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in the European Union**

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# Duration of Fiscal Budgetary Consolidations in the European Union<sup>(\*)</sup>

by

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## Abstract

This paper examines the duration of fiscal consolidations among the fifteen EU Members States using data from the European Commission for the period 1960-2000. Using the duration model approach, we estimate the hazard and survivor functions of our series. Then we discuss what is the duration model that best fits our data, and which are the explanatory variables that best explain the probability of ending a fiscal consolidation period. We also deal with those aspects related to sample heterogeneity and the sensitivity of the results to different possible definitions of fiscal adjustment. We find evidence that the probability of ending a period of fiscal consolidation depends on the debt level, the magnitude of the adjustment, the extent of expenditure cuts, and the degree of cabinet fragmentation. We also find that under a stricter definition of fiscal consolidation, political variables, such as coalition size and election year, gain importance with respect to economic variables as predictors of the probability of ending a fiscal consolidation period.

**Keywords:** Duration analysis, Fiscal consolidation, Fiscal adjustment, Heterogeneity.

**JEL classification:** C41, H30

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## 1. Introduction

Between 1992 and 1998, the fulfillment of the Maastricht convergence criteria depended mainly on the ability of the European Members States to reduce their public deficits below the 3% GDP target. From 1999 on, to remain inside the limits imposed by the Stability and Growth Pact depends on the continuation of the fiscal consolidation that these countries started some years ago.

The integration into the European Monetary Union originated a wave of fiscal adjustments around Europe. This called the attention of some prominent scholars who started to study aspects such as the type of fiscal adjustments, the quality of these adjustments and the determinants of successful consolidations. For example, according to McDermott and Wescott (1996) and Alesina and Perotti (1995, 1996a, 1996b, 1998), Buti and Sapir (1998) and Von Hagen, Hallett and Strauch (2001), fiscal adjustments that rely primarily on spending cuts in transfers and in the government wage bill can be expansionary (anti-keynesian effect) and have a better chance of success than do fiscal adjustments that rely primarily on tax increases and cuts in public investment (which tend not to last and are contractionary). With respect to the best moment to introduce a consolidation and the speed of the adjustment, it has been affirmed that fiscal consolidations are usually started in periods of positive economic growth (Von Hagen, Hallett and Strauch, 2001), and that fast tax- reforms accompanied by deep labour market reforms increase the chances of success of the fiscal adjustment (Lindbeck, 1994).

In the field of Political Economy, some other authors combined those previous findings and tried to disentangle the political and institutional determinants that explain why some countries pursued some types of adjustment and not others, and what were the electoral consequences of these processes of fiscal consolidation<sup>1</sup>. With respect to the first question, Perotti and Kontopoulos (1998) and Mulas-Granados (2002), find that the composition of the budget during periods of fiscal consolidation is affected by the fragmentation of the cabinet, and the ideology of the party in government. On the electoral aspects of fiscal policy, Halleberg and Von Hagen (1997) have studied the

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<sup>1</sup> For a literature review on the political economy of budget deficits, see Alesina and Perotti (1995), and Persson and Tabellini (1999).

effects of electoral systems on fiscal outcomes, and Alesina, Perotti and Tavares (1997) have shown that large consolidations, and those mostly based on public wages and transfers, are not conducive to electoral defeat or a change in the government more frequently than average.

Nevertheless, in spite of the fact that in the previous literature the success of fiscal consolidations has been defined in terms of duration<sup>2</sup>, nobody has yet analysed the duration of fiscal consolidations in the European Union using the duration model approach. It remains to be investigated what explains that some consolidation experiences last longer than others. It also has to be answered what are the main economic and institutional variables that affect the probability of ending a fiscal consolidation sooner or later. This study comes precisely to fill this gap.

In this paper we analyse the time spells between two consecutive years of fiscal expansion, or in other words, what are the number of years between the beginning and the end of a fiscal consolidation. We do this using the methodology of duration models that we have applied to data for the 15 EU Member States between 1960-2000.

The article proceeds as follows. In section 2, we explain our criteria to select episodes of fiscal consolidation and we present our data. In section 3, we briefly describe the main aspects of duration models. In section 4 we present the empirical results that we have obtained. This section is divided into three parts: one that studies the hazard and the survivor functions in a non-parametric analysis; another one that studies the determinants of the probability of ending a fiscal consolidation; and final section that replicates the previous parametric analysis taking into account the period and group heterogeneity of our sample. Finally, in section 5 we develop a sensitivity analysis of our results to an alternative definition of fiscal consolidation. The final considerations in section 6 recapitulate the main findings of this article.

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<sup>2</sup> “A consolidation is deemed successful, if, two years after the initial adjustment, the government budget balance is at least 75 percent of the balance in the first year of the consolidation episode. A consolidation is called unsuccessful, if this condition is not met” (Von Hagen, Hallett and Strauch, 2001: 6). Alesina and Perotti (1995, 1996b) discuss the robustness of their results with regard to different definitions.

## 2. Duration of Fiscal Consolidations in the EU

Public deficit in the EU has been above 3% of GDP since 1975 and reached its maximum in 1993 after the 1992-93 recession recording 6% of GDP. These persistent deficits led to rapidly increasing government debt, which jumped from 30% of GDP in the 1970s to a maximum of 72% in 1996, and still remains at 64% of GDP (with Belgium, Greece and Italy over 100%). Under such unsustainable path, the Maastricht convergence criteria forced a strong fiscal consolidation in the European Union, which achieved a deficit reduction of 5 percentage points between 1993 and 1999.<sup>3</sup>

In this study we use annual data between 1960-2000 for the fifteen EU Members States: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. To define our dependent variable we use data on cyclically adjusted budget balances. This data expresses the budget balances (Total Public Revenues minus Total Public Expenditures) adjusted by the economic cycle<sup>4</sup>, as a percentage of the Gross Domestic Product of each country.

Based on this data, we generate a dummy variable called “*Failure*”, which takes value zero when the annual variation of the cyclically adjusted budget balance is bigger than zero (years of fiscal consolidation), and is equal to one, when the annual variation is zero or lower than zero (years of fiscal expansion). Using the dates in which a failure event occurs, we build a new variable called “*Duration*”, that counts the intervening years between two consecutive failures, that is, the time span that the fiscal consolidation lasts. In our sample, the minimum number of years that a consolidation lasts is one year, and the maximum is ten years.

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<sup>3</sup> See EC (2000) for further information about the process of public deficit reduction in the run to EMU.

<sup>4</sup> We use data from AMECO, the Macroeconomic Database of the European Commission. The Commission’s method to estimate the cyclically adjusted series involves three steps. In the first step, the output gap is computed as the difference between the actual output and an estimated output trend, applying the Hodrick-Prescott (HP) filter. In the second step, the budget sensitivity to the output gap is computed. This allows to compute the cyclical component of the budget. Finally, the cyclically adjusted budget balance is obtained by deducting the cyclical component from the actual government budget balance. For further details, see EC (2000b).

Table 1. Descriptive statistics: Failure and duration

	Failure			Duration		
	All countries	Lowly- indebted	Highly- indebted	All countries	Lowly- indebted	Highly- indebted
Mean	0.479	0.493	0.458	2.055	1.959	2.194
Std. Dev.	0.500	0.501	0.499	1.478	1.314	1.684
Variance	0.250	0.251	0.249	2.185	1.725	2.837
Skewness	0.085	0.027	0.170	1.844	1.533	1.921
Kurtosis	1.007	1.001	1.029	6.952	4.950	7.077
No. of failures	237	145	92			
Observations	495	294	201			

In Table 1 we present the structure of our data on *Failure* and *Duration*. As can be seen, the total number of observations is 495. The average duration of fiscal consolidations is 2.06 years. The number of registered failures is 237, and the average probability of ending a fiscal consolidation is 48%. The sample can be divided into two groups:

- 1) The group of *Highly-indebted* countries is integrated by those countries with an average Debt/GDP ratio above the EU-15 average ratio. These countries are: United Kingdom, Greece, Netherlands, Ireland, Italy and Belgium. Their average duration is 2.19 years and its probability of ending the consolidation is 46%.
  
- 2) The group of *Lowly-indebted* countries is made of those countries with an average Debt/GDP ratio below the EU-15 average ratio. These countries are: Luxembourg, Finland, France, Spain Germany, Austria, Denmark, Portugal and Sweden. In this group the average duration of fiscal consolidations is 1.96 years, and its probability of failure is 49%.

In Table 2, seven periods can be identified, all with different average durations and probabilities of failure. It is very interesting to observe that from 1962 to 1981, the average duration of fiscal consolidations was around 1.6 years, and the average probability of ending the consolidation was well above 50%. Between 1982 and 1991, the average duration increased until it reached 1.9 years and the probability of failure decreased to remain at 50%. Finally, during the nineties, and especially from 1996 to 2000, the average duration of fiscal consolidations reached 2 years with a probability of

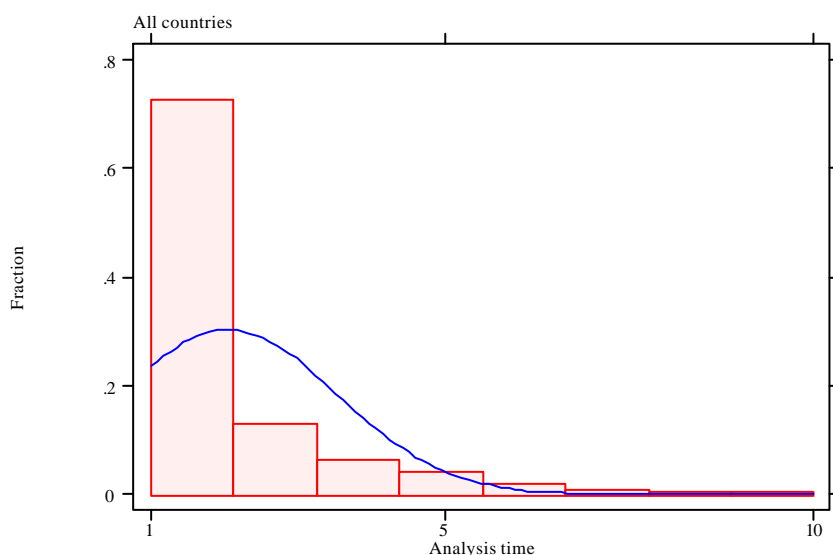
ending the consolidation of only 16%. This last result derives from the fact that at the end of 2000, which is the last year in our sample, twelve out of fifteen EU Member States were still under ongoing consolidation episodes<sup>5</sup>. Most of those episodes were initially launched by the Maastricht convergence criteria, and are currently reinforced by the Stability and Growth Pact. Because these consolidations were still ongoing in 2000, the probability of ending the consolidation for 1996-2000 is very low.

Table 2. Descriptive statistics: Failure and duration by periods

Periods	Failure		Duration		Freq.
	Mean	Std. Dev.	Mean	Std. Dev.	
62/72	0.532	0.502	1.734	1.022	79
73/77	0.547	0.501	1.560	0.889	75
78/81	0.717	0.454	1.633	1.057	60
82/87	0.400	0.493	2.056	1.319	90
88/91	0.661	0.478	1.804	1.212	56
92/95	0.433	0.500	1.883	1.075	60
96/00	0.160	0.369	3.547	2.207	75
All	0.479	0.500	2.048	1.450	495

Figure 1 below shows the duration of fiscal consolidations in the period 1960-2000, where 46% of fiscal consolidations lasted one year, 21% two years, 13% three years, and 20% lasted four years or more.

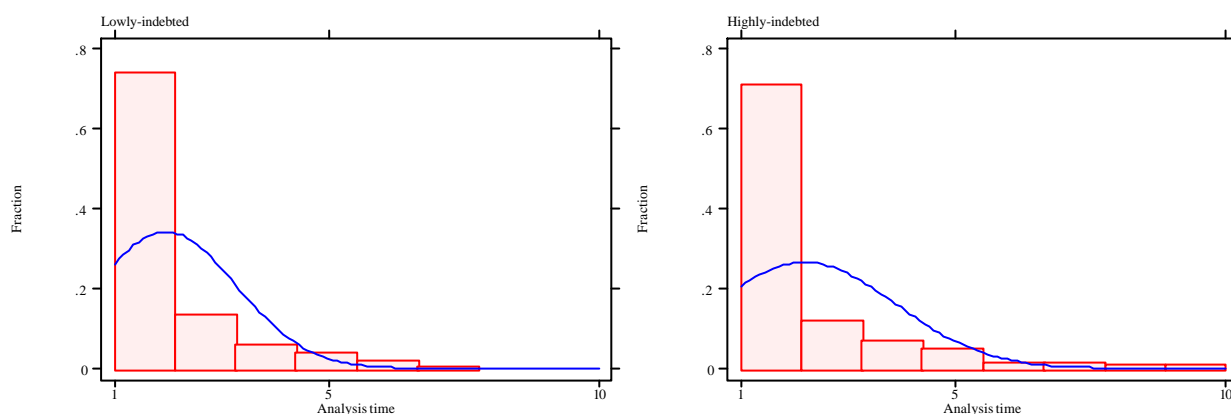
Figure1: Duration of Fiscal consolidations in the UE, 1960-2000.



<sup>5</sup> The three countries that just ended their consolidation episodes in 2000 are Denmark, Germany and the Netherlands.

As could be expected, the group of *Highly-indebted* countries shows a flatter distribution than the Lowly-indebted one, because less number of its fiscal consolidations finished in the first four years, and many more of them lasted five or six years.

Figure2: Duration of Fiscal consolidations in the UE, 1961-2000. By group of countries.



### 3. Duration Analysis

In this section, we offer a description of the main concepts that best characterize duration models. These models have been mainly used in Labor Economics<sup>6</sup>, to study the duration of periods of employment and unemployment and the determinants of entry and exit rates<sup>7</sup>.

In the field of Public Economics and Fiscal Adjustments, the duration of consolidation periods had been studied by different authors (mainly Alesina and Perotti, 1995, and Alesina and Ardagna, 1998) in an indirect way. The approach consisted in a two-step analysis: first, a pre-selection of consolidation episodes according to a pre-defined threshold; and second, a detailed account of the number of years contained in each episode and a description of the main characteristics attributable to them. This

<sup>6</sup> Duration models have been also used in the field of Industrial Organization, to analyze for example the life duration of multinational subsidiaries in the UK manufacturing industry (Mc Cloughan and Stone, 1998), or to analyze investment decisions (Licandro, Goicolea and Maroto, 1999).

<sup>7</sup> See Kiefer (1988) for a literature review. See also Sosvilla-Rivero and Maroto (2001) for a detailed study of the duration of exchange rates regimes in the European Monetary System (EMS). This section borrows heavily from the section they dedicate to duration analysis in that article.



approach allowed them to attribute certain characteristics as correlated to longer or shorter durations and more or less successful experiences.

Until now, only Von Hagen, Hallett and Strauch (2001) have analyzed the duration of fiscal consolidations in the EU using a duration model, but only with data until 1998. Nevertheless, maybe because their study covers many more aspects of consolidations beyond the determinants of the duration of fiscal adjustments, the short section they dedicate to this analysis lacks a serious discussion of the most adequate duration model for this type of analysis, and omits some of the more important explanatory variables that determine the duration of consolidation episodes.

Before we continue with the paper, it is useful to review the basic concepts and functions used in duration analysis.

### 3.1. Non-parametric analysis

In the non-parametric or empirical analysis we use the information contained in the “*Duration*” variable. In our case, this variable counts the intervening years between two years of fiscal expansion, or in other words, between the beginning and the end of a fiscal consolidation.

Those econometric models developed to analyze this type of information are called duration models. If we define  $T$  as the discrete random variable that measures the time span between the beginning of a fiscal consolidation and its transition to a non-consolidation period, the observations at our disposal consist of a series of data  $(t_1, t_2, \dots, t_n)$  which correspond to each of the observed durations of each consolidation episode in our sample. The probability distribution of the duration variable can be specified by the cumulative distribution function:

$$F(t) = Pr(T < t) \tag{1}$$

which indicates the probability that the random variable  $T$  is smaller than a certain value  $t$ .

The corresponding probability function is then:

$$P(t)=Pr (T=t) \quad (2)$$

But in duration models two main functions are used to characterize the probability distribution of the duration variable:

(a) The survivor function is defined as:

$$S(t)=Pr(T \geq t)=1-F(t) \quad (3)$$

and it gives the probability that the duration of the fiscal consolidation is greater than or equal to  $t$ .

(b) The hazard function is defined as:

$$h(t)=Pr(T=t/ T \geq t) \quad (4)$$

and it gives, for each duration, the probability of ending a consolidation episode and starting a fiscal expansion, conditioned to the duration of the consolidation through that moment.

There exists a relation between both functions given by the following expression:

$$S(t) = \prod_{s=1}^t (1 - h(s)) \quad (5)$$

One of the advantages of the hazard function is that it allows us to characterize the dependence path of duration. Formally, there exists a positive duration dependence in  $t^*$  if  $dh(t)/dt > 0$ , in the moment  $t=t^*$ . This positive correlation implies that the probability that a fiscal consolidation ends in  $t$ , given that it has reached  $t$ , depends positively on the length of this consolidation episodes. Thus, the longer the episode, the higher the conditional probability of entering into a fiscal expansion. Similarly, there exists negative duration dependence if  $dh(t)/dt < 0$  in  $t=t^*$ . In this case, the longer the fiscal adjustment episode, the lower the conditional probability of starting a fiscal expansion.

The non-parametric analysis is used to estimate the unconditional hazard function which registers all the observations for which there is a change, that is, the relative frequency of observations with  $T=t$ . For this analysis of duration, the Kaplan-Meier estimate is widely used (Kaplan and Meier, 1958). The hazard function is calculated as follows:

$$\hat{h}(t) = \frac{d_t}{n_t} \quad (6)$$

where  $d_t$  represents the number of failures registered in moment  $t$ , and  $n_t$  is the surviving population in moment  $t$ , before the change takes place. From the hazard function, it is possible to obtain the cumulative hazard function with an estimation procedure proposed by Nelson (1972) and Aalen (1978). This hazard function is then given by the following expression:

$$\hat{H}(s) = \sum_{s=1}^t \hat{h}(s) \quad (7)$$

The Kaplan-Meier survivor function for duration  $t$  is calculated as the product of one minus the existing risk until period  $t$ :

$$\hat{S}(t) = \prod_{j|t_j \leq t} \left( \frac{n_j - d_j}{n_j} \right) \quad (8)$$

### 3.2. Parametric analysis

The non-parametric analysis is very limited because it does not take into account other variables that can influence the probability of ending a period of fiscal consolidation. In order to address the issue of other variables determining this probability, we also include in this paper a section dedicated to parametric analysis. In the literature, the model that has usually been used to characterize the hazard function is the *Model of Proportional Hazard* (PH), which assumes that the hazard function can be split as follows:

$$h(t, X) = h_0(t) * g(X) \quad (9)$$

where  $h_0(t)$  is the baseline hazard function that captures the dependency of data to duration, and  $g(X)$  is a function of individual variables. This function of explanatory variables is a negative function usually defined as  $g(X)=\exp(X'\hat{\alpha})$ . Note that in this proportional specification regressors intervene re-escalating the conditional probability of abandoning the period of fiscal consolidation, not its own duration.

This model can be estimated firstly without imposing any specific functional form to the baseline hazard function, following the *Cox Model* (1972)<sup>8</sup>:

$$h(t, X) = h_0(t) * \exp(X' \mathbf{b}) \quad (10)$$

An alternative estimation can be done by imposing one specific parametric form to the function  $h_0(t)$ . In this case, the models most commonly used are the *Weibull Model* and the *Exponential Model*. In the first one,  $h_0(t)=pt^{p-1}$ , where  $p$  is a parameter that has to be estimated. When  $p=1$ , the *Weibull Model* is equal to the *Exponential Model*, where there exists no dependency on duration. On the other hand, when the parameter  $p>1$ , there exists a positive dependency on duration, and a negative dependency when  $p<1$ . Therefore, by estimating  $p$ , it is possible to test the hypothesis of duration dependency of fiscal consolidations.

#### 4. Empirical Results

In this section we present the results obtained from the duration analysis of the different episodes of fiscal consolidation that have taken place between 1960 and 2000 in the European Union. First, we present the results of the non-parametric analysis obtained after estimating the Kaplan-Meier survivor and hazard functions. And secondly, we present the results of the parametric analysis obtained after including explanatory variables in the duration models previously specified.

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<sup>8</sup> Mathematically, the baseline hazard function,  $h_0(t)$ , is defined for all time  $t$  in which a change has taken place, and it is not defined for other moments of time. But the survivor function  $S(t)$  is defined for all values of  $t$ .

#### 4.1. Non-parametric estimation

Table 3 below shows the number of failures and the surviving population registered at each moment  $t$ , and the Kaplan-Meier survivor function. For durations greater than eight, there are no failures because there are some consolidation episodes (those lasting longer than seven years) that had not yet finished in 2000.

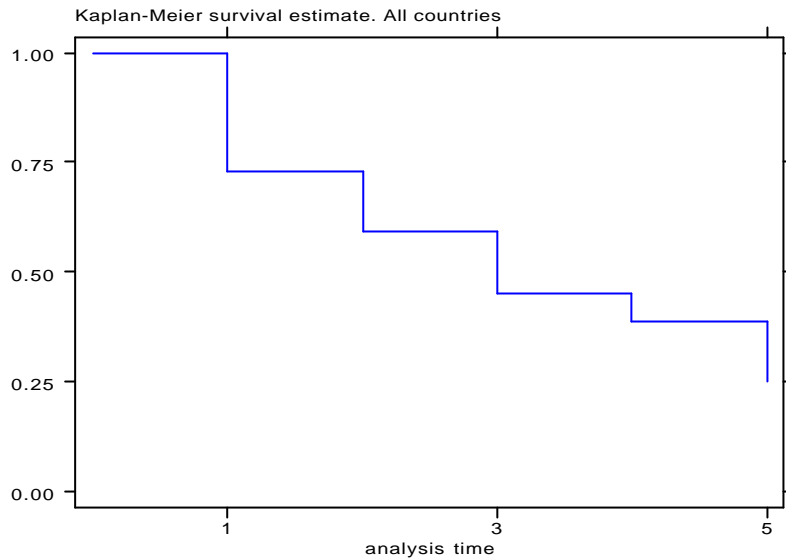
Table 3. List the Kaplan-Meier survivor function

Duration	Begin Total	Fail	Net Lost	Survivor Function
1	485	132	111	0.728
2	242	44	65	0.596
3	133	32	32	0.452
4	69	10	21	0.387
5	38	10	11	0.285
6	17	2	6	0.251
7	9	1	4	0.224
8	4	0	2	0.224
9	2	0	1	0.224
10	1	0	1	0.224

Subsequently, we have censored our sample at five years, and we have created a new duration variable. The new duration variable has the same values than the original duration variable for durations shorter than five years, but groups under value five all longer durations.

Figure 3 shows the estimated survivor function for the fifteen EU Member States using the new duration variable. This function gives for each period the probability of maintaining the fiscal consolidation. As can be observed, the probability of maintaining the consolidation decreases strongly (0.4) in short consolidations (those that last one and two years). For longer durations, the decrease in the probability of maintaining the fiscal consolidation is smoother. For the whole sample, the average probability of maintaining a certain consolidation is estimated to be 0.6.

Figure 3. Kaplan-Meier survivor function. All countries



Below, Figure 4 presents the estimated survivor functions for both groups of countries. The probabilities of continuing the fiscal consolidation after the first year and the second year drop dramatically in both groups of countries. As can be observed, the divergence between the groups increases after the second year. These results are influenced in the group of *Lowly-indebted* countries by such countries as Luxembourg and Finland, which combine very few periods of fiscal consolidation with very short durations when these few consolidations occur (average durations of 1.71 and 1.95 years, respectively). On the opposite side, in the group of *Highly-indebted* countries, Italy and Belgium combine a considerable amount of consolidation experiences with an average duration of 2.37 and 2.26 years, respectively. Italy shows the largest average duration of fiscal consolidations, but this result is a combination of little number of consolidation episodes of medium length, and a single and very long consolidation effort of ten years in the nineties.

Figure 4. Kaplan-Meier survivor functions by group

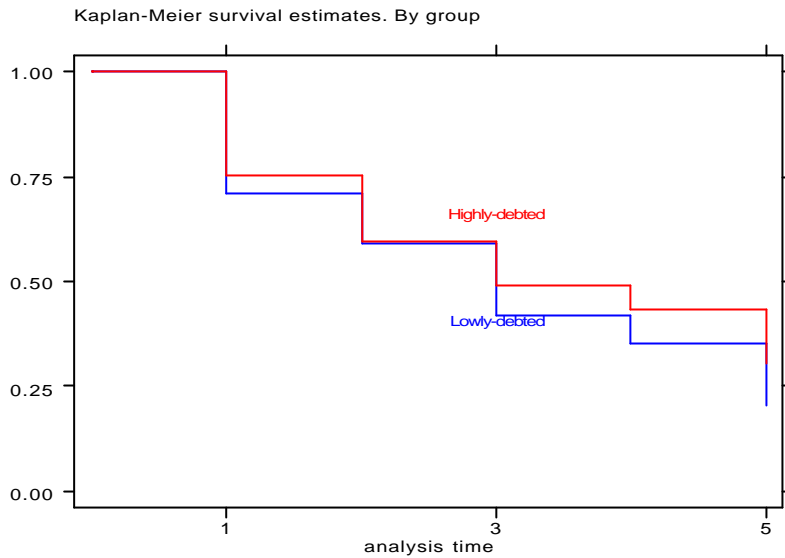


Figure 5 presents the estimated survivor function by periods. It is very interesting to observe that in the period of strongest fiscal consolidation (1996-2000), when 11 countries entered in the third stage of EMU, the probability of maintaining the consolidation remained close to 85% almost independently of whether the consolidation started one, two, three or four years before.

Figure 5. Kaplan-Meier survivor functions by periods

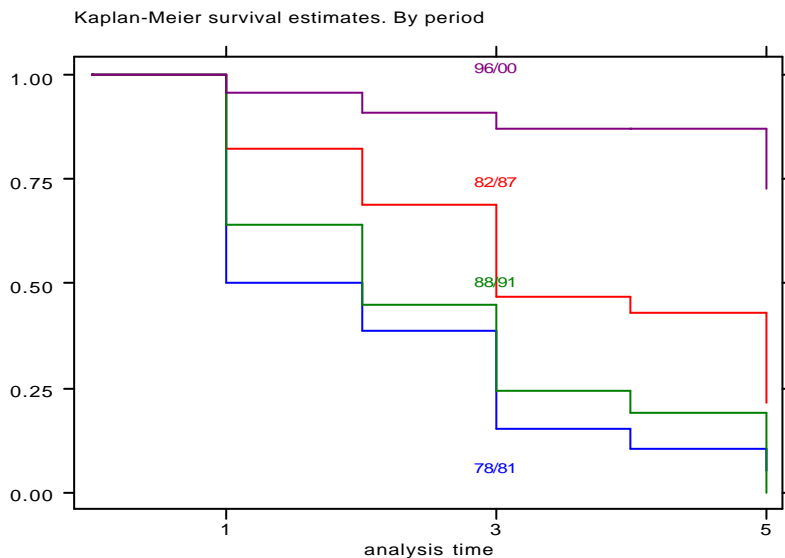
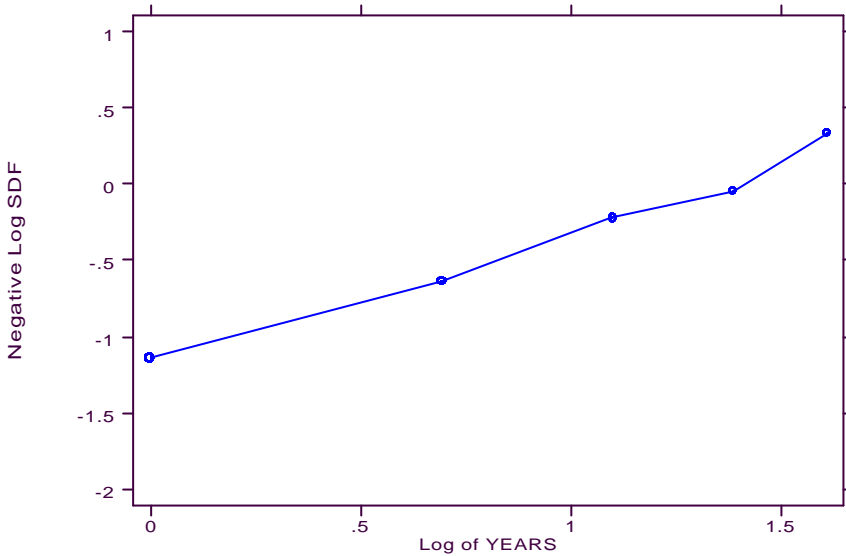


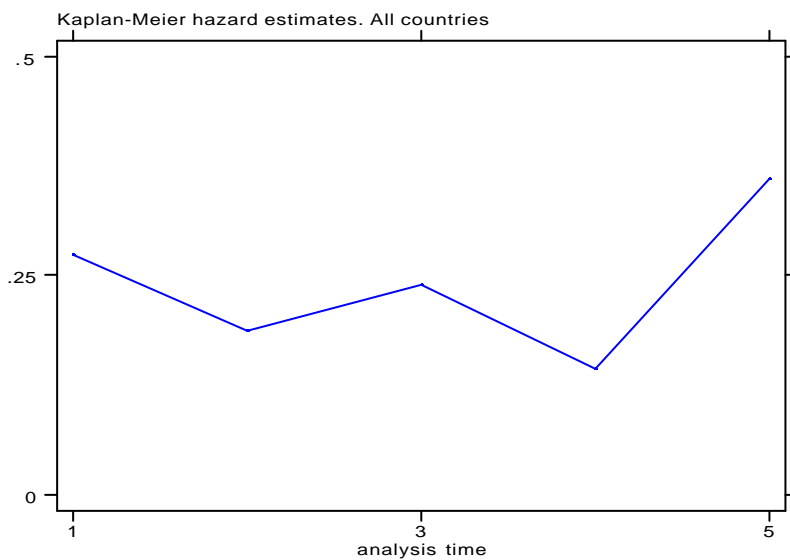
Figure 6 shows the log-log plot for the Kaplan-Meier survivor function. As can be seen, this plot reveals linearity, suggesting that a monotonic hazard function could be appropriate for our data.

Figure 6. Log Negative Log survivor function



The estimated hazard function in Figure 7 gives additional evidence of that interpretation, since its shape indicates positive duration dependence. The convexity of that function implies that the probability of ending a fiscal consolidation is an increasing function in  $t$ , conditional on duration. This means that the longer the period of fiscal consolidation accumulated until  $t$ , the higher the probability that the consolidation will end in moment  $t$ . That hazard rate is higher after one year of consolidation, after three years of consolidation, and much higher after five or more years of consolidation.

Figure 7. Kaplan-Meier hazard function. All countries





In order to test whether there exists homogeneity or heterogeneity in our sample, and whether or not we can expect equal survivor functions, we perform the Cox regression-based test for equality of survival curves. According to the results shown in Table 4, we cannot reject that equality of survival curves exists.

Table 4. Cox regression-based test for equality of survival curves

All Countries	Events		Relative Hazard
	Observed	Expected	
Austria	19	16.68	1.171
Belgium	17	20.66	0.834
Denmark	13	14.63	0.905
Finland	20	15.97	1.293
France	16	13.86	1.177
Germany	18	19.88	0.923
Greece	21	15.91	1.361
Ireland	14	13.04	1.098
Italy	12	16.69	0.727
Luxembourg	11	12.03	0.934
Netherlands	15	13.6	1.132
Portugal	18	18.81	0.978
Spain	15	12.19	1.267
Sweden	15	12.71	1.208
UK	13	20.33	0.651
Total	237	237	1
LR chi2(14)		10.18	
Pr>chi2		0.75	

Nevertheless, when we do the same test differentiating our sample by periods and groups of countries, we obtain very different results. Tables 5 and 6 contain the results of the Cox regression-based test for equality of survival curves by group and by period, respectively. As the *p-values* show, we cannot reject the null hypothesis of equality of groups, but we reject the hypothesis that equality of periods exists. Thus we can say that our sample shows temporal heterogeneity, but no spatial heterogeneity.

Table 5. Cox regression-based test for equality of survival curves

Group	Events		Relative hazard
	Observed	Expected	
Lowly-indebted	145	136.77	1.063
Highly-indebted	92	100.23	0.929
All	237	237	1
LR chi2(1)		1.19	
Pr>chi2		0.27	

Table 6. Cox regression-based test for equality of survival curves

Periods	Events		Relative Hazard
	Observed	Expected	
62/72	42	33.11	1.67
73/77	41	28.94	1.90
78/81	43	24.03	2.35
82/87	36	43.58	1.04
88/91	37	24.49	1.93
92/95	26	27.05	1.24
96/00	12	55.8	0.24
All	237	237	1
LR chi2(6)		83.3	
Pr>chi2		0.00	

Again, the last period is very interesting, because it has a very low relative hazard rate. This indicates that in the second half of the nineties almost all EU countries entered a period of fiscal consolidation, but in most cases these consolidations had not yet finished in the last year of our sample. Because these consolidations were still ongoing in 2000, the relative hazard rate for 1996-2000 is very low.

#### 4.2. Parametric estimation

In this section we analyze the factors that explain the probability of ending fiscal consolidations. On the one hand, we include a set of economic variables that are expected to be related to different lengths of fiscal consolidation, and on the other, we include a set of political variables that we think are important to explain the non-economic determinants of these consolidations.

We have included the following variables:

1) Debt/GDP ratio: this is a continuous variable that measures the public debt with respect to Gross Domestic Product for each country. Given that our dependent variable has been built based on cyclically adjusted budget balances that include interest payments generated by the pending debt, we expect that higher Debt/GDP ratios will be

associated with longer episodes of fiscal consolidation, and thus associated with lower probabilities of ending the consolidation.<sup>9</sup>

2) Strength of consolidation: this continuous variable is the result in absolute terms of subtracting the annual variation of the cyclically adjusted budget balance to the chosen threshold that determines when a fiscal consolidation takes place. Remember that in our analysis the threshold is zero. This means that we consider any given year as a year of fiscal consolidation if the variation of the cyclically adjusted budget balance with respect to the previous year has been positive in any amount bigger than zero. In Section 5 of this article we will analyze the sensitivity of our results to a change in the threshold from 0% to 1%.

3) Coalition size: this variable measures the number of political parties in government for each country and each year of our sample.<sup>10</sup>

4) Cabinet size: this variable measures the number of spending ministers in the cabinet<sup>11</sup> for each year and each country. The inclusion of both variables is related to the idea that fragmentation in decision-making is negative for expenditure control, because each group in a majority can push for an expenditure but it only internalizes a part of the costs and distortions of the associated increase in revenues needed to equilibrate the

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<sup>9</sup> The source of this variable as well as the rest economic variables or other variables based on economic data, is the AMECO Database of the European Commission.

<sup>10</sup> In the literature of fiscal adjustments there are many articles that prefer to use as a proxy for degree of decision-making fragmentation, an explanatory variable called “type of government” used for the first time by Roubini and Sachs (1989). We prefer however to use the simplest measure of all and the least subjective one, which is the number of parties in the government. We follow here Perotti and Kontopoulos (1998). Data on the number of parties in government until 1995 has been borrowed from Prof. Roberto Perotti, and we thank him especially for his generosity. His source is Woldendorp, Keman and Budge (1993) and *The Europa World Yearbook* for Greece, Portugal and Spain (the whole period), and all countries from 1995-2000.

<sup>11</sup> We have considered spending ministers to be the following: 1) Industry or Trade and/or ministers with related and/or subdivided competences like Foreign Trade, Commerce, and State Industries (if not attributed to Public Works-see next); 2) Public Works and/or Infrastructure and/or ministers with related and/or subdivided competences like (Public) Transportation, Energy, Post, Telecommunications, Merchant Marine, Civil Aviation, National Resources, Construction (if not specifically attributed to Housing-see below), Urban Development, etc; 3) Defense, 4)Justice; 5) Labor; 6) Education; 7) Health; 8) Housing; 9) Agriculture. Also all ministers with economic portfolio are added to this group: 10) Finance and/or ministers with related and/or subdivided competences like First Lord of the Treasury, Budget, Taxation, etc.; 11) Economic Affairs and/or ministers with related and/or subdivided competences like (Regional) Economic Planning or Development, Small Businesses. As with the previous variable, we have borrowed this variable from Prof. Perotti until 1995 and have reproduced the rest of data until 2000 following the same criteria. The sources were again: Woldendorp, Keman and Budge (1993) and *The Europa World Yearbook* for Greece, Portugal and Spain (the whole period), and all countries from 1995-2000.

budget (Weingast, Shepsle and Johnson, 1981). Therefore, the larger the number of actors with a voice in the fiscal decision-making process, the stronger the pressure for more expenditures, and thus the larger the deviation from the optimal fiscal policy. This is why we expect that larger coalition governments and larger cabinets will be associated with shorter durations and higher probabilities of ending the fiscal consolidation.

5) Number of failures: this variable simply measures the accumulated number of failures (ends of fiscal consolidations) that have taken place in each country before the current consolidation. We expect that the higher the accumulated number of failures, the less stable is the country in maintaining a tight fiscal policy. Under such circumstances it is more likely that the consolidation will end sooner.

6) Quality of the adjustment: this variable measures the contribution of primary expenditures (current public expenditures minus interest payments) to the total deficit reduction achieved in each consolidation year. Let  $Contribution = (X_t - X_0) / (S_t - S_0)$ , be the contribution of primary expenditures  $X$  to the adjustment in the surplus  $S$ , achieved between the first year of the consolidation episode  $0$ , and the year under consideration  $t$ <sup>12</sup>. Following all the literature on fiscal adjustments mentioned in the introduction, we expect that the higher the contribution of primary expenditures to the overall amelioration of the budget, the lower the probability that the consolidation will end, because we expect expenditure-based consolidations to last longer than revenue-based adjustments.

7) Election year: this is a dummy variable, with value 1 when there was a general election in year  $t$  in country  $i$ , and it is zero when there is no election.<sup>13</sup> Because fiscal adjustments are unpopular, and politicians tend to spend more just before the election assuming fiscal illusion and misinformed voters<sup>14</sup>, we expect election years to increase the probability of ending the consolidation

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<sup>12</sup> In this concrete definition of the variable we follow Von Hagen, Hallett and Strauch (2001: 10)

<sup>13</sup> Source: Armingeon., Beyeler, and Menegale (2000).

<sup>14</sup> See Buchanan and Wagner (1977) on fiscal illusion, and see Alesina, Cohen and Roubini (1992) on electoral business cycles.

We have estimated the functional forms discussed in section 3 by maximum likelihood, using 411 observations and 195 failures. Table 7 contains the parameter estimates for these alternative hazard function models. Recall that a positive parameter indicates an increase in the hazard rate, that is, an increase in the probability that the consolidation will end in period  $t+1$ , given that it lasted through period  $t$ .

Table 7. Parametric estimation of proportional hazard model

Duration	Cox	Exponential	Weibull
Debt/GDP	-0.011** (-5.29)	-0.010** (-5.04)	-0.014** (-5.70)
Strength of adjustment	0.081 (1.62)	0.069 (1.45)	0.108* (1.81)
Coalition size	-0.016 (-0.38)	-0.009 (-0.22)	-0.036 (-0.71)
Cabinet size	0.110** (3.91)	0.101** (3.83)	0.145** (3.90)
N. Failures	0.015** (8.67)	0.012** (9.53)	0.031** (13.25)
Quality of adjustment	-0.043** (-4.63)	-0.042** (-4.94)	-0.048** (-4.17)
Election year	0.151 (-1.24)	0.160 (1.40)	0.179 (1.16)
Constant		-2.580** (-8.46)	-4.957** (-10.99)
p			2.692** (19.95)
AIC	2074.31	719.31	524.45
Wald chi2(7)	153.13	172.48	261.4
No. of failures	195		
Number of obs	411		

Absolute z-statistics in parentheses.

Robust variance-covariance matrix used.

\* significant at 10%; \*\* significant at 5%

As we can see in the table above, the three alternative specifications give almost identical results. All explanatory variables are significant and show the expected signs: the higher the Debt/GDP ratio and the higher the contribution of primary expenditures to deficit reduction, the less probable it is that the consolidation ends; the stronger the adjustment, the higher the number of spending ministers in the cabinet, the higher the number of accumulated failures, and during election years, the higher the probability that the fiscal consolidation ends and a fiscal expansion starts. The only unexpected sign comes from the variable Coalition size, because the three estimations predict more

fragmented coalitions associated with lower probabilities of ending the consolidation. This result is probably very much influenced by cases of very institutionalized coalition governments that have decisively reduced public deficits with the strength of single party governments. These are specially the cases of Belgium, the Netherlands, Denmark and Italy, all with coalition governments of three to five parties, that launched several fiscal consolidations since the mid eighties.

Nevertheless, the only explanatory variables that are statistically significant are Debt/GDP ratio, the Strength of the adjustment (only in the Weibull estimation), Cabinet size, the Number of failures, and the Quality of the adjustment. The  $p$  parameter in the Weibull estimation is statistically significant, positive and bigger than one, which means that the hazard function grows with time, and this is consistent with the empirical hazard function previously commented in the non-parametric analysis (see Figure 6). Therefore, we find significant positive duration dependence.

To select the best parametric model, there are different possibilities. When parametric models are nested, the likelihood-ratios or the Wald tests can be used to discriminate between them. This can certainly be done in the case of Weibull versus exponential. When models are not nested, however, these test are unsuitable and the task of discriminating between models becomes difficult. A common approach to this problem is to use the Akaike Information Criterion (AIC). Akaike (1974) proposed penalizing each log likelihood to reflect the number of parameters being estimated in a particular model and then comparing them. For this purpose, the AIC can be defined as:

$$AIC = -2 * (\log \text{likelihood}) + 2(c + q + 1) \quad (17)$$

where  $c$  is the number of model covariates (explanatory variables) and  $q$  is the number of model-specific auxiliary parameters. Although the best-fitting model is the one with the largest log likelihood, the preferred model is the one with the smallest AIC value. As we can see in Table 5, according to the AIC criteria, the Weibull estimation is the parametric model that best fits our data. In Table 5, we can also see the Wald test statistics, normally used for computation of the significance level of the estimate parameters. These tests confirm the superiority of the Weibull estimation.

Finally, there exists an additional method to test the power of each model, through graphic analysis of the Cox-Snell residuals (1968). These residuals are defined as follows:

$$\hat{e} = -\log S(t/x) \tag{18}$$

where  $S(t/x)$  is the estimated probability of surviving to time  $t$ . If the fitted model is correct, these residuals, which are always positive, should have a standard censored exponential distribution with hazard ratio 1. We can verify the model's fit by calculating, based for example on the Kaplan-Meier survival estimates or the Aalen-Nelson estimator, an empirical estimate of the cumulative hazard function, using the Cox-Snell residuals ( $cs$ ) as the time variable. If the model fits the data, then the plot of the cumulative hazard versus  $cs$  should be a straight line with slope equal to unity and beginning at the origin.

As can be observed in Figure 9, the *Weibull plot* clearly satisfies the exponential requirement for most of the time, except for larger residuals, where the slope appears to exceed the unity. This confirms that the *Weibull* model should be our preferred model.

Figure 9. Cox-Snell residuals to evaluate fit of 3 regression models



### 4.3. Heterogeneity

In the non-parametric analysis we showed that there was only temporal heterogeneity in our sample, and no spatial heterogeneity. In this section we repeat the parametric analysis of the previous section, but now we include dummy variables to control for the mentioned temporal heterogeneity<sup>15</sup>.

Table 8. Parametric estimation of proportional hazard model with heterogeneity

Duration	Cox	Weibull
Debt/GDP	-0.006** (-2.37)	-0.006** (-2.1)
Strength of adjustment	0.078* (1.65)	0.109* (1.86)
Coalition size	0.016 (0.36)	-0.011 (-0.19)
Cabinet size	0.050* (1.68)	0.073* (1.77)
N. Failures	0.013** (7.8)	0.030** (12.42)
Quality of adjustment	-0.038** (-3.89)	-0.038** (-2.8)
Election year	0.090 (0.75)	0.096 (0.61)
1962-1972	1.927** (5.01)	2.253** (5.22)
1973-77	1.579** (4.25)	1.977** (4.7)
1978-81	1.893** (5.27)	2.247** (5.61)
1982-87	1.267** (3.75)	1.474** (4.07)
1988-91	1.745** (5.21)	1.947** (5.18)
1992-95	1.424** (4.19)	1.697** (4.7)
Constant		-6.292** (-11)
p		2.844** (20.46)
AIC	2023.09	459.55
Wald chi2(13)	205.92	319.53
No. of failures	195	
Number of obs	411	

Absolute z-statistics in parentheses.

Robust variance-covariance matrix used.

\* significant at 10%; \*\* significant at 5%

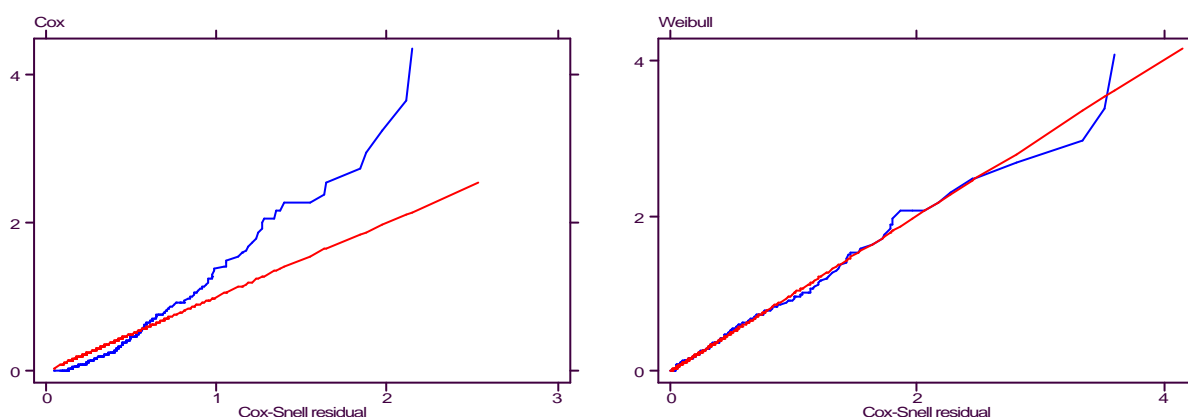
<sup>15</sup> We include dummy variables for all periods except the final one.



Results in Table 8 confirm our previous findings. After controlling for periods, where all control variables were statistically significant, the only explanatory variable that has lost statistical significance is the Cabinet Size, while Debt/GDP, Number of failures and Quality of adjustment, remain as strong predictors of the probability of ending the fiscal consolidations.

Again, the AIC statistics show that the Weibull estimation is the best model for our data. The analysis of the Cox-Snell residuals below confirms this statement.

Figure 10. Cox-Snell residuals to evaluate fit of two regression models with heterogeneity



## 5. Sensitivity analysis

In this last section we replicate the parametric analysis of section 4.1, but now we change the definition of fiscal consolidation. Now we consider that a fiscal consolidation takes place in a given year if the cyclically adjusted budget balance with respect to GDP in that year increased by 1% or more from the previous year. By changing the threshold from 0% to 1% we want to test the sensitivity of our results to different definitions of fiscal adjustment. We can say that the 0% threshold is the minimum threshold that one can impose to differentiate fiscal consolidation years from fiscal expansion ones. The 1% threshold is the most common in the literature on fiscal adjustments<sup>16</sup>, because it discriminates in favor of strong consolidation experiences,

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<sup>16</sup> In the literature (for example, Alesina and Perotti, 1995, and Perotti 1998; and Von Hagen, Hallett and Strauch, 2001), fiscal consolidations are defined as periods in which the cyclically adjusted primary balance (current revenues minus current expenditures, excluding interest payments) increased by at least 1.25% of cyclically adjusted GDP two consecutive years, or when it increased by 1.5% or more in one year and was positive but less than 1.25% the previous or the subsequent year. Because we are doing

where the political commitment to reduce the public deficit is strong and cannot be attributed to unintended outcomes.

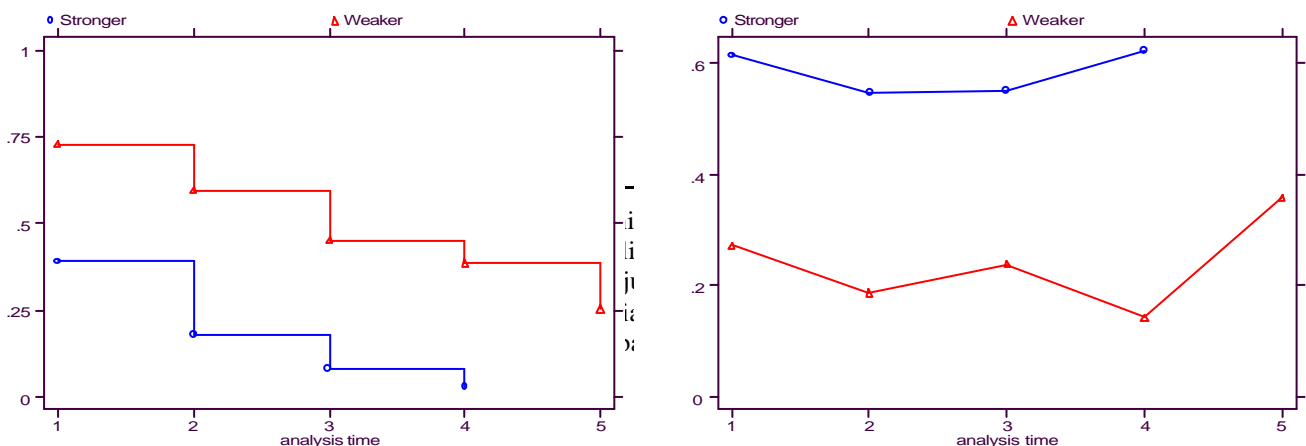
As we can see in Table 9, the number of failures under the *Stronger* definition (the 1% threshold) is bigger than under the *Weaker* definition (390 versus 237). Furthermore, under the *Stronger* definition, the average probability of ending the fiscal consolidation is much higher than under the previous definition (77.8% versus 47.6%), and the average duration is much lower (1.29 years versus 2.05). The maximum duration under this new threshold is four years.

Table 9. Descriptive statistics: Failure and duration by threshold

	Failure		Duration	
	Weaker	Stronger	Weaker	Stronger
Mean	0.476	0.778	2.048	1.295
Std. Dev.	0.500	0.416	1.450	0.623
Variance	0.250	0.173	2.103	0.389
Skewness	0.095	-1.341	1.690	2.322
Kurtosis	1.009	2.798	5.787	8.343
No of failures	237	390		
Observations	495	501		

In Figure 11 we show the Kaplan-Meier survivor and hazard estimates for both thresholds. As we can see, the probability of maintaining the consolidation after the first year decreases even more under the new definition (0.6 versus 0.4) than what it did under the initial definition. These differences are maintained for longer durations, because the probability of maintaining the consolidation after the second year decreases 0.2 under the new definition, when it only decreased about 0.1 under the initial definition. This behavior is translated into a smoother estimated hazard function, that clearly shows higher positive dependency on accumulated duration under the *Stronger* definition than under the *Weaker* one.

Figure 11: Kaplan-Meier survivor and hazard functions by threshold.



Finally, we estimate the same model that we estimated with the initial threshold, but now under the new definition of fiscal consolidation. We expect the coefficients of all explanatory variables to maintain their signs and their statistical significance.

In Table 10 below, we present a comparison of the Weibull estimations under the *Weaker* (threshold 0%) and the *Stronger* (threshold 1%) definitions of fiscal consolidation.

Table 10. Parametric Weibull estimation by threshold

Duration	Weaker	Stronger
Debt/GDP	-0.014** (-5.70)	-0.012** (-4.96)
Strength of adjustment	0.108* (1.81)	0.104** (2.15)
Coalition size	-0.036 (-0.71)	0.122** (2.62)
Cabinet size	0.145** (3.90)	0.071** (2.29)
N. Failures	0.031** (13.25)	0.011** (15.99)
Quality of adjustment	-0.048** (-4.17)	-0.019 (-1.15)
Election year	0.179 (1.16)	0.207* (1.67)
Constant	-4.957** (-10.99)	-3.490** (-9.63)
p	2.692** (15.65)	3.548** (24.50)
AIC	524.45	347.96
Wald chi2(7)	261.4	356.62
No. of failures	195	316
Number of obs	411	414

Absolute z-statistics in parentheses

Robust variance-covariance matrix used.

significant at 10%; \*\* significant at 5%

As can be observed by looking at the results above, the effect of the Debt/GDP ratio, the Strength of adjustment, the Size of the cabinet and Number of failures is the same under both definitions: the larger the level of Debt, the less likely is that the consolidation ends; and the larger the Strength of adjustment, the Cabinet and the Number of accumulated failures, the more probable is that the consolidation finishes.

Nevertheless, under the stronger definition, the Quality of the adjustment stops being statistically significant . While the two political variables, such as Coalition size and Election year, suddenly gain statistical significance (Coalition now shows the expected sign). Under the stricter new definition, larger coalitions, larger cabinets, and election years increase the probability of ending a fiscal consolidation. Or in other words, under stricter definitions of fiscal consolidation, economic explanatory variables lose predictive power in favor of political variables. These results indicate that stronger fiscal adjustments are the result of strong and very committed governments not threatened by the fear of losing next elections, willing to pursue unpopular policies with the objective of improving the government's budget balance.

## **6. Final Remarks**

In this article we have examined the duration of fiscal consolidations in the European Union. To do this we have applied the methodology of duration models to annual data on cyclically adjusted budget balances for the 15 EU Member States between 1960 and 2000. We have studied the time spells between two fiscal expansions, or in other words, the number of years between the beginning and the end of fiscal consolidation episodes, calculating the hazard and the survivor functions for those consolidations.

First, we have done a non-parametric analysis where we have only taken into account time, in order to assess the impact of duration on the probability of maintaining a fiscal consolidation. Results suggest that this probability decreases rapidly after the first year and decreases less dramatically for longer durations. Also we have estimated the empirical hazard function, and the results showed a positive slope from the third year on. We distinguished two groups of countries (*Highly-indebted* countries, when their average debt ratio was above the sample mean, and *Lowly-indebted* countries otherwise), and seven periods of fiscal adjustment. After performing a test for equality of survivor functions, we rejected that equality between countries and groups existed and we assumed period heterogeneity in our sample.

Second, we have performed a parametric analysis, in order to control for more variables that could influence the probability of ending fiscal consolidations. We have

found that the level of Debt, the Fragmentation of the cabinet (measured by the number of spending ministers), the Strength of the adjustment, and the quality of the adjustment (measured by the contribution of primary expenditures to the total amelioration of the budget balance), helped to explain the probability of ending the fiscal consolidations. After repeating the calculations including some dummy variables to control for the mentioned heterogeneity, previous findings remained unaltered.

Finally, we have performed a sensitivity analysis, changing our initial definition of fiscal consolidation and repeating the parametric analysis under the new definition. After comparing the results obtained under the *Weaker* and the *Stronger* definitions, we have found that under the *Stronger* definition, political variables gained importance with respect to economic variables as predictors of probability of ending the fiscal consolidations.

We consider this study the first attempt to analyze systematically the determinants of duration of fiscal consolidations episodes in the European Union. Our results are very relevant to better understand the determinants of longer or shorter experiences of fiscal adjustment. For example, the current process of pro-cyclical fiscal policies recently denounced by the European Commission<sup>17</sup>, and the subsequent ending of most of the fiscal consolidation episodes originally launched in the mid 1990s to qualify for the third stage of EMU, can be more easily interpreted from the new perspective that our results provide. It certainly seems that once every country has qualified for the third stage of EMU, the combined effect of accumulated duration, economic slowdown, forthcoming elections<sup>18</sup> and relaxed political commitment towards adjustment, is definitively at the core of the current difficulties that the Stability and Growth Pact is currently facing.

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<sup>17</sup> See EC (2001).

<sup>18</sup> Between 2000 and 2001 parliamentary and/or presidential elections took place in eight out of the fifteen EU Member States (Finland, France, Greece, Ireland, Italy, Portugal, Spain and United Kingdom). In line with their electoral discourses, the red and green government coalition that resulted from the 2002 German elections, was the first one in Europe to question the future of the Stability and Growth Pact.

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