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NORMATIVE VERSUS POSITIVE ANALYSIS OF GOVERNMENT EXPENDITURES:

An Application toThree Decades of Defence Spending

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1. Introduction

The aim of this paper is to model the evolution of defence expenditures in a number of European countries. The benchmark model is the one used in Borcherding and Deacon (1972) which, in a second step, is augmented with extra control variables, viz. supply side factors (political as well as international effects).

The Borcherding and Deacon (1972) model, using a few assumptions, is used to estimate the demand for public services in a number of US municipalities. Using relatively limited data, these estimations yield the degree of publicness of the public good concerned, its price elasticity as well as income elasticity. Most studies on this topic that I have encountered (including the aforementioned) deal with the estimation of the demand for local public goods in a cross section setting. The advantage that local public goods offer, is that they are encountered in (almost) every municipality in differing amounts. Taking a cross section of municipalities then offers one an array of public good allocations combined with differing levels of demographic, fiscal and economic variables. This then allows the researcher to explain the observed quantity of a certain public good by characteristics of the municipality (urbanisation, tax rates, median income, population,...). The observed relationship is then most often dubbed "the demand for public good X". For it is implicit in this literature that the quantities of public good observed are precisely those that are demanded by the median voter. This quite strong assumption thus states that the executive (and eventually the politician) is merely the executor of the median voter's preferences with regard to public good provision. Reality however contradicts this far too optimistic assumption. Governments (be it local or national) are regularly overturned and voted away. Were they truly to be the executor of the median voter's wishes, this would not be the case[1], or at least not so frequently. We assume however that the observed outcome on public goods is to some extent determined by the wishes

[1] "...under the conditions of single peaked preferences, honest revelation of preferences, single dimension elections and binary choices, the outcome of majority voting is that the median voter's preferences will emerge as the collective preference." (Tridimas, 1993, p.127)

of the median voter. The incumbent however also has an influence on the determination of the expenditures of the public good. Janssens, Moesen and Pauwels (1980) equally use this assumption in their estimation of the demand for some categories of government spending. They assume that these differences in spending are partly to be attributed to different ideologies of governments. The incumbent may have different motives for deviating from the median outcome in public spending (electoral or ideological motives, favours to his constituency,...) but those are not treated as such in this paper.

Our approach differs in a number of respects from the traditional literature on the estimation of demand for public goods. First of all, in most studies (see infra) demand for different local public goods are being examined. This paper shall focus solely on defence spending (clearly not a local public good). This approach leads us to a second difference of this paper with the rest of the literature, being the time-series nature of the data. Whereas other studies, even those comparing between countries, use cross section data, we shall use time series data for each country. For each country the variation in the relevant variables shall be used to derive a demand function for defence spending.
Finally but perhaps quite important, we intend to see whether characteristics of the political situation in the country influence the amount of defence goods produced. We consider these political characteristics to be an important determinant of the supply side of the public goods. We assume that they determine (together with the relevant demand variables) the observed expenditures on defence. To this end we shall first estimate a model in which only "demand variables" are used to determine the level of provision of defence spending. In a second step, we add political variables and check whether the two approaches yield differing outcomes. Should the latter variables matter, then we can conclude that their non-inclusion would almost inevitably lead to imprecise figures on the price- and income elasticities.

The remainder of the paper is structured as follows: in part two the relevant literature is situated and its main results are briefly summarised; in part three

the used model is described; part four gives a description of the data and the relevant variables and the data; part five gives the estimation results and the final part concludes.

2. Literature review

In this paragraph we shall give an overview of the literature that is relevant for the analysis in this paper. We have drawn upon two different strands of the literature. One is concerned with the estimation of the demand for local and (sometimes) national public goods. The other one is concerned with the relationship between public finance on the one hand and political and institutional arrangements on the other hand. We shall start off with the literature on the estimation of the demand for public goods.

Most of the papers encountered deal with the estimation of the demand for local public goods[2]. The use of local data provides one with a lot of differing quantities of a certain public goods found in municipalities with different socio-economic characteristics. These characteristics might then be used to explain the differences in observed quantities of the public good. Borcherding and Deacon's (1972) seminal contribution uses a demand side model to estimate the demand for state public services (in the US). The demand for the public service depends upon its marginal tax price, the median voter's income as well as on the population size. Relatively few data are needed to yield estimates of price elasticity, income elasticity and the degree of publicness of the public good.

Bergstrom and Goodman (1973) consider the demand for municipal public goods (in the US). The estimated equations are along the lines of those tested by Borcherding and Deacon (1972) except that the former use an entire array of different socio-economic control variables[3]. Pommerehne and Frey (1976) further stress the superiority of the median voter model in an early defence of the public choice approach. They use local data from Swiss communities and find that the

[2] As a matter of fact, I encountered only two papers which deal with the demand for national public goods: Dao (1995) and Janssens, Moesen and Pauwels (1987).

public choice approach yields better results than a traditional model. Local data are equally used by Schwab and Zampelli (1987) who try to disentangle the effect of (rising) income upon the price of the local public good (via wages) from its effect upon demand for the public good.

Dao (1995) considers a cross-section of about one hundred countries and estimates demand functions for defence, housing, social security, education and health care. One conclusion is that the demand for education and health care appears to be price-inelastic. Janssens, Moesen and Pauwels (1987) estimate a system of demand equations for different categories of Belgian (national) public goods. Given the nature of the data, a time-series is used (1961-1980). The authors take into account the ideological position of the government coalition. One of the conclusions is that left wing governments are more likely to increase the relative importance of pure public goods whereas right wing governments do the same with merit goods. This last contribution has brought us to the second strand of literature which is important for the purposes of this paper.

A whole strand of the economic literature is devoted to the interaction between economic and political factors. The relationship between the economic conditions of the moment and the incumbent's probability of reelection, the relationship between the economy and the government's popularity, the pre-electoral manipulation of economic instruments in order to increase the government's chances of winning the election, the nature of public spending which is determined along partisan lines,... are but a few research topics which have been endeavoured in the past decades in this very interesting branch of economic research.

The literature which investigates the interaction between politics and the economy, can broadly be divided into two strands: political business cycle (PBC) literature and the partisan cycle (PC) literature[4].

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[3] Amongst others, these are: percentage of houses that are owner occupied, percentage of population over 65, percentage non-white,...

[4] For an exhaustive overview of this literature, see Paldam (1997)

The first one (PBC) was mainly developed by Nordhaus (1975) and investigates whether the economy is deliberately steered into a boom by the present government before the next election in order to increase the incumbent's chances of reelection.

However, the strand we are particularly interested in is the one of the Partisan Cycle (PC), a notion first introduced by Hibbs (1975). This literature asserts that there is a causal relationship between the nature of a party's ideology and the policy it('s government) executes. Empirical results on partisan cycles range from absolutely no support to strong support. Paldam (1997) reports that the most important research on US data has always supported the partisan cycle theory. Two interesting recent contributions are those provided by Van Dalen and Swank (1996) and Cusack (1997)

Van Dalen and Swank (1996) look at different categories of government spending[5]. Their sample is limited to the Dutch post-WW II governments. The authors then try to find out whether these governments engage in pre-electoral spending, partisan spending or a combination of both. They find that "both models of the policy maker appear to be applicable to the Dutch case". Each category of government spending is increased before the election. Furthermore, right wing governments tend to increase spending on defence and infrastructure and decrease spending on social security and health care. Left wing governments act in the opposite way. Cusack (1997) looks at the government's budget as a whole and then examines whether governments[6] behave more like policy seekers (and thus try to implement the policy that fits its electorate the most) or like office seekers (who, once in office, try to please the median voter in order to stay in power after the next election). Cusack finds that left-wing governments tend to increase the size of government expenditures as a percentage of GDP, whereas right-wing governments tend to decrease the government's size. Furthermore, governments don't seem to be acting as mere policy seekers in their actions. The

[5] They use the following six categories: defence, infrastructure, public administration, education, health care and social security.

implemented policy reveals that the wishes of the electorate (read: parliament) are also being taken into account.

If we combine both strands of the literature described above, we arrive at the purpose of this paper. We intend to look at one category of public goods, namely defence. We first estimate a standard demand function for this public good for a number of European countries using time series data. In a next stage we estimate the same model that has been supplemented with political determinants (supply side). A comparison of both sets of results should then show us which model is the more accurate description of reality. A last little exercise would then be to look for differences in the results for Nato-countries versus non-Nato countries.

3. The model

The model that shall be used, is based on Borcherding and Deacon (1972). After comparison of possibilities and difficulties of different models[7] we have chosen the aforementioned. Out of several different models (see literature review) this one met our main requirements. These were the following: it had to be applicable to a national public good (most models use a local public good setting) without far-stretching modifications of the model; an equivalent for the (local) data of the original model had to be found on a national level; finally the model had to be flexible enough in order to be safely extended to include other control variables. The model that fit this description almost perfectly is the one developed by Borcherding and Deacon (1972). This model implicitly assumes that the observed quantities of a certain public good are exactly the ones that are desired by the median voter. Since we think this assumption of a benevolent policy maker might be somewhat optimistic, we modify the original model in a second stage.

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[6] Cusack uses a pooled cross-sectional dataset of 15 OECD countries for a time period that ranges from 1955 to 1989.

[7] We have, amongst others, consulted Janssens, Moesen and Pauwels (1980), Tridimas (1993), Schwab and Zampelli (1987), Dao (1995), Bergstrom and Goodman (1973), Pommerehne and Frey (1976) and of course Borcherding and Deacon (1972).

By including political control variables we try to account for the fact that the policy maker is not merely driven by median voter concerns. The same rationale for including political control variables has already been used in the paper by Janssens, Moesen and Pauwels (1987). As opposed to their approach, we intend to use more as well as more sophisticated political variables.

The model[8] starts with the assumption of a Cobb-Douglas production function with constant returns to scale for the production of public goods.

$$(1) \qquad X = aL^{\beta}K^{1-\beta}$$

With X = the physical output in a particular category

L = labour

K = Capital

a = technology

In a Cobb-Douglas production function with constant returns to scale the β and (1-β) can be interpreted as respectively the share of labour costs and of capital costs in the total costs. Using the assumption of cost minimisation, the following result emerges.

$$(2) \qquad Marginal\ Cost = C_x = \left(\frac{1}{a}\right)\left(\frac{w}{\beta}\right)^{\beta}\left(\frac{r}{1-\beta}\right)^{1-\beta}$$

Where w = wage

r = rental price of capital

In the original model the following applies: "Within each political unit[9], both factors are available for public purchase at invariant prices [...]. However,

[8] Henceforth, when we refer to "the (original) model", we shall be talking about the seminal one developed by Borcherding and Deacon (1972).

[9] 'political unit' can be interpreted as the level of government at which the supply of the public good takes place.

between political units capital is assumed to be perfectly mobile, whereas labour is not. This implies that the rental price per unit of capital is the same over all units, but the wage can differ." (Borcherding and Deacon, 1972, p. 892). Our analysis is somewhat different however. The analysis of Borcherding and Deacon (1972) is of a cross-section nature. They examine a number of public services over different US states at a certain period in time. Therefore, their assumption of equal rental rates of capital and differing wage rates seems not so illogical. Our analysis differs in some respects, primarily because of the nature of the data at hand. We focus on one national service (defence) in a certain country, over a time span of several decades. It is then not likely that the rental price of capital remains the same over all these years. Therefore, for our purpose, we have to take the wage rate as well as the rental price of capital to be variable. Taking constant terms together, expression (2) reduces to[10]:

$$(3) \qquad Marginal\ Cost = C_x = a' w^{\beta} r^{1-\beta}$$

Let us now define q, the amount of the public good that is available for the median voter (in this stage, we could as well refer to the representative voter). We can relate this amount q to the total quantity of the public good X as follows:

$$(4) \qquad q = \frac{X}{N^{\alpha}}$$

With N being the size of the population and α a measure for the degree of publicness of the public good. Should α be equal to one, we would have complete rivalry and hence a pure private good. A value of α equal to zero would be an indication for complete non-rivalry and a pure public good. Given this, we can now define the taxes each person/median voter should pay to finance the

[10] This assumes furthermore that the technology does not change over the years, or in other words that the relative shares of labour and capital (β,1-β) remain the same over the time span under consideration. We shall come back to this in the paragraph on the estimation procedures.

production of the public good (we assume taxes are distributed evenly across the population). The taxes per person are then given by:

$$(5) \qquad T = \frac{C_x X}{N}$$

which stands for marginal cost times total production, divided by total population. We can then define the marginal tax price per unit q, or in other words, what does each median voter / tax payer pay per unit of public good he receives.

$$(6) \qquad s = \frac{T}{q} = C_x N^{\alpha-1}$$

Whereas equation (4) defines how much of the entire production each individual can appropriate, the following equation states how the median voter's demand for the public good comes about:

$$(7) \qquad q = As^{\eta} y^{\delta}$$

Where η = price elasticity of demand

δ = income elasticity of demand

A = a constant

The above equation shows that the median voter's demand for the public good depends on the (marginal tax) price per unit public good he appropriates as well as on his income. Since the actual quantities of a public good are mostly unobservable as well as immeasurable, we need to be able to implicitly describe the demand for the public good using the expenditures on the public good, which are observable.

Now, using expressions (3), (6) and (7) we can now write per capita expenditures (e) on the public good. Per capita expenditure on the public good is given by e =q*s. After some manipulations, this gives us the expression we are interested in:

$$(8) \qquad e = \widetilde{A}\left[w^{\beta} r^{(1-\beta)}\right]^{(\eta+1)} N^{(\alpha-1)(\eta+1)} y^{\delta}$$

Writing this in logarithmic form, this yields:

$$(9) \qquad \ln e = \ln \widetilde{A} + (\eta+1)\ln\left[w^{\beta} r^{(1-\beta)}\right] + (\alpha-1)(\eta+1)\ln N + \delta \ln y$$

Expression (9) is the first model that shall be estimated. Using only wage rate, rental price of capital, per capita income and population size, we are able to derive the price elasticity of the public good, its elasticity with respect to income and population. Furthermore, the degree of publicness can be derived from these estimation results. Each equation shall be estimated separately for every country under consideration. In the previous paragraph we have assumed the production function remains the same over the entire time series under analysis (see footnote 10). Prior to the estimation of the demand equation, we shall have to analyse whether this is the case. We shall do this by considering whether the shares (β) of wage costs in total expenditures wander widely over the time series. Should they not differ significantly from each other, we could assume that the same production function (except for the technology parameter a) is being used over the entire period under consideration. We could then impose this by using the average β as an approximation for the share of wage costs in total defence expenditures.

The first model shall be tested by estimating expression (9). However, this model states, at least implicitly, that the quantity of the public good we observe, is precisely the quantity the median voter desires[11]. In our opinion this assumes a) the applicability of the median voter model b) a benevolent policy maker who

[11] This becomes clear once we look at expression (7), expressing the median voter's demand for the public good he can appropriate. The expenditure per capita merely multiplies this demanded quantity with the marginal tax price and hence equally depends on characteristics of the median voter.

merely executes the median voter's and c) neutral external circumstances. There are various reasons why these different conditions might not be fulfilled.

First of all the median voter model imposes very restrictive assumptions. These are: single-peaked preferences of the voters, honest revelation of preferences, single dimension elections and binary choices (Tridimas, p. 127) These are clearly conditions which are most unlikely to be simultaneously fulfilled in real life. Furthermore, the use of per capita income in equation (9) uses the approximation that the median voter has the mean income, which is an equally questionable assumption. This first criticism deals with the applicability of the median voter model due to the fulfilment of theoretical requirements. This is not something we can change and is just a shortcoming of the model/reality we have to live with. The following two points deal with the fact that the model might be incomplete and needs supplementing.

The assumption of the politician as a benevolent executor of the median voter's wishes rather than an independent policy-maker might be hard to uphold. Apart from the median voter's wishes, the politician has his own agenda which he wishes to see fulfilled. That is why we want to extend this first model with some extra political control variables that might account for possible discretionary behaviour by the incumbent. We believe that differing approaches to defence policy are most likely to show up upon the left-right dimension[12]. Van Dalen and Swank (1996) concluded that right wing governments in post-war Netherlands are more likely to increase spending on defence. The control variables we want to use refer to the government's position on a left-right scale as well as the defence minister's position on a left-right scale (see paragraph 4).

Finally, not all changes in defence expenditure (or any other category of public goods) are due to changes in the underlying price-, income- or politics variables. The proximity of major wars, Fall of the Berlin Wall, Nato-membership or not,... are all factors which could possibly account for changes in per capita defence expenditures. A dummy variable shall be included to account for the Fall of the

[12] As opposed to the differences being related to number of parties in government, type of government,...

Berlin Wall. A Nato-dummy is not appropriate because of the limited number of European Non-Nato countries and because we do not use a panel data approach. Rather, it seems more appealing to compare the entire estimation results of non-member countries with those of the member countries. The second model is thus merely an extension of the first one and is just the same as equation (9) except that it is supplemented with the control variables discussed above. The rationale for the extended model is thus the following: equation (9) does represent the wishes of the median voter and e (the desired level of public spending) would be observed if only his wishes were taken into account. However, the politician knows the wishes of the median voter but adds to or subtracts from the median voter's desired level of public spending. Hence, the observed level of public spending is not equal to the desired level and the estimation of the extended model then disentangles the median voter's wishes from the politician's manipulations.

For each country under consideration, we shall estimate equation (9) as well as the extended equation. An likelihood ratio test will then decide whether the inclusion of political and external variables has been a sensible thing. In other words, does the bare median voter model fit reality most or do politics actually matter?

4. Variable description

The variables that we need for the estimation are described in this section. We divided them into two sections: expenditure related variables and political variables. Variables that will be actually used in the estimations, have been typed in bold. Variables that were needed to construct other ones, were not.

4.1 Defence expenditure variables

The expenditure variables for defence have been partly taken from the data sets by Professor Tomas R. Cusack at http://www.wz-berlin.de/~tom/data.en.htm. This is a number of data sets assembled from OECD sources and International

Institute for Strategic Studies data. The variables supplied by Cusack are (amongst others) the following:

GOVEMP: general government employment as a percentage of working age population

MILEMP: military personnel employment as a percentage of working age population

GOVWAGE: general government wage outlays as a percentage of GDP

TOTEXP: general government total expenditures as a percentage of GDP

MILEXP: general government military expenditures as a percentage of GDP

Other essential data are:

LABFORCE: working age population (in absolute figures) (Source: OECD Economic Outlook)

GDP: Real Gross Domestic Product (expressed in ECU, constant prices) (Source: see GDPCAP)

GDPCAP: Real Gross Domestic Product per capita (expressed in ECU, constant prices) (Source: Eurostat, Economy and finance)

POP: total population on January 1 (Source: Eurostat, Demographic indicators)

Other variables that were needed, have been constructed in the following way:

$MILWAGE = \frac{MILEMP}{GOVEMP} \times GOVWAGE$ = total wage outlays to military personnel, expressed as percentage of GDP.

An implicit assumption for the construction of the *MILWAGE* variable is that the payroll structure in the army is not very different from that in the rest of the public service. Or, when the army is responsible for half of the government's employment, that they also receive half of the total wages paid by government. We can see no direct objections to this simplifying assumption.

$$\textbf{\textit{MILSHARE}} = \frac{MILWAGE}{MILEXP}$$ = share of military wage outlays in total military expenditures

$$\textbf{\textit{AVWAGE}} = \frac{MILWAGE \times GDP}{MILEMP \times LABFORCE}$$ = average wage outlays for the average military employee, expressed in constant prices (see definition GDP(CAP) above).

MILCAP = $(MILEXP) * (GDPCAP)$ = per capita military expenditures

INTREST: long term interest rate (Source: OECD Economic Outlook)

4.2 Political variables

GOV: a variable that indicates the political stance of the government. A value for each party's political stance on a scale from 0 (extreme left wing) to 10 (extreme right wing) was taken from Huber and Inglehart (1995) and if not available from Castles and Mair (1984). These values were weighted according to the number of ministers a certain party had in the coalition[13]. In this way a government with one socialist and ten conservatives would be considered more right wing than a government with one conservative and ten socialists. According to us, this is a more correct approach than just adding up the constituting parties or even worse, an ad hoc attribution of either "left-wing signature" or "right-wing signature". The eventual value obtained is between zero and ten and is an indication for the government's position on the left-right spectrum. Again, the higher the number, the more right wing the government is.

MIN: Ideology score, again on a scale from zero to ten, for the minister of defence. For the minister the score of the party he/she belongs to was taken from Huber

[13] The final result is a weighted average of the different (ideology) scores that are present in the government. Hence, the value of the variable GOV is also situated between zero and ten.

and Inglehart (1995). If this source did not provide a score, the Castles and Mair (1984) scale was used. The data on the ministers of defence was taken from Woldendorp, Keman and Budge (1993, 1998).

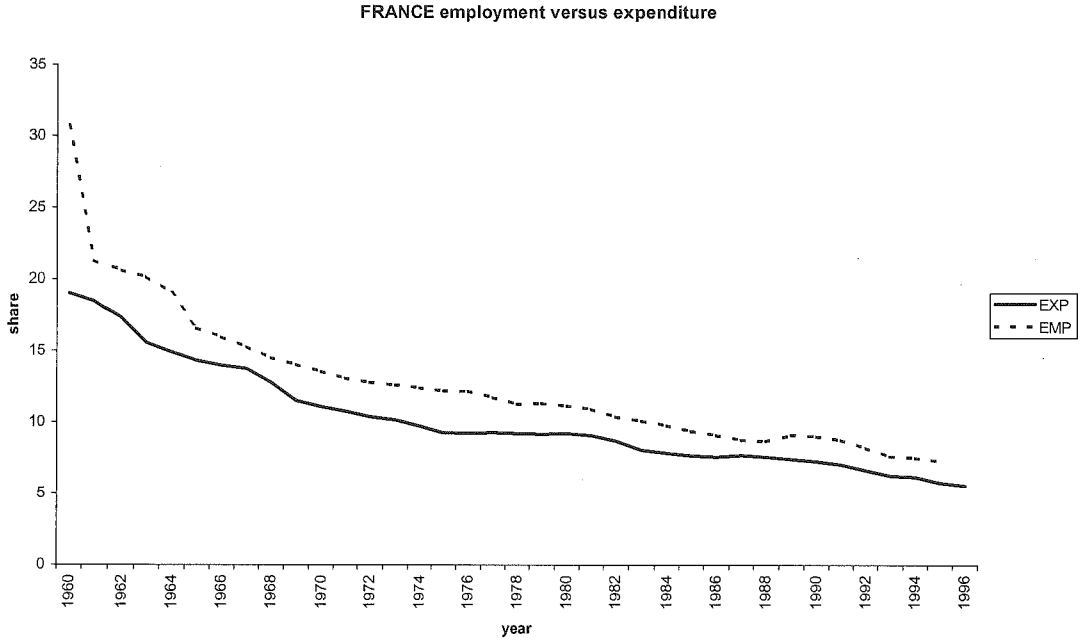
5. Data description and estimation techniques

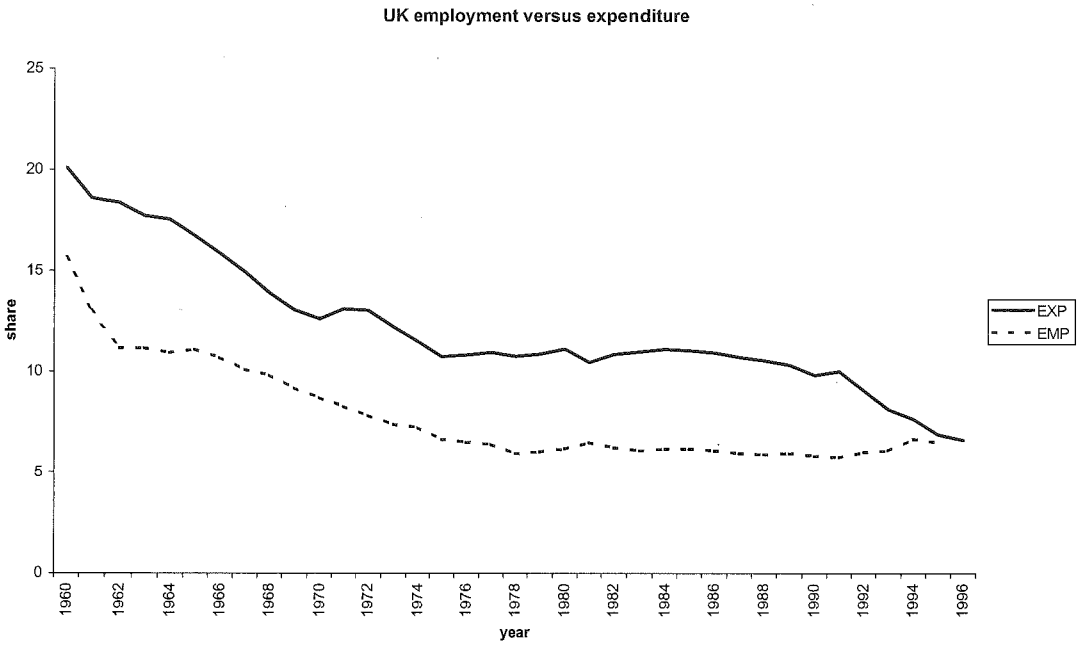
The model we described in the third paragraph, shall be estimated for three European countries. These are France, Germany and the UK. Data considerations as well as the importance of these countries on European defence have determined their selection. Furthermore, France is a non-Nato country which allows us to compare results between Nato and non-Nato countries. In this paragraph we shall first give some notes on the most important data we used. Detailed descriptive statistics can be found in the appendix.

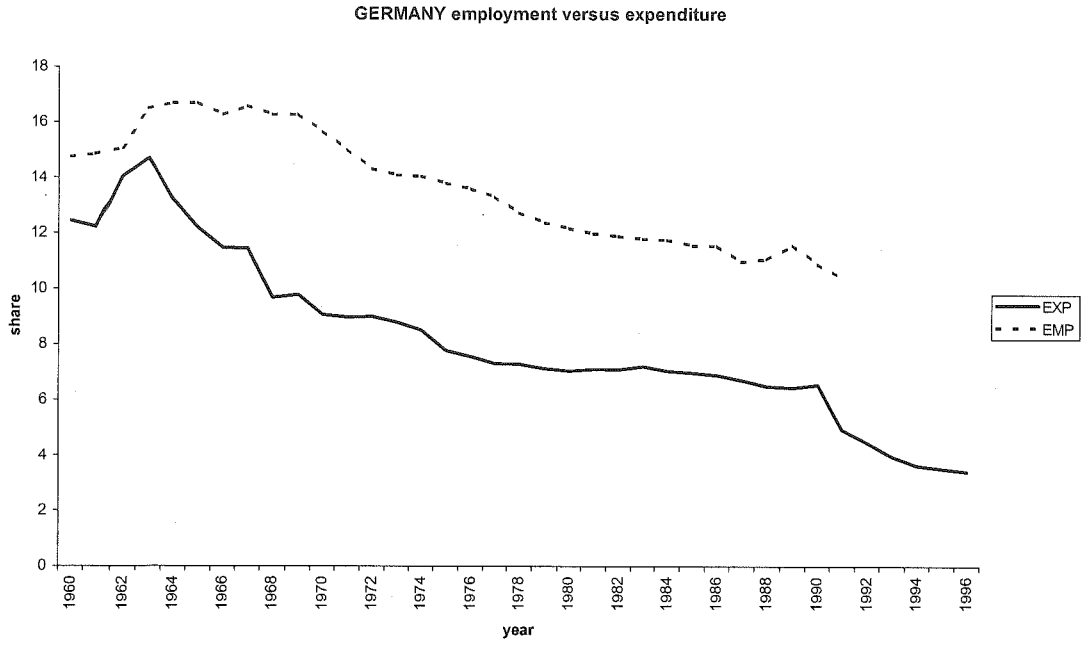
5.1 Military spending

To situate the topic, it might first be interesting to take a look at the evolution of military expenditures as well as military employment. In figure 1, we consider the evolution of military employment as a percentage of total government employment and at military expenditures as a percentage of total government expenditures.

Figure 1: Military employment versus government employment
Military expenditures versus government expenditures







In the above figures, the dotted lines represent the percentage of civil servants that works in the army. The full line denotes the percentage of government expenditures that is spent on military expenditures. All the series display a steady decline. Military employment shows a steady decline in France and Germany, whereas the UK has kept its military employment more or less stable for the last two decades at a level of about 6% of total government employment. Furthermore, in all the countries the employment series follows the expenditure series pretty closely. This means that spending per military employee stays about the same over the period under consideration. We see this as a first indication that the technology for the production of military goods hasn't dramatically changed over the years. E.g. should expenditures fall more rapidly than employment, this could be interpreted as a productivity increase where the same output could be delivered with less expenditures per person employed. Caution is required however, decreasing expenditures per military employed could equally imply that the output produced is of a lesser quality.

One final observation is that, whereas France's military expenditures decrease continually over the years, those of the UK and Germany clearly exhibit a steep decline just after 1990. This could be a first indication for a Berlin Wall effect, which at first sight appears to be only valid for the two Nato members. Whether

these preliminary assertions turn out to be valid, needs to be examined in the estimation results.

One very important variable for the analysis is the share of labour costs in total defence expenditures (β in equation 9). Should these shares remain about the same over the time series, then we could assume that the production function (apart from the technology) has not changed dramatically. If this share does not exhibit erratic behaviour, then we shall impose the mean value in the rest of the analysis. We need to consider carefully the consequences of changing the β all the time. Should we allow this share to change constantly, we would implicitly allow the production function to change all the time. Although, this does not necessarily present a problem, we would prefer to fix the share at its mean level, given that the fluctuation around the mean is not too large. In figure 2 we have plotted the evolution of the share of wage costs in total military expenditures for the three countries under consideration. In terms of equation we want to estimate, the β has been drawn. The lowest full line in the figure belongs to the UK, the dotted line represents France and the remaining one is for Germany. The β for the UK fluctuates a little but is centred around 17 %. The series for France exhibits some more erratic behaviour but no actual trend appears to be present. The series for Germany rises sharply until the second half of the seventies. Afterwards, the share of labour costs fluctuates around a share of about 40%. In the light of these observations, we opt to use one labour share for the UK and France, namely the average of the entire series (17 % for the UK and 32 % for France). For Germany, we shall use two different shares, one for the period 1960 to 1974 (33 %) and one for the period 1975 up to 1991 (40 %).

Figure 2: evolution of labour costs as percentage of total defence expenditures

5.2 Political data

Due to lack of data on the political stances of the parties on the beginning of the Fifth Republic (late fifties to early seventies), the extended model cannot be tested for France. Enough political data were available for Germany as well as for the UK, so the estimation for these countries provided no problem.

Due to the majoritarian two party electoral system in the UK, all governments since 1960 have been single party governments. Therefore, the ideological position of the minister of defence is exactly the same as that from the government. Hence, the inclusion of *GOV* as well as *MIN* does not make a lot of sense, if only from a multicollinearity point of view. We therefore only include *GOV* in the demand equations. As to the position of the median voter in the UK, not a lot can be said. Since 1960 (beginning of our dataset) all UK governments have consisted of only one party. This is of course due to their electoral system.

This does not mean however that the median voter actually voted for the party in office. Precisely the nature of the majoritarian electoral system allows a party to get a minority of the total votes and yet secure the majority in parliament. In Germany, slight non-proportionalities (due to voting threshold) equally exist but not to the extent that the median voter's preferences would not be present in the government. In our dataset for Germany (1960 to 1991) the FDP, which is the median party, only didn't belong to the government for six years.

5.3 Practical issues concerning estimation

We can now rewrite the equation that shall be estimated in terms of the variables we have constructed.

$$\ln MILCAP = CONSTANT + (\eta+1)\ln(AVWAGE^{MILSHARE} INTREST^{(1-MILSHARE)}) + (\alpha-1)(\eta+1)\ln POP + \delta \ln GDPCAP + \varepsilon \quad (10)$$

Following Janssens, Moesen and Pauwels (1987), we can simplify the notation by using:

$$COST = MILSHARE * \ln AVWAGE + (1 - MILSHARE) * \ln INTREST$$

and following Borcherding and Deacon (1972), we divide *MILCAP* by $(AVWAGE^{MILSHARE} INTREST^{(1-MILSHARE)})$. Estimating equation (10) (with the 'deflated'[14] *MILCAP*) then directly yields us the estimate of the price elasticity of demand η, the coefficient on *COST*. Since we have a nonlinearity in the estimated coefficients (see coefficient on POP), we shall estimate equation (10) by using Nonlinear Least Squares. The traditional hypothesis testing as well as statistical inference are not troubled by this estimation method. The only

[14] In appendix 2, this variable shall be suitably referred to as *DEFLATE*

drawback is that the R^2 is not longer guaranteed to lie in the range of zero to one (Greene, 2000, p. 420).

We expect the capturability parameter α to be not significantly different from zero. Defence is the public good par excellence for which non-rivalry (as well as non-exclusion) should apply. As for the price elasticities, Dao (1995) (using a cross section of countries, see literature review) reports no significant influence of prices on per capita defence spending except for a group of small LDC's. As for the income elasticity, the author reports an income elasticity of about unity.

6. Estimation results

In this section we shall summarise the main estimation results for Germany, the UK and France. Given the nonstationarity of the GDPCAP series and the presence of autocorrelation, we opted for taking first differences. We did not feel the need to also add a trend since possible remaining trends will be captured by the constant (Pindyck and Rubinfeld, 1991, p.141). The first differencing doesn't change the interpretation of the estimated coefficients as elasticities. Due to the time series nature of the data, we didn't expect any troubles from heteroskedasticity. We checked this, using a White test, and found our hypothesis confirmed. Therefore, no corrections for heteroskedasticity were made. The detailed estimation results can be found in appendix 2. The summary of the main findings will be given below in table 1 and 2.

In the demand equation (table 1), the income elasticity for the German equation is significantly different from zero and positive. However, one drawback is that, given these results, we cannot tell whether the estimated value is significantly larger than one or significantly smaller than one. This blurs the interpretation of the coefficient somewhat. That is why we drew a confidence interval for which the income elasticity is greater than one. The associated probability with δ being larger than one is about 78%. For the UK the only variable we are interested in that is significant, is the price elasticity. This turns out to be negative as we had

expected. For France the results are quite disappointing. Not a single coefficient shows up significant and the R^2 has a very low value.

The capturability parameter α does not show up significant in either of the equations. We expected a coefficient that was equal to zero. We cannot reject this hypothesis. However, we equally cannot reject the hypothesis that α is equal to one. Hence, not a lot of sensible things can be said about this coefficient.

As for any remaining autocorrelation, the D.W. statistics for Germany and France don't allow us to reject the null of no autocorrelation, the statistic for the UK is inconclusive.

Table 1: Estimation results for the demand equation

	Germany	UK	France
Constant	-0,0338	0,0053	0,0523
	(0,0190)	(0,0138)	(0,0549)
η (price elasticity)	-2,002**	-1,0097**	$-5{,}23*10^{-5}$
	(0,2779)	(0,0798)	$(3{,}86*10^{-5})$
α (capturability	0,9248	282,6392	-4,185
parameter)	(2,8808)	(2362)	(9,8748)
δ (income	1,5514**	0,1719	-0,6798
elasticity)	(0,4458)	(0,3315)	(0,7440)
Time period	1961-1991	1961-1995	1966-1995
R^2 *adj.*	0,65	0,82	0,03
D.W.	1,84	1,40	1,88

Standard errors between brackets, * denotes significance at the 10% level, ** denotes significance at the 5% level.

We shall now comment on the results for the extended equation. Since the previous equation assumes the mere execution of the median voter's preferences, we supplemented it with political control variables and a dummy for the Fall of the Berlin Wall. Using a likelihood ratio test we can then determine which model

fits the observed reality best. If the second equation turns out to be the 'best', we could, with some reserve, state that the bare median voter demand equation is only partly responsible for the observed differences in defence spending and that politics and external factors do matter. Once again we stress that for France not enough political variables were found and hence only the Berlin Wall dummy was included.

Table 2: Estimation results for the extended equation

	Germany	UK	France
Constant	-0,0158	-0,0377	0,0639
	(0,0791)	(0,0321)	(0,0597)
η (price elasticity)	-2,0706**	-1,0008**	$-5.53*10^{-5}$
	(0,3070)	(0,0726)	$(3,96*10^{-3})$
α (capturability	-1,2845	304,90	-4,8649
parameter)	(3,2452)	(2617)	(10,089)
δ (income	1,3893**	-0,2094	-0,7732
elasticity)	(0,5095)	(0,3120)	(0,7748)
Gov	0,0119	0,0092*	–
	(0,0200)	(0,0048)	
Min	-0,0137	–	–
	(0,0167)		
Wall	-0,0653	-0,0594**	-0,0198
	(0,0554)	(0,0180	(0,0365)
Time period	1961-1991	1961-1995	1966-1995
R^2 *adj.*	0,63	0,86	0,01
D.W.	2,02	2,03	1,90

Standard errors between brackets, * denotes significance at the 10% level, ** denotes significance at the 5% level.

Eyeballing the results reveals that the variables that were significant in the first equation, retain their significance as well as their approximate magnitude. This shows us that the median voter demand model (using prices, income, ...) cannot simply be dismissed and is part of the explanation of the observed quantities of the public good. The UK is the only country for which the GOV variable turns up significant. The coefficient is positive, yielding the interpretation that the more right wing the government is, the more per capita spending on defence will increase (given a certain cost level), or the less per capita spending on defence will decrease (given a certain cost level). Given the two party constellation of British politics, we can say that Conservative governments were prone to increase per capita defence spending whereas Labour governments were inclined to decrease it. The precise interpretation is that conservative governments carried out larger increases and smaller decreases of defence spending relative to labour governments. For Germany, the coefficient on the government variable also turns out to be positive, yet imprecisely estimated. The Wall dummy does shows up negative as well as significant for the UK. For the other countries, the coefficients are equally negative, yet imprecisely estimated. The interpretation of this negativity is that, after 1989, defence spending increases have been smaller than the years prior to 1989. The converse equally applies: defence spending decreases were larger after 1989 compared to the period before 1989. It could well be so that the Wall dummy doesn't show up significant because the data for Germany only run up to 1991 and that it was too early to see a clearly distinguishable effect from the Fall of the Wall.

As for the model with the best fit, the results are mixed. The likelihood ratio test revealed that we could reject the null hypothesis of valid restrictions only for the case of the UK. Hence, for the UK, the extended model appears to provide a better explanation for the observed reality. For the two other countries the extra control variables didn't substantially add to the explanatory power of the model.
In conclusion we could say that the median voter model is of great importance, given the amount of variation in the data it can explain. The inclusion of political variables as well as the wall dummy increases the fit of the UK

equation. We might conclude that there is some evidence for political influence as well as influence from external effects on defence expenditures, but the overall results are too fragile to clearly establish the magnitude as well as the channels through which the influence runs. France remains a puzzle, yielding insignificant estimates and a very low R^2. France was the country we included because of its non-Nato membership, but given its estimation results it does not seem wise to comment on possible differences between Nato and non-Nato countries. Furthermore, future research on other categories of government spending should show whether all French government spending shows such erratic and (at first sight) inexplicable behaviour.

In future research we could equally attempt to do the above exercise for some more countries, hence testing the robustness of the conclusions yielded. Furthermore, we could experiment with varying the share of labour costs each year rather than imposing that it is fixed. Other functional forms for the production function could equally be attempted.

7. Conclusion

In this paper we have attempted to model the evolution of three decades of defence spending in Germany, France and the UK. To this end we initially used the model by Borcherding and Deacon (1972), a demand model which explains the observed quantities of a public good in terms of its price, the income of the median voter and the size of the population. Implicit in this model is the assumption that the observed quantities of the public good are those demanded by the median voter. Since we believe this to be a major shortcoming of the model, we have opted to include supply side variables as well. We believe this to be a more correct approach of the observed reality where politicians and policy-makers observe the demand of the median voter, take it into account but do not entirely carry it out. Political considerations, ideological affiliations as well as external circumstances equally shape the policy that is being carried out. Therefore, the second model is based on the first one but is supplemented with the aforementioned control variables. Ultimately, the comparison between the results of both the equations should tell us which of the two is the better description of the observed reality.

The estimation results are not entirely along the lines of what we expected but are promising as to the principle that politics and external circumstances do matter. For France, the results of both equations didn't tell us anything at all and were consequently quite disappointing. For Germany, both models yielded significant estimates of price elasticity as well as income elasticity, however the political variables and the Berlin Wall dummy didn't prove to be significant. The Berlin Wall dummy proved to have the right sign but the coefficient was imprecisely estimated. Furthermore, with regard to model selection, the extended model didn't prove to be the best choice, leaving us (at this stage) with the bare median voter model. However, for the UK, the extended model proved to be a better description of reality, exhibiting a significant coefficient on the political variable as well as on the Berlin Wall dummy. The interpretation of the political coefficient was that, ceteris paribus, increases of defence expenditures were larger under conservative governments and decreases of defence

expenditures were smaller under conservative governments. The interpretation of the coefficient on the Wall dummy taught us that, as expected, after 1989, increases in defence spending were smaller and decreases were larger than in the period prior to 1989.

The results on whether either model performs better are thus mixed. It could either be that politics did not matter in Germany and France and that the Fall of the Berlin Wall did not matter for the determination of defence expenditures.
The other explanation, which we adhere to, is that politics as well as external circumstances do matter, but that it was too early to find a significant Berlin Wall effect in Germany and that the political control variables were perhaps chosen as well as measured along the wrong dimension. In future research we could experiment with other political control variables (such as number of coalition partners, ideological divide within the government,...) rather than the ideological position of the government on a left to right scale. A robustness test of the above results, by including other countries in the dataset, could be revealing as to the justification of our (preliminary) claims. This would allow us not only to discriminate along Nato/Non-Nato lines but to equally look at the difference between European and non-European countries, hence shedding a light on the choice of appropriate control variables.

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Appendix

Appendix 1: descriptive statistics

Milshare

	Germany	France	UK
Mean	0,37	0,32	0,17
Median	0,39	0,32	0,18
Stdev	0,06	0,02	0,02
Min	0,22	0,27	0,15
Max	0,44	0,36	0,22

Intrest

	Germany	France	UK
Mean	7,59	9,86	9,67
Median	7,43	9,15	9,62
Stdev	1,25	2,68	2,75
Min	5,93	6,20	5,17
Max	10,56	16,29	14,88

Avwage

	Germany	France	UK
Mean	41895,31	28853,55	18322,35
Median	46951,85	28740,02	18851,10
Stdev	7830,75	7100,59	4341,26
Min	28041,64	16913,71	10909,16
Max	49424,37	38384,80	27240,34

Milcap

	Germany	France	UK
Mean	465,34	527,85	482,00
Median	477,60	545,79	471,06
Stdev	55,25	61,26	58,90
Min	338,65	432,31	395,29
Max	549,14	601,94	606,91

Gov

	Germany	France	UK
Mean	5,56	-	6,80
Median	5,89	-	7,71
Stdev	1,13	-	1,49
Min	4,23	-	4,43
Max	6,86	-	7,71

Appendix 2: Detailed estimation results

Germany demand equation

Method: Least Squares
Sample(adjusted): 1961 1991
Included observations: 31 after adjusting endpoints
DLOG(DEFLATE)=C(1)+C(2)*D(COST)+(C(3)-1)*(C(2)+1)*DLOG(POP)

+C(4)*DLOG(GDPCAP)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.033800	0.019036	-1.775611	0.0871
C(2)	-2.002289	0.277938	-7.204088	0.0000
C(3)	0.924893	2.880836	0.321050	0.7506
C(4)	1.551492	0.445839	3.479938	0.0017

R-squared	0.686093	Mean dependent var	-0.023056
Adjusted R-squared	0.651215	S.D. dependent var	0.126060
S.E. of regression	0.074449	Akaike info criterion	-2.237500
Sum squared resid	0.149650	Schwarz criterion	-2.052469
Log likelihood	38.68124	Durbin-Watson stat	1.847001

Germany extended equation

Method: Least Squares
Sample(adjusted): 1961 1991
Included observations: 31 after adjusting endpoints
DLOG(DEFLATE)=C(1)+C(2)*D(COST)+(C(3)-1)*(C(2)+1)*DLOG(POP)

+C(4)*DLOG(GDPCAP)+C(5)*GOV+C(6)*MIN+C(7)*WALL

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.015809	0.079188	-0.199644	0.8434
C(2)	-2.070631	0.307053	-6.743571	0.0000
C(3)	-1.284521	3.245232	-0.395818	0.6957
C(4)	1.389399	0.509502	2.726977	0.0118
C(5)	0.011990	0.020017	0.598984	0.5548
C(6)	-0.013711	0.016708	-0.820636	0.4199
C(7)	-0.065367	0.055467	-1.178482	0.2502

R-squared	0.710545	Mean dependent var	-0.023056
Adjusted R-squared	0.638182	S.D. dependent var	0.126060
S.E. of regression	0.075827	Akaike info criterion	-2.125049
Sum squared resid	0.137993	Schwarz criterion	-1.801245
Log likelihood	39.93826	Durbin-Watson stat	2.029681

UK demand equation

Method: Least Squares
Sample(adjusted): 1961 1995
Included observations: 35 after adjusting endpoints
DLOG(DEFLATE)=C(1)+C(2)*D(COST)+(C(3)-1)*(C(2)+1)*DLOG(POP)

+C(4)*DLOG(GDPCAP)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.005355	0.013846	0.386772	0.7016
C(2)	-1.012278	0.079813	-12.68310	0.0000
C(3)	222.6830	1485.896	0.149864	0.8818
C(4)	0.172311	0.331505	0.519785	0.6069

R-squared	0.843034	Mean dependent var	-0.012552
Adjusted R-squared	0.827844	S.D. dependent var	0.104950
S.E. of regression	0.043546	Akaike info criterion	-3.322809
Sum squared resid	0.058783	Schwarz criterion	-3.145055
Log likelihood	62.14916	Durbin-Watson stat	1.402905

UK extended equation

Method: Least Squares
Sample(adjusted): 1961 1995
Included observations: 35 after adjusting endpoints
DLOG(DEFLATE)=C(1)+C(2)*D(COST)+(C(3)-1)*(C(2)+1)*DLOG(POP)

+C(4)*DLOG(GDPCAP)+C(5)*GOV+C(6)*WALL

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.037663	0.032190	-1.170004	0.2515
C(2)	-1.009409	0.072648	-13.89461	0.0000
C(3)	278.8784	2200.080	0.126758	0.9000
C(4)	-0.209291	0.312019	-0.670763	0.5077
C(5)	0.009260	0.004897	1.891060	0.0686
C(6)	-0.059448	0.018078	-3.288403	0.0026

R-squared	0.887455	Mean dependent var	-0.012552
Adjusted R-squared	0.868051	S.D. dependent var	0.104950
S.E. of regression	0.038123	Akaike info criterion	-3.541202
Sum squared resid	0.042147	Schwarz criterion	-3.274570
Log likelihood	67.97103	Durbin-Watson stat	2.039110

France demand equation

Method: Least Squares
Sample(adjusted): 1966 1995
Included observations: 30 after adjusting endpoints
DLOG(DEFLATE)=C(1)+C(2)*D(COST)+(C(3)-1)*(C(2)+1)*DLOG(POP)

+C(4)*DLOG(GDPCAP)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.052302	0.054966	0.951530	0.3501
C(2)	-5.23E-05	3.86E-05	-1.352642	0.1878
C(3)	-4.185000	9.874821	-0.423805	0.6752
C(4)	-0.676898	0.744016	-0.909790	0.3713

R-squared	0.137123	Mean dependent var	-0.006611
Adjusted R-squared	0.037560	S.D. dependent var	0.079024
S.E. of regression	0.077526	Akaike info criterion	-2.152838
Sum squared resid	0.156268	Schwarz criterion	-1.966012
Log likelihood	36.29257	Durbin-Watson stat	1.888565

France extended equation

Method: Least Squares
Sample(adjusted): 1966 1995
Included observations: 30 after adjusting endpoints
DLOG(DEFLATE)=C(1)+C(2)*D(COST)+(C(3)-1)*(C(2)+1)*DLOG(POP)

+C(4)*DLOG(GDPCAP)+C(5)*WALL

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.063964	0.059716	1.071132	0.2943
C(2)	-5.53E-05	3.96E-05	-1.397157	0.1746
C(3)	-4.864947	10.08935	-0.482186	0.6339
C(4)	-0.773242	0.774864	-0.997906	0.3279
C(5)	-0.019863	0.036552	-0.543411	0.5917

R-squared	0.147196	Mean dependent var	-0.006611
Adjusted R-squared	0.010747	S.D. dependent var	0.079024
S.E. of regression	0.078599	Akaike info criterion	-2.097914
Sum squared resid	0.154444	Schwarz criterion	-1.864381
Log likelihood	36.46871	Durbin-Watson stat	1.905367