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What determines the duration of a fiscal consolidation program?

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Abstract

This paper assesses the determinants of the length of fiscal consolidation using annual data for 17 industrial countries over the period 1978-2009.

Relying on a narrative approach to identify fiscal consolidation episodes, we show that fiscal variables (such as the budget deficit and the level of public debt) and economic factors (such as the degree of openness, the inflation rate, the interest rate and per capita GDP) are crucial for the fiscal consolidation process. Additionally, we employ duration analysis over a set of consolidation spells and find that, as time goes by, the likelihood of a fiscal consolidation ending is higher. However, the hazard function is not monotonic: indeed, it increases until the eighth or ninth year and starts decreasing afterwards. We also find that: (*i*) spending-driven consolidations are shorter than tax-driven consolidations; (*ii*) both types of consolidation are longer in Non-European countries than for European countries; and (*iii*) the size of the consolidation program (in percentage of GDP) does not significantly affect duration.

All in all, our results support the importance of cuts in government spending as a way of bringing economies into a sustainable path for public debt. Moreover, they highlight the role played by a fiscal framework that imposes discipline in governments as a device to credibly shorten the length of fiscal consolidation episodes.

Keywords: *fiscal consolidations, duration analysis, Weibull model, cubic splines.*
JEL Classification: *C41, E62.*

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"... continued focus on nominal deficit targets runs the risk of compelling excessive fiscal tightening if growth weakens...

... the potential onset of "adjustment fatigue"... remains a threat to continued program implementation..."

- IMF (July 16, 2012)

1 Introduction

The Great Recession had a major impact on the public finances of many developed countries around the world. While the fiscal stance was sound in 2007, the recessionary effect associated with the most recent financial turmoil, the funds transferred by fiscal authorities with the ultimate goal of rescuing the banking sector, and the discretionary measures adopted by several governments in an attempt to boost economic activity have led to substantial fiscal deficits and pushed government debt to historically high levels.

The shift from stimulus to austerity came in 2010 and was the natural consequence of the view about the need to withdraw such expansionary fiscal policies as the economic recovery materialized. In addition, after the eclosion of the Greek crisis, urgent measures were requested from several countries to avoid being the next in line and to convince markets that they were different.[1] Not surprisingly, fiscal consolidation programs were quickly designed and austerity packages started to be implemented.

Despite this, the collective pressure to be tough on deficits, as well as the somewhat sudden nature of many of these fiscal retrenchments have raised doubts about their effectiveness in terms of narrowing the gap in public finances and bringing government debt into a sustainable path. Indeed, as business cycles seem to be increasingly lacking synchronization (Rafiq and Mallick, 2008; Mallick and Mohsin, 2010) and both monetary and fiscal stability appear to be closely linked to financial stability (Granville and Mallick, 2009; Sousa, 2010, 2012; Castro, 2011; Agnello et al., 2012), there is a growing sentiment that the "recipe may be killing the patient" and an intense debate about the potential need to make the adjustment period more flexible, in order to fine-tune the fiscal consolidation process and minimize the likelihood of counter-productive recessions.

In this context, understanding the timing and the length of fiscal consolidation and, in particular, its determinants becomes crucial. In fact, assessing the trade-off between consolidation of

[1] For an assessment of the impact of concerns about long-term (un)sustainability of public finances on government bond markets, see, for instance, Schuknecht et al. (2009). As for the effects of changes in rating notations and outlook on the spreads of government bond yields, see Afonso et al. (2012). For a new empirical method to investigate long-term fiscal developments, see Afonso et al. (2011).

public finances and economic growth is key for the formulation of effective policies and that means investigating the duration of fiscal consolidation programs.

Moreover, while European countries have emphasized the importance of fiscal consolidation as pre-requisite for sustainable growth, other countries such as the US and the UK have recognized that fiscal austerity may hurt short-term growth and are allowing a longer adjustment over time. Therefore, analyzing the differences between programs implemented in European countries and those put in place elsewhere, as well as determining whether the likelihood of a consolidation ending increases or not as it becomes older may provide important guidelines to the current challenges faced by fiscal authorities.

We aim at providing the answers to the abovementioned issues in this paper. First, we identify fiscal consolidation episodes based on the narrative approach developed by Devries et al. (2011). More specifically, accounts and records of what countries were intending to do at the time of publications (such as the OECD Economic Surveys, the IMF Economic Developments reports and the IMF Staff Reports) are examined in order to assess fiscal policy actions that lead to a reduction of the government deficit. Second, we use data for a group of 17 industrial countries over the period 1978-2009 and rely on continuous and discrete-time duration models to analyze the macroeconomic and fiscal determinants of the duration of fiscal consolidation programs. We also distinguish between spending-driven and tax-driven adjustments and characterize fiscal consolidation in European vis-a-vis Non-European countries. Third, we investigate the survival of fiscal consolidation episodes by considering the importance of duration dependence.

We find that the macroeconomic environment plays an important role at explaining the duration of fiscal consolidation. In particular, higher per capita GDP, lower real interest rates, higher inflation and more trade openness help shortening the adjustment.

Additionally, the state of the fiscal stance drives the length of the episode and fiscal authorities should behave in a vigilant manner regarding its dynamics: while larger budget deficits lead to a longer consolidation process, a rise in the level of public debt may undermine the likelihood of it ending.

In what concerns spending-driven and tax-driven consolidations, the first are generally shorter, corroborating the idea that cuts in government spending are more prone at successfully achieving a sustainable path for public debt. However, the size of the consolidation program (in percentage of GDP) does not seem to affect duration. Moreover, spending and tax-driven consolidations are generally of shorter duration in European countries than in Non-European countries. This, in turn, highlights that the establishment of a supra-national institutional framework imposing discipline in governments can be a credible device towards reducing the length of fiscal consolidation episodes.

With regard to the duration dependence in fiscal consolidation, our results suggest that it is positive, i.e. the likelihood of a fiscal consolidation ending increases over time. However, the pattern of the hazard rate is nonlinear: the probability of a fiscal consolidation ending increases until about the eight/ninth year of duration and decreases afterwards. This nonlinear behaviour is also found in spending-driven consolidations and, to a lesser extent, in tax-driven adjustment programs, and corroborates the idea of an "adjustment fatigue" (IMF, 2012).

The rest of the paper is organized as follows. Section 2 reviews the existing literature on the duration of fiscal consolidation. Section 3 presents the econometric model. Section 4 provides the empirical analysis. Finally, Section 5 concludes.

2 Review of the Literature

The existing literature on fiscal consolidation has typically focused on the relative importance of the various factors driving the adoption and the implementation of fiscal adjustments

In what concerns the start of fiscal consolidation programs, both the state of public finances and the economic conditions prevailing at the time of consolidation have been regarded, in most of the empirical works, as important determinants (Perotti, 1999; Giavazzi et al., 2000; Alesina et al., 2008). In particular, according to the European Commission (2007), Guichard et al. (2007) and Barrios et al. (2010), fiscal consolidations are more likely to be launched when the stance of general governments is weak (i.e. there is a large indebtedness) and the domestic economy is performing relatively well compared to the other countries. Both conditions are also seen as key for boosting the overall size of consolidation and, thereby, to increase the probability of success (Afonso and Jalles, 2011; von Hagen et al., 2002).[2]

Other factors impacting on the probability of experiencing successful fiscal adjustments include: (*i*) the timing of the austerity measures; (*ii*) their size; and (*iii*) their composition. With regard to the *timing* effect, "gradual" consolidations appear to be more successful than "cold shower" adjustments. However, at high and sharply rising debt levels and in a low-growth environment, a "cold shower" may be more effective (European Commission, 2007; Barrios et al., 2010). Similarly, von Hagen et al. (2002) find evidence of consolidation "fatigue", that is, when an episode of fiscal consolidation lasts for a relatively long period, the likelihood that the adjustment process will be reversed is higher. As for the *size* of the fiscal consolidation program, 'severe' adjustments generally signal the commitment of governments to achieve long-term sustainability of public debt. Putting it differently, as a result of the rise in credibility of the consolidation strategy, the expectations that higher taxes and interest rates might be needed in the future fade away and growth starts

[2] For an analysis of the economic, institutional and political determinants of the threen main components of fiscal policy (i.e. discretion, persistence and responsiveness), see Afonso et al. (2010).

materializing (Giavazzi and Pagano, 1996; von Hagen and Strauch, 2001). In the case of *composition* effects, Alesina and Perotti (1995, 1997, 1998), McDermott and Wescott (1996) and Buti and Sapir (1998) show that spending-driven fiscal consolidation programs (notably with respect to government consumption and transfers) have a better chance of success than fiscal adjustments that rely primarily on tax increases and cuts in public investment. This is mainly due to the pro-growth nature of government spending cuts vis-a-vis tax increases (Ardagna 2004; Alesina and Ardagna, 1998, 2010). It also reflects the impact of the fall in short- and long-term interest rates on costs and prices, which ultimately stimulate consumption and boost GDP growth (Ahrend et al., 2006).

Tackling a more general question dealing with the effect of fiscal policy on the economy, Blanchard and Perotti (2002) find that positive government spending shocks increase output and private consumption and have a crowding-out effect over private investment, while positive tax shocks have a negative effect on output and private spending. Despite the case for spending-based efforts, the implementation of tax-reforms in combination with deep labor market reforms significantly increase the likelihood of a successful fiscal adjustment (Lindbeck 1994).

We also note that some studies focused on the impact of fiscal consolidation on income distribution. For instance, Alesina and Perotti (1997) and Alesina and Ardagna (1998) show that during and in the aftermath of successful consolidations, the profit share often rises. Mulas-Granados (2005) also finds that successful fiscal consolidations are associated with higher income inequality, though less so for revenue-based adjustments than for expenditure-based ones. In the similar vein, Agnello and Sousa (2012) uncover a significant widening of the income gap during episodes of fiscal consolidation. However, while fiscal policy that is driven by spending cuts seems to be detrimental for income distribution, tax hikes appear to have an equalizing effect. The authors also show that when consolidation plans represent a small share of GDP, income inequality rises, which suggests that the burden associated with the effort affects disproportionately households at the bottom of the income distribution.

As can be inferred from the abovementioned literature, there is an important gap regarding the determinants of the *length* of fiscal consolidation programs and, in particular, at assessing if austerity measures exhibit duration dependence. These questions have gained a renewed interest in light of the sharp increase in deficits and the quick debt build up observed in many developed countries in recent times. In fact, the return to "normal times" is calling for the implementation of fiscal consolidation and many countries are now facing the challenges and the uncertainty about the effects of these fiscal measures on econoic activity (Cimadomo, 2012; Cimadomo et al., 2012), as well as the driving forces and the duration of such adjustment programs.

In this context, the duration analysis emerges as an important tool at providing some light to the issue. Having been employed in labour economics to assess the duration of spells of unemployment (Allison, 1982; Kiefer, 1988) and, more recently, to analyze the duration of the business cycles phases (Sichel, 1991; Zuehlke, 2003; Davig, 2007; Castro, 2010, 2012), this framework can be extremely useful at assessing the duration of fiscal consolidation programs. Not surprisingly, a few studies have started to explore this idea. For instance, the seminal work by Illera and Mulas-Granados (2002) provides evidence on the political economy of the duration of fiscal consolidation in the European Union. More recently, Molnar (2012) build on a deterministic framework to investigate the impact of economic and political drivers of the spell of fiscal consolidation, despite not accounting for duration dependence.

We improve upon the existing literature in several directions. First, we identify fiscal consolidation episodes based on the narrative approach implemented by Devries et al. (2011). As argued by the authors, the standard statistical approach which focuses on variation of the cyclically adjusted primary budget balance (CAPB) may lead to biased results, because: (*i*) the CAPB may suffer from measurement error and this, in turn, can be correlated with economic developments; and (*ii*) it omits periods during which fiscal consolidation actions were followed by adverse shocks and offsetting discretionary measures. For these reasons, the narrative approach can help us achieving a sounder measure of the discretionary component of fiscal policy, by eliminating the endogenous response to the economy. In fact, rather than looking at fiscal outcomes, policy actions that are explicitly motivated by deficit reduction are assessed by examining official budgetary documents of what countries were intending to do at the time of publications (such as the IMF Recent Economic Developments reports, the IMF Staff Reports or the OECD Economic Surveys). Second, we build on a database for 17 industrialized countries over the period 1978-2009 to analyze the duration of fiscal consolidation. This allows us to contrast the evidence for European and Non-European countries. Given the current developments associated with the adoption of fiscal austerity measures in many EU countries, our research can provide some insights to the debate and the criticism regarding the long-lasting nature and the time allotment of these programs. Finally, we use both continuous-time and discrete-time duration models to investigate whether the likelihood of a fiscal consolidation ending depends on its own age. In this way, we are able to understand the key economic determinants of the duration of fiscal consolidation, as well as to assess the extent to which the programs are duration-dependent.

3 Econometric Model

3.1 The continuous-time duration model

The duration variable is defined as the number of periods – years in this study – that a fiscal consolidation is being implemented. If T is defined as the discrete random variable that measures the time span between the beginning of a fiscal consolidation and the moment it ends, the series of data at our disposal $(t_1, t_2, \ldots, t_n)$ will represent the duration of the fiscal consolidation program. The probability distribution of the duration variable T can be specified by the cumulative distribution function:

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

This function measures the probability of the random variable T being smaller than a certain value t. The corresponding density function is then $f(t) = dF(t)/dt$. An alternative function for the distribution of T is the survivor function, $S(t) = Pr(T \geq t) = 1 - F(t)$. This function measures the probability of the duration of a fiscal consolidation being greater than or equal to t. A particularly useful function for duration analysis is the hazard function

$$h(t) = f(t)/S(t), \tag{2}$$

which measures the rate at which consolidation spells will end at t, given that they lasted until that moment. In other words, it captures the probability of exiting from a state in moment t conditional on the length of time in that state. From the hazard function, we can derive the integrated hazard function:

$$H(t) = \int_0^t h(u)du, \tag{3}$$

and compute the survivor function as follows:

$$S(t) = \exp[-H(t)]. \tag{4}$$

The hazard function allows for a characterization of the dependence duration path. If $dh(t)/dt > 0$ when $t = t^*$, there is positive duration dependence in t^*, that is, the probability of a fiscal consolidation ending at t, given that it has reached t, increases with its age. Thus, the longer the consolidation is, the higher the conditional probability of it ending will be.

Several parametric countinuous-time duration models can be proposed to measure the magnitude of the duration dependence and the impact of other time-invarying variables on the likelihood of an event ending, but the functional form that has been mostly employed to parameterize the hazard function is the proportional hazards model:[3]

$$h(t, \mathbf{x}) = h_0(t)\exp(\boldsymbol{\beta}'\mathbf{x}), \tag{5}$$

where $h_0(t)$ is the baseline hazard function that captures the duration dependence of the data, $\boldsymbol{\beta}$ is a $(K \times 1)$ vector of parameters to be estimated and $\mathbf{x}$ is a vector of covariates that do not vary over the duration of the event. This model can be estimated without imposing any specific functional form on the baseline hazard function, which leads to the so-called Cox model. However, this procedure is not adequate when we are studying duration dependence. An alternative estimation imposes one specific parametric form for the function $h_0(t)$, the most popular being the Weibull model. In this case, the (baseline) hazard function can be characterized as:

$$h_0(t) = \gamma p t^{p-1}, \tag{6}$$

with $\gamma > 0$ and $p > 0$. In this hazard function, γ is a constant and p parameterizes the duration dependence. If $p > 1$, the conditional probability of a turning point occurring increases as the phase gets older, i.e. there is positive duration dependence; if $p < 1$ there is negative duration dependence; finally, if $p = 1$, there is no duration dependence. In this last case, the Weibull model is equal to an Exponential model. Therefore, by estimating p, we can test for duration dependence in fiscal consolidations.

Including the Weibull specification for the baseline hazard function in the proportional hazard function given above by equation (5), we have:

$$h(t, \mathbf{x}) = \gamma p t^{p-1}\exp(\boldsymbol{\beta}'\mathbf{x}). \tag{7}$$

Hence, the corresponding survival function can be written as follows:

$$S(t, \mathbf{x}) = \exp\left[-H(t, \mathbf{x})\right] = \exp\left[-\gamma t^p \exp(\boldsymbol{\beta}'\mathbf{x})\right]. \tag{8}$$

This model can be estimated by Maximum Likelihood. The likelihood function for a sample of $i = 1, \ldots, n$ spells (fiscal consolidations) is given by

$$L(\cdot) = \prod_{i=1}^{n} f(t_i, \mathbf{x}_i) = \prod_{i=1}^{n} h(t_i, \mathbf{x}_i)^{c_i} S(t_i, \mathbf{x}_i), \tag{9}$$

where c_i indicates when observations are censored. If the sample period under analysis ends before

[3] This means that the ratio of the hazard rates for any pair of observations is constant over time.

the turning point has been observed, they will be censored ($c_i = 0$); if the turning points are observed in the sample period, they will not censored ($c_i = 1$).

The corresponding log-likelihood function can be written as follows:[4]

$$\ln L(\cdot) = \sum_{i=1}^{n} \left[c_i \ln h(t_i, \mathbf{x}_i) + \ln S(t_i, \mathbf{x}_i) \right], \tag{10}$$

or, making use of the respective Weibull hazard and survival functions

$$\ln L(\cdot) = \sum_{i=1}^{n} \left[c_i \left(\ln \gamma + \ln p + (p-1) \ln t_i + \boldsymbol{\beta}' \mathbf{x}_i \right) - \gamma t_i^p \exp(\boldsymbol{\beta}' \mathbf{x}_i) \right]. \tag{11}$$

This is the basic structure of the log-likelihood function for the Weibull model that we will estimate in this study with the aim of analyzing the presence of duration dependence in fiscal consolidation programs. However, the possibility that this may not be the most adequate model to employ - because although the life of a fiscal consolidation is a continuous-time process, available data is inherently discrete - leads us to consider, in addition, a discrete-time duration analysis.

3.2 The discrete-time duration model

Allison (1982) argues that when the discrete units are very small, one can treat time as if it is continuous. However, when the time units are very large, a discrete-time duration analysis may be more effective. This may be particularly relevant in the case of fiscal consolidations, where the available data is grouped into large (yearly) discrete-time intervals. Additionally, discrete-time duration models can have the advantage of easing the inclusion of time-varying covariates in the framework.

To implement discrete-time methods, we can start with a continuous-time model – the proportional hazards model is a sensible choice – and, then, derive the appropriate estimator for data grouped into intervals. A discrete-time (grouped data) version of the proportional hazards model was developed by Prentice and Gloeckler (1978).[5] First, it is assumed that time can only take integer values ($t = 1, 2, 3, \ldots$) and that we observe n independent spells (fiscal consolidations) ($i = 1, 2, \ldots, n$) starting at $t = 1$. The observation continues until time t_i, at which either an event occurs or the observation is censored, i.e. the event is observed at t_i, but not at t_{i+1}. A vector of time-varying explanatory variables $\mathbf{x}_{it}$ is also observed. Therefore, the discrete-time hazard rate can be defined as follows

$$P_{it} = \Pr[T_i = t | T_i > t, \mathbf{x}_{it}], \tag{12}$$

[4] See Allison (1982) and Kiefer (1988) for details.

[5] These models are analysed in detail by Prentice and Gloeckler (1978), Allison (1982), Kiefer (1988) and Jenkins (1995).

where T_i is the discrete random variable representing the uncensored time at which the fiscal consolidation ends. Consequently, P_{it} measures the conditional probability of consolidation i ending at time t, given that it has not ended yet. Assuming that the data is generated by the continuous-time proportional hazard model (5), Prentice and Gloeckler (1978) show that the corresponding discrete-time proportional hazard function can be expressed as

$$P_{it} = 1 - \exp\left[-h_t \exp(\boldsymbol{\beta}'\mathbf{x}_{it})\right] = 1 - \exp\left[-\exp(\theta_t + \boldsymbol{\beta}'\mathbf{x}_{it})\right], \tag{13}$$

which is equivalent to the so-called complementary log-log (or cloglog) function

$$\ln\left[-\ln(1 - P_{it})\right] = \theta_t + \boldsymbol{\beta}'\mathbf{x}_{it}, \tag{14}$$

where θ_t ($= \ln h_t$) represents the logarithm of an unspecified (baseline hazard) function of time, $\mathbf{x}_{it}$ is a vector of time-varying explanatory variables and the vector of coefficients $\boldsymbol{\beta}$ is identical to the one in the continuous-time proportional hazards model (5). This means that the continuous-time and discrete-time models will provide estimates of the same parameter, assuming that a proper interval for the observations is chosen. This, in turn, is set in such a way that the actual values of the covariates are constant over the interval.

In order to proceed with the estimation of the model, one needs to specify θ_t. One suitable and quite popular functional form for θ_t is the discrete-time analogue to the Weibull model, which yields:[6]

$$\theta_t = \ln h_t = \alpha + (p - 1)\ln t. \tag{15}$$

Other flexible functions include: (i) a polynomial-in-time specification ($\theta_t = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \alpha_3 t^3 + ...$), where we may have linear, quadratic, cubic or other polynomials for the hazard function; (ii) piecewise-dummies ($\theta_t = \alpha_0 + \alpha_1 d_1 + \alpha_2 d_2 + \alpha_3 d_3 + ...$) - i.e. one dummy for each particular sub-period of time - where the hazard rate is assumed to be the same within each time-group, but different between those groups; (iii) or a fully non-parametric specification with one dummy for each value of t for which an event is reported (time-dummies). Given their flexibility, some of these alternatives will also be evaluated in this study.

Prentice and Gloeckler (1978) and Allison (1982) show that the discrete-time log-likelihood

[6] Note that $\theta_t = \ln h_t = \ln(\gamma p t^{p-1}) = \alpha + (p-1)\ln t$, where $\alpha = \ln(\gamma p)$ and t is the duration of the fiscal consolidation program.

function for a sample of $i = 1, ..., n$ spells can be written as

$$\ln L(\cdot) = \sum_{i=1}^{n}\sum_{j=1}^{t_i} y_{it} \ln\left(\frac{P_{ij}}{1-P_{ij}}\right) + \sum_{i=1}^{n}\sum_{j=1}^{t_i} \ln\left(1-P_{ij}\right), \tag{16}$$

where the dummy variable y_{it} is equal to 1 if fiscal consolidation i ends at time t, and 0 otherwise.

Hence, this function just the log-likelihood function for the regression analysis of binary dependent variables. Plugging equation (14) into (16) and using the adequate specification for the baseline hazard function, one can estimate the model by Maximum Likelihood.

4 Empirical analysis

The empirical results from the estimation of the Weibull and Cloglog models and other more flexible specifications for the hazard function are analyzed in this section. However, we start by presenting the data employed in this duration analysis.

4.1 Data

The data used in duration analysis consists of spells, which, in our study, represent the number of years that a fiscal consolidation lasts ($DurCons$).

We consider annual data for 17 industrialized countries over the period 1978-2009.[7] Fiscal consolidation episodes are identified using the work of Devries et al. (2011), which is based on a narrative approach. As argued by the authors, the standard statistical approach which focuses on variation in the cyclically adjusted primary budget balance (CAPB) may lead to biased results for two important reasons. First, the CAPB may suffer from measurement error that is potentially correlated with economic developments. Second, it omits periods during which fiscal consolidation programs are followed by adverse shocks and offsetting discretionary measures. For these reasons, we follow Devries et al. (2011), who examine accounts and records of what countries were intending to do at the time of publications (such as the IMF Recent Economic Developments reports, the IMF Staff Reports or the OECD Economic Surveys) to uncover policy actions that are motivated by deficit reduction. This procedure eliminates the endogeneity of the response of fiscal policy to the economy, as it captures policymakers' decisions.

Although the main goal of our paper is to test for the presence of duration dependence in fiscal consolidations, an additional objective is to evaluate whether and how the economic environment affects their length. To proceed with such task, we use several fiscal and macroeconomic variables

[7] The countries included in our sample are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Portugal, Spain, Sweden, the United Kingdom, and the United States.

as regressors of the duration analysis. A complete description of all variables is presented in Table 1.

[INSERT TABLE 1 AROUND HERE]

According to von Hagen and Strauch (2001), Illera and Mulas-Granados (2002), Molnar (2012) and von Hagen et al. (2002), the initial fiscal conditions can determine the length of all the adjustment process. To account for this, we consider the general government budget surplus (GBS) and the general government debt ($Debt$) both in percentage of GDP, as regressors of the discrete-time duration analysis. We expect that higher budget deficits and higher public debt may trigger a longer consolidation process.

The macroeconomic conditions represent another important dimension that can influence not only the success, but also the timing and duration of a fiscal consolidation process (von Hagen and Strauch, 2001; von Hagen et al., 2002 ; Molnar, 2012). We control for those effects by considering the growth rate of real per capita GDP ($GDPpc$), the unemployment rate (UR) and the trade openness ($Open$). A higher growth rate of real per capita GDP and a lower unemployment rate are expected to fasten the end of a fiscal consolidation program due to the positive effect on government revenue and the negative impact on social expenditures. A similar effect is expected with regard to trade openness, as more transactions with other countries might imply an increase of government revenue.

In what concerns the monetary conditions, we consider the real interest rate (RIR) and the inflation rate ($Infl$). A higher inflation rate contributes to an erosion of the real value of the debt, which may reduce the length of a fiscal consolidation episode. Lower interest rates are expected to be beneficial as well, because the interest payments on debt fall.

We also expect that the occurrence of a crisis ($Crisis$) may influence the duration of a fiscal consolidation. For instance, banking crises may lead to a collapse of the economy and a sharp decrease in government revenue. This, in turn, can require large packages to rescue the financial system and severely deteriorate public finances (Reinhart and Rogoff, 2009, 2011).[8] Currency crises occur when there is a strong fall in a currency's value in terms of other currencies, while inflationary crises are typically associated with situations in which governments inflate away the real value of their debts. As for sovereign debt crises, they can happen when investors question the ability of governments to fulfill their financial obligations. As such, we add to the model a dummy variable that takes value 1 when a currency crisis, inflation crisis, stock market crisis, (external or domestic)

[8]Furceri and Zdzienicka (2012) investigate the short and medium-term impact of debt crises on GDP, and find significant and persistent output losses, as well as a stronger effects than banking and currency crises.

debt crisis or banking crisis is identified. It is not clear if the effect is negative or positive, but we conjecture that such crisis may undermine a consolidation episode that is taking place or even promote the start of a (new) fiscal consolidation.

The kind and the size of the fiscal consolidation are two additional factors that may influence its duration. In particular, spending-driven consolidations might be shorter than tax-driven consolidations, because cuts in the expenditures tend to be more effective than increases in taxes. In fact, Ardagna (2009) shows that cuts in government spending typically promote a permanent and substantial increase in government debt and also lead to a large reduction in interest rates. Alesina and Ardagna (2010) suggest that a spending reduction is more likely to reduce government deficit and public debt (in percentage of GDP), as well as to avoid recession, than tax increases. To collect this effect, we employ a dummy variable that takes value 1 when a spending-driven consolidation is implemented ($SpendCons$). Regarding the size, we consider that the higher the fiscal consolidation package is, as percentage of GDP ($SizeCons$), the longer the consolidation will be, because more time is needed to implement that package.

Finally, we distinguish between fiscal consolidation programs that were implemented in European countries from those undertaken by Non-European countries, by considering a dummy variable that takes the value of 1 for European countries, and 0 for Non-European countries.

The descriptive statistics for all variables used in this study are reported in Table 2.

[INSERT TABLE 2 AROUND HERE]

4.2 Weibull and cloglog estimations

We begin the empirical analysis by presenting the hazard rates and the survival functions for the duration of fiscal consolidations. We provide information for all consolidations and also by the type of consolidation, i.e. spending-driven versus tax-driven consolidation programs.

Figure 1 plots the hazard rates and the survival functions. The hazard rates for the full sample show that the conditional probability of a consolidation spell ending at term t, given that it has not ended yet, tends to increase over time until the sixth year. However, they slightly decrease afterwards. As a result, there is some indication that the duration dependence may be nonlinear or not monotonically increasing. In the case of spending-driven and tax-driven consolidations, it seems that the hazard rates do not change much over time, which might indicate that they are not duration dependent. As for the survival functions, they steadily fall over time not only in the full sample, but also for spending-driven and tax-driven consolidations.

[INSERT FIGURE 1 AROUND HERE]

A deeper statistical examination is provided in Table 3 (and in the following tables) with a parametric continuous-time and a discrete-time duration analysis. For each estimation - apart from the estimated coefficients and the corresponding robust standard errors –, we present the value of the log-likelihood function ($LogL$), the Akaike Information Criterion (AIC), the Schwarz Bayesian Information Criterion ($SBIC$), the Likelihood Ratio Index (LRI), the number of observations and the number of ended consolidation spells (in the Cloglog specifications).[9]

We start by considering a basic continuous-time Weibull model (Columns 1 and 2). As the relevant fiscal and economic regressors are time-varying, only the duration dependence parameter (p) is estimated. The results suggest the existence of positive duration dependence, as p is statistically greater than 1. Moreover, the second derivative of the baseline hazard function ($h_0(t) = \gamma p t^{p-1}$) indicates the presence of decreasing positive duration dependence (p is statistically lower than 2), which means that the probability of a fiscal consolidation ending at time t, given that it lasted until that period, increases over time but at a decreasing rate (Castro, 2010). This "decreasing rate" highlights that there is a reasonable group of consolidations that tend to persist over time. The only regressor in our list that does not vary over time is the dummy variable *European*. Hence, we include this variable in the model to check whether there are significant differences in the duration of fiscal consolidations between European and Non-European countries. The results reported in Column 2 show that the sign of the coefficient associated to the dummy variable is positive, thereby, indicating that fiscal consolidations tend to last longer in Non-European countries.

Given the abovementioned drawbacks linked to the continuous-time duration model, we also present the results from the estimation of discrete-time duration models. We start by assuming the following specification for the logarithm of the baseline hazard function in the discrete-time cloglog model: $\theta_t = \alpha + (p-1)\ln t$, where t measures the duration of a consolidation, i.e. $t = DurCons$. The results from the estimation of this model, without any additional regressor, confirm the findings of the continuous-time model (see Column 3): the likelihood of a fiscal consolidation ending increases over time, but at a decreasing rate. We also find some weak evidence for longer consolidations in Non-European countries.

In Columns 5-7, we add fiscal and economic variables that are expected to affect the duration of a consolidation. The evidence of positive duration dependence is still not affected with the inclusion of these time-varying regressors. In fact, it is reinforced since we now have evidence of constant positive duration dependence. Thus, disregarding those determinants can lead to biased estimates

[9] This corresponds to y_{it} in equation (16). Note also that we do not censor spells, because all fiscal consolidations ended in the sample period.

of the true duration dependence parameter (Jenkins, 1995).

Regarding the fiscal stance, we observe that the size of the budget deficit and the level of the public debt are important determinants of the length of a fiscal consolidation. In particular, higher budget deficits require a longer consolidation process. However, increasing debt levels may undermine the consolidation by increasing the likelihood of it ending.[10] This means that fiscal authorities must give special attention to the evolution of the public debt when they decide to implement a fiscal consolidation.

In what concerns the macroeconomic variables, our results show that better economic conditions, such as a higher per capita GDP or a lower unemployment rate, contribute to shorter (and successful) consolidations. Such conditions are expected to contribute to an increase in the fiscal revenues and a decrease in social expenditures, which might, in turn, speed up the consolidation process. The likelihood of a consolidation ending also increases when the real interest rate falls or when the inflation rate rises: on the one hand, lower interest rates help reducing interest payments on debt; on the other hand, higher inflation rates erode the real value of the public deficit and debt. Therefore, under these conditions, the consolidation program tends to be shorter. A similar effect is found for the degree of openness: the likelihood of a fiscal consolidation ending is higher for more open economies. This can be explained by the fiscal revenue from taxes on external transactions and the improvement in domestic conditions due to the increase in exports.

In Column 6, we also add the *Crisis* dummy variable to the model. The empirical findings show that when a banking crisis, a currency crisis, a domestic or an external debt crisis, an inflation crisis or a stock market crash occurs, the likelihood of a consolidation ending increases. Hence, a crisis tends to undermine the consolidation episode that is taking place.

In Column 7, we consider two additional variables that control for the typology and the size of the fiscal consolidation program. The results confirm our conjecture that spending-driven consolidations tend to be shorter than tax-driven consolidations. This might be the case, because cuts in the expenditures are usually more effective than increases in taxes. Nevertheless, our evidence is not statistically sufficient to argue that bigger consolidation packages are associated to longer consolidation processes. Finally, as with the inclusion of all these additional regressors the dummy variable *European* is no longer statistically significant, we decided to remove it from the model. Thus, after controlling for fiscal and macroeconomic conditions, no differences are found in the duration of fiscal consolidations between European and non-European countries.

[INSERT TABLE 3 AROUND HERE]

[10] We use the first lag of these variables to account for delays in the report of the fiscal data and to avoid simultaneity problems. Results are also more robust when the lag of these variables are considered.

4.3 A more flexible specification for the hazard function

Being a parametric framework, the Weibull model imposes a restrictive constraint on the shape of the hazard function, since its continuous distribution – as well as its discrete equivalent – can only rise or decline in a monotonic way. However, this pattern may not be adequate, as Figure 1 suggests. Consequently, other more flexible specifications should be considered. As a result, we test some polynomial-in-time specifications (linear, quadratic and cubic) for the hazard function in the cloglog framework.

Table 4 shows that the quadratic specification is among the best fittings of the data. This is the case, not only because the two coefficients in the quadratic polynomial specification (Column 2) are highly significant, but also because the AIC and $SBIC$ are lower and the LRI is higher than in the linear and cubic specifications (Columns 1 and 3, respectively). Moreover, the quadratic specification of $DurCons$ also seems to be a slightly better alternative than the selected discrete-time specification reported in Column 7 of Table 3. For instance, the log-likelihood and the LRI are higher in the former than in the later and the AIC also favours the quadratic specification. Hence, we rely on the polynomial-in-time quadratic specification to analyze the duration of fiscal consolidations.

The results provided by this estimation are quite interesting and indicate that the likelihood of a fiscal consolidation ending increases over time. Indeed, the coefficient on $DurCons$ is positive. However, this pattern is observed only until a certain duration. In fact, the coefficient on $DurCons^2$ becomes negative, so that the likelihood of a fiscal consolidation ending falls afterwards.

This piece of evidence is in line with the hazard rates presented in Figure 1, in particular, with the peak after six years of duration. Moreover, the estimated hazard function plotted in Figure 2 for the quadratic Cloglog specification - obtained from Column 2 in Table 4 - confirms this behaviour: after controlling for the fiscal and macroeconomic determinants, the likelihood of a fiscal consolidation ending increases over time until reaching about nine years of duration; then, it starts falling.[11] This means that only fiscal consolidations that last less than nine years exhibit positive duration dependence. This can be the result of a build up in reputation regarding some particular consolidations or simply due to the need of a strong and reasonably short fiscal adjustment. For longer consolidations, the effect is negative, thereby, implying that they tend to persist when they pass the ninth year threshold. This is consistent with the potential "adjustment fatigue", which can be a threat to the successfulness of the program implementation (IMF, 2012). Additionally, the use of a quadratic specification does not affect the relevance of the fiscal and macroeconomic

[11] All the estimated hazard functions plotted in Figure 2 are obtained from the respective regression for which covariates are set at their sample means, with the exception of the dummy variables, which are evaluated at their mode.

variables in explaining the duration of fiscal consolidations.

[INSERT FIGURE 2 AROUND HERE]

This new piece of evidence contrasts with the monotonically increasing estimates for the hazards rates obtained from: (*i*) the basic Weibull specification reported in Column 1 of Table 3; (*ii*) the basic Cloglog (Column 3 of Table 4); and (*iii*) the Cloglog with regressors (Column 7 of Table 4).

The estimation of a more flexible specification that imposes no constraints on the shape of the hazard function helps clarifying potential doubts about its configuration. Therefore, we estimate a fully non-parametric or time-dummies specification with a dummy variable for each t for which an event is reported. In this context, the coefficients on the dummy variables allow for a free determination of the shape of the hazard function. The results from the estimation of a time-dummies specification ($D\_DurCons1$ to $D\_DurCons10$) are presented in Column 4 and show that the increase in the likelihood of a consolidation ending is not monotonically increasing.[12] As can be seen, the coefficients do not increase steadily over time. Instead, they evolve irregularly, a feature that is also clear in Figure 2 (Cloglog with year dummies). Nevertheless, the patterns resemble more the quadratic Cloglog than the other Cloglog and Weibull hazard functions: the likelihood of a consolidation ending increases over time but, after the eighth year of duration, it starts to decrease. The findings associated to the piecewise-dummies for two and five years reported in Columns 5 and 6 also confirm the initial increase and the later decrease in the likelihood.[13] Hence, this additional evidence supports the quadratic behaviour of the hazard function.

According to Beck et al. (1998) and Finocchiaro and Lin (2000), one possible drawback of using dummy variables in these models is the fact that the respective estimated hazard function is likely to "zig-zag" in time.[14] Hence, the results may not be easily interpretable. Beck at al. (1998) suggest using "natural cubic splines" to smooth out the coefficients and the hazard function based on them. As a result, we replace the vector of dummy variables by a vector of spline basis variables that are cubic polynomials of t (or $DurCons$). Since the number of spline variables that is needed is lower than the number of time-dummies, statistical significance is easier to achieve and the time-dependence of the hazard function is straightforward to test. The results with two and three cubic splines are presented in Columns 7 and 8. It can be seen that the coefficients of the covariates remain statistically significant and have the expected signs. Moreover, the coefficients for the splines in the

[12] As there are no consolidations in the sample that last 11, 12 or 13 years, those dummy variables cannot be included in the model. Thus, we assume that the hazard rate is the same over the last four years.

[13] Notice that the hazards are maximized for the ninth-tenth years of duration ($D\_Dur2yr9\_10$) in the first case, and for the sixth-tenth interval ($D\_Dur5yr6\_10$), in the second case.

[14] Additionally, since there is usually high multicollinearity among the dummy variables, individual coefficient estimates tend to have large standard errors.

specification with two cubic splines are also highly significant.[15] The best way of interpreting them is to look at the respective estimated hazard function in Figure 2 (Cloglog with two cubic splines). This hazard function adjusts relatively well to the Cloglog-dummy hazard function, but the most interesting finding is that the Cloglog model with two cubic splines corroborates the results obtained with the parametric-in-time quadratic specification of Column 2. In particular, they confirm that the likelihood of a fiscal consolidation ending behaves in a non-monotonic way, increasing until about the eight/ninth year of duration and decreasing afterwards. Hence, this Cloglog specification represents the best framework to study the duration of fiscal consolidations and the one that provides the most accurate characterization of the likelihood of a fiscal consolidation ending after a certain duration.

[INSERT TABLE 4 AROUND HERE]

4.4 Spending-driven versus tax-driven consolidations

In the previous Sub-Sections, we analyzed if fiscal consolidations are duration dependent, we looked at their specific behaviour over time and we assessed the macroeconomic and fiscal drivers of their duration. In addition, the results indicated that spending-driven consolidations tend to be shorter than tax-driven consolidations.

In order to investigate more extensively the behaviour of each type of consolidation, we now consider spending-driven and tax-driven programs in separate empirical duration analyses. In particular, we ask whether duration dependence is a characteristic of both or not and verify which fiscal and macroeconomic factors are more relevant in each situation.

Table 5 provides a summary of the estimation of a parametric continuous-time Weibull model (Column 1) and several discrete-time Cloglog specifications (Columns 2, 3 and 4) for spending-driven programs. In the case of the continuous-time Weibull specification, we find some evidence of positive (although decreasing) duration dependence (Column 1). However, when a discrete-time Cloglog model is used (Columns 2-4), duration dependence no longer seems to be present: the duration dependence parameter (p) is not statistically different from 1, which means that the likelihood of a spending-driven consolidation ending is likely to be constant over time and not increasing as suggested by the continuous-time model.

[15] The two spline-basis variables correspond to "knots" at terms 1, 7, and 14, respectively. This set of knots was chosen because it produces statistically significant variables and the lowest p-value in rejecting the null model in likelihood ratio tests. A 4-knot solution was also tried in Column 8, but none of the three cubic splines has proved to be statistically significant at a 5% level. Moreover, the AIC and the $SBIC$ are higher in this regression than in Column 7. Hence, the model with two cubic splines is the preferred one.

The duration of this type of consolidation program is significantly affected by the government deficit and the public debt levels and in the same way as for all consolidations. The state of the economy is also important to explain duration: a better economic environment (i.e. a higher per capita GDP and a lower unemployment rate) shortens spending-driven consolidation episodes. The likelihood of a consolidation process ending also increases when the inflation rate rises, which can be due to erosion of the real value of public debt. Moreover, our results indicate that the occurrence of a crises can undermine this particular type of consolidation process. In contrast, changes in the real interest rate, in the degree of openness or in the size of the consolidation package do not seem to significantly affect the duration of spending-driven consolidations. Additionally, while the previous analysis did not detect significant differences in fiscal consolidation between European and Non-European countries, the results show that spending-driven consolidations tend to be shorter for European countries.[16]

These findings are corroborated by the more flexible specifications reported in Columns 5-7. Even though no evidence of duration dependence is found in the discrete-time Cloglog specifications, these additional regressions show that the behaviour of the hazard rate is neither constant over time, nor monotonically increasing. Indeed, it seems to evolve in a nonlinear way: the estimation of polynomial-in-time specifications (linear, quadratic and cubic) shows that the cubic framework is the one that best fits to the data. The coefficients on the "duration" variable $DurCons$ and their corresponding powers are only statistically significant in this case.[17] Given this, the likelihood of spending-driven consolidations ending initially increases (the coefficient on $DurCons$ is positive); then, it falls (the coefficient on $DurCons^2$ is negative); finally, it starts increasing again (the coefficient on $DurCons^3$ is positive).

We also estimate an (almost) fully non-parametric or time-dummies specification with one dummy for each relevant duration in order to allow for a free determination of the shape of the hazard function.[18] The results are reported in Column 6 and the respective estimated hazard function is shown in Figure 3. They indicate an increase in the hazards in the first years and a fall in the last years, which is in line with the results found for the whole sample of fiscal consolidation episodes.[19]

[INSERT FIGURE 3 AROUND HERE]

[16] Note that the coefficient of the dummy variable *European* is significantly positive for all regressions, which means that the likelihood of a spending-driven consolidation ending is higher in the group of European countries.

[17] In the other cases, the "duration" parameters are never statistically significant, the likelihood and the LRI are lower and the AIC and $SBIC$ higher. To save space, we only present the results for the (most relevant) polynomial-in-time cubic specification, but the other results (linear and quadratic) are available upon request.

[18] There are no spending-driven consolidations in the sample that last for five years or more.

[19] The estimated hazard rates for the basic Weibull are obtained from the results of Column 1. For the other analogue discrete-time Cloglog specifications (Columns 2-5), the estimated hazard rates are flat (i.e. constant over time), as the duration parameter is close to 1.

Due to the problems mentioned before for this kind of specification, we generate some "natural cubic splines". The empirical findings are reported in Column 7 and the estimated hazard rates are drawn in the last graph of Figure 3.[20] They confirm the results provided by the cubic Cloglog model, as they show that the likelihood of spending-driven consolidations behaves in a non-monotonic and nonlinear way, increasing until the third year, then, falling until the fifth year and, finally, starting to increase again. Putting it differently, the evidence points to a more complex evolution of these events over time than the traditional monotonically increasing pattern that is usually observed in studies about the business cycle. This finding is also in contrast with the quadratic and concave behaviour of the duration of all fiscal consolidations over time. Nevertheless, there is evidence of duration dependence in both cases.

[INSERT TABLE 5 AROUND HERE]

The results for tax-driven consolidations, presented in Table 6, are slightly different. First, with regard to the effects of fiscal and macroeconomic regressors, public debt, real GDP per capita and real interest rate play a significant role in explaining duration: high debt levels, deterioration of economic environment and higher interest rates may undermine a tax-driven consolidation process. Additionally, this type of consolidation program seems to last longer in Non-European countries than in European countries. Second, only the continuous-time Weibull model (Column 1) is able to provide clear evidence of positive duration dependence. However, the more flexible polynomial-in-time specifications show that the duration of tax-driven consolidations has a similar behaviour to the spending-driven ones. The cubic specification is, once again, the one that best fits the data: the likelihood of tax-driven consolidations ending starts by increasing, then, it decreases and, finally, it increases again.[21] This pattern is confirmed in Figure 4, where the estimated hazard rates are plotted (see cubic Cloglog). The time-dummies estimates (Column 6) also suggest a non-monotonic behaviour of the hazards, a feature that is confirmed by the more adequate specification with natural cubic splines (Column 7). In addition, the cubic Cloglog model shows that the results are quite similar to the ones obtained for spending-driven consolidations, although the statistical significance is somewhat weaker. This, in turn, is consistent with our conjecture that duration dependence is stronger in spending-driven than in tax-driven consolidations. It also helps explaining why the former tend to be shorter (and, perhaps, more effective) than the latter.

[20] We also estimate regressions with quadratic cubic splines, but the respective coefficients are not statistically significant and the corresponding hazards are not well defined. Those results are available upon request.

[21] The "duration" parameters associated to the linear and quadratic specifications are never statistically significant, the likelihood and the *LRI* are lower and the *AIC* and the *SBIC* are higher. These results are available upon request.

[INSERT FIGURE 4 AROUND HERE]

[INSERT TABLE 6 AROUND HERE]

5 Conclusions

This study analyses the fiscal and macroeconomic determinants of the likelihood of a fiscal consolidation ending and the presence of duration dependence in fiscal consolidation programs.

We consider annual data for 17 industrialized countries over the period 1978-2009 and rely on a narrative approach adopted by Devries et al. (2011) for identifying fiscal consolidation episodes.

Estimating continuous and discrete-time duration models, we find that: (*i*) higher budget deficits require a longer consolidation process; (*ii*) increasing public debt levels undermine consolidation by boosting the likelihood of it ending; (*iii*) good economic conditions contribute to shorter (and successful) consolidations; (*iv*) lower real interest rates, higher inflation rates and more trade openness bring a faster consolidation process; and (*v*) economic, fiscal or financial crises may end the adjustment process sooner than expected.

We also show that spending-driven consolidations are shorter than tax-driven consolidations. However, the size of the consolidation program (in percentage of GDP) does not seem to explain duration. Similarly, no significant differences are found in the duration of fiscal consolidations for European and non-European countries.

Additionally, the empirical evidence supports the existence of positive duration dependence in fiscal consolidation, that is, the likelihood of fiscal consolidation programs' ending tends to increase over time. However, the behaviour of the hazard rates is not monotonically increasing. Indeed, they tend to display a nonlinear pattern in that the likelihood of a fiscal consolidation ending increases until about the eight/ninth year of duration and decreases afterwards. This feature seems to be in accordance with the idea of some "adjustment fatigue" that can compromise the successfulness of the consolidation program.

When we split the sample into spending-driven and tax-driven consolidations, our results show that both types of adjustment programs are mostly affected by the fiscal stance and the economic environment. Moreover, they suggest that both types of consolidation are of shorter duration in European countries than for Non-European countries. In what concerns the duration dependence, the evidence is somewhat weaker. However, we confirm that the likelihood of spending and tax-driven consolidations also behave in a non-monotonic fashion, starting by increasing until the second or third year, then, decreasing until the fifth year and, finally, increasing again. This result is more relevant for spending-driven consolidation programs, but contrasts with the quadratic behaviour of the duration of fiscal consolidations in general.

From a policy perspective, the findings of the current work corroborate the idea that cuts in government spending are more effective than tax hikes at delivering fiscal consolidation. In addition, they highlight that fiscal authorities need to pay a special attention to the evolution of public debt when implementing austerity measures. Similarly, the patterns of the interest rate and the inflation rate need to be carefully addressed as a mean of obtaining a signal of the successfulness of the consolidation program. Finally, countries whose economies are more open to trade may be more prone to achieve a stabilization of the public finances.

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Appendix

A List of Tables

Table 1: Description of the variables.

Variable	Source(s)	Description
DurCons	Devries et al. (2011)	Duration of the fiscal consolidation in years.
GBS	AMECO and National Statistics	General government budget surplus (% GDP).
Debt	Abbas et al. (2010)	General government debt (% GDP).
GDPpc	WDI (World Bank, 2011)	Annual growth rate of GDP per capita.
Unemp	WDI (World Bank, 2011)	Unemployment rate.
RIR	WDI (World Bank, 2011)	Real interest rate.
Infl	WDI (World Bank, 2011)	Annual inflation rate (GDP deflator).
Open	PWT 7.0 (Heston et al., 2011)	Trade openness, i.e. exports plus imports in percentage of GDP.
Crisis	Reinhart and Rogoff (2011)	Dummy variable that takes the value of 1 when a crisis episode occurs; and 0, otherwise.
SpendCons	Devries et al. (2011)	Dummy variable that takes the value of 1 for spending-driven consolidations; and 0, otherwise.
SizeCons	Devries et al. (2011)	Size of the fiscal consolidation package in percentage of GDP.
European	Authors' computation	Dummy variable that takes the value of 1 for European countries; and 0, otherwise.

Note: AMECO is the annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs (DG ECFIN). It contains data for EU-27, the euro area, EU Member States, candidate countries and other OECD countries (Australia, Canada, Iceland, Japan, Korea, Mexico, New Zealand, Norway, Switzerland and United States). Fiscal data for Australia have been retrieved from the Australian Bureau of Statistics.

Table 2: Descriptive statistics.

Variable	Obs.	Mean	S.D.	Min.	Max.
DurCons	148	4.34	3.03	1	14
GBS	148	−4.60	3.21	−14.52	3.23
Debt	148	72.54	35.17	12.85	191.64
GDPpc	148	1.98	1.72	−4.02	5.90
Unemp	148	9.61	4.29	2.02	23.88
Open	148	50.24	28.57	12.40	143.52
RIR	148	6.48	2.33	0.33	12.15
Infl	148	3.16	3.01	−1.60	24.61
Crisis	148	0.36	0.48	0	1
SpendCons	148	0.57	0.50	0	1
SizeCons	148	0.89	0.93	0	4.49
European	148	0.66	0.48	0	1

Table 3: Continuous-time (Weibull) and discrete-time (Cloglog) estimations - Full sample.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
p	$1.504^{+,d}$	$1.603^{+,d}$	$1.346^{+,d}$	$1.455^{+,d}$	$2.262^{+,c}$	$2.301^{+,c}$	$2.095^{+,c}$
	(0.142)	(0.118)	(0.191)	(0.168)	(0.395)	(0.464)	(0.507)
GBS					0.405^{***}	0.433^{***}	0.428^{***}
					(0.110)	(0.107)	(0.118)
Debt					0.017^{***}	0.015^{**}	0.018^{***}
					(0.005)	(0.006)	(0.005)
GDPpc					0.429^{**}	0.485^{**}	0.482^{**}
					(0.199)	(0.200)	(0.203)
Unemp					-0.124^{***}	-0.076^{**}	-0.076^{**}
					(0.040)	(0.040)	(0.033)
RIR					-0.162^{**}	-0.215^{**}	-0.209^{**}
					(0.080)	(0.103)	(0.086)
Infl					0.305^{***}	0.307^{***}	0.369^{***}
					(0.089)	(0.103)	(0.118)
Open					0.025^{***}	0.037^{***}	0.038^{***}
					(0.008)	(0.011)	(0.013)
Crisis						1.106^{*}	1.486^{**}
						(0.632)	(0.707)
SpendCons							1.192^{**}
							(0.504)
SizeCons							−0.618
							(0.484)
European		0.742^{*}		0.693^{*}	0.769		
		(0.388)		(0.361)	(0.633)		
Constant	-2.500^{***}	-3.234^{***}	-1.854^{***}	-2.503^{***}	-4.420^{**}	-4.859^{**}	-5.555^{**}
	(0.314)	(0.459)	(0.306)	(0.441)	(1.761)	(1.967)	(2.375)
LogL	−45.1	−43.2	−94.0	−92.4	−48.1	−46.3	−43.3
AIC	94.1	92.4	192.1	190.9	116.2	112.7	110.7
SBIC	97.5	97.4	198.5	200.5	146.2	142.6	146.6
LRI	–	–	0.013	0.030	0.343	0.367	0.408
Observ.	39	39	185	185	148	148	148
Ended	–	–	39	39	29	29	29

Notes: Robust standard errors (clustered by country) for the estimated coefficients are in parentheses. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%; and *, 10%. The sign "+" indicates that p is significantly higher than 1 using a 5% one-sided test with robust standard errors; d, c and i, indicate the presence of decreasing, constant or increasing positive duration dependence at a 5% level, respectively. $AIC = 2[-LogL + k]$ and $SBIC = 2[-LogL + (k/2)LogN]$, where $LogL$ is the log-likelihood for the estimated model, k is the number of regressors and N is the number of observations. LRI is the likelihood ratio index or pseudo-R^2 ($LRI = 1 - LogL/LogL_0$, where L_0 is the likelihood of the model without regressors). "*Ended*" indicates de number of non-zero observations in the Cloglog model, which also corresponds to the number of consolidation spells. Columns (1) and (2) present the results of a continuous-time Weibull model; Columns (3) to (7) show the results of a discrete-time Cloglog model that is analogue to the continuous-time Weibull model.

Table 4: Other specifications for the baseline hazard function - Full sample.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$DurCons \|\| Spline1$	0.176**	0.794**	0.765				0.611***	0.599*
	(0.075)	(0.324)	(0.766)				(0.229)	(0.325)
$DurCons^2 \|\| Spline2$		−0.043**	−0.038				−0.649**	−0.675
		(0.019)	(0.115)				(0.259)	(0.889)
$DurCons^3 \|\| Spline3$			−0.001					0.586
			(0.005)					(2.311)
$D\_DurCons1$				−1.456				
$D\_DurCons2$				−1.018				
$D\_DurCons3$				−1.356				
$D\_DurCons4$				−0.288				
$D\_DurCons5$				−0.240				
$D\_DurCons6$				1.961**				
$D\_DurCons7$				0.822				
$D\_DurCons8$				1.401**				
$D\_DurCons9$				1.282*				
$D\_DurCons10$				1.106				
$D\_Dur2yr1\_2$					−1.104			
$D\_Dur2yr3\_4$					−0.676			
$D\_Dur2yr5\_6$					0.771			
$D\_Dur2yr7\_8$					1.171			
$D\_Dur2yr9\_10$					1.247**			
$D\_Dur5yr1\_5$						−0.688		
$D\_Dur5yr6\_10$						1.527***		
GBS	0.393***	0.455***	0.455***	0.449***	0.425***	0.419***	0.455***	0.456***
	(0.105)	(0.138)	(0.135)	(0.148)	(0.132)	(0.118)	(0.140)	(0.136)
$Debt$	0.017***	0.021***	0.021***	0.023***	0.023***	0.023**	0.021***	0.021***
	(0.005)	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
$GDPpc$	0.445**	0.496**	0.495**	0.505*	0.456**	0.474**	0.496**	0.495**
	(0.182)	(0.209)	(0.211)	(0.266)	(0.206)	(0.197)	(0.210)	(0.209)
$Unemp$	−0.054	−0.105***	−0.105**	−0.116**	−0.113***	−0.124***	−0.111***	−0.109***
	(0.036)	(0.039)	(0.042)	(0.051)	(0.039)	(0.032)	(0.040)	(0.042)
RIR	−0.210**	−0.199**	−0.199**	−0.207	−0.188	−0.195*	−0.196**	−0.198**
	(0.084)	(0.097)	(0.098)	(0.131)	(0.116)	(0.107)	(0.100)	(0.101)
$Infl$	0.321***	0.403***	0.403***	0.402***	0.402***	0.382***	0.409***	0.407***
	(0.090)	(0.130)	(0.130)	(0.152)	(0.140)	(0.123)	(0.133)	(0.131)
$Open$	0.034***	0.038***	0.038***	0.036**	0.033***	0.033***	0.038***	0.038***
	(0.010)	(0.012)	(0.013)	(0.015)	(0.012)	(0.009)	(0.012)	(0.012)
$Crisis$	1.445**	1.420**	1.417*	1.479*	1.371*	1.317*	1.426**	1.414*
	(0.660)	(0.706)	(0.726)	(0.764)	(0.718)	(0.791)	(0.719)	(0.730)
$SpendCons$	1.190**	1.358**	1.359**	1.564**	1.543**	1.515**	1.394**	1.384**
	(0.515)	(0.573)	(0.568)	(0.681)	(0.643)	(0.652)	(0.588)	(0.580)
$SizeCons$	−0.703	−0.617	−0.619	−0.593	−0.715	−0.768	−0.621	−0.621
	(0.490)	(0.503)	(0.512)	(0.545)	(0.526)	(0.500)	(0.508)	(0.515)
$Constant$	−4.692**	−6.609**	−6.558**	−4.147**	−4.021**	−3.888**	−6.506**	−6.438**
	(1.822)	(2.631)	(3.246)	(1.893)	(1.678)	(1.581)	(2.577)	(2.861)
$LogL$	−44.7	−42.1	−42.1	−38.4	−41.7	−40.1	−41.7	−41.8
AIC	113.5	110.2	112.2	106.9	113.5	106.1	109.4	111.7
$SBIC$	149.4	149.2	154.2	151.8	158.4	145.1	148.4	153.6
LRI	0.389	0.425	0.423	0.475	0.430	0.453	0.430	0.429
$Observ.$	148	148	148	148	148	148	148	148
$Ended$	29	29	29	29	29	29	29	29

Notes: Robust standard errors (clustered by country) for the estimated coefficients are in parentheses. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%; and *, 10%. The Cloglog regressions in Columns 1 to 3 are performed using polynomial baseline hazard functions: linear, quadratic and cubic, respectively. A fully non-parametric specification with one dummy for each year is employed in the regression of Column 4. Piecewise-dummies for two and five years are used in regressions corresponding to Columns 5 and 6, respectively. In Column 7, two natural cubic splines of *DurCons*, with knots at terms 1, 7 and 14, are considered; and, in Column 8, three natural cubic splines of *DurCons*, with knots at terms 1, 5, 10 and 14, are used.

Table 5: Spending-driven fiscal consolidations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
p	$1.590^{+,d}$	1.045	1.127	1.003			
	(0.116)	(0.200)	(0.410)	(0.354)			
$DurCons \vert\vert Spline1$					4.050^{*}		1.029^{*}
					(2.125)		(0.595)
$DurCons^2 \vert\vert Spline2$					-1.288^{**}		-4.753^{**}
					(0.655)		(2.409)
$DurCons^3 \vert\vert Spline3$					0.114^{**}		15.442^{**}
					(0.057)		(7.732)
$D\_DurCons1$						0.729	
$D\_DurCons2$						1.132^{*}	
$D\_DurCons3$						1.531^{**}	
$D\_DurCons4$						1.537^{**}	
GBS			0.429^{***}	0.466^{***}	0.509^{***}	0.550^{***}	0.519^{***}
			(0.114)	(0.130)	(0.171)	(0.171)	(0.178)
$Debt$			0.030^{***}	0.030^{***}	0.028^{***}	0.032^{***}	0.028^{***}
			(0.007)	(0.007)	(0.007)	(0.008)	(0.008)
$GDPpc$			0.906^{***}	0.893^{***}	0.918^{***}	0.961^{***}	0.922^{***}
			(0.192)	(0.203)	(0.248)	(0.230)	(0.252)
$Unemp$			-0.112^{**}	-0.120^{***}	-0.163^{***}	-0.157^{***}	-0.161^{***}
			(0.052)	(0.043)	(0.062)	(0.051)	(0.062)
RIR			0.045				
			(0.097)				
$Infl$			0.373^{***}	0.333^{***}	0.375^{***}	0.363^{***}	0.377^{***}
			(0.096)	(0.089)	(0.110)	(0.127)	(0.116)
$Open$			0.007				
			(0.011)				
$Crisis$			1.652^{***}	1.535^{***}	1.721^{***}	1.612^{***}	1.706^{***}
			(0.519)	(0.449)	(0.653)	(0.576)	(0.655)
$SizeCons$			−0.766				
			(0.585)				
$European$	1.022^{***}	0.890^{***}	2.029^{**}	1.856^{***}	2.293^{***}	2.065^{***}	2.327^{***}
	(0.342)	(0.256)	(0.968)	(0.677)	(0.789)	(0.652)	(0.818)
$Constant$	-2.284^{***}	-1.244^{***}	-4.597^{***}	-3.903^{***}	-6.867^{***}	-4.608^{***}	-5.041^{***}
	(0.306)	(0.252)	(1.523)	(0.754)	(2.084)	(0.981)	(1.308)
$LogL$	−48.4	−69.5	−30.5	−31.7	−29.4	−30.0	−29.2
AIC	102.7	144.9	84.9	81.3	80.9	84.0	80.3
$SBIC$	108.3	152.9	114.2	103.3	107.7	113.3	107.2
LRI	–	0.038	0.471	0.450	0.489	0.479	0.494
Observ.	47	105	85	85	85	85	85
Ended	–	47	35	35	35	35	35

Notes: Robust standard errors (clustered by country) for the estimated coefficients are in parentheses. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%; and *, 10%. Column 1 presents the results of a continuous-time Weibull model; Columns 2 to 4 show the results of a discrete-time Cloglog model that is analogue to the continuous-time Weibull model. The remaining Cloglog regressions are performed using: a cubic polynomial baseline hazard function (Column 5), a fully non-parametric specification with one dummy for each relevant year (Column 6), and three natural cubic splines of *DurCons*, with knots at terms 1, 3, 5 and 7 (Column 7).

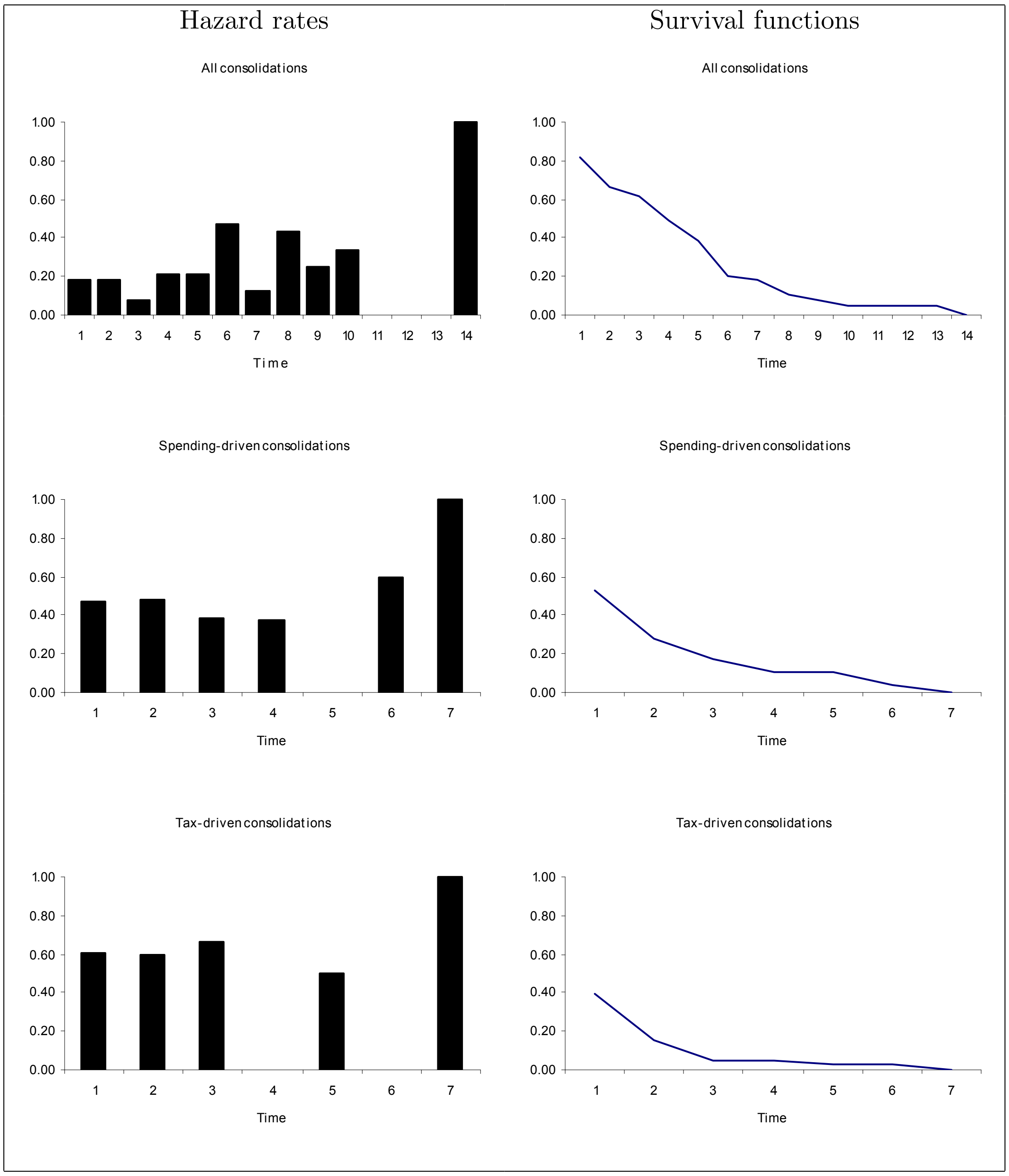
Table 6: Tax-driven fiscal consolidations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
p	$1.571^{+,d}$	0.984	1.559	0.965			
	(0.120)	(0.333)	(0.555)	(0.402)			
$DurCons\|\|Spline1$					1.827		0.493
					(1.933)		(0.676)
$DurCons^2\|\|Spline2$					−0.604		-2.717^{*}
					(0.573)		(1.514)
$DurCons^3\|\|Spline3$					0.053^{*}		8.835^{*}
					(0.029)		(5.317)
$D\_DurCons1$						0.764^{***}	
$D\_DurCons2$						0.132	
$D\_DurCons3$						2.067^{***}	
GBS			0.075	0.116^{*}	0.103	0.149^{**}	0.106
			(0.101)	(0.063)	(0.067)	(0.075)	(0.067)
$Debt$			0.015^{***}	0.010^{***}	0.011^{**}	0.014^{***}	0.011^{**}
			(0.005)	(0.003)	(0.004)	(0.005)	(0.004)
$GDPpc$			-0.310^{**}	-0.285^{***}	-0.278^{***}	-0.358^{***}	-0.281^{***}
			(0.150)	(0.090)	(0.077)	(0.115)	(0.077)
$Unemp$			−0.105				
			(0.093)				
RIR			0.223^{***}	0.140^{**}	0.175^{**}	0.199^{***}	0.179^{***}
			(0.075)	(0.060)	(0.077)	(0.076)	(0.077)
$Infl$			0.039				
			(0.039)				
$Open$			−0.016				
			(0.015)				
$Crisis$			0.432				
			(0.520)				
$SizeCons$			0.132				
			(0.252)				
$European$	1.041^{*}	0.855^{**}	1.908^{**}	0.930^{**}	0.895^{**}	1.000^{**}	0.912^{**}
	(0.627)	(0.434)	(0.815)	(0.418)	(0.423)	(0.420)	(0.424)
$Constant$	-1.912^{***}	-0.691^{*}	-1.936^{***}	-1.270^{**}	−2.960	-2.506^{***}	-2.240^{*}
	(0.570)	(0.394)	(0.541)	(0.584)	(1.973)	(0.885)	(1.262)
$LogL$	−33.7	−41.4	−26.6	−28.7	−28.1	−26.4	−27.9
AIC	73.3	88.8	77.1	71.4	74.2	70.9	73.7
$SBIC$	78.2	95.3	100.5	85.1	91.8	88.5	91.3
LRI	–	0.062	0.256	0.196	0.213	0.259	0.219
Observ.	38	65	52	52	52	52	52
Ended	–	38	29	29	29	29	29

Notes: : Robust standard errors (clustered by country) for the estimated coefficients are in parentheses. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%; and *, 10%. Column 1 presents the results of a continuous-time Weibull model; Columns 2 to 4 show the results of a discrete-time Cloglog model that is analogue to the continuous-time Weibull model. The remaining Cloglog regressions are performed using: a cubic polynomial baseline hazard function (Column 5), a fully non-parametric specification with one dummy for each relevant year (Column 6), and three natural cubic splines of *DurCons*, with knots at terms 1, 3, 5 and 7 (Column 7).

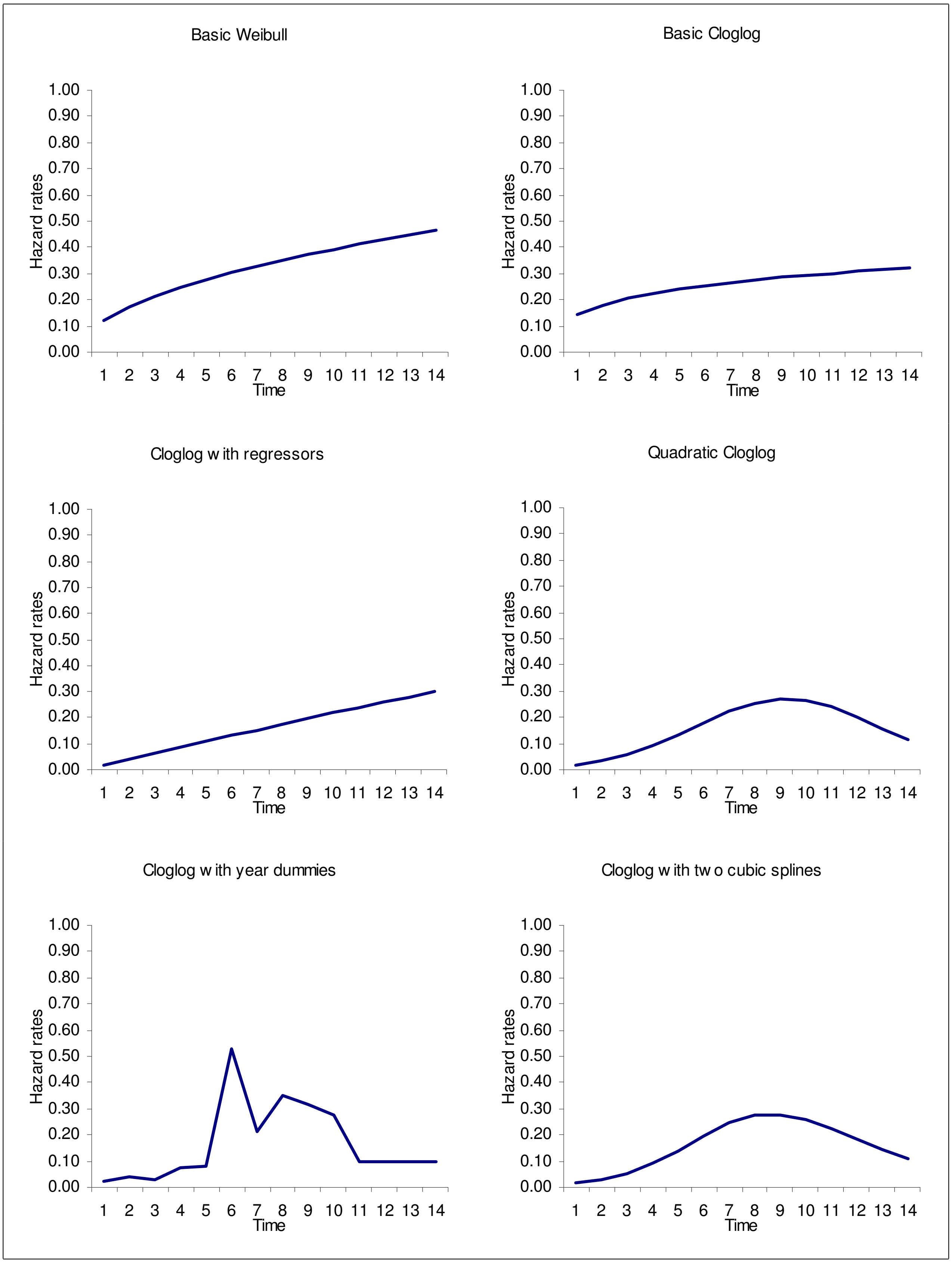
B List of Figures

Figure 1. Non-parametric estimates for the hazard rates and survival functions.



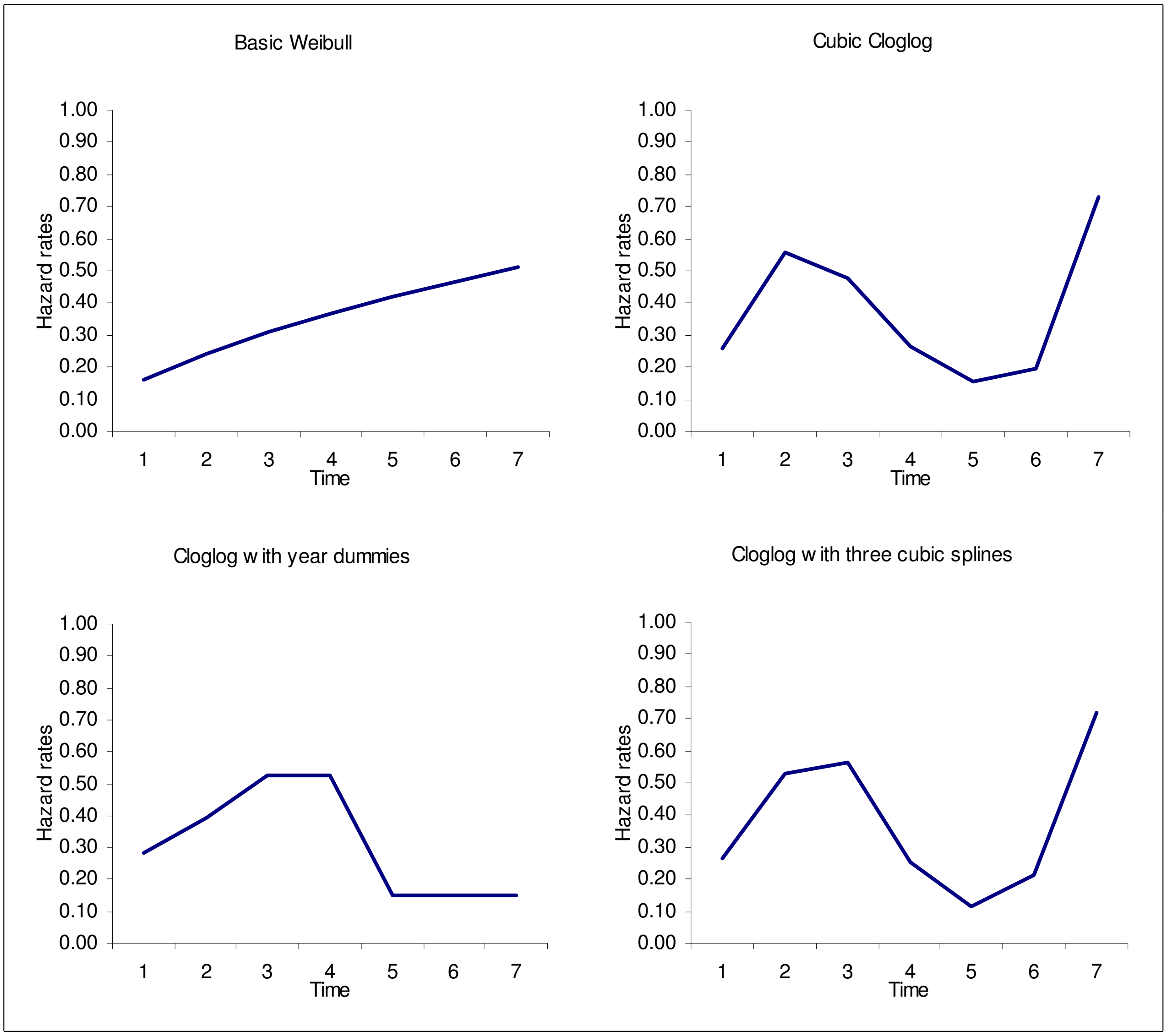
Notes: The values for the hazard rates and survival functions are presented in Table 2.

Figure 2. Estimated hazard rates: all fiscal consolidations.



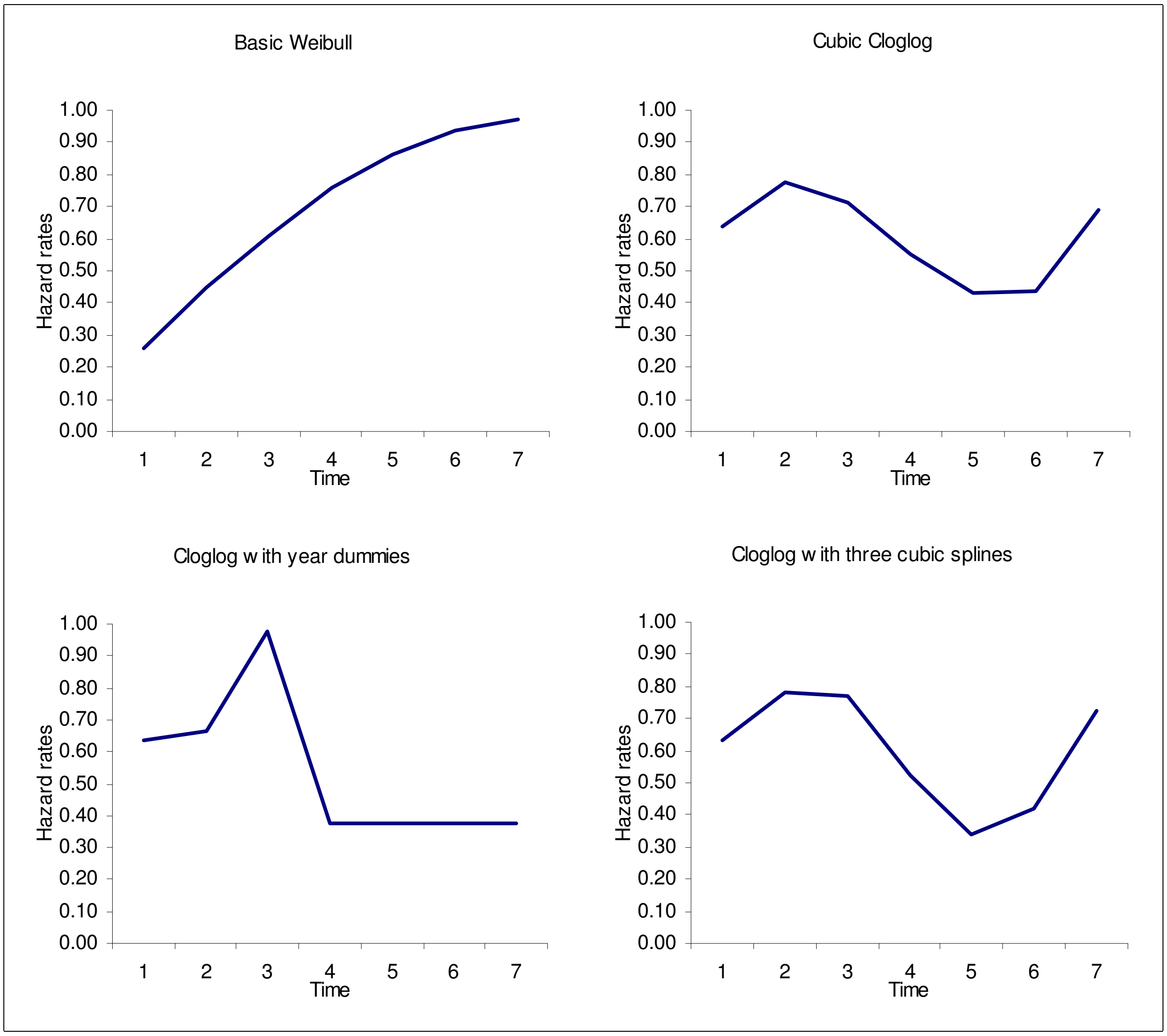
Notes: See Tables 3 and 4. Estimated hazard rates computed by evaluating the continuous variables at their means; the dummy variables are evaluated at their modes.

Figure 3. Estimated hazard rates: spending-driven fiscal consolidations.



Notes: See Table 5. Estimated hazard rates computed by evaluating the continuous variables at their means; the dummy variables are evaluated at their modes.

Figure 4. Estimated hazard rates: tax-driven fiscal consolidations.



Notes: See Table 6. Estimated hazard rates computed by evaluating the continuous variables at their means; the dummy variables are evaluated at their modes.

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