Health Expenditures in the OECD: A Political Economy Analysis Using Structural Breaks

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Abstract

We write this paper with the main purpose of investigating whether or not political factors influence the structural changes in health expenditure. We are not concerned about shocks as most researchers do; but instead we search for significant structural break dates and try to find a correlation between them and political changes. We choose to study health expenditure due to its relevance in terms of share on GDP and share on public expenditure and because of the continuous growth it shows over the last decades. We use probit models for our empirical tests. Public health expenditure share on GDP is found to have a statistically significant higher probability of breaking in election years which is a clear indication of possible political effects. By opposition break dates on Private health expenditure share on GDP show no correlation with elections. In addition, the probability of occurrence of breaks in public current health expenditure significantly increases in election years and the coefficients are higher and more significant in this case than the case of total public health expenditure. However, this is not verified in investment expenditure which means that elections seem to have a higher impact on short term expenses. Majority governments show a lesser probability of inducing breaks during their term in office but a higher probability before elections. Although we sometimes found statistically significant differences depending on the ideology of the respective government (i.e. left or right) we failed to achieve consistent and coherent results to allow us to establish a clear conclusion. We based our study on a data set of 23 OECD countries between the years 1960 and 2006.

João Cardosa

1. Introduction

Several studies have analyzed whether democratic governments adjust their macroeconomic policies around the election date to increase their prospect for being re-elected. As a consequence of their opportunistic behavior a business cycle may arise and last until the next election (Rogoff 1990).

Other studies concentrate on the partisan politics that shape the public policies after elections. In this respect, scholars are divided into two major schools of thought. One of them suggests that partisan politics plays little if any role in how governments in modern industrialized democracies shape their programs and the way they finance them. A leading example of this is the general position that a uniform logic of industrialization dictates the major course or direction of policy leaving partisan politics at the margin (Skinner 1976; Thomas 1980).

The opposing school attributes central importance to the ideological differences that exist between social groups and the parties that represent these groups (e.g., Tufte 1978; Hibbs 1987a, 1987b). The left-right dimension is fundamental. Lower income groups and labor in general are seen as favoring a large and active state. Upper income groups and capital in general are depicted as aiming to minimize the role of the state in shaping market operations and outcomes. These latter groups are particularly concerned to limit the size of the state and its control over the financial resources of the respective society. Parties competing for votes orient their programs to serve these different interests; once in office they will differ not only in their macro-economic policies and fiscal outcomes, notably the trade-off between inflation and unemployment but also the level of public expenditure and the size of budget deficits. While economic, technological, and demographic factors are also important in shaping policies, the place of partisan politics is central.

During our research we will have the chance to approach both the opportunistic and the partisan theories as they apply to public health expenditure. First we will check if in election years we find structural breaks in the expenditure series which should give us a sufficient indication of possible politics influence. Then we will try to correlate the sign of the breaks with the parties in government to check for ideology effects.

Now, concerning health expenditure we must mention that many researchers have studied its evolution and tried to find its determinants. It is widely accepted that variations in national income generally account for most of the cross country differences in health outlays (Newhouse 1977; Culyer 1989; Hitiris and Posnett 1992).

Our main purpose is to investigate if political factors are one possible determinant of structural changes in health expenditure series. We do not consider temporary shocks; we instead look for significant structural breaks and try to determine whether they are related to political changes.

Usually, when researchers try to account for the structural breaks is to isolate their effects and to transform the original series in a stationary series. We, however are taking a novel approach: we try to use the dates of structural breaks to further explore the time of their occurrence, and relate them to political variables using probit models.

Dealing with structural breaks has always been an issue for econometricians; a change in trend is a one-time event with a permanent effect and those who ignore this confound leads to mistaking them for temporary shocks that seem more long lasting than they really are (Perron 1989; Rappoport and Reichlin1989). In a recent paper Hansen (2001) concluded that structural change is pervasive in economic time series relationships, and it can be quite perilous to ignore. Inferences about economic relationships can go astray, forecasts can be inaccurate, and policy recommendations can be misleading.

Structural changes have been observed in many economic and financial time series. In a study of a large set of macroeconomic time series, Stock and Watson (1996) reported that the majority of the series displayed instability. Such structural breaks pose a formidable challenge to economic forecasting and have led authors such as Clements and Hendry (1998, 1999) to view it as the main source of forecast failure.

In the last fifteen years or so a large amount of research has been done pertaining to issues related to structural changes and to try to distinguish between structural changes and unit roots. In the literature we can find many papers related to estimation and inference about break dates for single equations with or without restrictions (e.g. Hidalgo and Robinson, 1996), with extensions to multi-equations systems where allowance is also made for changes in the variability of the shocks. We can also find tests for structural changes including tests for a single or multiple changes and tests valid with unit root or trending regressors (e.g.Gil-Alana, 2004), and tests for changes in the trend function of a series that can be integrated or trend-stationary. Also studied is testing for a unit root versus trend-stationarity in the presence of structural changes in the trend function and testing for cointegration in the presence of structural changes and issues related to long memory and level shifts (e.g., Diebold and Inoue, 2001). But still, as Perron (2005) points out in his survey, some important questions remain to be addressed: limit distributions of estimates of break dates in a cointegrated system with multiple structural changes, issues of non-monotonic power functions for tests of structural changes, evaluating the frequency of permanent shocks; just to name a few.

Given the nature of the problems, it is important to have procedures that are valid for multiple structural changes. For example, with many financial time series, allowing for structural breaks reduces considerably the estimates of the long-memory parameters within regimes (e.g., Granger and Hyung, 2004, for stock return volatility). Are these estimate reductions statistically significant? Are the reductions big enough that one can consider the process as being of a short-memory nature within regimes?

Is there a significant evidence of structural changes? Is the long-memory parameter stable across regimes?

The econometrics and statistics literatures have a long way to go in order to provide reliable tools to answer these questions. However, there are some new tools developed in the past few years that are useful aids in specifying, analyzing and evaluating econometric models.

The procedure we follow for structural break detection is based on Bai and Perron (2003) *"Computation and Analysis of Multiple Structural Change Models"* and then we proceed with our own probit models searching for correlations between the dates of structural changes and of political changes. Our method could be applied to any other expenditure series, and this might yield some interesting results, national defense, culture and entertainment, education and social security are examples of sectors which are susceptible of being influenced by political factors due to their strong involvement in public expenditure.

We focus on the health expenditure for several reasons. Public expenditure on health accounts for more than 70% of total expenditure on health which means that it is widely dependent on government policy in terms of level and trend. Also health care expenditure has been growing much more rapidly than the national income in the U.S. and other developed countries for some time (NBER Issue No.14, Winter 2006). In the U.S., for example, health care expenditures as a share of GDP have tripled since 1950, from 5% then to 15% as it is today. The causes of this dramatic increase are less well understood (Barros 1998), and although some researchers believe this is partly due to the aging population (Bains - OECD, 2003) most think that much is largely due to rising expenditures per person at a given age (Jacobzone, 2003). This distinction is important because benefit levels are determined by government policy, while demographics are largely outside of government control. Another reason for us to choose health expenditure is that we have available information for almost for all OECD countries which has been consistently collected and stored throughout the years.

Through a simple observation of the political data available from Armingeon et al. (2008) we can realize that in most countries the governments cyclically change from left to right and vice versa. Sometimes the changes occur in scheduled election years, but many times they also occur in non scheduled years due to government falls.

Do these party government changes have an impact as significant as to create or at least contribute to structural breaks on health expenditure series? Can public expenditure on health be increased before elections by opportunistic politicians? Do different ideology governments create opposite sign trend breaks in public health

expenditure? Do structural breaks occur more often in a specific type of government (coalition/majority)? These are the main questions that we will try to answer.

This paper is organized as follows. In the next section we look at some data about health expenditure and show its growing importance to public and private budgets, as well as its weight on the GDP. In section 3 which is divided in three subsections we present some of the most relevant findings that researchers have made in three research fields: political business cycles; the impact of government ideology on policies; and health expenditure drivers. Next in section 4 we discuss our main objectives and expectations. In section 5 which is divided in 4 subsections we present our own data, then we explain the process of identifying the structural breaks based on the work of Bai and Perron (2003), and give an example of the whole process applied to a specific series and a specific country. We finish section 5 with a graphical overview of the structural breaks.

Section 6 is composed by 3 subsections; on 6.1 we present all dependent variables and regressors and also the probit models; on 6.2 we apply the binomial probit models and discuss their results; at last on 6.3 we investigate the multinomial probit models and discuss the results achieved.

Section 7 is dedicated to possible omissions and mistakes that we acknowledge about our method; we also give some references for future research. We summarize our results in section 8, which is our last one.

2. The importance of health expenditure

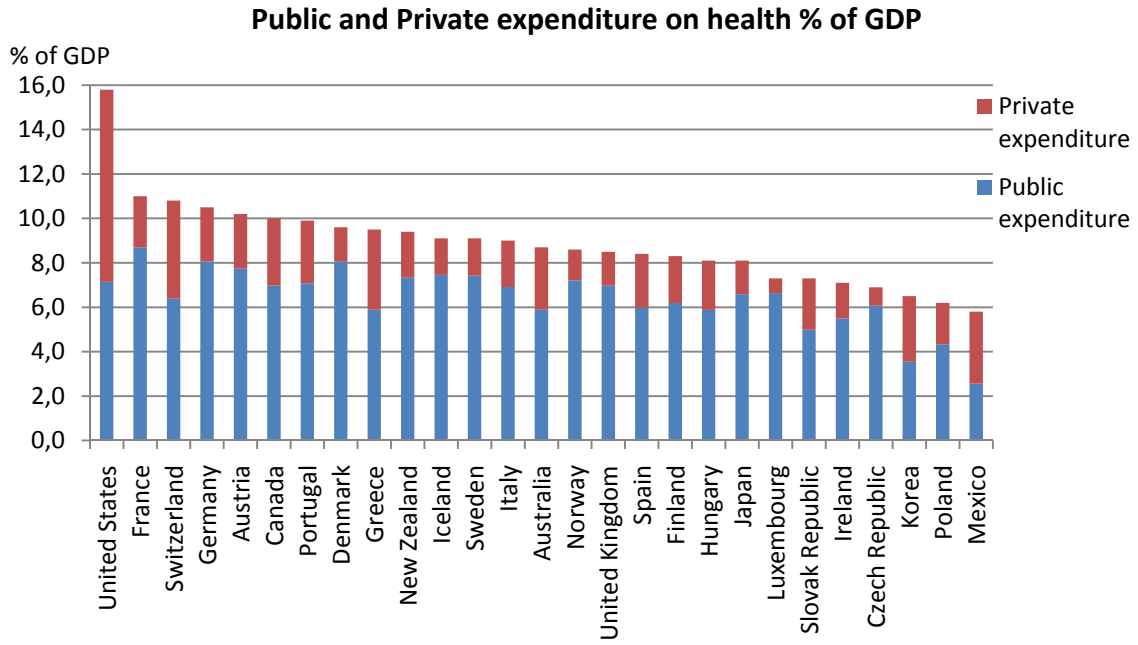
Health expenditure accounted for about 4% of GDP when the OECD was founded in 1960, but the average across OECD countries is now nearly 9%, and it is close to or above 11% in several large national economies. The health sector of national economies has grown dramatically in importance over time, yet there are great differences among countries, not only in spending but also with respect to other indicators.

2.1. Expenditure on health compared to GDP

In 2006, the average share of GDP that OECD countries devoted to health spending reached nearly 9%. However, this share varied considerably across OECD countries, ranging from around 6% in Korea, Poland and Mexico up to 16% of GDP in the case of the United States (figure 2.1). The number of countries now spending more than 10% of their GDP on health goods and services stood at seven in 2006 (Belgium is omitted from the graph), compared with four in 2000 and only two countries in 1995. Concerning public expenditure as a share of GDP, there was an almost threefold difference between the highest and lowest countries. Public spending on health in France accounted for 8.7% of GDP in 2006, while in Korea, where health care is evenly

split between public and private financing, public financing of health equated to 3.5% of GDP.

Figure 2.1 - Public and Private Expenditure on Health share on GDP per country - 2006

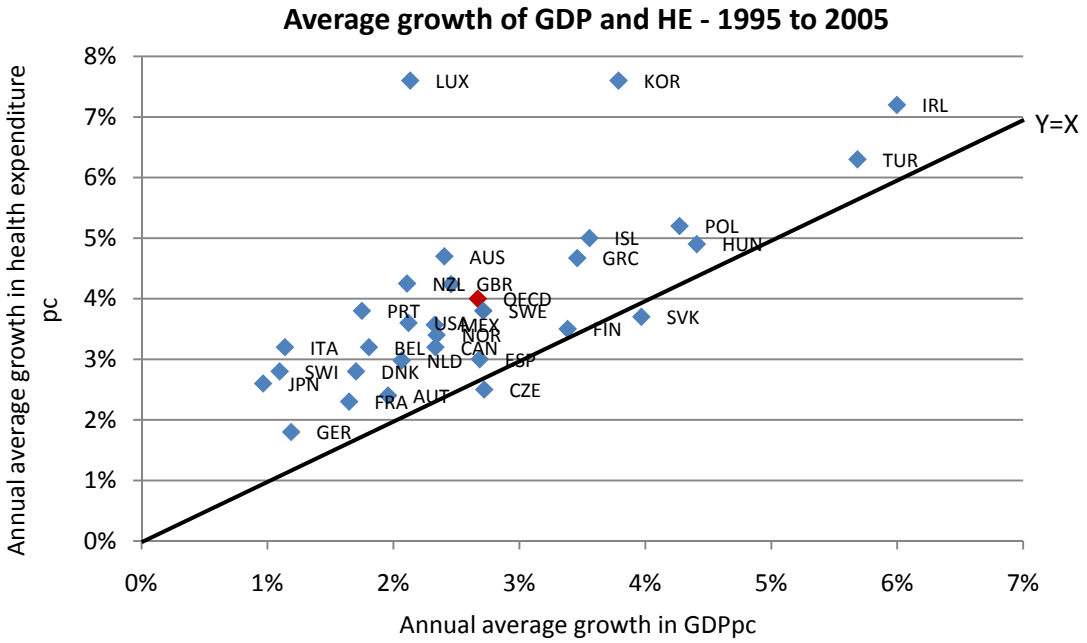


Changes over time in the ratio of health expenditure to GDP reflect the combined effects of trends in both GDP and health expenditure. Nearly all OECD countries have experienced an increase in the proportion of the national economy devoted to health over the past ten years. On average, health expenditure growth outpaced by a wide margin the overall economic growth between 1995 and 2005, although, in some countries, the increase in the share of GDP devoted to health has been more modest over that period. Spain, Finland and Hungary are examples where the overall economic growth has been almost matched by a growth in health spending. The Czech Republic and Slovakia are the only examples we find where the annual growth of GDP has been higher than the annual growth in health spending annual growth.

2.2. Expenditure on health per capita

Between 1995 and 2005, the health expenditure per capita, on average across the OECD, is estimated to have grown by around 4% annually in real terms. This compares with average economic growth of 2.5% over the same period, resulting in an increasing share of the economy devoted to health. However, behind this OECD average, there are significant differences among the countries and significant changes in time.

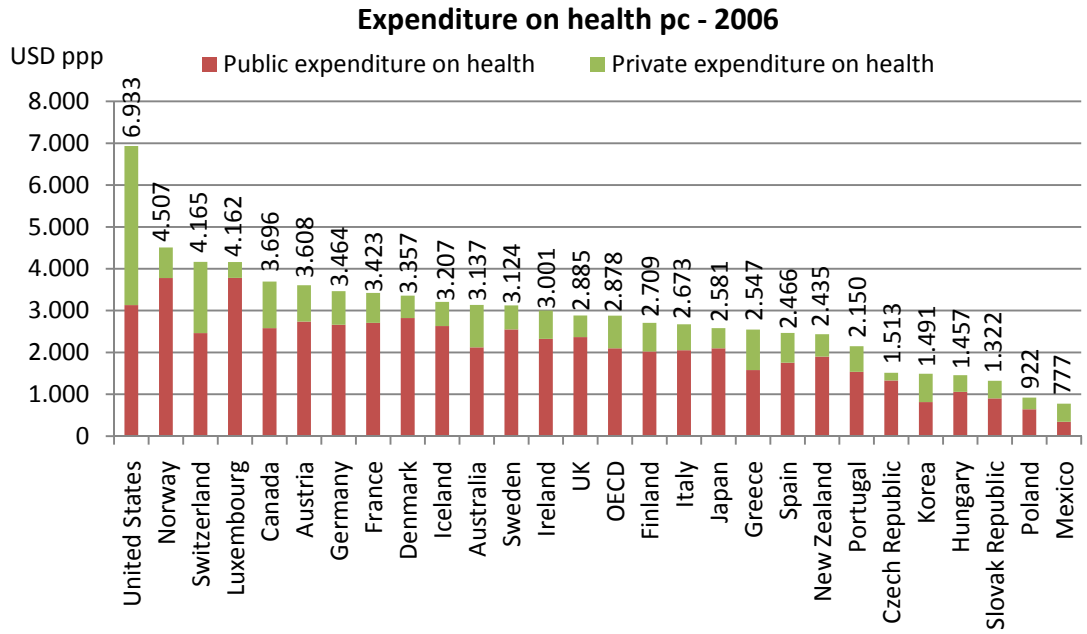
Figure 2.2 – Growth of GDP and total expenditure on health per country in real terms



In general, the countries that have experienced the highest growth over this period, such as Korea and Ireland, have been those countries that started out with relatively lower health expenditures per capita in the mid-1990s. Health expenditure growth in these two countries (as well as in Luxembourg) has been almost two times greater than the OECD average over this period. By contrast, countries such as Germany and France have experienced moderate (below average) health expenditure growth of around 2% per year between 1995 and 2005, partly as a result of cost-containment measures and slow economic growth during this period. Therefore, by 2005, expenditure on health per capita compared to an OECD average in Germany and France was only around 20% higher, in real terms, than the levels in 1995, which were about 50% higher.

To make a more comprehensive assessment of health spending in a country, both the health spending to GDP ratio (figure 2.1) and health spending per capita (figure 2.3) should be considered together. Countries having a relatively high health spending to GDP ratio might have relatively low health expenditure per capita, and conversely, countries with relatively low health expenditure to GDP ratio might have relatively high expenditure per capita. For example, Austria and Portugal both spent around 10% of their GDP on health; however, per capita spending (adjusted to USD PPP) was almost 70% higher in Austria. Also, Greece and Japan reported a similar health spending per capita in 2006. However, this represented 9.5% of GDP in Greece compared with only 8.1% of GDP in Japan.

Figure 2.3 –Expenditure on health per capita, public and private, 2006 – USD ppp



Total per capita spending on health shows considerable variation across the OECD. Such differences in spending levels can reflect a wide array of market and social factors as well as the diverse financing and organizational structures of the health system in each country.

In 2006, the highest spending country of the OECD was the United States, devoting 6 933 USD PPP per capita to health. This equated to more than two and a third times the average of OECD countries. After the United States were Norway and Switzerland with around two-thirds the level of spending per capita of the United States, but still more than 50% above the OECD average. Around half the OECD countries are then clustered in a band between USD 2 500 and USD 3 500 at PPP, representing between 90% and 125% of the OECD average. At the other end of the scale there is a group of five countries (Mexico, Poland, the Slovak Republic, Korea and Czech Republic), each with health expenditure per capita at a level of less or close to a half the OECD average.

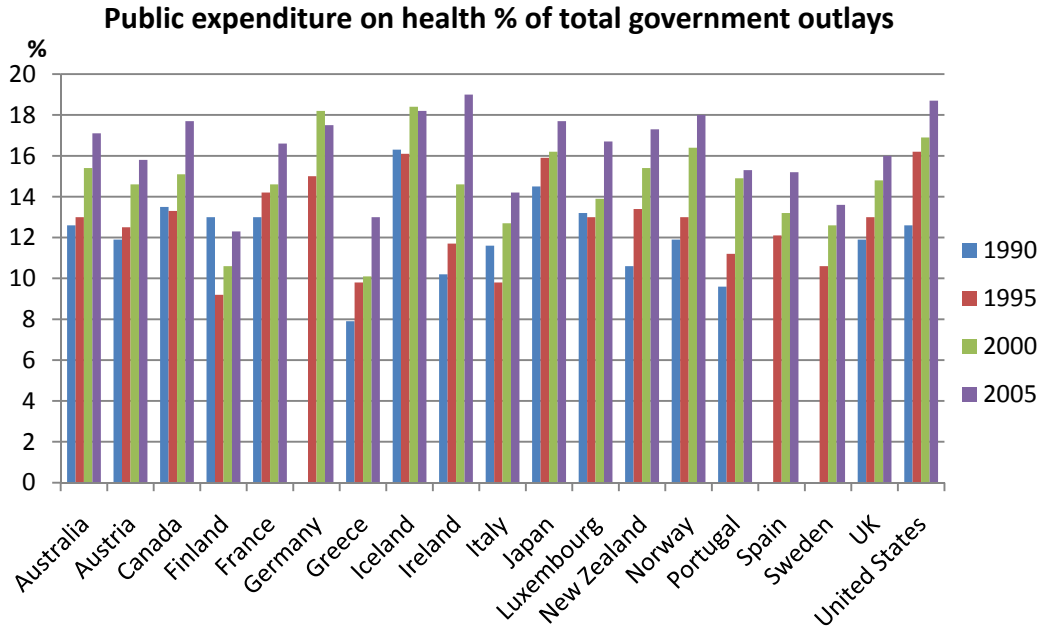
2.3. Public expenditure on health compared to total government outlays

Public expenditure on health has also been growing in terms of weight in total public expenditure. From figure 2.4 below we can see that almost every country shows an upward trend between 1990 to 2005. Germany and Iceland are the only two exceptions that have seen the public health expenditure decrease its weight on total government outlays from 2000 to 2005, although by a narrow margin.

In 2005 the public health expenditure exceeded 16% of total government outlays compared to only 12% as fifteen years before. This indicates that there is a high

importance of public health expenditure and this was one of the reasons for choosing this topic for our work.

Figure 2.4 – Public expenditure on health share on total government outlays



The essential goal of this section is to assess the magnitude of health expenditure compared to GDP and the magnitude of public health expenditure compared to total health expenditure and total government outlays.

3. Review of the relevant literature

Since we are interested in the effects of politics on health expenditure we decided to divide the literature review in three distinct subsections. First we start by reviewing the Political Business Cycles (PBC) theory, where we study conceptually how the politicians manipulate the economy to achieve personal ends according to their own motivations or party ideology.

Secondly, following the partisan theory from PBC we review the question of the impact of political parties on policy; what are the main differences between left and right in theory; is there a consistent empirical evidence that different ideology parties make a difference.

The third and last subsection of the literature review is about health expenditure drivers. We basically try to find if political factors (e.g. types of governments, election years) had already been tested as relevant variables to explain variations in health expenditure and if there is any evidence of the impact of government ideology on health expenditure.

3.1. Political business cycles

A substantial amount of research has already been done around "Political Business Cycles". Many authors have tried to find the political factors that may influence the business cycle or even create the cycle.

Theoretical research has concentrated on both partisan and opportunistic models. The two model types were initially based on monetary policy as the driving force and differ essentially in the motivation of policymakers, as well as in the modeling of expectations formation. These differences led to some very different types of politically induced economic cycles. Opportunistic models were first formalized by Nordhaus's (1975), he went on to show that if voting was based on economic performance in the recent past and if expectations of inflation were backward-looking, an opportunistic incumbent whose objective is maximizing the probability of reelection, would find it optimal to induce an inflation unemployment cycle corresponding to the length of his term, with there being a boom just before an election and a recession afterwards. In Nordhaus's model it is assumed that the government controls monetary policy, voters behave irrationally and fiscal policy plays no role.

Soon after, Hibbs (1977) presented a model of partisan policymakers in which the different macroeconomic goals were the key driving force. The basic partisan model starts with the observation that right-wing and left-wing parties have different positions on economic issues and hence different macroeconomic objectives (different preferences over inflation and unemployment). Fluctuations in economic activity induced by these partisan differences are generated by movements along the Phillips curve, where it is assumed that expectations are not rational.

A basic criticism of the original Hibbs model is the same critique that was applied to the Nordhaus model, namely that it relies on mistaken expectations of what policy will be and monetary surprises in order to get the real effects. Also the assumption that monetary policy is used by parties in government to achieve unemployment and growth targets is an unsatisfactory one given the independence of monetary authorities, namely the FED and the ECB.

Subsequent to these first early models there has been a large amount of work. Theoretical research has concentrated on both opportunistic and partisan models consistent with voters behaving rationally, both in forming expectations about future policy and in voting on the basis of those expectations.

Alesina (1987, 1988) made an important work where partisan post-electoral cycle was argued to be consistent with rational expectations.

Opportunistic pre-electoral manipulation was rationalized by assuming that there is imperfect information about a incumbent's competence, with expansionary policy before an election taken as an indicator of a higher competence, as in the pioneering work of Rogoff and Sibert(1988), Rogoff(1990) and in the papers that followed.

More recently Drazen (2000) concluded that models based on manipulating the economy via monetary policy are unconvincing both theoretically and empirically, while fiscal policies conform much better to the data and form a stronger basis for a convincing theoretical model of electoral effects on economic outcomes. Based on Rogoff's (1990) model of political business cycles, extended to include monetary policy, Drazen incorporated both monetary and fiscal policies in a rational opportunistic framework with separate monetary and fiscal authorities. He also presents some empirical evidence in favor of the active fiscal-passive monetary (AFPM) model of the opportunistic political business cycle.

On the empirical side there has been extensive work testing the original and subsequent models, and more generally, looking for empirical evidence of political determinants of business cycle activity. There are a number of clear electoral effects on macroeconomic variables. Although there is wide agreement that aggregate economic conditions affect political outcomes, there is significant disagreement about whether there is opportunistic manipulation that can be observed in the case of macro data. The partisan PBC has been tested less than the opportunistic model has been although there is a general agreement on the existence of partisan effects, especially on economic activity.

Drazen (2000) has summarized the empirical work in a survey. We present here the main conclusions of his work using his own definition of "regularities".

Table 3.1 – Empirical regularities on the PBC literature

Regularity 1	Aggregate economic conditions before an election, specifically per capita output or income growth (and to a lesser extent inflation), have a significant effect on voting patterns in the U.S. and other countries.
Regularity 2	There is no significant pre-electoral increase in aggregate economic activity prior to elections in either the U.S. or the OECD countries.
Regularity 3	In many OECD countries there is a clear post-electoral increase in inflation. In the U.S., there is evidence of such a post-electoral increase in inflation prior to 1979, but no evidence thereafter.
Regularity 4	There is evidence of pre-electoral increase in money growth rates in many countries. In the U.S., there is pre-electoral effect from 1960 to 1980, but none thereafter. There is no evidence for the U.S. of an electoral cycle in the Federal Funds rate.
Regularity 5	There is a clear partisan effect on economic activity in the U.S., with economic activity being significantly higher under Democrats than Republicans in the first half of their terms.

Table 3.1 (continued)

Regularity 6	There is no consensus on the role of monetary policy or inflation surprises in driving partisan effects, with views varying widely.
Regularity 7	There is evidence of pre-electoral increase in transfers and other fiscal policy instruments in a number of countries. In the U.S., this appears strongest prior to 1980.

Drazen concludes that the use of monetary surprises as a driving force of a political business cycle just does not provide a very convincing scenario.

An alternative approach is that fiscal policy is the key driving force, especially in pre-electoral manipulation in many countries. Tufte (1978) documents a number of clear incidents of pre-electoral opportunistic manipulation of fiscal transfers, both social on security payments and on veterans' benefits. Keech and Pak (1989) found an electoral cycle for veterans' benefits in the U.S. between 1961 and 1978. Similarly, Alesina (1988) shows that there was an electoral cycle in the net social transfers relative to GNP over the period 1961 to 1985. Alesina, Cohen, and Roubini (1992), as well as Alesina and Roubini (1990), find evidence for an opportunistic cycle in transfers.

Some researchers have found that the fiscal cycle is especially strong in developing countries. For example, in Israel, Ben-Porath (1975) shows convincingly that opportunistic policymaking with respect to taxation in light of elections was quite consistent over the period 1952-73. Krueger and Turan (1993) argue that pre-electoral fiscal manipulation was common in Turkey in the period 1950-1980. Pre-electoral fiscal manipulation is common in Latin America, the increase in the deficit in Mexico before the 1994 elections being one of many examples.

Cross country studies yield similar results. Ames (1987) presents a panel study of 17 Latin American countries in which he shows that over the period 1974-1982, government expenditures increased by 6,3% in the pre-election year and decreased by 7,6% in the year after the election. Schuknecht (1996) studied the political business cycle in 35 developing countries between 1970 and 1992. He uses a political dummy which is positive in the year of elections, negative in the year after elections and zero otherwise and finds a clearly significant effect of elections on the fiscal balance, but no significant effect on economic output. Gonzalez (1999) and Shi and Svensson (2000) extend Rogoff(1990) model of political budget cycles to study the effect of the degree of democracy on the magnitude of fiscal cycles. Gonzalez includes two further variables: the cost of removing a policymaker from office and "transparency". Meaning the probability that voters learn about the competence of the incumbent costlessly, that is, independent of signaling. They found that an electoral budget cycle emerges only if removing a politician from office is not too costly. Transparency also has

intuitive effects: the higher the degree of transparency, the lower the amount of distortion away from the first best in political budget cycle.

From many researches, some of them referred above, there appears to be a strong role for fiscal policy. This suggests that basing PBC models on fiscal policy rather than monetary policy is much more convincing and solves some basic problems because of which monetary PBC models have been criticized, namely that fiscal policy has real effects on economic activity even if anticipated.

The role of monetary policy in a political cycle is probably more passive rather than active, accommodating a fiscal stimulus that opportunistic policymakers may employ to affect election outcomes, as Woolley (1984) and Beck (1987) have argued. Also Beck (1987) pointed out that there is a passive political monetary cycle caused by a political cycle in fiscal instruments, but the Fed does not actively induce a political cycle.

Drazen (2000) presented a Active Fiscal – Passive Monetary (AFPM) model, the fiscal side follows the model of Rogoff (1990) of political budget cycles, with an incumbent using fiscal policy to help his re-election prospects. The monetary side of the model is consistent with that of Clarida, Gali and Gertler (1999), policy is controlled by a separate monetary authority, which may nonetheless accommodate a fiscal expansion. Drazen assumes heterogeneous voters meaning that a policymaker cannot maximize the utility of a "representative" agent, and transfers can be targeted at specific groups, so that there can be a significant effect on voting as a result of fiscal manipulation without necessarily being an effect on the aggregate economic activity. Drazen inspected the data and found space broadly consistent with the model.

3.2. Left-Right Ideology and government policies

The question of the impact of political parties on policy making has been the object of much scrutiny and debate in the past decades. The main theoretical debate concerns the relative weight of socio-economic and political variables in determining policy outputs. Advocates of the so-called 'convergence' school of thought argue that industrialized societies of the twentieth century have become increasingly similar, facing the same kind of problems and applying the same kind of solutions. Consequently, so the argument goes, political, institutional and cultural differences do not matter much when it comes to explaining variations in policy outputs (Skinner 1976; Thomas 1980). In reaction to the convergence argument, policy scholars have suggested that indeed politics does matter (Castles & McKinlay 1979b). Without denying the importance of economic factors, advocates of the 'politics matters' school of thought argue that there is a correlation between partisan variables and policy outputs. One key hypothesis of the partisan theory is that there exists a law-like tendency of policy making that takes into account the outcomes of former elections,

depending on the left-right party composition of government. Ceteris paribus, changes in the left-right party composition of government are hypothesized to be related to changes in policy making.

For example both Solano (1983) and Swank (1988) focus on the relationship between the total government spending as a percentage of GDP and the left-right party composition of the government across roughly similar sets of OECD countries. Swank found that changes in the party composition of government are associated with variations in spending but Solano found no party effect on public spending.

Pampel and Williamson (1988) and Hicks et al. (1989) examine the impact of parties on welfare expansion in advanced liberal democracies. However their conclusions disagree. Pampel and Williamson find no significant correlation between the party composition of the government and welfare expansion; Hicks, Swank and Ambuhl find that left governments generate an increase in the rate of welfare expansion while governments of the right are associated with a decrease in the rate of welfare expansion. Tavares (2004) found evidence that left-wing and right-wing cabinets make partisan oriented policies: the left tends to reduce the deficit by raising tax revenues while the right relies mostly on spending cuts.

The quantitative literature on partisan theory is quite extensive and has a readily understandable theoretical point of reference, but it lacks scientific coherence and directionality (McKinlay 1996). This fact is puzzling because qualitative studies often support the idea that the left-right partisan division matters for policy outputs (Klingemann et al. 1994; Stokke 1989), one possibility is that parties matter in many different ways which are more difficult to capture in quantitative studies than in qualitative studies. In other words, partisan effects would be too subtle to ensure sufficient robustness of cross-sectional statistical estimates. Another possibility is that some empirical studies may have tested the partisan influence hypothesis with the wrong methodology or with the wrong variables.

Imbeau, Petry and Lamari (2001) studied the relationship between the left-right party composition of government and policy outputs through a meta-analysis of 693 parameter estimates of the party-policy relationship published in 43 empirical studies. They addressed three important questions: how often do estimates support the left-right party impact hypothesis? What is the average magnitude of the effect size of left-right party impact? Are partisan cycle explanations more sensitive to substantive factors (e.g., the policy domain of government intervention; the historical period of analysis) or to issues of measurement and methodology? In response to the first two questions, they find that 154 (22 percent) of the estimates support the left-right party impact hypothesis, 48 (7 percent) of the estimates contradict the hypothesis, and 491 (71 percent) of the estimates fail to support the hypothesis. Applying the 'vote-counting' meta-analytic technique, they conclude that the null hypothesis of no left-right party impact cannot be rejected. They reach the same conclusion using a revised

'combined tests' technique to generate an 'average effect size' of left-right partisan impact on policy. The average correlation of 0.28 effect between party and policy indicates that approximately 8 percent of the variation in policy output is accounted for by the variation in the left-right party composition of a government. However, a test of statistical significance of the average effect size shows that the absence of a partisan impact in the population cannot be ruled out.

Although the authors recognize that given the extreme diversity of tests reviewed, judging solely on the basis of overall numbers of successes or the effect size involves a real risk of committing a Type II error (accepting the null hypothesis while it is false). Indeed, the success rate rises from 0.22 to 0.50 for tests on the size of the state in the post-1973 period.

In response to the third question, they find from the multivariate logistic regression model that there are four variables that positively influence the probability of success in empirical tests of left-right partisan theory. Success occurs more frequently with multivariate tests, with measures of the size of the state as opposed to measures based on specific policy domains (especially foreign affairs and the economy), based on post-1973 data and with a measure of party strength based on popular vote. When other explanatory variables are kept constant, multivariate tests of the impact of the left-right division of the popular vote on the size of the state during the post-1973 period are approximately three times more likely to be reported as successful than bivariate tests of party impact on welfare during the pre-1973 period when party strength is assessed with a mixed measure (however the difference in the probability of success decreases when the tests introduced by Wilensky (1976, 1981) are removed from the analysis).

On the other hand, the variables for financial government activity, left-right party ideology, and sample size all fail the statistical significance test in the multivariate analysis.

The absence of a statistical impact of the sample size variable on success appears to contradict the notion that left-right partisan effects are virtually always present but that their magnitude is so small that they can only be detected using large samples.

The relatively high success rate of post-1973 left-right partisan tests of the size of the state suggests some degree of directionality in the field. One possible explanation is that partisan theorists have improved their methodology over time: post-1973 tests would be more successful than pre-1973 tests because they are reported in studies that are more recent and therefore methodologically more sophisticated. However, the data do not support this interpretation. In order to test for a separate effect for methodological improvement over time, Imbeau, Petry and Lamari included the year of publication of individual studies as an additional control and found that the coefficient was not significant. They suggest a better explanation; the left-right partisan composition of government predicts welfare spending better than policy

outputs in other domains in the pre-1973 period. In the post-1973 period, however, it is the size of the state that is the best predicted by the left-right partisan composition of government. The data therefore suggest a strengthening of the left-right partisan divide over total government spending (and a decrease in the left-right partisan divide over welfare spending) in OECD countries during the period of analysis. This appears to be compatible with the view of two historically divergent periods, each one characterized by a distinct partisan climate: the pre-1973 years coincide with high economic growth and a broad left-right consensus over macroeconomic implications of public policy. In this context, left-right partisan conflicts occurred mainly over welfare spending as a means of redistributing a society's abundant resources. By contrast, the post-1973 period is characterized by lower rates of growth, higher inflation and unemployment and increased left-right conflicts over the appropriate size of the public sector (Peters 1990; Przeworski & Wallerstein 1982). One might hypothesize that, as the substantive stakes of left-right party rivalry shifted away from social welfare and toward the overall size of the public sector, the frequency of success and the effect size of individual tests of partisan impact on the overall size of the state have tended to increase relative to tests of partisan impact on welfare.

3.3. The main drivers of Health Care Expenditure (HCE)

As we saw in section 2 the share of health care expenditure in GDP rises rapidly in virtually all OECD countries, causing an increasing concern among politicians and the general public. This rapid growth jeopardizes the sustainability of public budgets and causes an increasing interest in the determinants of health care expenditures. The literature proposes many factors are possible drivers of health care expenditures. Yet, economists have failed to reach an agreement on what the main determinants of this development are.

The effect of politics and policies on health outcomes and expenditure has rarely been studied.

In this section we resume the most relevant literature to date. We present a table from "Aggregate studies of age and health Expenditures", a technical paper published by the Australian Productivity Commission and updated by us.

We divided the original table in four new tables with the objective of grouping the papers by their main conclusions

The first table contains the papers whose main objective was relating health expenditure with income.

Table 3.2 – Literature review on health care expenditure related to income

Author	Year	Countries	Empirics	Main conclusions
Newhouse	1977	13 developed nations	Cross national comparison	Compares per capita GDP with per capita HCE, and is able to attribute 92 per cent of the variance between HCE to per capita GDP differences across the nations studies.
Culyer	1989	European countries	Reviews the reform process of nations battling rising health care requirements	Concludes that given the strength of the relationship between HCE and income, growing expenditures are consequently beyond the reach of policy.
Hitiris and Posnett	1992	OECD	Uses a sample of 560 cross sectional and time series observations to test the determinants of HCE	Their results reaffirmed that the vast majority of expenditures on health are caused by income discrepancies. The impact of demographic variables was quite limited under all their model specifications, if even found to be significant.
Jonsson and Eckerlund (OECD)	2003	OECD	Cross country study of OECD member states 1998	Replicates Newhouse 1977 with more recent data, but now attributes only 77 per cent of cross country comparison to differences in income.

It is widely accepted that variations in national income generally account for most of the cross country differences in health outlays.

The next tables resume papers that although were not aimed at investigating the correlation between income and health expenditure most of them included income as a control variable, as we do on our own models.

Table 3.3 – Literature review on health care expenditure related to demographic variables

Author	Year	Countries	Empirics	Main conclusions
Fuchs	1984		Qualitative and quantitative analysis	Examines trends in HCE, and age specific morbidity and mortality. Fuchs concludes that spending is a function of death, and aggregate expenditure has been rising with the number of persons approaching their final years.
Getzen	1992		Cross country study of real HCE growth between 1960 and 1990	If income is included in the regression, ageing is not found to be significant, implying that rising HCE and rising ages are the result of an indirect relationship with other variables. Moreover, concludes that ageing affects only the allocation of expenditures, but will not substantially increase the total level of HCE.
Gerdtham, Josson and MacFarlan	1992		Cross country study of the determinants of HCE	Tests a variety of background and institutional variables. Background variables are mostly socio-economic, and include ageing and per capita income, as well as alcohol and tobacco consumption. Institutional variables refer to funding arrangements, access schemes etc.
Lamers and Van Vliet	1998	Netherlands	Study of Dutch social insurance system	Found that health outlays in the last year of life were some 15.3 times greater than costs than for those otherwise.

Table 3.3 (continued)

Richardson and Robertson	1999	Australia	Uses Australian subdivisions in cross section to test for determinants of HCE	Compares the use of GP services per capita across the 186 Australian SSDs. After standardising for a number of statistically significant variables (inc. urban/rural, aboriginality, public hospitals etc), found the age/sex variable explains only 3 per cent of the cross sectional variance.
Zweifel, Felder and Meiers	1999	Switzerland	Uses Swiss data 83-94 test if rising health costs can be explained by "closeness to death"	Although calendar age variables were statistically significant the respective coefficients were of little influence on the model. Quarters to death however, contained much more explanatory power.
Stooker et al.	2001	Netherlands	Tests the determinants of HCE primarily as a function of years remaining	Reaches similar conclusions to Zweifel et al. Significantly however, Stooker et al, attribute only 10 per cent of total health costs to the dying, arguing that any measures taken to reduce the costs of dying will have only a moderate impact on the total health budget.
Sheehan	2002	20 OECD countries	Cross country study 1989-1999	Tests for correlation between real health growth over the decade and growth in the proportion of over 65s. Reports a correlation coefficient of 0.04, and a number of countries reported highly counter intuitive results- suggesting that there is no relation between the two. Concludes that we are getting older later, rather than older younger.

Table 3.3 (continued)

Moise and Jacobzone (OECD)	2003	OECD	Cross country study of OECD member states 1997	Finds little correlation between per capita HCE and percentage of population aged over 65.
Bains (OECD)	2003	EU countries	Projects HCE to 2050 EU member states	Projections map current age-sex-expenditure profiles against predicted pop changes. Ageing will increase public HCE as a percentage of GDP by between 0.7 and 2.3 percentage points.
Seshamani and Gray	2004	United Kingdom	Longitudinal study of hospital costs in Oxfordshire UK	Finds a relationship between proximity to death, particularly the last year of life (but extending back 15 years), and hospital costs.

From the table above we can conclude that there seems to be a consensus among the authors pointing to the fact that at the proximity to death individuals increase health expenditure, though we cannot say that proportion of population aged over 65 or median age are relevant factors when comparing health expenditure among countries.

Table 3.4 – Literature review on health care expenditure related to other variables than income and demographics

Newhouse	1992	USA	Using a fixed weight expenditure profile, to compare health spending between 1950 and 1987	Examines the role played by access to insurance, increased incomes, supplier induced demand, and low productivity growth of health services, concluding that these factors account for most of the rise in HCE.
Barros	1998	24 OECD countries	Empirical cross country study	Population ageing, type of health system, and existence of gatekeepers are found to be non-significant

Table 3.4 (continued)

Karatzas	2000	USA	Time series test of US aggregate per capita real HCE 62-89	Constructs a variety of models which include economic, health stock and demographic variables to predict per capita real health expenditure.
Chernichov-sky and Markowitz	2004	Israel	Time series study of HCE 1966 to 1998	Uses median age, doctors per 1000 persons, mean years of schooling and GNP per capita to explain HCE per capita. Coefficient on median age is insignificant.
Jacobzone	2003		Survey article	Demography, is a secondary factor in the overall increase of HCE. The key factor is technology and rising relative prices for medical inputs, combined with the intensity of medical care at older ages. Points to the high concentration of medical costs at the end of life, and argues that failure to account for this will tend to overstate any future predictions.
Di Matteo	2005	USA	American state-level data for the period 1980–1998 and Canadian province-level data for the period 1975–2000	Ageing population distributions and income explain a relatively small portion of health expenditures when the impact of time effects, which is a partial proxy for technological change, is controlled for

Table 3.4 (continued)

Navarro, Muntaner, Borrell, Benach, Quiroga, Rodríguez-Sanz, Vergés and Pasarín	2006	OECD countries	Analyzed a number of political, economic, social, and health variables over a 50-year period	Find support for the hypothesis that the political ideologies of governing parties affect some indicators of population health. Their analysis makes an empirical link between politics and policy, by showing that political parties with egalitarian ideologies tend to implement redistributive policies
Dormont, Martins, Pelgrin and Suhrcke	2007	OECD	Empirical study on OECD countries	Rising HCE trend has little relation to demography, but it is rather driven by consumers preferences for longer lives and the diffusion of technological progress
Hartwig	2008	19 OECD countries	Empirical study using data from a panel of 19 OECD countries	Health care expenditure is driven by wage increases in excess of productivity growth

Many authors have searched for explanatory variables for variations of health expenditure. In the table above we present some of the most relevant papers published, in some cases the authors claim that strong correlations have been identified. However there is some lack of consistency in methods and results since rarely there have been some papers corroborating each other.

Our next table refers precisely to investigations that have been made to question methods and data related problems like non stationary series used in models that assume stationarity.

Table 3.5 – Literature review on health care expenditure and empirical methods used and series analysis

Author	Year	Countries	Empirics	Main conclusions
Hansen and King	1996		Critical study of the econometric methods used in many of the above studies	Suggests that standard time series models where HCE is a function of real per capita GDP and a selection of non-income variables may be misspecified. Finds variables in many OECD orientated models are not stationary, arguing that this violates an assumptions of an OLS regression.
Blomqvist and Carter	1997		Reviews methodological problems that arise from issues in the data	Found unit roots in HCE and GDP and concluded that both are non-stationary
McCoskey and Selden	1998		Applies newly developed panel unit root tests to the concerns of non stationary series by Hansen and King	Using new tests contradict Hansen and King by rejecting the null hypothesis of unit root for both HE and GDP
Gerdtham and Lothgren	2000		Tests the data for stationarity and cointegration	OECD health expenditure and GDP data from the period 1960-1997 proves to be non-stationary. The studies which have relied on this data set to reach their conclusions may have reached the wrong conclusions.
Salas and Raftery	2001		Questions Zweifel's methodologies and results econometrically	Identifies two particular problems with the Zweifel et al study: a) Study assumes HCE and time to death to be unrelated; and b) sample selectivity problems which they claim weren't properly controlled for.

Table 3.5 (continued)

Dow and Norton	2002		Explores the econometric methodologies of the paper by Zweifel et al.	Building on the concerns of Salas and Raftery, Dow and Norton have additional problems with Zewifel et al. They claim Zweifel et al.'s choice of model selection is a flaw in the study.
Jewell et al.	2003		Tests for structural breaks in the data	Counter's the conclusions of other econometric criticisms, claiming that after structural breaks are controlled for, the data proves to be reliable and stationary.

The available empirical methods are extensive and can lead to diverse results even while using the same data series. Several authors have reached different conclusions and contradicted each other basing their studies in different approaches although using the same data. As econometrics evolve this kind of situation is expectable, therefore our own approach can be considered innovative, as we are using a new method which relies in part on the work recently published (2003) by Bai and Perron.

4. Discussion

The main hypothesis that we discuss in this paper is that political factors actually do influence public health expenditure; we expect to find evidence of this, not basing our research on temporary shocks as most researchers do, but on structural breaks on the expenditure series. Usually when researchers try to account for the structural breaks they attempt to isolate their effect and transform the original series in a stationary series. We, however attempt to use the structural break dates and explore the years of their occurrence further, namely correlating with political variables using probit models. Following this procedure we hope to achieve results that we would not be able to achieve using the original series since our dependent variable is a specific piece of information. The information that is extracted from the original series is actually very important because trend breaks are one-time events with a permanent effect. Hansen (2001) concluded that structural change is pervasive in economic time series relationships, and it can be quite perilous to ignore. Inferences about economic relationships can go astray, forecasts can be inaccurate, and policy recommendations

can be misleading. The new tools developed in the past few years are useful aids in econometric model specification, analysis and evaluation.

Our objective is to answer questions such as: do party government changes have an impact as significant as to create or at least contribute to structural breaks in health expenditure series? Can public expenditure on health be increased before elections by opportunistic politicians? Do different ideology governments create opposite sign trend breaks in public health expenditure? Do structural breaks occur more often in a specific type of government (coalition/majority)?

We begin by indentifying the structural breaks on health expenditure series, GDP per capita and government consumption per capita. We do it independently of political information, that is to say we do not test specific dates when we are identifying the breaks we simply compute the most relevant breaks in each series following Bai and Perron (2003). The only restriction that we impose in the process of identifying the structural breaks is that they cannot occur within a four observations radius between each other. This is both a logical imposition since governments are supposed to hold office for four years and a methodological imposition since a time series with less than four observations fail to produce statistically significant estimators for trend and level coefficients. Anyway; this restriction is not so significant since almost every break is estimated to occur farther from each other than four observations.

In every country included in our data set the government proposes and is responsible for the annual state budget. That means that governments take decisions every year about the public expenditure composition and have a significant impact on the economy. The points when the probability of significant breaks occurrence is higher should be when there are government changes, namely after or before elections, and when the incumbent party is defeated and a party from a different ideology wins the election.

If different ideologies follow different governing paths, than we should find some evidence of change in policies in the years prior to the election and the years after it. Relaying on fundamentals of the ideology we should expect leftwing parties to increase social expenditure once they are elected, and eventually increase the public share in sectors like education and health (Glyn 2001). Rightwing parties are expected not to increase, or even reduce social expenditure and eventually decrease the government weight in the economy, including in social sectors, promoting de-regulation and introducing free market reforms.

Elections are usually held every four years, or in shorter intervals if for some reason the government falls or resigns to impose new elections. If in fact political ideology is a relevant variable when we think of public expenses, than election years should be critical points for changes in several public expenditure series. With this thought in mind we should expect to find significant changes in several public expenditure series in election years. Those changes can be either a tendency break or a level break.

5. Empirical Analysis

5.1. Data

Our data set covers a set of OECD countries between the years 1960 and 2006 and relies on two main sources. Macroeconomic indicators and Health expenditure are from *OECD – Health Data* (2008) while political data is taken from Budge et al. (1993), updated to 1995 by Woldendorp et al. (1998) and updated again to 2006 by Armingeon et al. (2008).

We restricted our research to the 23 countries[1] available in the "Comparative Political Data Set 1960-2006", given by Armingeon et al. (2008).

Whenever possible we have used 47 observations for each country, corresponding to the period of 1960 to 2006 but that was not always possible since some of the series were incomplete in OECD – Health Data. Also in Armingeon et al. (2008) for the cases of Greece, Spain and Portugal, political data were collected only for the democratic periods. Summing up we have an average of 37 annual observations per country.

5.2. Identifying the Structural Breaks – the procedure

We have started our research by analyzing individually all the time series. Following the procedures of Bai and Perron (2003) *"Computation and Analysis of Multiple Structural Change Models"* we have determined the most relevant structural breaks in all the time series for all the countries.

5.2.1 Theory

Both the statistics and the econometrics literature contain a vast amount of work on issues related to structural changes, most of it specifically designed for the case of a simple change. The problem of multiple structural changes has received considerably less but increasing attention. Recently, Bay and Perron (1998) considered estimating multiple structural changes in a linear model estimated by least squares. The results are obtained under a general framework of partial structural changes which allows a subset of the parameters not to change (and, of course, includes a pure structural change model as a special case). They also addressed the important problem of testing for multiple structural changes: a sup Wald type tests for the null hypothesis of no changes versus an alternative containing an arbitrary number of changes and a procedure that allows one to test the null hypothesis of, say, *l* changes, versus the alternative hypothesis of *l*+1 changes. The latter is particularly useful in that it allows a

[1] Australia, Austria, Belgium, Canada , Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States

specific to general modeling strategy to consistently determine the appropriate number of changes in the data.

They first address the problem of the estimation of the break dates and present an efficient algorithm to obtain global minimizers of the sum of squared residuals based on the principle of dynamic programming which requires at most least-squares operations of order $O(T^2)$ for any number of breaks. Their method can be applied to both pure and partial structural change models. They also consider the problem of forming confidence intervals for the break dates under various hypotheses about the structure of the data and errors across segments. In particular, we may allow the data and errors to have different distributions across segments or impose a common structure. The issue of testing structural changes is also tested under very general conditions on the data and the errors. They also discuss how the tests can be constructed allowing different serial correlation in the errors, different distribution for the data and the errors across segments or imposing a common structure. They also address the issue of estimating the number of breaks. To that effect they discuss methods based on information criteria and a method based on sequential testing procedure. All methods are implemented in a Gauss program that we extensively used.

5.2.2 The model

Since we are interested in trend and level breaks only, we perform a regression of each variable on a constant and on time. Consider the following linear regression model with *m* breaks (*m*+1 regimes):

$$y_t = \beta_j + t\delta_j + u_t \qquad t = T_{j-1} + 1, \dots, T_j$$

for $j = 1, \dots, m+1$. In this model y_t is the observed dependent variable at time t, β_j and δ_j are the vectors of coefficients of a constant and time; u_t is the disturbance at time t. The indices $(T_1, \dots, T_m)$, or the break points, are explicitly treated as unknowns (we use the convention that $T_0 = 0$ and $T_{m+1} = T$). The purpose of this is to estimate the unknown regression coefficients together with the break points when T observations on y_t are available. This is a pure structural change model where all the parameters are subject to change. The variance of u_t does not need to be constant. Indeed, breaks in variance are permitted provided they occur at the same dates as the breaks in the parameters of the regression.

The authors recognize that the existence of breaks in the variance could be exploited to increase the precision of the break date estimators. However they do not pursue that avenue and instead they treat the variance as a nuisance parameter and focus on breaks in the conditional mean of y_t.

The method of estimation considered is that based on the least-squares principle. For each *m*-partition $(T_1, \dots, T_m)$, the associated least-squares estimates of β_j and δ_j are obtained by minimizing the sum of squared residuals

$$\sum_{j=1}^{m+1} \sum_{t=T_{j-1}+1}^{T_j} [y_t - \beta_j - \delta_j]^2$$

Let $\hat{\beta}(\{T_j\})$ and $\hat{\delta}(\{T_j\})$ denote the estimates based on the given m-partition $(T_1, \dots, T_m)$ denoted $\{T_j\}$. Substituting these in the objective function and denoting the resulting sum of squared residuals as $S_T(T_1, \dots, T_m)$, the estimated break points $(\hat{T}_1, \dots, \hat{T}_m)$ are such that $(\hat{T}_1, \dots, \hat{T}_m) = argmin_{T_1,\dots,T_m} S_T(T_1, \dots, T_m)$, where the minimization is taken over all partitions $(T_1, \dots, T_m)$ such that $T_i, \dots, T_{i-1} \geq q$. Thus the break-point estimators are global minimizers of the objective function. The regression parameter estimates are the estimates associated with the *m*-partition $\{\hat{T}_j\}$, i.e. $\hat{\beta} = \hat{\beta}(\{\hat{T}_j\}), \hat{\delta} = \hat{\delta}(\{\hat{T}_j\})$. Since, the break points are discrete parameters and can only take a finite number of values, they can be estimated by a grid search. This computational method becomes rapidly excessive when $m > 2$. Fortunately, there exists a very efficient method presented in Bai and Perron (2003) which we will present in the next subsection.

5.2.3 Method to compute Global minimizers

Bai and Perron (2003) propose an algorithm based on the principle of dynamic programming that allows the computation of estimates of the break points as global minimizers of the sum of squared residuals. This algorithm uses at most least-squares operations of order $O(T^2)$ for any number of structural changes *m*, unlike a standard grid search procedure which would require least squares operations of order $O(T^m)$. The basis of the method was considered by Guthery (1974), Bellman and Roth (1969) and Fisher (1958).

The basic idea of the approach becomes fairly intuitive once it is realized that, with a sample of size T, the total number of possible segments is at most $T(T+1)/2$ and is therefore of order $O(T^2)$.

Figure 5.1 – Special case with $T = 10$ and $m = 2$ and $h = 3$

The vertical axis represents the initial date of a segment and the horizontal axis the ending date. Each entry represents an estimated sum of squared residuals corresponding to the associated segment. The global sum of squared residuals for any *m*-partition $(T_1, \ldots, T_m)$ and for any value of *m* must necessarily be a particular linear combination of these $T(T+1)/2$ sums of squared residuals. The estimates of the break dates, the *m*-partition $(\hat{T}_1, \ldots, \hat{T}_m)$, correspond to this linear combination with a minimal value.

		Terminal date									
		1	2	3	4	5	6	7	8	9	10
Starting Date	1	a	a	o	o	b	b	b	b	b	b
	2	·	a	a	c	c	b	b	b	b	b
	3	·	·	a	a	c	b	b	b	b	b
	4	·	·	·	a	a	o	o	b	b	b
	5	·	·	·	·	a	a	o	b	b	b
	6	·	·	·	·	·	a	a	d	d	b
	7	·	·	·	·	·	·	a	a	d	o
	8	·	·	·	·	·	·	·	a	a	o
	9	·	·	·	·	·	·	·	·	a	a
	10	·	·	·	·	·	·	·	·	·	a

a segment not considered since it must be at least of length 3
b segment not considered since otherwise there would be no place for 3 segments
c segment not considered since otherwise there would be no place for a segment prior to it
d segment not considered since otherwise there would be no place for a segment after it
o possible segment

The dynamic programming algorithm can be seen as an efficient way to compare possible combinations (corresponding to different *m*-partitions) to achieve a minimum global sum of squared residuals.

In practice, less than $T(T+1)/2$ segments are permissible. First, some minimum distance, h, between each break may be imposed. In our case we have always tried to impose the minimum distance of $h = 4$ since that's the usual period between elections. Other reductions are possible. The largest segment must be short enough to allow *m* other segments before or after. Finally, a segment cannot start at dates 2 to *h*, since otherwise no segment of minimal length *h* could be inserted at the beginning of the sample.

Once the sums of squared residuals of the relevant segments have been computed and stored, a dynamic programming approach can be used to evaluate which partition

achieves a global minimization of the overall sum of squared residuals. This method essentially proceeds via a sequential examination of optimal one-break (or two segments) partitions. Let $SSR(\{T_{r,n}\})$ be the sum of squared residuals associated with the optimal partition containing r breaks using the first n observations. The optimal partition solves the following recursive problem:

$$SSR(\{T_{m,T}\}) = \min_{mh \le j \le T-h} [SSR(\{T_{m-1,j}\}) + SSR(j+1, T)]$$

The procedure starts by evaluating the optimal one-break partition for all sub-samples that allow a possible break ranging from observations h to $T - mh$. Hence, the first step is to store a set of $T - (m+1)h + 1$ optimal one-break partitions along with their associated sum of squared residuals. Each of the optimal partitions correspond to subsamples ending at dates ranging from $2h$ to $T - (m-1)h$.

The next step is to search for optimal partitions with two breaks. Such partitions have ending dates ranging from $3h$ to $T - (m-2)h$. For each of these possible ending dates, the procedure looks at which one-break partition (saved earlier) can be inserted to achieve a minimal sum of squared residuals. The outcome is a set of $T - (m+1)h + 1$ optimal two breaks (or three segments) partitions. The method continues sequentially until a set of $T - (m+1)h + 1$ optimal $(m-1)$ breaks partitions are obtained with ending dates ranging from $(m-1)h$ to $T - 2h$. The final step is to see which of these optimal $(m-1)$ breaks partitions yields an overall minimal sum of squared residuals when combined with an additional segment. The method can therefore be viewed as a sequential updating of $T - (m+1)h + 1$ segments into a single optimal one, two and up to $(m-1)$ breaks partitions (or into two, three and up to m sub-segments); the last step simply creating a single optimal m breaks (or $m+1$ segments) partition.

A central result in Bay and Perron (1998) concerns the convergence of the break fractions $\hat{\lambda}_i = \frac{\hat{T}_i}{T}$ and the rate of convergence. The results obtained show not only that $\hat{\lambda}_i$ converges to its true value λ_i^0 but that it does so at the fast rate T, i.e. $T(\hat{\lambda}_i - \lambda_i^0) = O_p(1)$ for all i. It is important, however, to note that this rate T convergence pertains to the estimated break fractions $\hat{\lambda}_i$ and not to the break dates $\hat{T}_i$ themselves. For the latter, the result shows that with a probability arbitrarily close to one, the distance between $\hat{T}_i$ and T_i^0 is, in large samples, bounded by a constant independent of the sample size.

This convergence result is obtained under a very general set of assumptions allowing a wide variety of models. It, however, precludes integrated variables (with an autoregressive unit root) but permits trending regressors. The assumptions concerning the nature of the errors in relation to the regressors $\{x_t, z_t\}$ are of two kinds. First, when no lagged dependent variable is allowed in $\{x_t, z_t\}$, the conditions on the residuals are quite general and allow substantial correlation and heteroskedasticity.

The second case allows lagged dependent variables as regressors but then, of course, no serial correlation is permitted in the errors $\{u_t\}$. In both cases, the assumptions are general enough to allow different distributions for both the regressors and the errors in each segment.

Bay and Perron (2000) present an extensive simulation analysis pertaining to the size and power of the tests, the accuracy of the asymptotic approximations for the confidence intervals and the relative merits of different methods to estimate the number of breaks. The methods are shown to be adequate, in general, but care must be taken when using series with particular specifications.

The recommended method for empirical applications is first to look at the *UD max* or *WD max* tests to see if at least one break is present. If these indicate the presence of at least one break, then the number of breaks can be decided based upon a sequential examination of the $supF(l+1|l)$ statistics constructed using global minimizers for the break dates (i.e. ignore the test $F(1|0)$ and select m such that the tests $supF(l+1|l)$ are insignificant for $l \geq m$).

5.2.4 Double Maximum Tests (*UD max* and *WD max*)

Often, an investigator wishes not to pre-specify a particular number of breaks to make inference. Bai and Perron (1998) have introduced two tests of the null hypothesis of no structural break against an unknown number of breaks given some upper bound *M*. These are called the *double maximum tests*. The first is an equal weighted version defined by *UD max*F_T(M,q)=max$_{1\leq m\leq M}F_T(\hat{\lambda}_1,\ldots,\ \hat{\lambda}_m;q)$, where $\hat{\lambda}_j = \hat{T}_j/T$ (*j*=1,…,m) are the estimates of the break points obtained using the global minimization of the sum of squared residuals. The second test applies weights to the individuals tests such that the marginal p-values are equal across values of m and is denoted *WD max*F_T(M, q).

5.2.5 A Test of l versus $l+1$ Breaks

Bai and Perron (1998) proposed a test for l versus l +1 breaks, labeled sup$F_T(l$ +1$|$ $l)$. The method amounts to the application of (l+1) tests of the null hypothesis of no structural change versus the alternative hypothesis of a single change. The test is applied to each segment containing the observations $\hat{T}_{i-1}$ to $\hat{T}_i$ $(i = 1 \ldots., l+1)$. We conclude for a rejection in favor of a model with (l +1) breaks if the overall minimal value of the sum of squared residuals (over all segments where an additional break is included) is sufficiently smaller than the sum of squared residuals from the l breaks model. The break date thus selected is the one associated with this overall minimum.

5.3. An Exmple

Example: Ireland - Public expenditure on health share on GDP

The first step is to consider the UDmax and WDmax tests. Both indicate the presence of structural breaks against the null hypothesis of no breaks.

The UDmax test is: 962,1936 (the critical value at the 1% level is: 16,19)
The WDmax test at the 1% level is: 2381,1 (The critical value is: 17,8)

Table 5.1 – Running the gauss procedure for computing successively the break dates yields the following results:

Number of Breaks	1	2	3	4	5	6	7	8
The number of the observation where the breaks occur	24	22	20	10	8	8	8	4
		38	31	20	17	17	17	8
			41	31	21	21	21	17
				41	31	31	26	21
					41	35	30	26
						41	34	30
							41	34
								41
SupF(l+1|l) tests using global otimizers under the null		44,15	85,31	24,55	14,85	7,59	7,59	7,59
The critical values of supF(i+1|i) at the 10% level		12,19	13,20	13,79	14,37	14,68	15,07	15,42

Following the SupF test as suggested in Bai and Perron (2003) the number of breaks that better fits the data is five (shadowed area in the table above).

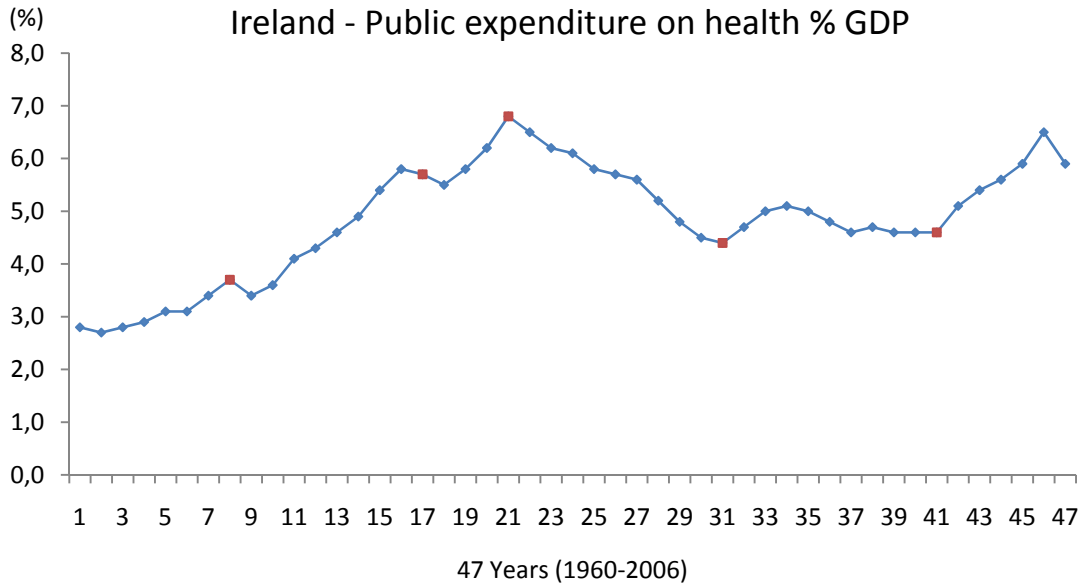
Table 5.2 – Output from Gauss of the regression considering five structural breaks:

Valid cases:	47	Dependent variable:	Y
Missing cases:	0	Deletion method:	None
Total SS :	54,853	Degrees of freedom:	35
R-squared:	0,983	Rbar-squared:	0,978
Residual SS:	0,907	Std error of est:	0,161
F(12,35):	173,413	Probability of F:	0
Durbin-Watson:	2,035		

Variable	Estimate	Std. Error	t-value	Prob. >|t|
X01	2,479	0,125	19,756	0,000
X02	0,130	0,025	5,223	0,000
X03	0,528	0,275	1,916	0,064
X04	0,317	0,021	15,235	0,000
X05	-2,310	1,406	-1,642	0,109
X06	0,430	0,072	5,972	0,000
X07	1,776	0,473	24,922	0,000
X08	-0,238	0,018	-13,402	0,000
X09	6,385	0,649	9,838	0,000
X10	-0,044	0,018	-2,496	0,017
X11	-3,930	1,714	-2,293	0,028
X12	0,217	0,038	5,642	0,000

Confidence intervals for the break dates
The 95% C,I, for the 1,0000 th break is: 7,0000 9,0000
The 95% C,I, for the 2,0000 th break is: 16,0000 18,0000
The 95% C,I, for the 3,0000 th break is: 20,0000 22,0000
The 95% C,I, for the 4,0000 th break is: 30,0000 32,0000
The 95% C,I, for the 5,0000 th break is: 40,0000 42,0000

Figure 5.1 Graphically – The series is represented in blue and the suggested break dates are in red



We admit that we did not make tests for the existence of unit roots in the series, but from a theoretical point of view it is reasonable to assume that the series are not integrated. The results could be further supported using the method of Havrey, Leybourne and Taylor in "Simple, robust and powerful tests of the breaking trend hypothesis", if this works as the authors claim, although their paper is not yet published, the break tests can be applied to any series since they are robust to every type of trend.

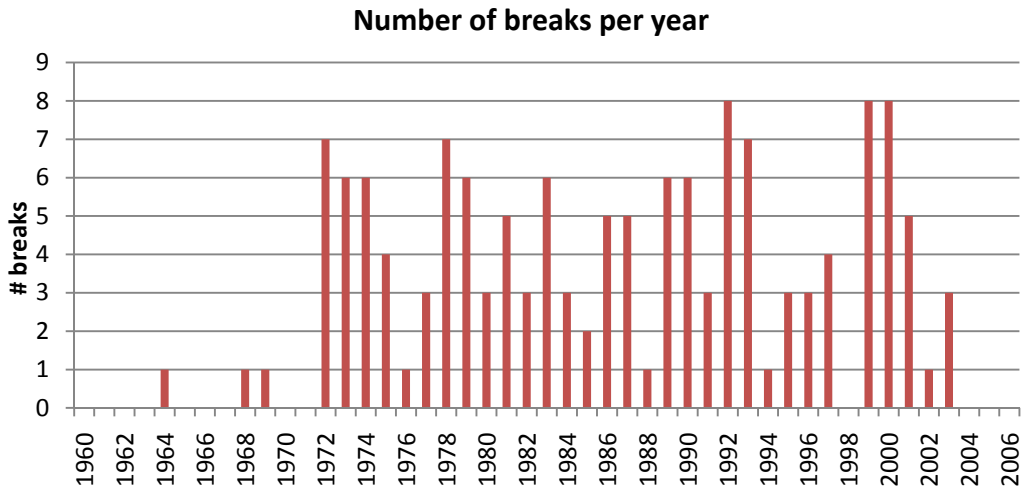
After computing all the relevant structural breaks, we had what we needed to start testing whether if those breaks were somehow induced or influenced by political changes, namely ideological changes in government.

The way we thought most suitable to test the hypothesis was creating Probit models and Multinomial Probit models.

5.4 Table - Structural break years on GDPpc per country

Australia	1964	1968	1977	1981	1987	1991	1999	
France	1974	1979	1987	1992	1999			
Greece	1973	1978	1983	1992	1997			
Denmark	1969	1973	1980	1986	1993	2001		
Netherlands	1974	1979	1982	1989	1993	2001		
Austria	1974	1977	1980	1987	1992	1997	2000	
Belgium	1974	1979	1983	1987	1992	1999	2003	
Canada	1972	1981	1988	1991	1995	2000		
Finland	1973	1978	1986	1989	1992	1996	2001	
Germany	1972	1975	1978	1981	1990	1993	1999	2003
Iceland	1972	1982	1986	1993	2001			
Ireland	1977	1986	1989	1993	2000			
Italy	1974	1979	1983	1990	1993	1999		
Japan	1973	1978	1984	1987	1991	1997	2001	
New Zealand	1973	1978	1985	1990	1996			
Norway	1979	1982	1985	1989	1992	1996	2000	2003
Portugal	1972	1975	1981	1984	1992	2000		
Spain	1973	1984	1990	1994	1999			
Sweden	1972	1976	1980	1983	1989	1993	1997	2000
Switzerland	1974	1979	1983	1986	1990	1995	1999	2002
United Kingdom	1972	1975	1978	1981	1989	1992	1999	
United States	1972	1975	1978	1983	1990	1995	2000	
Luxembourg	2000							

Figure 5.2 Total of structural breaks on GDPpc per year (sum of all countries)



6. Explaining the Breaks

This Section is composed by 3 subsections; on 6.1 we present all dependent variables and regressors and also the probit models; on 6.2 we apply the binomial probit models and discuss their results; at last on 6.3 we investigate the multinomial probit models and discuss the results achieved.

6.1. Probit Methodology

In the following models the dependent variable named "series" is a binary variable defined as:

$$\text{"Series"} \begin{cases} 1 \; if \; a \; break \; occures \\ \\ 0 \; otherwise \end{cases}$$

The series used as dependent variables are the following:

- Public Expenditure on Health share on Gross Domestic Product

This is one of the most important series used, since public expenditure is directly defined by the government, therefore it may be a good indicator to whether a government tends to spend more or less than the previous one.

Also it is clearly a social expenditure and one should expect to see some differences between different ideology governments. We decided to use it in percentage of the GDP so the economic growth impact is absorbed.

- Public Current Expenditure on Health share of Public Expenditure on Health

This is also a very important series because it can give us an insight about the time horizon in government decisions. In other words, if we realize that political changes affect the structure of this series it could be an indication that governments worry more with the short term impact of their policies than the long term impact, because current expenditure includes nurses and physicians wages, the costs of a nation-wide vaccination program, payments for hospital cleaning services, among many others.

- Public Investment on Medical Facilities share on Public Expenditure on Health

Like the previous series this one should also give us an insight about the time horizon in government decisions, but by opposition to Public Current Expenditure if we realize that political changes affect the structure of this series it could be an indication that governments are more concerned about the long run.

- Total Expenditure on Health share on Gross Domestic Product

Using the Total Expenditure instead of just the Public Expenditure will work basically as a control parameter in the sense that we should not expect the same results or at least not the same impact strength of the political factors. Because Total expenditure also includes Private Expenditure it is not entirely defined by the government and so it should not reflect the policies as well as the Public Expenditure is expected to.

- Private Expenditure on Health share on Gross Domestic Product

Private expenditure may obviously be influenced by government policies although never directly, so we expect very weak influence of political factors to this series structure, which ultimately will further support the results we expect in Public Expenditure.

- Public Expenditure on Health share on Total Expenditure on Health

With the inclusion of this series we will try to measure which political factors, if any, affect Public share in Total health expenditure, for example we should expect that leftwing cabinets would tend to increase this share relying on their social fundamentals.

The political regressors are all taken from The Comparative Political Data Set I (Armingeon et al. 2008) which was compiled by researchers at the University of Berne. The data set contains a collection of political and institutional data covering the OECD countries for the period 1960-2007. In our research we use the following variables[2]:

- Election year ($Election\_year$): this is a binary variable which takes the value 1 if there is an election on that year and 0 otherwise.
- Gov. right (gov_right): cabinet composition; right wing parties in percentage of total cabinet posts, weighted by days.
- Gov. left (gov_left): cabinet composition; left wing parties in percentage of total cabinet posts, weighted by days.
- Majority ($Majority$) (from Woldendorp et al. (1998)): binary variable which takes the value 1 if there is a majority in office that year

  $$Majority \begin{cases} 1 \; if \; gov.type < 4 \\ \\ 0 \; otherwise \end{cases}$$

  "gov_type" Type of Government. Classification: (1) single party majority government (2) minimal winning coalition (3) surplus coalition (4) single party minority government (5) multi party minority government (6) caretaker government (temporarily).

[2]After each variable we write in brackets in the same way they appear in the models

- Coalition ($Coalition$) (from Woldendorp et al. (1998)): binary variable which takes the value 1 if there is a coalition in office that year

$$Coalition \begin{cases} 1 \; if \; gov.type = \{2; 3; 5\} \\ 0 \; otherwise \end{cases}$$

The control variables are:

- Break GDP ($Break\_GDP$)
- Break Government Consumption ($Break\_Gov\_Consumption$)
- GDP Growth rate (GDP_Growth_rate)
- Government consumption growth rate ($Gov\_Cons\_Growth\_rate$)

6.2. Results

We have constructed nine different models, each one with a specific purpose in testing political variables impact in the structural breaks of the series above.

For each model we tested one by one all health series as dependent variables and for each health series we computed the model with different combinations of the regressors, which means that we tested several variants of each model using different combinations of the regressors.

We computed all these combinations to get stronger results and possibly identify irrelevant variables.

6.3. Binomial Models

Binomial models allow us to identify variables that increase the probability of structural breaks occurrence in the dependent series.

Five of the nine models are intended to test specific political regressors, the other four to test interactions between election years and the other political variables.

1st Model – Testing Election effect

$$Series = c + \beta 1 Election\_year + \beta 2 Break\_GDP + \beta 3 Break\_Gov\_Consumption + \beta 4 GDP\_Growth\_rate + \beta 5 Gov\_Cons\_Growth\_rate$$

Table 6.1 – Results of Model 1 for Public Health Expenditure share on GDP, coefficients[3] and *t-stat*

Regressors:		Dependent Variable: Breaks in Public Health Expenditure % GDP						
Election_year	Coefficient	0,35***	0,38***	0,32***	0,35***	0,33***	0,33***	0,33***
	p-value	*0,00*	*0,00*	*0,01*	*0,01*	*0,01*	*0,01*	*0,01*
Break GDP	Coefficient		0,53***		0,47***			
	p-value		*0,00*		*0,00*			
Break Gov. Cons.	Coefficient			0,54***	0,52***			
	p-value			*0,00*	*0,00*			
GDP Growth rate	Coefficient					0,80		-0,18
	p-value					*0,73*		*0,94*
Gov. Cons. Growth rate	Coefficient						1,94	1,98
	p-value						*0,21*	*0,22*
Included observations		815	704	735	704	711	711	711
Obs with Dep=0		700	602	630	602	607	607	607
Obs with Dep=1		115	102	105	102	104	104	104
McFadden R-squared		0,014	0,036	0,038	0,058	0,013	0,015	0,015
Akaike info criterion		0,808	0,807	0,798	0,791	0,830	0,828	0,831
Schwarz criterion		0,819	0,826	0,816	0,817	0,850	0,847	0,857
Sum squared resid		97,59	84,24	86,80	82,23	87,79	87,53	87,54

From the table above we can clearly conclude that structural breaks in Public Health expenditure as a percentage of the GDP have higher probability of occurring in an election year. Although we should not forget that we are working with annual observations, which mean that we cannot say that the break occurred in one specific year, but from one year to the next one. So when we say that breaks tend to occur in election years we mean that those years are turning points.

In every variant of the model, the variable Election_year is statistically significant for very high levels of significance, no matter what control variables are included. This result is very interesting and favorable to the hypothesis that political factors are actually one of the reasons for occurrence of breaks in public expenditure. Although we cannot conclude yet that ideology has a significant role because government changes are not necessarily ideological changes, we have an indication that is surely worth investigating. Besides that possible partisan effect, the opportunistic case may also be an explanation especially if the break occurs right before the election or if the dependent variable is current public health expenditure which has an impact on the short run.

[3] Coefficient with * for p-value<10%
Coefficient with ** for p-value]1%; 5%]
Coefficient with *** for p-value ≤1%

Breaks in GDP and breaks in government consumption also produce significant coefficients. We included these variables just as controls, the strong correlation was expectable.

The dependent variable is a ratio of the expenditure series over GDP which means a break on GDP represents a break in the denominator and consequently it might represent a break in our dependent variable unless the numerator moves proportionately in the same direction, but these breaks should be controlled for because they do not result from a direct effect of policy towards health expenditure and that is the reason for the inclusion of break_GDP as a control variable.

We also decided to include breaks on government consumption as a control variable because we are specifically investigating breaks in health expenditure and not in total government outlays, so the breaks in health expenditure that are a consequence of a broader change in policy that affects many other public sectors should be controlled for.

On the next table we replace Public Health expenditure by Total Health expenditure and compute exactly the same model and variants. We should also expect a high influence of elections, since Public expenditure represents for every country a significant share of total expenditure.

Table 6.2 – Results of Model 1 for Total Health Expenditure share on GDP, coefficients and t-stat

Regressors:		Dependent Variable: Breaks in Total Health Expenditure % GDP						
Election_year	Coefficient	0,29***	0,24**	0,21*	0,21*	0,25**	0,25**	0,25**
	p-value	*0,01*	*0,04*	*0,08*	*0,08*	*0,04*	*0,04*	*0,04*
Break GDP	Coefficient		0,42***		0,36***			
	p-value		*0,00*		*0,01*			
Break Gov. Cons.	Coefficient			0,64***	0,60***			
	p-value			*0,00*	*0,00*			
GDP Growth rate	Coefficient					0,48		0,22
	p-value					*0,84*		*0,93*
Gov. Cons. Growth rate	Coefficient						0,61	0,57
	p-value						*0,70*	*0,74*
Included observations		899	764	800	764	773	773	773
Obs with Dep=0		786	662	696	662	670	670	670
Obs with Dep=1		113	102	104	102	103	103	103
McFadden R-squared		0,009	0,020	0,042	0,051	0,007	0,007	0,007
Akaike info criterion		0,754	0,778	0,748	0,756	0,787	0,787	0,790
Schwarz criterion		0,764	0,796	0,765	0,780	0,805	0,805	0,814
Sum squared resid		98,07	86,79	87,13	84,35	88,74	88,73	88,73

As we expected the Election_year also has a significant impact on the probability of occurrence of structural breaks in Total Health expenditure share on GDP. But it is

worth noticing that the coefficients are lower and the p-values are higher, that means years of elections do not seem to have the same impact on the probability of occurrence of structural breaks in Total Health expenditure as they have in Public Health expenditure. This result is very important and reinforces our previous assessment that political factors seem to make a difference.

Breaks in GDP and in Government consumption are again significant and have the highest coefficients; this was expectable by the same reasons we discussed previously.

To further strengthen this result we will next compute the very same model and variants with structural breaks in Private Health expenditure share on GDP as dependent variable.

We should expect a much lower explaining power from Election_year, since the private expenditure is under jurisdiction of individuals and families, although it can be influenced through fiscal policies.

Table 6.3 – Results of Model 1 for Private Health Expenditure share on GDP, coefficients and t-stat

Regressors:		Dependent Variable: Breaks in Private Health Expenditure % GDP						
Election_year	Coefficient	0,15	0,16	0,13	0,14	0,16	0,17	0,17
	p-value	*0,22*	*0,24*	*0,30*	*0,29*	*0,22*	*0,21*	*0,21*
Break GDP	Coefficient		0,29*		0,27*			
	p-value		*0,06*		*0,08*			
Break Gov. Cons.	Coefficient			0,19	0,17			
	p-value			*0,21*	*0,29*			
GDP Growth rate	Coefficient					-0,17		0,27
	p-value					*0,95*		*0,92*
Gov. Cons. Growth rate	Coefficient						-0,87	-0,93
	p-value						*0,61*	*0,60*
Included observations		826	715	746	715	721	721	721
Obs with Dep=0		735	633	664	633	640	640	640
Obs with Dep=1		91	82	82	82	81	81	81
McFadden R-squared		0,003	0,009	0,005	0,011	0,003	0,004	0,004
Akaike info criterion		0,697	0,714	0,697	0,716	0,709	0,709	0,711
Schwarz criterion		0,708	0,734	0,716	0,741	0,728	0,728	0,737
Sum squared resid		80,82	72,08	72,68	71,95	71,74	71,71	71,71

As earlier anticipated, Election_year is not statistically significant for predicting structural breaks in Private Health expenditure share on GDP. The lowest p-value is achieved in the last two variants where we did not include Break GDP nor Break Government Consumption as regressors. Even in these variants the p-value is 21% which is too high for the coefficient to be considered relevant.

Also an interesting point is to notice that the control variable breaks on government consumption completely loses its strength; breaks on GDP remain

relevant explanatory variables but loose significance and the coefficients decrease sharply.

We will now examine the results for Public Current Expenditure on Health and Public Investment on Medical Facilities, both as percentage of Public Expenditure on Health. With these two series we should be able to take some conclusions about the time horizon relevant for political decisions. Government expenditure can be categorized into either 'current expenditure' or 'investment expenditure'. Current expenditure is recurring spending or, in other words, spending on items that are consumed and only last a limited period of time. They are items that are used up in the process of providing a good or service. In the case of the health sector, current expenditure would include salaries and expenditure on consumables - stationery, drugs for health service, bandages and so on.

By contrast, investment expenditure implies spending on assets. This is the purchase of items that will last and will be used repeatedly in the provision of a good or service. In the case of the health sector, examples would be the building of a new hospital, the purchase of new computer equipment or networks, etc.

The breakdown between these two types of spending is very important. Capital expenditure has a lasting impact on the economy and helps to provide a more efficient, productive economy. A new hospital, for example, will be much more efficient and will allow more patients to be treated for many years into the future. Current expenditure, however, does not have such a lasting impact. Once the money is spent, it is irreversible and the effect on the economy is simply a short-term one.

Table 6.4 – Results of Model 1 for Public Current Expenditure on Health share on Public Expenditure on Health, coefficients and t-stat

Regressors:		Dependent Variable: Breaks in Public Current Health Expenditure % Public Health Expenditure						
Election_year	Coefficient	0,29**	0,38***	0,37***	0,39***	0,40***	0,38***	0,39***
	p-value	*0,03*	*0,01*	*0,01*	*0,01*	*0,00*	*0,01*	*0,01*
Break GDP	Coefficient		0,07		0,08			
	p-value		*0,70*		*0,66*			
Break Gov. Cons.	Coefficient			-0,03	-0,09			
	p-value			*0,87*	*0,61*			
GDP Growth rate	Coefficient					4,49		3,72
	p-value					*0,13*		*0,23*
Gov. Cons. Growth rate	Coefficient						2,26	1,56
	p-value						*0,21*	*0,41*
Included observations		626	566	576	566	555	555	555
Obs with Dep=0		542	490	499	490	479	479	479
Obs with Dep=1		84	76	77	76	76	76	76
McFadden R-squared		0,009	0,017	0,015	0,017	0,023	0,021	0,024
Akaike info criterion		0,788	0,786	0,785	0,789	0,791	0,793	0,794
Schwarz criterion		0,802	0,809	0,808	0,820	0,815	0,816	0,825
Sum squared resid		72,18	64,83	65,85	64,80	64,40	64,36	64,24

Given our findings with the previous variables is not surprising that Election_year significantly increases the probability of occurrence of breaks in Public Current Health Expenditure share on Public Health Expenditure, and what is worth noticing is that the coefficients are higher and more significant in this case than in the case of Public Expenditure on Health share on GDP. This means that elections seem to have a higher impact on current expenditure than on total expenditure, and according to our interpretation this is a clear indication that political factors have more impact on short-term oriented expenses and it can also be a strong support of the opportunistic political behavior theory.

It is worth noticing that the control variables are all insignificant in this model; no breaks on GDP or on government consumption seem to increase the probability of breaks occurring in the share of current expenditure on total public expenditure.

The next table presents the model with Investment on medical facilities as dependent variable and strengthens the previous result.

Table 6.5 – Results of Model 1 for Public Investment on Medical Facilities share on Public Expenditure on Health, coefficients and t-stat

Regressors:		Dependent Variable: Breaks in Public Investment on Medical Facilities % Public Health Expenditure						
Election_year	Coefficient	0,06	0,12	0,12	0,12	0,11	0,11	0,11
	p-value	*0,64*	*0,39*	*0,38*	*0,38*	*0,44*	*0,45*	*0,45*
Break GDP	Coefficient		-0,19		-0,18			
	p-value		*0,31*		*0,34*			
Break Gov. Cons.	Coefficient			-0,04	-0,07			
	p-value			*0,81*	*0,68*			
GDP Growth rate	Coefficient					2,06		1,54
	p-value					*0,45*		*0,60*
Gov. Cons. Growth rate	Coefficient						1,29	0,93
	p-value						*0,47*	*0,62*
Included observations		661	601	611	601	589	589	589
Obs with Dep=0		579	526	535	526	515	515	515
Obs with Dep=1		82	75	76	75	74	74	74
McFadden R-squared		0,000	0,004	0,002	0,005	0,003	0,003	0,003
Akaike info criterion		0,756	0,760	0,760	0,763	0,764	0,764	0,767
Schwarz criterion		0,769	0,782	0,781	0,792	0,787	0,787	0,797
Sum squared resid		71,80	65,49	66,46	65,47	64,57	64,58	64,54

In this case we did not find relevant coefficients, not even for low demanding levels of significance. The structural breaks identified in Investment series do not seem to be correlated with elections at all.

This result reinforces the idea that government changes have a smaller impact on long-term oriented expenses.

To finish model one we present a similar table for Public Expenditure on Health share on Total Expenditure on Health.

Table 6.6 – Results of Model 1 for Public Expenditure on Health share on Total Expenditure on Health, coefficients and t-stat

Regressors:		Dependent Variable: Breaks in Public Health Expenditure % Total Health Expenditure						
Election_year	Coefficient	0,17	0,20	0,17	0,20	0,16	0,15	0,15
	p-value	*0,14*	*0,12*	*0,16*	*0,11*	*0,20*	*0,23*	*0,23*
Break GDP	Coefficient		0,27*		0,28*			
	p-value		*0,06*		*0,06*			
Break Gov. Cons.	Coefficient			-0,09	-0,08			
	p-value			*0,58*	*0,61*			
GDP Growth rate	Coefficient					2,43		1,27
	p-value					*0,30*		*0,61*
Gov. Cons. Growth rate	Coefficient						2,67*	2,42
	p-value						*0,08*	*0,13*
Included observations		815	704	735	704	711	711	711
Obs with Dep=0		702	605	631	605	609	609	609
Obs with Dep=1		113	99	104	99	102	102	102
McFadden R-squared		0,003	0,009	0,004	0,010	0,005	0,008	0,009
Akaike info criterion		0,807	0,813	0,821	0,816	0,827	0,824	0,827
Schwarz criterion		0,819	0,833	0,839	0,841	0,846	0,843	0,852
Sum squared resid		97,07	84,410	89,02	84,36	86,98	86,61	86,55

The coefficients are significant for low demanding levels, in the first four variants. When we include GDP Growth rate or Government Consumption Growth rate in the model, election_year looses significance. So we do not have a clear picture to say whether or not elections influence the public share in Total Expenditure on Health. Maybe the multinomial probit models can provide us a different view.

The first model apparently leads to two important conclusions: elections have a significant impact in structural breaks of public expenditure on health series, so there is an obvious political factor determining the break dates. Other conclusion is that elections have a much higher impact on the breaks of current expenditure than in breaks on investment expenditure, this suggests that political factors are relevant essentially for short term expenses.

The next table is just a resume of the previous ones with the fourth variant of each model presented. This variant has consistently revealed the higher McFadden R-squared[4] and the most significant control variables.

[4] R^2=1-lnL(M_{full})/ lnL($M_{intercept}$), M_{full}=model with predictors, $M_{intercept}$=model without predictors, L=estimated likelihood

Table 6.7 – Resume table with variant four of every model, coefficient[5] and p-value

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Election	0,21* 0,08	0,35*** 0,01	0,14 0,29	0,20 0,11	0,39*** 0,01	0,12 0,38
Break GDP	0,36*** 0,01	0,47*** 0,00	0,27* 0,08	0,28* 0,06	0,08 0,66	-0,18 0,34
Break Cons	0,60*** 0,00	0,52*** 0,00	0,17 0,29	-0,08 0,61	-0,09 0,61	-0,07 0,68

For the next models unless we find them insufficient for explaining the results we shall present only a condensed table similar to this one.

2nd Model – Testing Ideology effect

$$Series = c + \beta 1 gov\_left + \beta 2 gov\_right + \beta 3 Break\_GDP + \beta 4 Break\_Gov\_Cons + \beta 5 GDP\_growth\_rate + \beta 6 Gov\_cons\_growth\_rate$$

In the second model we replaced Election_year by two ideology variables as defined in Armingeon et al (2006):

gov_right - Cabinet composition: right-wing parties in percentage of total cabinet posts, weighted by days.

gov_left - Cabinet composition: social-democratic and other left parties in percentage of total cabinet posts, weighted by days.

With this model we are just testing whether any ideology increases the probability of occurrence of breaks in the expenditure series.

We do not expect the coefficients associated with any of the ideology variables to be statistically relevant since both left and right parties should have similar probabilities of implementing changes once elected or try to hold office implementing new policies before elections. What could be different between the two ideologies is the sign of the break, we will address that question later while discussing multinomial models.

Notice that these ideology variables unlike Election_year are not binary and can take values as high as 100, which means the coefficients associated with them should be much lower simply due to a scale effect.

[5] Coefficient with * for p-value<10%
Coefficient with ** for p-value]1%; 5%]
Coefficient with *** for p-value ≤1%

Table 6.8 – Resume table of ideology effect

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Gov_left	-0,001 0,56	-0,002 0,32	0,000 0,86	0,000 0,97	0,000 0,98	0,000 0,87
Gov_right	0,000 0,99	-0,002 0,26	-0,001 0,77	0,000 0,94	0,000 0,95	0,002 0,42
Break GDP	0,378*** 0,01	0,465*** 0,00	0,278* 0,07	0,280* 0,06	0,006 0,97	-0,174 0,35
Break Cons	0,641*** 0,00	0,582*** 0,00	0,203 0,20	-0,033 0,84	-0,084 0,65	-0,043 0,81

As expected the coefficients turned out not to be significant. That means we found no evidence that any ideology has more probability of inducing breaks than the other.

Of all six dependent variables that we tested none has produced significant results. The closer that we got from significant coefficients was for Public Health expenditure share on GDP with a p-value exceeding 31%.

Recalling that the break year is no more than the turning point, we thought that interesting results could be found if we use lagged variables by one observation either before or after the break year. To test that possibility we have also computed this model considering ideology variables lagged by one year, but that also failed to produce significant results.

3rd Model – Testing Majority effect

$$Series = c + \beta 1 Majority + \beta 2 Break\_GDP + \beta 3 Break\_Gov\_Consumption + \beta 4 Growth\_Gdp + \beta 5 Gov\_Cons\_rate$$

In the third model we introduced the variable *Majority* and regressed it together with the four control variables used earlier. *Majority* is defined as:

If we think of majority governments compared with others, on the one hand we immediately tend to assume that they are more powerful and more capable of implementing reforms and significant policy changes. If that's true we should expect more breaks in public expenditure when majority governments hold cabinet. On the other hand majority governments are also associated with political stability and in that case we should expect fewer trend breaks in public expenditure during their term in office. Taylor and Herman (1971) have presented arguments for, and sometimes against, a series of hypotheses about the influence of the party system on the stability

of governments, and have tested them against data on the 196 governments which have held office in countries holding democratic elections throughout the post-war period. Their definition of government stability is simply the duration of government in days. They found a fairly strong relation between governmental stability and the fractionalization of the parliamentary party system. One-party governments were very significantly more stable than coalition governments. Majority governments were significantly more stable than minority governments. Neither the number of parties in the opposition nor the fractionalization of the opposition significantly affected governmental stability. Measures of fragmentation which also took account of an assumed 'left-right' ordering of the parties were no better predictors.

In the case of our model we did not find many interesting results. The only dependent variable that produces significant coefficients is Total Health Expenditure share on GDP, in all other cases the p-values associated with the regressor *Majority* averaged 60%.

Table 6.9 – Resume table of Majority effect

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Majority	-0,23*	0,09	0,06	-0,10	-0,10	0,05
	0,10	0,56	0,72	0,49	0,51	0,75
Break GDP	0,41***	0,46***	0,32**	0,25	0,06	-0,13
	0,01	0,00	0,04	0,11	0,72	0,50
Break Cons	0,67***	0,59***	0,25	0,03	-0,02	0,01
	0,00	0,00	0,13	0,86	0,90	0,94

As we can see in the first row the coefficient associated with majority is only significant (if we are not much demanding on significance levels) with the first dependent variable and it is negative which means that when majority governments hold cabinet is less probable that a break occurs in that variable.

As we interpret it this result supports the idea that majority governments imply political stability which in turn can translate e economical and social stability. Although we also recognize the lack of strength of our finding since only one dependent variable showed correlation.

For the same reasons discussed previously, we thought it might be useful to compute model 3 and all variants with one year lag in *Majority*. In this case the dependent variable Total Health Expenditure share on GDP fails to produce significant results and the only dependent variable that produced significant or nearly significant results was Public Expenditure on Health share on GDP.

Table 6.10 – Resume table of Majority(-1) effect

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Majority (-1)	-0,140 0,33	0,239 0,13	0,062 0,69	0,053 0,72	-0,110 0,49	0,040 0,81
Break GDP	0,404*** 0,01	0,464*** 0,00	0,318** 0,04	0,248 0,11	0,054 0,76	-0,128 0,50
Break Cons	0,659*** 0,00	0,593*** 0,00	0,244 0,13	0,016 0,92	-0,031 0,87	0,011 0,95

The coefficient associated with *Majority* is now positive, which means the fact that a majority government being in office increases the probability of a break occurring in Public expenditure on health share on GDP in the next year.

If we recall the results presented in Model that clearly shown the relevance of election years in breaks occurrence, we might think that a change from a majority government to another type of government maybe associated with the breaks. We will further explore this hypothesis when we compute models with interacting variables, namely election years and majority.

4th Model – Testing Coalition effect

$$Series = c + \beta 1 Coalition + \beta 2 Break\_GDP + \beta 3 Break\_Gov\_Consumption + \beta 4 Growth\_Gdp + \beta 5 Gov\_Cons\_rate$$

In the fourth model we introduced the variable *Coalition* and regressed it together with the four control variables defined earlier. *Coalition* is defined as:

Coalition governments include different parties, and eventually different ideologies. That may sometimes be a barrier to implement broad political changes since an agreement must be reached among the coalition forces. As a consequence one might expect less breaks occurring during coalition government terms.

The only dependent variable that our regressor seem somewhat correlated with is Public Health Expenditure share on Total Health Expenditure:

Table 6.11 – Resume table of Coalition effect

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Coalition	-0,14 0,25	-0,09 0,48	-0,13 0,31	-0,19 0,12	-0,03 0,84	0,05 0,73
Break GDP	0,41*** 0,01	0,46*** 0,00	0,32** 0,04	0,24 0,13	0,06 0,72	-0,13 0,50
Break Cons	0,66*** 0,00	0,60*** 0,00	0,25 0,13	0,03 0,86	-0,03 0,89	0,01 0,95

The coefficient associated with *Coalition* is always negative except for investment on medical facilities but just significant when the dependent variable is Public Health Expenditure share on Total Health Expenditure which means that the probability of occurrence of breaks under a coalition government is smaller for this variable.

Our previous hypothesis seems to have some statistical support; the decision making process and policy implementing may actually be somehow more difficult for trend breaking ideas under a coalition government.

Although we must acknowledge that only one in six dependent variables produced significant results and only for low demanding levels of significance.

For the same reasons discussed earlier, we thought it might be useful to compute model 4 and all variants with one year lag in *Coalition*. In this case two dependent variables produced significant results: Total Health Expenditure share on GDP and Public Health Expenditure share on Total Health Expenditure.

Table 6.12 – Resume table of Coalition(-1) effect

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Coalition (-1)	-0,185 0,13	-0,107 0,39	-0,149 0,25	-0,183 0,14	-0,026 0,85	-0,052 0,71
Break GDP	0,407*** 0,01	0,457*** 0,00	0,315** 0,04	0,233 0,13	0,060 0,74	-0,127 0,50
Break Cons	0,659*** 0,00	0,594*** 0,00	0,242 0,13	0,023 0,89	-0,029 0,88	0,016 0,93

For both dependent variables that produced significant results the coefficient associated with *Coalition(-1)* has two common features, it is always negative and just moderately significant. We cannot take any further conclusions besides that coalition governments seem to lack the strength or consensus among their members to produce significant policy/expenditure breaks.

We can draw some more conclusions when we compute multinomial models.

5th Model – Testing all political variables together

$$Series = c + \beta 1 Election\_year + \beta 2 Gov\_Left + \beta 3 Gov\_Right + \beta 4 Majority + \beta 5 Coalition + \beta 6 Break\_GDP + \beta 7 Break\_Gov\_Consumption$$

We decided to compute a model with all political variables together and also break GDP and break Government Consumption as control variables, to check if any of our previous findings would lose strength but we did not get different results from what we have seen until now. Namely, election year remains the most relevant variable for explaining the occurrence of breaks in Public Expenditure on Health share on GDP, in Total Expenditure on Health share on GDP and in Public Current Expenditure on Health share on Public Expenditure on Health and in a less extent in Public Expenditure on Health share on Total Expenditure on Health.

Ideology variables remain insignificant in every model and variant.

Majority remains a relevant regressor for explaining breaks in Total expenditure on Health share on GDP, p-values are quite similar to the third model and the coefficients are also negative which means that breaks are less likely to occur during the term of majority governments.

Coalition also appears closely relevant in this model for the same dependent variable as before, that is Public Expenditure on Health share of Total Expenditure on Health, although it loses quite a bit of strength the coefficients remain negative and maintain a similar magnitude.

As we have done before we also computed this model and variants with political variables lagged by one year. Once again the results did not change much when compared to the previous models where the regressors are individually tested. The only remark is that coalition which appeared relevant for Total expenditure on Health share on GDP in the individual model now completely lost its importance.

Until now we have clearly seen that election years are turning points, with many structural breaks being generated in those years. We also saw that left or right governments do not seem to have different probabilities to induce structural breaks in expenditure series.

Coalition and majority governments although appear to have some influence on the existence of structural breaks in some of the expenditure series lack consistency and strength.

Since election years seem to be so important we will now explore a little bit further what happens in those years by studying the interaction of election_year with other variables.

First we can multiply the election_year series by the ideology series, remembering that the first series is a binary series with one when an election takes place and zero otherwise, by multiplying with the ideology series we will get a new series that gives us the ideology of the elected government, or the ideology of the previous government if we use ideology with one year lag. Than we may try to take some conclusions on what ideology is more prone in inducing breaks.

The same reasoning can be applied with coalition and majority series.

In our first model regarding interactions we will use ideology series lagged with one year ahead. That means we are testing the impact of the elected government ideology on structural breaks of the dependent variables.

6th Model – Testing interaction of election with Ideology

$$Series = c + \beta 1 Election\_year + \beta 2 Election\_year * gov\_right(+1) + \beta 3 Election\_year * gov\_left(+1) + \beta 4 Gov\_right(+1) + \beta 4 Gov\_left(+1) + \beta 4 Break\_Gdp + \beta 5 Break\_Gov\_Cons$$

Table 6.13 – Resume table of interaction of election_year with ideology(+1)

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Election_year	0,94*** 0,00	0,12 0,69	0,17 0,60	-0,15 0,65	0,49 0,18	0,00 1,00
Election_year*gov_right(+1)	-0,01** 0,03	0,01 0,15	0,00 0,84	0,01 0,13	0,00 0,40	0,00 0,69
Election_year*gov_left(+1)	-0,01*** 0,01	0,00 0,92	0,00 0,86	0,00 0,32	-0,01 0,14	0,00 0,67
Gov_right(+1)	0,00 0,23	0,00* 0,09	0,00 0,71	0,00* 0,09	0,00 0,62	0,00 0,35
Gov_left(+1)	0,00 0,44	0,00 0,48	0,00 0,57	0,00 0,49	0,01* 0,06	0,00 0,51
Break GDP	0,35** 0,02	0,47*** 0,00	0,32** 0,04	0,35** 0,02	-0,11 0,57	-0,15 0,43
Break Gov. Cons.	0,60*** 0,00	0,52*** 0,00	0,14 0,39	-0,17 0,32	-0,12 0,53	-0,11 0,57

Looking at the first column we get somewhat unexpected results. Election_year remains a critical point for inducing breaks but both left and right ideology governments when elected diminish the probability of inducing breaks.

For the dependent variable Public Health expenditure share on GDP we get surprising results, it seems that only right ideology governments when elected tend to induce breaks.

Once again we get surprising results for current public health expenditure share on public health expenditure as a dependent variable, elections seem to lose its

explaining power. The only regressors that seem relevant are the election of left ideology governments with a negative coefficient, and left governments alone have a quite significant impact in inducing structural breaks to the dependent variable. We cannot yet comment on what sign may those breaks have.

In Public expenditure on health share on Total expenditure on health we get basically the same results has we got for Public expenditure on health share on GDP, that is only right ideology governments seem to induce structural breaks either when elected or during their term in office.

The next model is basically identical to the previous; the only difference is that now the ideology series are lagged by one year before. In other words we are now testing the impact of ideology of the government whose mandate is about to end.

7th Model – Testing interaction of election with Ideology

$$Series = c + \beta 1 Election\_year + \beta 2 Election\_year * gov\_right(-1) + \beta 3 Election\_year * gov\_left(-1) + \beta 4 Gov\_right(-1) + \beta 4 Gov\_left(-1) + \beta 4 Break\_Gdp + \beta 5 Break\_Gov\_Cons$$

Table 6.14 – Resume table of interaction of election_year with ideology(-1)

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Election_year	0,55* 0,08	-0,01 0,98	-0,23 0,49	-0,34 0,32	0,52 0,12	0,02 0,95
Election_year*gov_right(-1)	-0,01* 0,08	0,00 0,46	0,01 0,23	0,01* 0,10	0,00 0,64	0,00 0,43
Election_year*gov_left(-1)	0,00 0,74	0,01* 0,072	0,01 0,22	0,01* 0,08	-0,01 0,20	0,00 0,85
Gov_right(-1)	0,00 0,15	0,00 0,15	0,00 0,33	0,00 0,60	0,00 0,76	0,00 0,67
Gov_left(-1)	0,00 0,67	0,00* 0,06	0,00 0,23	0,00 0,52	0,00 0,44	0,00 0,73
Break GDP	0,40*** 0,01	0,54*** 0,00	0,35** 0,03	0,38*** 0,01	-0,03 0,87	-0,12 0,54
Break Gov. Cons.	0,64*** 0,00	0,54*** 0,00	0,14 0,39	-0,14 0,40	-0,09 0,65	-0,09 0,64

For Total Health expenditure share on GDP as dependent variable election years remain clearly the turning points, unless right ideology governments are in office before elections in which case the probability of structural breaks is less than it would be otherwise.

Computing the second dependent variable we found a very curious result, in contrast with previous models with +1 observation lag, the most relevant ideology in

inducing breaks is now left, and most interestingly before elections and not during the rest of their term in office when they actually tend decrease the probability of break occurrence.

When Public current health expenditure share on public expenditure on health is the dependent variable the only relevant regressor is the election_year unlike in the case of +1 lag when left ideology governments seemed to have a determining effect.

Finally when public health expenditure share on total health expenditure is the dependent variable both left and right governments when submitted to elections seem to induce structural breaks.

8th Model – Testing interaction of election with majority

$$Series = c + \beta 1 Election\_year * Left\_Cent\_Right + \beta 2 Break\_GDP + \beta 3 Break\_Gov\_Consumption + \beta 4 Dif\_Growth\_Gdp + \beta 5 Dif\_Gov\_Cons\_\%GDP$$

Table 6.15 – Resume table of interaction of election_year with majority(-1)

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Election_year	0,47*	0,22	0,36	0,36	-0,49	-0,59
	0,08	0,45	0,21	0,19	0,14	0,11
Election_year*majority(-1)	-0,33	0,24	-0,25	-0,15	1,15***	0,88**
	0,28	0,46	0,45	0,64	0,00	0,03
majority(-1)	0,00	0,17	0,17	0,12	-0,46**	-0,21
	0,99	0,39	0,41	0,54	0,02	0,28
Break GDP	0,44***	0,51***	0,38**	0,33**	0,01	-0,10
	0,00	0,00	0,02	0,04	0,97	0,61
Break Gov. Cons.	0,62***	0,55***	0,20	-0,09	-0,06	-0,05
	0,00	0,00	0,22	0,60	0,77	0,81

Looking at the current expenditure we can find a very powerful effect of majority governments inducing structural breaks when submitted to elections and only when submitted to elections because during the rest of their term in office the effect is exactly the opposite, the probability of occurring breaks is smaller than if the government were not a majority.

Concerning the variable “investment on medical facilities”, majority governments that are in office before elections seem to be an important driving force for structural breaks occurrence.

9th Model – Testing interaction of election with coalition

$$Series = c + \beta 1 Election\_year * Left\_Cent\_Right + \beta 2 Break\_GDP + \beta 3 Break\_Gov\_Consumption + \beta 4 Dif\_Growth\_Gdp + \beta 5 Dif\_Gov\_Cons\_\%GDP$$

Unlike majority governments coalition governments that are submitted to elections seem to have a negative impact on the probability of inducing structural breaks, but this effect only appears significant when the dependent variable is Private expenditure on health share on GDP.

6.4. Multinomial Probit Models

The conclusions we can take in the case of binomial models are limited to the probabilities of breaks occurrence, we cannot say anything about the type of break, namely the sign. With multinomial models we transformed each break in a positive or negative break depending on the slope change. We admit that different results might be achieved if we also searched for level breaks sign or combined in some manner both slope and level to define the break sign.

In this subsection we will try to answer questions like; do different ideologies increase the probability of different sign breaks? Does left or right governments tend to increase expenditure?

Until now we have proved that elections are in fact turning points for most of the series we are studying, we have also seen that ideology maybe an important factor when interacted with election years because it sometimes produces significant coefficients although we did not find consistent results.

Wgile using multinomial probit models our main purpose is to try to understand if the regressors that we found significant to explain the existence of structural breaks have a more specific impact, namely in terms of the sign of the break.

Our definition of break sign is simply the slope difference before and after the break year, which means that a negative break does not necessarily mean that the series slope becomes downward nor does the expenditure itself decreased because the slope break can be compensated or even exceeded by a level break of opposite sign.

The first multinomial model corresponds to the first binomial model we presented before.

1st Model – Testing Election effect

$$Series = c + \beta 1 Election\_year + \beta 2 Break\_GDP + \beta 3 Break\_Gov\_Consumption + \beta 4 GDP\_Growth\_rate + \beta 5 Gov\_Cons\_Growth\_rate$$

In this model we get a very interesting result, namely that the only dependent variable that produces clearly significant results is Public Current Expenditure on Health.

Table 6.16 – Resume table of election effect

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Election	0,08 0,58	0,16 0,31	-0,06 0,72	0,21 0,17	0,35** 0,04	0,06 0,72
Break GDP	-0,27* 0,09	-0,56*** 0,00	0,11 0,59	-0,27* 0,10	-0,01 0,96	-0,12 0,59
Break Cons	0,20 0,19	0,25 0,17	0,07 0,72	-0,18 0,32	0,33 0,12	0,24 0,26

We can conclude that election years increase the probability of a positive trend break occurring on current expenditure which confirms and reinforces our previous suspicion that governments are short sighted. The opportunistic hypothesis seems now more plausible.

Public health expenditure share on total health expenditure is the only other dependent variable that produced nearly significant coefficients and also positive ones.

In case of the other series we failed to achieve significant results and we did not find evidence supporting a positive or negative slope break. A suggestion for future researches is to include also the sign of level breaks using a different approach since that is not possible to do with our method.

An interesting observation is that break_GDP is significant with the first two dependent variables and the coefficients are negative; the interpretation is straightforward, since the dependent variables are ratios whose denominator is the GDP series, a positive break on the denominator should cause a negative break on the ration unless the numerator moves proportionately in the same direction which does not seem to be always the case.

2nd Model – Testing Ideology effect

$$Series = c + \beta 1 gov\_left + \beta 2 gov\_right + \beta 3 Break\_GDP + \beta 4 Break\_Gov\_Cons + \beta 5 GDP\_growth\_rate + \beta 6 Gov\_cons\_growth\_rate$$

On the second model regarding ideology we did not find much significant results whether we used lagged variables or not.

The only two dependent variables that are worth investigating are the Private expenditure on health share on GDP and the Public expenditure on health share on total expenditure on health and both lagged by one year.

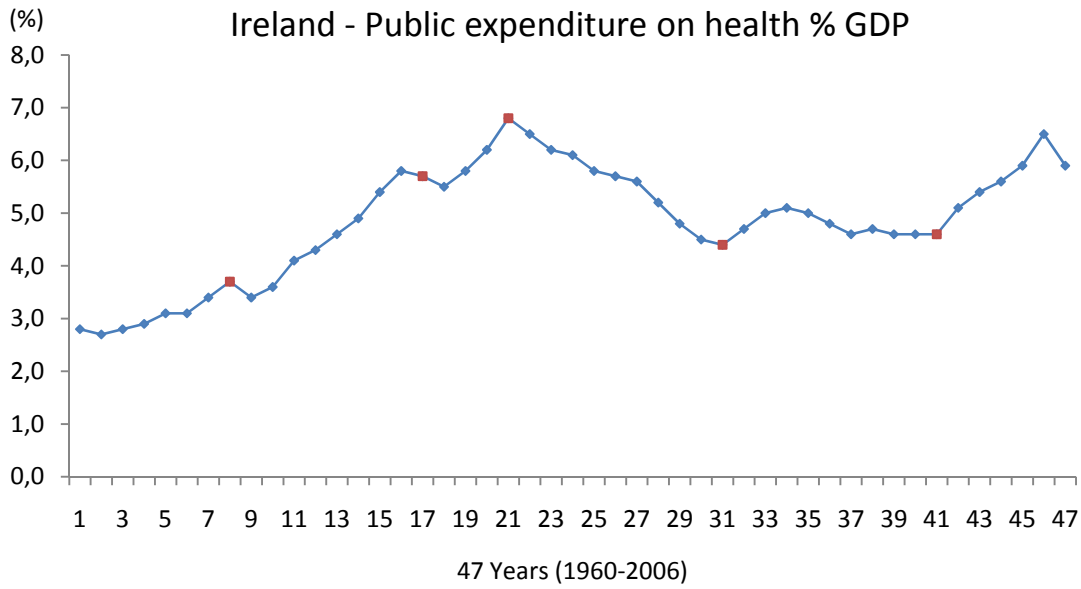
Table 6.17 – Resume table of ideology effect

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Gov_left(-1)	0,000 0,92	-0,002 0,50	-0,003 0,30	0,004 0,13	0,000 0,89	-0,001 0,73
Gov_right(-1)	0,000 0,88	0,000 0,90	-0,005** 0,05	0,005* 0,07	-0,001 0,83	0,001 0,76
Break GDP	-0,281* 0,08	-0,569*** 0,00	0,095 0,65	-0,279* 0,09	0,023 0,91	-0,134 0,54
Break Cons	0,217 0,16	0,286 0,12	0,039 0,84	-0,142 0,43	0,259 0,22	0,255 0,23

Curiously this is the only time that Private Expenditure share on GDP shows positive results. Right ideology governments seem to have a lagged negative influence on the slope of private expenditure and at the same time a positive influence on public share on total expenditure and these two coefficients are consistent with each other and suggest that right ideology governments increase the probability of substitution effects between private consumption and public consumption. That is somewhat unexpected since right ideology should tend to decrease the state weight on the economy. But if we look at gov_left coefficients what we find is also a positive probability (although less significant) of inducing positive trend breaks in the weight of the state on the economy and in this case we do not have the substitution effect i.e. the private expenditure seems unaffected.

Anyway that does not necessarily mean that in absolute terms we would have an increase in public health expenditure share on total for both ideologies; nor a decrease in private expenditure for right, because we are not taking into account what happens in terms of the level. The chart presented on section 5.2.2 and repeated here illustrates this point:

Figure 6.1 Series represented in blue and the suggested break dates in red



The first structural break is a positive trend break associated with a negative level break which makes the expenditure actually lower at least in the first years after the structural break.

3rd Model – Testing Majority effect

$$Series = c + \beta 1 Majority + \beta 2 Break\_GDP + \beta 3 Break\_Gov\_Consumption + \beta 4 Growth\_Gdp + \beta 5 Gov\_Cons\_rate$$

No relevant results were achieved in this model.

4th Model – Testing Coalition effect

$$Series = c + \beta 1 Coalition + \beta 2 Break\_GDP + \beta 3 Break\_Gov\_Consumption + \beta 4 Growth\_Gdp + \beta 5 Gov\_Cons\_rate$$

The conclusion driven from the third and forth model is that neither majority nor coalition seem to produce significant results either considered with one year lag or not. So we skip presenting the resume tables and proceed discussing the next model.

5th Model – Testing all political variables together

$$Series = c + \beta 1 Election\_year + \beta 2 Gov\_Left + \beta 3 Gov\_Right + \beta 4 Majority + \beta 5 Coalition + \beta 6 Break\_GDP + \beta 7 Break\_Gov\_Consumption$$

Like in the binomial models we also computed here a model with all political variables together and also break GDP and break Government Consumption as control

variables, in order to check whether any of our previous findings would lose strength but we did not get different results from what we have seen until now. Namely, election year remains relevant for increasing the probability of occurrence of breaks in Public current expenditure on health share on public. And right ideology governments maintain the same coefficients and significance that we have just discussed.

None of the insignificant regressors gains strength.

6th Model – Testing interaction of election with Ideology

$$Series = c + \beta 1 Election\_year + \beta 2 Election\_year * gov\_right(+1) + \beta 3 Election\_year * gov\_left(+1) + \beta 4 Gov\_right(+1) + \beta 4 Gov\_left(+1) + \beta 4 Break\_Gdp + \beta 5 Break\_Gov\_Cons$$

Table 6.18 – Resume table of interaction of election_year with ideology

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Election_year	0,294 0,44	-0,251 0,56	-0,348 0,42	0,077 0,84	0,763 0,11	-0,251 0,58
Election_year*gov_right(+1)	-0,002 0,68	0,007 0,18	0,003 0,58	0,004 0,45	0,003 0,69	0,001 0,92
Election_year*gov_left(+1)	-0,004 0,41	0,003 0,62	0,004 0,46	0,000 0,94	-0,014** 0,03	0,008 0,17
Gov_right(+1)	0,002 0,62	-0,003 0,39	-0,004 0,19	-0,002 0,48	0,002 0,62	0,001 0,70
Gov_left(+1)	0,001 0,75	0,000 0,99	-0,004 0,19	0,001 0,85	0,009** 0,03	-0,003 0,35
Break GDP	-0,266* 0,09	-0,568*** 0,00	0,083 0,69	-0,269 0,10	0,048 0,81	-0,116 0,60
Break Gov. Cons.	0,207 0,18	0,292 0,11	0,089 0,65	-0,152 0,39	0,279 0,20	0,299 0,16

Interacting election year with ideology lagged by one year ahead brings an interesting result with the dependent variable “current expenditure”, the probability of occurring a negative trend break around election year is higher if the elected government is from the left wing. Although left governments appear to increase the probability of positive trend breaks which can be seen in the regressor gov_left(+1), that probability is reversed if they have just won an election, that could be a sign of opportunistic behavior if they were already in government before the election; or a partisan indication if the previous government was not from left ideology.

Table 6.19 – Resume table of interaction of election_year with ideology lagged by one year

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Election_year	0,37 0,31	-0,51 0,23	-0,61 0,17	-0,26 0,58	0,63 0,13	-0,78 0,15
Election_year*gov_right(-1)	-0,01 0,14	0,01* 0,07	0,00 0,54	0,01 0,24	0,00 0,78	0,01 0,15
Election_year*gov_left(-1)	0,00 0,89	0,01 0,23	0,01* 0,08	0,00 0,51	-0,01 0,13	0,01 0,12
Gov_right(-1)	0,00 0,33	0,00 0,30	-0,01** 0,04	0,00 0,47	0,00 0,79	0,00 0,61
Gov_left(-1)	0,00 0,97	0,00 0,20	-0,01* 0,06	0,00 0,39	0,00 0,28	0,00 0,25
Break GDP	-0,26* 0,10	-0,61*** 0,00	0,08 0,72	-0,29* 0,09	0,07 0,73	-0,14 0,54
Break Gov. Cons.	0,20 0,20	0,30 0,11	0,07 0,71	-0,12 0,51	0,28 0,19	0,31 0,16

If we use the ideology regressors lagged by one year back instead we find that right wing parties increase the probability of positive trend breaks in public expenditure on health share on GDP, that could be a sign of opportunistic behavior.

Although these results might be interesting and significant we must acknowledge that they lack some consistency since just a few dependent variables produce significant coefficients.

8th Model – Testing interaction of election with majority

$$Series = c + \beta 1 Election\_year + \beta 2 Election\_year * majority(-1) + \beta 3 majority(-1) + \beta 4 Break\_Gdp + \beta 5 Break\_Gov\_Cons$$

Table 6.20 – Resume table of interaction of election_year with majority lagged by one year

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Election_year	0,46 0,15	-0,55 0,23	0,35 0,43	0,16 0,62	-0,16 0,65	-0,40 0,40
Election_year*majority(-1)	-0,48 0,18	0,85* 0,08	-0,48 0,32	0,06 0,88	0,69* 0,08	0,56 0,28
majority(-1)	0,14 0,54	-0,09 0,69	0,53* 0,08	-0,02 0,94	-0,46** 0,04	0,01 0,95
Break GDP	-0,27* 0,09	-0,55*** 0,00	0,12 0,56	-0,27 0,11	-0,01 0,94	-0,10 0,64
Break Gov. Cons.	0,20 0,19	0,25 0,18	0,10 0,63	-0,18 0,32	0,30 0,15	0,24 0,26

Interacting the variable majority lagged by one year with election year gives us a binary variable that is 1 when a majority government is in office prior to elections and zero otherwise. Looking at the coefficients produced with current expenditure share on public expenditure and their significance we think there is a powerful effect that suggest opportunistic behavior. When majorities are submitted to elections the probability of a positive trend break occurring increases significantly but during the rest of their term in office the probability of a negative trend break occurring is actually higher, that reinforces the conclusion we reached using binomial models that majority governments seem to have more power to induce positive breaks before elections. These observations seem to corroborate the opportunistic political business cycle theory.

9th Model – Testing interaction of election with coalition

$$Series = c + \beta 1 Election\_year * Left\_Cent\_Right + \beta 2 Break\_GDP + \beta 3 Break\_Gov\_Consumption + \beta 4 Dif\_Growth\_Gdp + \beta 5 Dif\_Gov\_Cons\_\%GDP$$

The interaction of election years with coalition governments did not produced any interesting results so we decided not to present the usual table.

7. Acknowledgments and future research

Different results might be achieved in multinomial models if we also considered level breaks or somehow combine both slope and level to define the break sign but this requires a different approach. Following our method it is not possible to accomplish this goal.

We did not make tests for the existence of unit roots in the series used, we assumed that they were not integrated. Had we found the series to be integrated we could have proceeded differently, maybe by differentiating the original series and then extracting the structural breaks which in such a case would just be level breaks. Although we do not believe that the results would change significantly we encourage further research on this point to achieve stronger results.

The results could be strengthened using the method of Havrey, Leybourne and Taylor in "Simple, robust and powerful tests of the breaking trend hypothesis", if it works the same way the authors claim although their paper is still not published, then the break tests can be applied to any series since they are robust to every type of trend.

Ideology differences may be detected if instead of looking just for election years and the party that is elected, separately from the party that left the cabinet, one looks for both at the same time, doing so would allow to create a new variable for example "election_change" that could be a binary variable which would take the value 1 in election years where the government ideology as changed and zero otherwise.

We have made no distinction between majority single party governments and majority multiparty governments; interesting differences may arise if that difference is accounted for, although we must mention that the number of observations is limited and the more partitions are made in the data the less robust will be the results.

Other series could be tested as dependent variables, not just expenditure series like national defense, culture and entertainment, education and social security; but other series like unemployment level, GDP per capita or GDP growth rate and so on.

8. Conclusion and contribution

The procedure we followed is novel; we did not find in the literature a similar method although we found extensive work on structural breaks and a wide acceptance of their importance. Structural changes have been observed in many economic and financial time series. In a study of a large set of macroeconomic time series, Stock and Watson (1996) reported that the majority of the series displayed evidence of instability. Such structural breaks pose a formidable challenge to economic forecasting and have led authors such as Clements and Hendry (1998, 1999) to view it as the main source of forecast failure.

Structural changes are pervasive in economic time series relationships, and it can be a compromising mistake to ignore them. Inferences about economic relationships can go astray, forecasts can be inaccurate, and policy recommendations can be misleading.

Our procedure is a simple one, we begin by detecting the most relevant structural break dates on the expenditure series and computing the sign of those breaks using the trend of each segment and we do so following the recommendations of Bai and Perron (2003) *"Computation and Analysis of Multiple Structural Change Models"*. Based on the information collected we then create our dependent variables which are binary variables with 1 when a break occurs and 0 otherwise. Finally we compute binomial probit models where we try to establish a correlation between the breaks occurrence and political factors (e.g. election years, ideology in office, type of government). We have also computed multinomial probit models where the dependent variables may take the values 1; 0 or -1 depending on the sign of the break.

This method or way of reasoning is an innovation and can be applied in many other cases with potentially interesting results because we are not concerned about shocks as most researchers do; we instead search for significant structural break dates independently of any other information and then try to find a correlation with political changes. Obviously the break detection method can be improved and possibly become more reliable as the econometric literature evolves.

To summarize our findings we present two summarizing tables:

Table 8.1 – Significance of the coefficients found in binomial probit models

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Election	strong	strong	none	Weak	strong	none
Ideology	none	none	none	None	none	none
Majority	strong	weak	none	None	none	none
Coalition	weak	none	none	Weak	none	none
Election*ideology	strong	weak	none	Weak	weak	none
Election*majority	none	none	none	None	strong	strong
Election*coalition	none	none	strong	None	none	none

We found that structural breaks in Public Health expenditure share on GDP have higher probability of occurring in election years. Elections seem to have a higher impact on current expenditure than on total expenditure, and no impact on investment. That is noticeable not only by the value of the coefficients but by their significance.

According to our interpretation majority governments seem to have a powerful effect on current expenditure on health, one the one hand they tend to be more stable (i.e. induce less structural breaks) during their term in office, but on the other hand the probability of occurring a break around the election year is higher if the government is a majority.

Although sometimes we found significant coefficients associated with ideology variables we failed to achieve consistent results.

We must also mention that the control variables break_gdp and break_government_consumption produced significant coefficients. We included these variables just as control parameters; we found a strong correlation as we expected. GDP was chosen as a control variable because we wanted to insure that effects not resulting directly from policy towards health expenditure were controlled for.

Breaks in government consumption was also elected as control variable because we are specifically investigating breaks in health expenditure and not on total government outlays, so the breaks in health expenditure that are a consequence of a broader change of policy that affects many other public sectors should be controlled for.

Table 8.2 – Significance of the coefficients found in multinomial probit models

	Total Exp.	Public Exp.	Private Exp.	Public Share	Pub. Current	Pub. Investment
Election	none	none	none	none	strong	none
Ideology	none	none	strong	strong	none	none
Majority	none	none	none	none	none	none
Coalition	none	none	none	none	none	none
Election*ideology	weak	strong	strong	none	strong	weak
Election*majority	none	strong	none	none	strong	none
Election*coalition	none	none	none	none	none	none

Using multinomial models we found less significant coefficients although it is worth mentioning that election years seem to have a positive influence in inducing positive trend breaks on current expenditure. However we cannot say with certainty if this is due to opportunistic behavior, it surely leads us to believe that it is a strong possibility.

Once again majority governments produced strong results when interacted with election years and they seem to exhibit a peculiar behavior that suggests opportunistic behavior, namely increasing the probability of negative trend breaks on current expenditure during their term in office but increase the probability of positive trend breaks when submitted to elections.

Concerning ideology variables we found some significant coefficients but they lacked consistency.

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