best disregard each another.

[18] Ram (1986, p.191): found that the "the overall impact of government size on growth is positive in almost all cases; the marginal externality effect of government size is generally positive […] and there exists a broad harmony between the estimates obtained from cross-section and time series data."

[19] When focusing on the time series analyses for France, Italia, Austria, Australia, Germany, Portugal, UK, USA, we realize that government size either does not play any role or has a negative influence.

The empirical contribution of this paper was to provide evidence of the existence of an inverted U-shaped relationship between government size and economic output using time-series data on France on a long period (1871- 2008). There are two main findings. First, it is not possible to find a robust relation with a linear equation of government size to explain GDP growth, while we found strong evidence of an inverted U-shaped relationship, once we use a quadratic model. Second the optimal size of the French government would be 30% as a share of total GDP and was reached in the late 1940s. This figure contrast with the 20% figure found in the studies on the size of the US government but is rather in accordance with the literature on other countries and especially on Europe. However our long time-series analysis gives more credence to an optimal ratio of 30% compared to the higher ratios found by other studies on Europe and especially on France. Our finding tends to confirm the hypothesis of a multitude of optimal State sizes and therefore inverted U-shaped curves peculiar to each country or institutional design.

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FIGURES AND TABLES (to insert in the text)

Figure1. Armey Curve

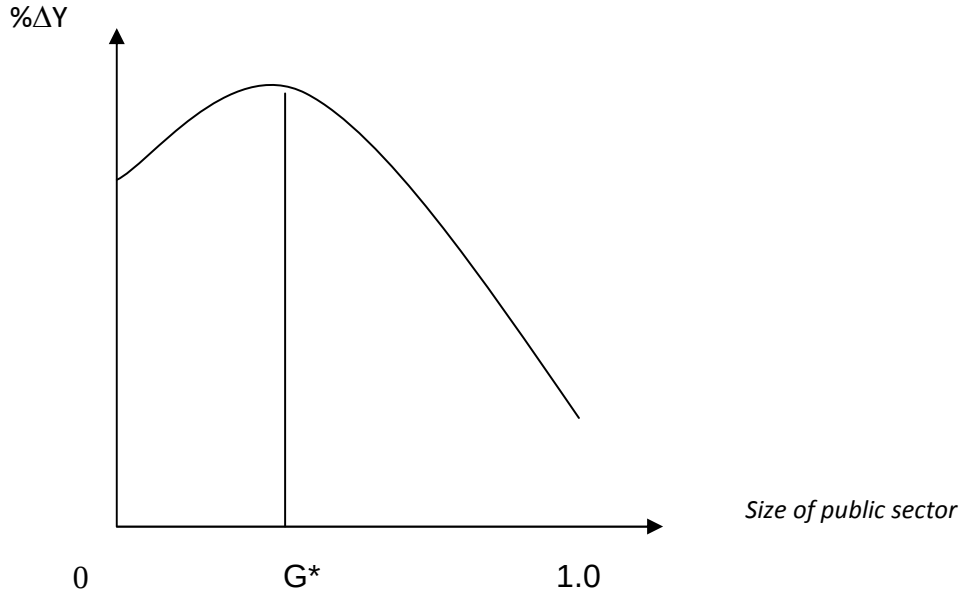

Figure 2. Relationship between growth and government size: a decomposition of the Armey Curve

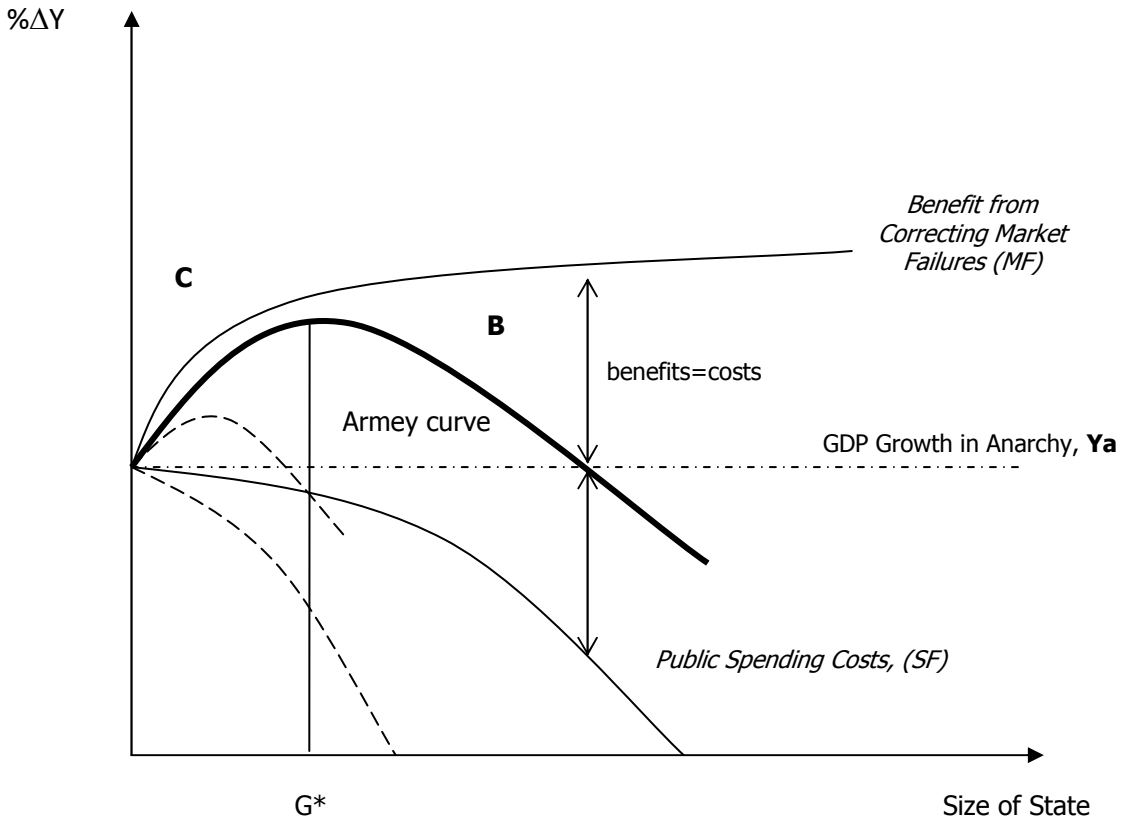

Figure 3. French GDP growth rate (1871-2008)

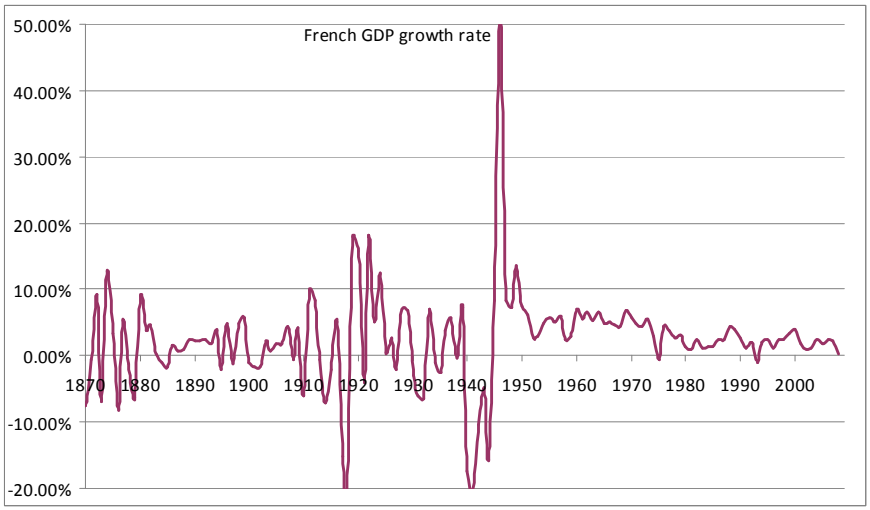

Figure 4. The annual share of government spending in GDP in France (1871-2008)

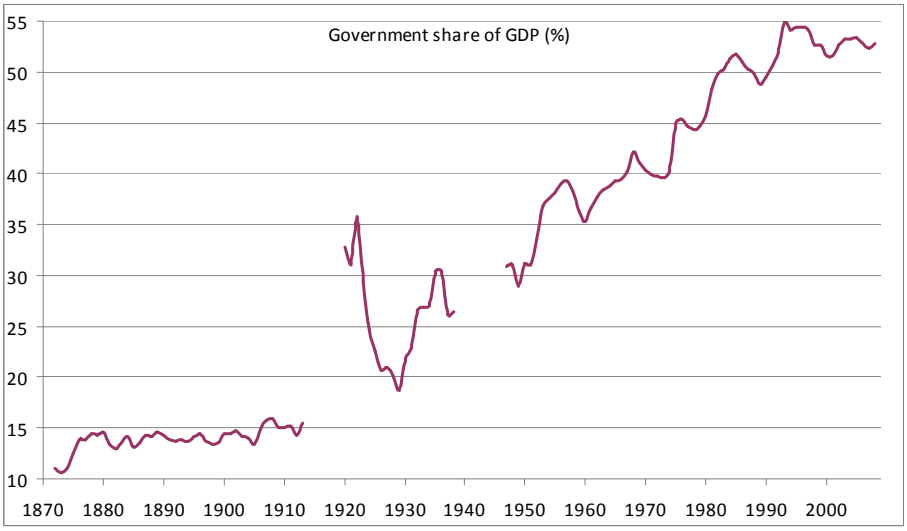

Figure 5. Growth and government size in France (1930-2009) (10 year mean)

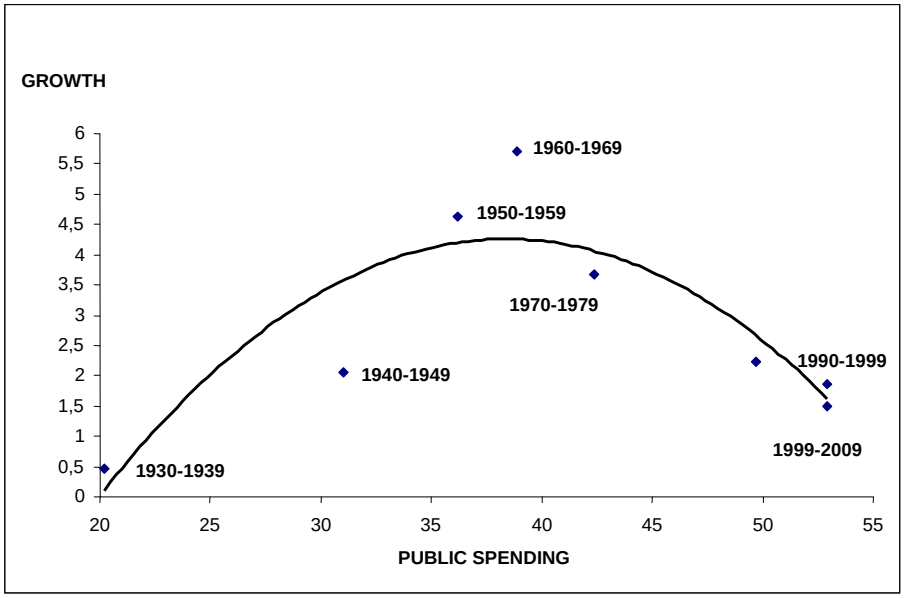

Table 1. Studies estimating a linear model

	NEGATIVE EFFECT	POSITIVE EFFECT	INCONCLUSIVE
OECD Countries	(19) Ahmed (1986), Landau (1983), Peden and Bradley (1989), Engen and Skinner (1992), Evans and Karras (1994), Hsieh and Lai (1994), Gallaway and Verder (1995), Karras (1997), Gwartney et al. (1998), Abrams (1999), Hansson and Henrekson (1999), Dalmagas (2000), Alesina and al. (1999), Bernholz (2000), Fölster and Henrekson (2001), Bassanini and Scarpetta (2001), Dar and Amirkhalkhali (2002) Illarionov and Pivarova (2002) Kustepeli (2005)	(2) Bairan (1988), Macnair et al. (1995)	(6) Gemmell (1983), Saunders (1985), Levine and Renelt (1992), Sheeley (1993), Andres and al. (1996), Ghali (1999)
Developping Countires	(6) Landau (1985), Assane and Pourgerani (1994), Karikari (1995), Hanson and Hebrekson (1994), Guseh (1997), Zhang and Zou (1998)	(2) Sattar (1993), Cooray (2008)	(2) Cronovith (1998), Bairan (1990) Anaman (2004)
OECD and developping countires	(5) Rao (1989), Grier and Tullock (1989), Barro (1991), Lee (1995), Barro (1997)	(1) Ram (1986)	(4) Komendi and al. (1985), Scully (1990), Lin (1994), Lee and Lin (1994)

Sources: articles published between 1983 and 1998 in refereed journals (Nijkamp and Poot, 2004, Table 2) and articles in bibliography.

Table 2. Studies estimating a non-linear model

AUTOR	PERIOD	PANEL	OPTMAL SIZE
Grossman (1987)	1929-1982	USA	19%
Grossman (1988)	1929-1982	USA	nc
Peden (1991)	1929-1986	USA	20%
Carlstrom and Gokhaie (1991)	After-war	USA	nc
Karras (1993)	nc	nc	20%
Scully (1994)	1929-1989	USA	21.5-22.9%
Karras (1996)	1960-1985	118 countries	23%
Vedder and Gallaway (1998)	1947-1997	USA	17%
Chao and Gruber (1998)	1929-1996	Canada	27%
Scully (2000)	1995	22 OECDE/112 countries	20.2-22.3%
Afonso et al. (2003)	1990-2000	23 OECD	35%
Mavrov (2007)	1990-2004	Bulgaria	21.42 %
Pevcin (2004)	1950-1996	12 EU countries	36-42%
Magazzino (2008)	1862-1998 1950-1998	Italy	23.06% 32.83%
Davis (2009)	nc	low-income countries	40%
Chobanov and Mladenova (2009)	1970-2009	28 EU countries	25,00%
Forte and Magazzino (2010)	1970-2009	27 EU countries	35.39-43.50%

Table 3: Market Failure (s) *versus* State Failure (s)

Market Failure (s)	State Failure (s)
I Microeconomic level	**I Microeconomic level**
Public Good (Lindhal-Samuelson)	*State failure as democratic failures*
Monopole	No optimality of provision of public goods:
Externalities	Median voter, Majority Cycle,
Asymmetric information (Stiglitz)	Agency problem (Shirking literature)
Under production of public good (free rider)	Over production of public good: Bureaucracy
Cognitive dissonance	Cognitive dissonance (Brady and al. 1995)
(Akerlof and Dickens, 1983)	
	State failure per se or Inefficiency
	1. Public *versus* private
	(Mueller, 2003, Chapter 22)
	2. Derived externalities (Hayek, Ikeda 1994)
	3. Failures of political learning process
Transaction cost	4. Political transaction cost (Dixit, 1998) and
(Coase 1960, Arrow 1970, Williamson, 2005)	cost of rent seeking
II Macroeconomic level	**II Macroeconomic level**
Market instability and	State instability: political cycle
State stabilization policy (Keynes)	(Austrian Business Cycle)
Equity, growth and redistribution of income	Procedural justice
(distributive justice)	

Table 4. Production long cycles

High growth	Low growth	High growth	Low growth	High growth	Low growth	High growth	Low growth
1850-1868	1870-1889	1894-1913	1913-1921	1922-1941	1942-1946	1947-1973	1974-2009

Table 5. Government size cycles in France in the long run (1871-2008)

1872-1914	1917-1930	1930-1993	1993-2008
Stability (10%-15%)	Decrease (35%-20%)	Increase (30%-55%)	Stability (50-55%)

Table 6. Regression Results. Estimation of a linear relation between government size and economic growth, 1971-2008 - Heteroskedastic Newey-West correction

Dependant Variable	1	2	3
	Δ(LN_GDP_FR)		
Constant	-0.031*** (3.178)	-0.017 (0.899)	0.017 (0.786)
LN_GSIZE(t-1)	0.007*** (2.719)	0.006 (1.229)	-0.006 (1.044)
Δ(LN_GDP_EU)	1.194*** (8.160)	0.839*** (6.617)	0.628*** (5.080)
Δ(LN_OPEN)	-0.037 (0.723)	0.114*** (2.797)	0.049 (1.289)
Δ(LN_EMPLOY)			1.553*** (4.107)
Δ(LN_TAX(t-1))			0.164** (2.270)
Δ(LN_POP)			1.389*** (2.882)
AR adjustement (order)	1	/	/
Observations	120	97	97
Adj. R^2	0.504	0.736	0.681
Durbin-Watson stat	1.797	1.937	1.860
Jarque-Bera stat	5.160	5.302	4.600
Jarque-Bera p-value	0.075	0.070	0.100

*Note: Absolute value of Newey-West t-statistic in brackets; * significant at 10 percent; ** significant at 5 percent; *** significant at 1%*

Table 7. Regression Results. Estimation of a non-linear relation between Government Size and economic growth - Heteroskedastic Newey-West correction

Dependant Variable	1	2	3	4
	Δ(LN_GDP_FR)			
Constant	-0.381*** (2.835)	-0.525*** (3.781)	-0.458*** (3.211)	-0.478*** (3.23)
LN_GSIZE(t-1)	0.237*** (2.763)	0.326*** (3.740)	0.287*** (3.256)	0.296*** (3.204)
LN_GSIZE(t-1)²	-0.035*** (2.693)	-0.048*** (3.697)	-0.043*** (3.282)	-0.044*** (3.204)
Δ(LN_GDP_EU)	0.712*** (5.034)	0.580*** (4.550)	0.704*** (6.941)	0.681*** (7.343)
Δ(LN_OPEN)	0.124*** (2.837)	0.099** (2.275)	0.110*** (2.652)	0.110*** (2.669)
Δ(LN_EMPLOY)		1.054*** (3.257)	1.105*** (2.477)	1.063*** (3.258)
Δ(LN_TAX(t-1))			0.209*** (3.812)	0.192*** (3.257)
Δ(LN_POP)				0.377 (0.804)
Observations	123	104	97	97
Adj. R²	0.735	0.737	0.779	0.801
Durbin-Watson stat	1.972	2.110	1.870	1.907282
Jarque-Bera stat	4.761	4.718	5.340	2.275
Jarque-Bera p-value	0.092	0.094	0.069	0.320

Note: Absolute value of t statistic in brackets; * significant at 10 percent; ** significant at 5 percent; *** significant at 1%

Table 8. Regression Results. Robustness checks - Heteroskedastic Newey-West correction

Dependant Variable	1	2	3	4	5	6
	Δ(LN_GDP_FR)					
Constant	-0.375*** (2.759)	-0.384*** (2.840)	-0.296** (2.197)	-0.389*** (2.760)	-0.487*** (3.238)	-0.500*** (3.396)
LN_GSIZE(t-1)	0.236*** (2.880)	0.239*** (2.767)	0.197** (2.341)	0.221** (2.462)	0.302*** (3.205)	0.308*** (3.346)
LN_GSIZE(t-1)²	-0.035*** (2.862)	-0.035*** (2.699)	-0.030** (2.351)	-0.031** (2.251)	-0.045*** (3.199)	-0.046*** (3.336)
Δ(LN_GDP_EU)	0.700*** (4.692)	0.707*** (4.925)	0.728*** (5.090)	0.715*** (8.002)	0.675*** (7.017)	0.676*** (7.274)
Δ(LN_OPEN)	0.124*** (2.726)	0.127*** (2.831)	0.116** (2.624)	0.111*** (2.869)	0.114*** (2.707)	0.111*** (2.723)
Δ(LN_EMPLOY)				1.041*** (3.228)	1.072*** (3.212)	1.072*** (3.245)
Δ(LN_TAX(t-1))				0.183*** (3.538)	0.192*** (3.192)	0.195*** (3.273)
Δ(LN_POP)				0.925 (1.317)	0.363 (0.805)	0.436 (0.846)
REPUBLICS	YES			YES		
ELECT		0.003 (0.801)			0.002 (0.749)	
IDEOLOGY			-0.020 (1.449)			0.005 (0.564)
Observations	123	123	123	97	97	97
Adj. R²	0.731	0.734	0.719	0.806	0.800	0.799
Durbin-Watson stat	1.971	1.981	2.077	2.051	1.926	1.913
Jarque-Bera stat	4.326	4.163	5.118	1.385	2.449	2.204
Jarque-Bera p-value	0.114	0.124	0.077	0.500	0.293	0.332

Note: Absolute value of t statistic in brackets; * significant at 10 percent; ** significant at 5 percent; *** significant at 1%

APPENDIX

Figure A.1 Cusum of Squares Test

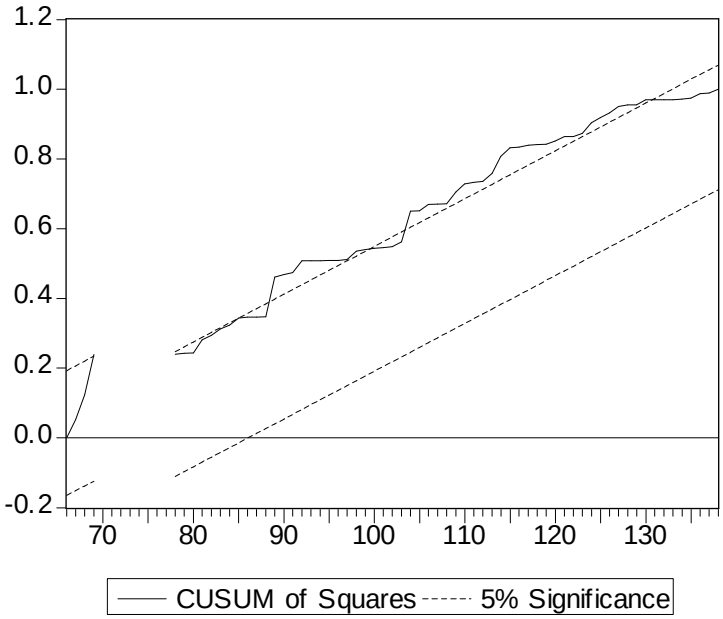

Table A.1 Data Presentation

GDP_FR	*French annual Gross Domestic Product in million 1990 International Geary-Khamis dollars*
Source	Maddison's website: http://www.ggdc.net/MADDISON/oriindex.htm Historical Statistics of the World Economy: 1-2008 AD- Table 2
GDP_EU	*European annual Gross Domestic Product in million 1990 International Geary-Khamis dollars*
Source	Maddison's website http://www.ggdc.net/MADDISON/oriindex.htm Historical Statistics of the World Economy: 1-2008 AD- Table 2: GDP levels-GDP Total 11 Western Europe (Austria, Belgium, Denmark, Finland, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, United-Kingdom)
GSIZE	*Share of the total public spending (Central State, Social Protection and local public authorities) as a percentage of the total GDP*
Source 1: 1871-1913	Levy-Leboyer and Bourguignon (1985, 1990): government consumption
Source 2: 1869-1974	Andre and Delorme (1983): total public spending/ (constant price) GDP
Source 3: 1959-2008	National accounts- INSEE (National Institute of Statistics and Economic Studies): (Billion constant euros) public administrations spending/(constant price) GDP
OPEN	*Degree of openness of the French economy, given by the sum of the importations and exportations as a percentage of the GDP*

Source 1: 1871-2002	Asselain and Blancheton (2005): goods importations as a percentage of the (current price) GDP, goods exportations as a percentage of the (current price) GDP
Source 2: 1960-2009	World Bank: the volume of trade as a percentage of GDP
EMPLOY	*Average number of workers per year*
Source	Bourlies, R., Cette, G., Lopez, J., Mairesse, J. and Nicoletti, G. (2010)
TAX	*Total tax rate*
Source	Piketty's website: http://piketty.pse.ens.fr/fichiers/public/Grasset2001/Livre/TabChap1.xls
POP	*French total population*
Source	Maddison's website:http://www.ggdc.net/MADDISON/oriindex.htm Historical Statistics of the World Economy: 1-2008 AD- Table 1: Population Levels, 1 AD - 2030 AD
IDEOLOGY	*Percentage of the left-wing deputies in the Lower Chamber of the Parliament (Chamber of Deputies for the 3rd and 4th Republic and National Assembly for the 5th Republic) excluding French overseas departments and territories and excluding the independent*
Source	Facchini and Melki (2011)
ELECT	*Dummy variable coded 1 for the elections years of the lower Chamber of the Parliament and 0 for the other years*
Source	Facchini and Melki (2011)

Table A.2 Descriptive Statistics

Variable	Minimum	Maximum	Mean	Std. Dev.
GDP_FR	71666	1423562	405380	404230
GDP_EU	272324	5979349	1794625	1672267
GSIZE	10.60	54.92	31.20	15.12
OPEN	5.93	47.01	28.83	8.68
EMPLOY	17923242	25493891	20118825	1909311
TAX	0.062	0.501	0.281	0.153
POP	37679	64058	46159	8066
IDEOLOGY	0.139	0.887	0.545	0.212

	D(LN_GDP_FR)	LN_GSIZE(t-1)	LN_GSIZE(t-1)²	D(LN_GDP_EU)	D(LN_OPEN)	D(LN_EMPLOY)	D(LN_TAX(t-1))	D(LN_POP)	ELECT	IDEOLOGY
D(LN_GDP_FR)	1.000000	0.142775	0.127040	0.656416	0.440749	0.510136	0.169934	0.356948	-0.090296	-0.225780
LN_GSIZE(t-1)	0.142775	1.000000	0.998421	0.035166	0.146972	0.227999	-0.015026	0.383539	-0.027809	-0.654214
LN_GSIZE(t-1)²	0.127040	0.998421	1.000000	0.015734	0.153474	0.238783	-0.031319	0.362657	-0.025258	-0.638826
D(LN_GDP_EU)	0.656416	0.035166	0.015734	1.000000	0.413588	0.266096	0.131660	0.241625	-0.058067	-0.101275
D(LN_OPEN)	0.440749	0.146972	0.153474	0.413588	1.000000	0.419004	-0.309432	0.211658	-0.151886	-0.131172
D(LN_EMPLOY)	0.510136	0.227999	0.238783	0.266096	0.419004	1.000000	-0.178767	0.163775	-0.086168	-0.178704
D(LN_TAX(t-1))	0.169934	-0.015026	-0.031319	0.131660	-0.309432	-0.178767	1.000000	0.062229	0.021766	-0.128653
D(LN_POP)	0.356948	0.383539	0.362657	0.241625	0.211658	0.163775	0.062229	1.000000	-0.013574	-0.505985
ELECT	-0.090296	-0.027809	-0.025258	-0.058067	-0.151886	-0.086168	0.021766	-0.013574	1.000000	0.024699
IDEOLOGY	-0.225780	-0.654214	-0.638826	-0.101275	-0.131172	-0.178704	-0.128653	-0.505985	0.024699	1.000000

Table A.3 Correlation matrix

NOTES

[i] The French GDP Growth has eroded over time. The French economic history can be presented as follows (see Figure A.2 in appendix). The French economy experienced two main critical stages until the Second World War: 1860 – 1890, 1929 – 1939 (Asselain, 1984a, 172). On the contrary, from 1945 to 1973, it experienced a steady growth period. After that, the GDP growth slow downed and was even negative in 1993 and 2009. War played an important part in the evolution of the French growth at the end of the 19th century as well as during the 20th century.

The 1860-1890 period was called before 1929, "*la Grande Crise*"[i]. It corresponded approximately to the 1873-1896 Kondratieff cycle of long-run prices decrease. In France, this stage began during the decade 1860 and was confirmed by the decrease in the GDP per capita during the 1880's (Lévy-Leboyer 1971). The origins of the decrease were the American Civil War, the *phylloxera* plague that destroyed harvest, the decreasing investment return in railway, the weight of trade between France and Great Britain and the agricultural depression. After the prosperous 1890-1913 period (Asselain 1984a, ch.4), followed the 1914-1918 war and the rebuilding from 1918 to 1929. However, as early as 1924, the level of the French GDP and national income is the same as in 1913 but growth is quite fast (Asselain 1984b, p.25). 1929 is obviously a date of break down followed by a recession and imbalance period (1930 – 1935), which, contrary to numerous countries, lasted beyond.

The 1937 reforms, under the "*Front Populaire*", of the Blum's government had only temporary effects. The 1937 and 1939 increases did not make up the deep recession of 1938. The economic instability corresponds to a high political instability: the fall of the Blum's government and the accession of the Chautemps's government in 1938. On the contrary, during the 1945-1973 period, the annual GDP growth is high. On the 1949 – 1969 period the average annual growth rate is 4.6 and 6.6 from 1969 to 1973 (Caron 1981, p.158). From 1975, as numerous European developed countries, France experienced very low growth rates compared to prior and to other big formerly industrialized countries like Great-Britain or United-States.