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Has the Stability and Growth Pact Changed the Likelihood of Excessive Deficits in the European Union?*

S. Tolga Tiryaki

Research and Monetary Policy Department
Central Bank of the Republic of Turkey
İstiklal Caddesi No: 10
06100-Ankara, Turkey

tolga.tiryaki@tcmb.gov.tr

Abstract

This paper presents an empirical analysis of excessive deficit spells in the European Union using transition data methods. Probabilities of transition between excessive and non-excessive deficit states are estimated with time-varying macroeconomic covariates as explanatory variables. The quantitative effects of discretionary fiscal and monetary policies and cyclical factors on transition probabilities are disentangled so that we can account for what factors and by how much they contributed to certain member countries' breaching of the Pact. Another finding is that the Stability and Growth Pact seems to have reinforced fiscal discipline in most of the member countries.

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1. Introduction

Issues relating to the conduct of fiscal policy in a monetary union have been the subject of both academic research and policy discussions ever since the idea of a common currency area in Europe has flourished. Indeed, the European Union (EU) placed a strong emphasis on the necessity of fiscal discipline across member countries in order to ensure the effective functioning of the Economic and Monetary Union (EMU). The EU materialized this view by the signing of the Maastricht Treaty in 1991 and the Stability and Growth Pact (SGP) in 1997. Accordingly, member countries should not run government deficits in excess of 3 percent of GDP, and their gross public debt should not exceed 60 percent of GDP.

How often do we see ‘excessive deficits’ in the EU? What is the extent to which business cycles or discretionary fiscal policy can be held accountable for triggering them? Which factors play a more dominant role in ending excessive deficits? Has the Stability and Growth Pact changed any of these answers? In this study I aim to provide answers to these questions by looking at empirical evidence on excessive deficit spells.

There is a rich and growing literature on whether any sort of fiscal constraint is needed in monetary unions to prevent excessive deficits or accumulation of government debt; see, for example, Uhlig (2002), Masson (1996), Beetsma and Uhlig (1999), Fatás and Mihov (2003), Dornbusch (1997), Chari and Kehoe (2004), among others. Fiscal policy is the only national instrument for stabilization in a monetary union. Therefore, it could be argued that constraining the use of this instrument hampers the flexibility of stabilization policy. In particular, given that certain idiosyncratic shocks (for example, demand shocks) can be managed optimally by fiscal policy, the occurrence of a severe shock may be weathered less effectively because of a fiscal deficit limit. This scenario may be especially relevant for those countries that are already running deficits close to or greater than the allowed limit.

A considerable part of proposals for reforming the Stability and Growth Pact has been centred on the inflexibility of the Pact when a member country experiences a similar situation. Indeed, the reformed version of the Pact (2005) calls for a thorough assessment of the country's macroeconomic condition before applying the terms of the excessive deficits procedure, including financial penalties. Therefore, it is important to understand what factors have actually played role in triggering a transition to a deficit of greater than 3 percent of GDP. Is it a slowdown in GDP growth or an increase in unemployment that invokes automatic stabilizers, thereby resulting in excessive deficits? Or is it the national governments trying to stimulate the economy by means of using expansionary fiscal policy at their discretion? It is interesting to disentangle the mechanics of exceeding the limit, and of returning back. This paper sheds some light on the issue of what causes the transitions to either side of the reference value for the budget deficit.

A variety of recent empirical studies on European fiscal policy have mainly considered the effectiveness of fiscal policy before and after the Stability and Growth Pact (Galí and Perotti, 2003), or the political and institutional determinants of budget deficits and government debt (Mark and de Haan, 2005; Hallerberg et al., 2007), among others. Hughes-Hallet and McAdam (2003) approach the issue of excessive deficits from another angle by analysing the probability distribution of excessive deficits in Europe under a variety of monetary and fiscal policy rules. They calculate that the probability of breaching the 3 percent rule of the Pact is 0.80 under 'either a targeting rule (inflation or monetary) or a Taylor rule for monetary policy' and 'a 3 percent deficit target for fiscal policy'.

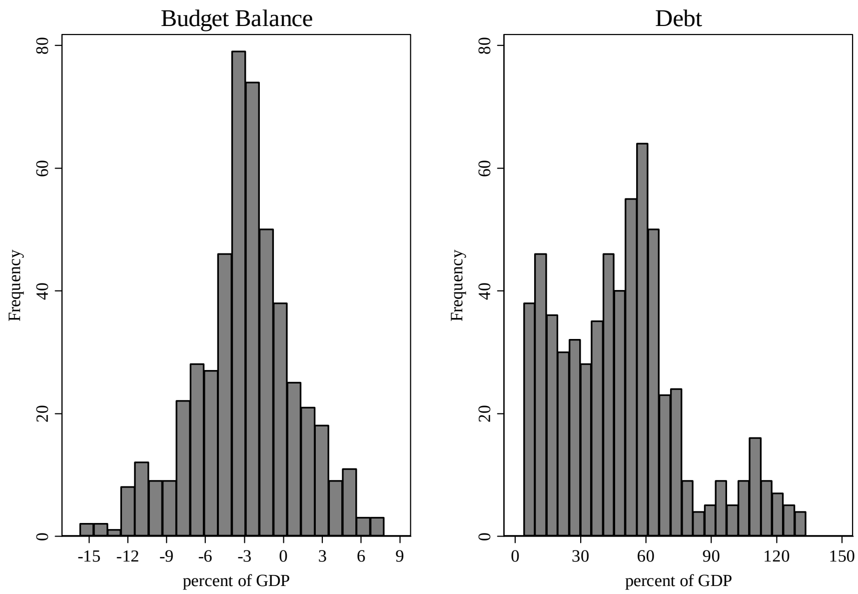
In this study, on the other hand, I concentrate on the marginal case when the budget balance moves from a non-excessive deficit state to an excessive deficit state, or vice versa. The histogram in Figure 1 shows that the distribution of government budget deficits of the EU member countries between 1970 and 2005 was centred at approximately 3 percent of GDP. Therefore, we may infer that the 3 percent of GDP has always been regarded as an implicit threshold even before the Stability and Growth Pact. In spite of the consistency in budget deficits, the histogram of debt ratios has three distinct peaks at around 15 percent, 60 percent, and 110 percent of GDP.

I use duration (survival/transition) analysis to estimate the discrete hazard rate, which is defined as the probability of a transition to another state conditional on survival in the original state up to that instant.[1] I closely follow Bayar and de Boer (2002) who carry out the same analysis for the 15 member countries of the EU covering the period 1970-1999. I extend their analysis by including the 10 new members of the EU and the period after the Stability and Growth Pact. This enables us to comment on the effectiveness of the Pact in maintaining fiscal discipline. In

[1] For a survey of duration analysis see, for example, Kiefer (1988), Lancaster (1990), Greene (2003), and Jenkins (2005).

addition, I also control for the effect of monetary policy on estimated transition probabilities so that I can provide some evidence on the interaction between monetary and fiscal policies.

Fig. 1. Distribution of Budget Balance and Government Debt for the 25 EU Member Countries, 1970-2005.



In the remainder of this paper I analyse two different cases separately. The first case considers the transition to an excessive deficit state from a non-excessive deficit state. I estimate the conditional likelihood of exceeding the 3 percent budget deficit ratio using a number of macroeconomic variables as explanatory variables (covariates). The set of covariates includes fiscal policy variables, such as the cyclically adjusted expenditure and revenue of general government, and the debt level, or other macroeconomic variables ranging from GDP growth rate to unemployment and long-term real interest rates. I also include central bank rates to measure the role of monetary policy in transition intensities. As for the second case, I carry out the same analysis for transitions from an excessive deficit state to a non-excessive deficit state.

One of the main findings is that discretionary fiscal policy has always been an important, if not the most important, reason behind the transition to an excessive deficit state. Among the cyclical factors, GDP growth also has a large coefficient.

The situation is not similar for the transition probabilities to non-excessive deficit states. Discretionary fiscal policy is not effective in ending excessive deficit spells. This finding makes a strong case for avoiding excessive deficits from the outset. Also, estimated coefficients do not change at statistically meaningful levels after the Stability and Growth Pact, except for the baseline hazard of entry into an excessive deficit state, which is assumed constant and country-invariant.

2. Econometric Method

In this section, I lay out the econometric model of the duration data of excessive deficit spells. The exposition of the basic survival analysis concepts here relies on a combination of Bayar and de Boer (2002), Jenkins (1995, 2005), and Greene (2003).

2.1. Derivation of the Discrete Hazard Rate

Let the continuous random variable T_i be the length of a spell i for a member country. Because I examine entries into and exits from excessive deficits separately the spell can be either the spell of being in excessive deficits or of being in non-excessive deficits. It has a probability density function of $f(t)$ and a cumulative probability distribution function of $F(t)$, which is also known in the survival analysis literature as the *failure function*, $\Pr(T_i \le t) = F(t)$. The *survivor function* $S(t)$ is defined as $S(t) \equiv \Pr(T_i > t) = 1 - F(t)$. Suppose that the country has not been in the excessive deficit state for m years since, say, year $t - m$. Given that the spell i has lasted until year t, the probability that the country will enter the excessive deficit state in the next Δt is $l(t, \Delta t) = \Pr(t \le T_i \le t + \Delta t \mid T_i \ge t)$. Associate this conditional probability with the probability density function $f(t)$ by first recognizing that $f(t)$ is the slope of the cumulative probability distribution function $F(t)$ as

$$\begin{aligned} f(t) &= \lim_{\Delta t \to 0} \frac{\Pr(t \le T_i \le t + \Delta t)}{\Delta t} \\ &= \lim_{\Delta t \to 0} \frac{F(t + \Delta t) - F(t)}{\Delta t} \\ &= \frac{\partial F(t)}{\partial t} = -\frac{\partial S(t)}{\partial t}. \end{aligned} \tag{1}$$

Then, define the *hazard rate*[2] $h(t)$ as

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[2] "The probability density function $f(t)$ summarizes the concentration of spell lengths (exit times) at each instant of time along the time axis. The hazard function summarizes the same concentration at each point

$$\begin{aligned} h(t) &= \lim_{\Delta t \to 0} \frac{\Pr(t \le T_i \le t + \Delta t \mid T_i \ge t)}{\Delta t} \\ &= \lim_{\Delta t \to 0} \frac{F(t + \Delta t) - F(t)}{\Delta t} \cdot \frac{1}{S(t)} \\ &= \frac{f(t)}{S(t)}. \end{aligned} \tag{2}$$

Combining the last lines of (1) and (2) obtain the following relationships between hazard rate and survivor function:

$$h(t) = -\frac{\partial \ln S(t)}{\partial t} \tag{3}$$

and

$$S(t) = \exp\left[-\int_0^t h(s) ds \right]. \tag{4}$$

Given that we have annual data, we cannot observe whether a transition has occurred within the period. Indeed, the hazard or survival is still continuous but, in the terminology of survival analysis, the spell lengths are *interval-censored*. In this case, define intervals by $[a_0, a_1]$, $(a_1, a_2], \ldots, (a_{k-1}, a_k]$ where $a_0, a_1, \ldots, a_k$ are dates, e.g., a_1 = 31.12.1999. The value of the survivor function at the end of the *j*th interval is $\Pr(T_i > a_j) = S(a_j) = 1 - F(a_j)$. The probability of exit from spell *i* within the *j*th interval, e.g., during 1999, is $\Pr(a_{j-1} < T_i \le a_j) = F(a_j) - F(a_{j-1}) = S(a_{j-1}) - S(a_j)$. The *interval* (or *discrete*) *hazard rate* is (for derivation, see, Jenkins, 2005)

$$h(a_j) = 1 - \frac{S(a_j)}{S(a_{j-1})} \tag{5}$$

which is the conditional probability that we are trying to estimate.

2.2 Estimation

Jenkins (1995) develops an 'easy estimation method' for discrete-time duration models by simply re-arranging the original duration data structure so that there are now as many records as the length of the spell. Details of this data re-organization are clearly described and illustrated in Jenkins (2005).

A typical problem in survival analysis occurs when the completion of a spell is unobservable. This is called *right-censoring*. For example, our sample spans the

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of time, but conditions the expression on survival in the state up to that instant, and so can be thought of as summarizing the instantaneous transition intensity" (Jenkins, 2005, p. 15).

1970-2005 period, so we cannot know whether a spell that has been going on between 2002 and 2005 has actually completed in 2005 or not. Therefore, I use an indicator variable c_i to distinguish spells that are complete (c_i = 1) or not (c_i = 0).

The likelihood function for our sample, including both complete and right-censored spells, can be written as

$$\begin{aligned} L &= \prod_{i=1}^{n} \left[\Pr(T_i = j)\right]^{c_i} \left[\Pr(T_i > j)\right]^{1-c_i} \\ &= \prod_{i=1}^{n} \left[\left(\frac{h_{ij}}{1-h_{ij}} \right) \prod_{k=1}^{j} (1-h_{ik}) \right]^{c_i} \left[\prod_{k=1}^{j} (1-h_{ik}) \right]^{1-c_i} \\ &= \prod_{i=1}^{n} \left[\left(\frac{h_{ij}}{1-h_{ij}} \right)^{c_i} \prod_{k=1}^{j} (1-h_{ik}) \right] \end{aligned} \tag{6}$$

where $h_{ij} = \Pr(T_i = j \mid T_i \geq j)$ is the discrete hazard for an individual spell i during year j. The first line of (6) is composed of the likelihood contributions of complete and censored spells, respectively. Since I assume that the discrete hazard rate is not country specific, I treat multiple hazards for a single country as individual spells. For example, there can be two distinct excessive deficit spells of a country, say, the first one between 1970 and 1975, and the second one between 1987 and 1994; and I index the first spell with i = 1, and the second with i = 2.

Jenkins (2005) defines a new binary variable y_{ik} = 1 if the spell ends in year k (that is, c_i = 1 and $k = T_i$), and y_{ik} = 0 otherwise (that is, either [c_i = 1 and $k < T_i$] or [c_i = 0 for all k]). Using this variable, re-arranging, and taking logs, obtain the log-likelihood function to be maximized

$$\log L = \sum_{i=1}^{n} \sum_{k=1}^{j} \left[y_{ik} \log h_{ik} + (1-y_{ik}) \log(1-h_{ik}) \right] \tag{7}$$

which has the same form as the standard log-likelihood function for regression of a binary variable in which y_{ik} is the dependent variable.

Lastly, I specify the discrete hazard rate as the complementary log-log function

$$h_{it} = 1 - \exp\{-\exp[\theta(t) + \beta' X_{it}]\} \tag{8}$$

where $\theta(t)$ is a function of the baseline hazard, which, following Bayar and de Boer (2002), I will treat as an unknown constant, and X_{it} is the matrix of time-varying covariates. This specification is the discrete time counterpart of an underlying continuous time proportional hazards model (Jenkins, 1995).

The fact that the distribution of the dependent variable is concentrated on 0 values justifies the use of the complementary log-log specification, which is an asymmetric function and caters well for very small probability events.[3]

2.3. Data

The data sample spans the period between 1970 and 2005 and covers the 25 countries of the European Union as of 2005. But the data set is essentially an unbalanced panel, in which some countries have shorter samples than others due to data availability. I use revenue, non-interest (primary) expenditure and debt of general government, real long-term interest rate, GDP growth, unemployment, and central bank rate as explanatory variables.

Main data source is the Annual Macroeconomic Indicators (AMECO) database of the European Commission. General government revenue, primary expenditure, interest expenditure, debt stock, long-term real interest rate, GDP, and unemployment series are from AMECO database. The components of budget balances are cyclically adjusted by the Directorate General of the Economic and Financial Affairs of the European Commission, using the production function approach to estimating output gaps, which constitutes the reference method when assessing the stability and convergence programmes (the excessive deficits procedure). Using cyclically adjusted revenue and expenditure series eliminates the effects of automatic stabilizers arising from cyclical movements in economic activity. Hence, we are able to identify the effects of discretionary fiscal policy and business cycles separately.

Central bank rates come from different sources such as the IMF, Datastream, or central bank web sites. Central bank rates are the main policy interest rates of central banks observed at the first day of each year. In contrast to Bayar and de Boer (2002), I take one-year lags of all other macroeconomic covariates in estimations, rather than their current values. This enables us to assess the likelihood of an excessive deficit the next year, given macroeconomic conditions in the current year.

The dependent variable y_{ik} is the one defined in the previous sub-section, which is a binary variable with a high concentration on zero values. For separate estimations of entry and exit hazards, first I create two sub-samples by splitting

[3] The complementary log-log transformation is also the inverse of the cumulative distribution function of the extreme value (or log-Weibull) distribution.

excessive deficit states from non-excessive deficit states. Then I construct the dependent variable as follows: (*i*) assign the dependent variable at each group a default value of 0; and (*ii*) change the value of the dependent variable from 0 to 1 if it corresponds to the last data point in a particular spell unless the spell is right-censored.

3. Empirical Results

The coefficient vector β in equation (8) is estimated by maximising the log-likelihood function (7) with the discrete hazard rate defined as the complementary log-log function. Table 1 shows the results of the complementary log-log estimation for entry and exit hazards in the 25 member countries of the EU (EU25) as well as 12 euro area countries. In addition to the estimated coefficients and their corresponding z values, the table also includes the exponentiated coefficients. The coefficients in their crude form are difficult to interpret because of the complex functional form of the complementary log-log specification. A useful feature of the complementary log-log function is that exponentiated coefficients can be interpreted as the effect of the covariates on the hazard rate. Practically, the exponentiated coefficient should be read as the rate by which the hazard rate is multiplied. For example, in Table 1, the value 0.671, which is the exponentiated coefficient on government revenue for EU25 countries, means that, other things being equal, one percentage point higher government revenue makes it approximately 0.671 times less likely for a country to enter an excessive deficit spell.

As expected, revenue and non-interest (primary) expenditure have the greatest coefficients in the entry hazard estimation. Coefficients of all variables except for the coefficient of real long-term interest rate are statistically significant at conventional levels.

Table 1
Complementary Log-log Estimation of Excessive Deficit Spells

Dependent variable y_{ik}	Entry			Exit		
	Coef.	Exp. Coef.	Pr > |z|	Coef.	Exp. Coef.	Pr > |z|
EU25						
Revenue	-0.399	0.671	0.000	0.100	1.105	0.289
Non-int. expenditure	0.352	1.422	0.000	-0.102	0.903	0.314
Debt	0.039	1.039	0.000	-0.017	0.983	0.035
Interest rate	-0.075	0.927	0.501	0.119	1.126	0.163
GDP growth	-0.251	0.778	0.039	0.284	1.328	0.009
Unemployment	-0.193	0.825	0.009	-0.001	0.999	0.987
Central bank rate	0.288	1.333	0.000	-0.148	0.862	0.007
Constant	-0.583	0.558	0.791	-0.471	0.624	0.796
Number of obs.	241 (209 zero outcomes)			179 (145 zero outcomes)		
LR $\chi^2(7)$	52.37 (Pr > χ^2 = 0.0000)			21.88 (Pr > χ^2 = 0.0027)		
Euro area						
Revenue	-0.410	0.664	0.003	0.002	1.002	0.989
Non-int. expenditure	0.336	1.399	0.012	-0.088	0.916	0.556
Debt	0.049	1.051	0.000	-0.023	0.977	0.048
Interest rate	0.112	1.118	0.472	0.301	1.351	0.036
GDP growth	-0.336	0.715	0.024	0.391	1.478	0.014
Unemployment	-0.359	0.698	0.003	-0.032	0.968	0.607
Central bank rate	0.315	1.370	0.000	-0.314	0.731	0.001
Constant	0.396	1.486	0.903	3.978	53.429	0.111
Number of obs.	162 (140 zero outcomes)			126 (103 zero outcomes)		
LR $\chi^2(7)$	35.75 (Pr > χ^2 = 0.0000)			29.01 (Pr > χ^2 = 0.0001)		

Notes: The columns Pr > |*z*| show the probability of the estimated coefficient being different from zero. The rows LR $\chi^2(7)$ show the likelihood ratio test statistic for the null hypothesis that all coefficients except for the constant are jointly insignificant.

The estimated coefficients of revenue and expenditure are close the each other in absolute value, and a standard Wald test (not reported in tables) fails to reject the null hypothesis that they are equal to each other. This implies that a rise in government expenditure has the same effect on entry hazards as a decrease in government revenues.

Table 2
Effect of high debt on entry hazards, 1999-2005

	Belgium	Greece	Italy
Average debt ratio, lagged 1 year, 1999-2005	105.812	110.940	108.602
Average predicted hazard (actual debt)	0.095	0.365	0.318
Average predicted hazard (60-percent-of-GDP debt)	0.017	0.068	0.066

Notes: In-sample predictions are averaged in the second row, whereas debt ratios were fixed at 60 percent of GDP in the third row, keeping other variables the same when calculating in-sample predictions. The coefficients reported in the first panel of Table 1 are used in predictions.

Therefore, there is no asymmetric effect from the primary budget deficit arising from the sizes of revenue or expenditure independently, so we cannot say that expenditure-side policies affect the likelihood of entering into excessive deficit states more than tax policies, or vice versa.

Starting from the sample average level, one percentage point more government revenue reduces the probability of a transition into an excessive deficit state from 0.255 to 0.179, while one percentage point more primary expenditure raises this probability to 0.342, and one percentage point increase in government debt raises the probability to 0.264.

Although the government debt coefficient is small relative to other coefficients, huge differences observed in the debt ratios of EU countries have considerably large cumulative effects on the predicted hazard rates. The average general government consolidated debt stock over the period 1999-2005 was ranging from as high as 110.24 percent of GDP in Greece to as low as 6.43 percent in Luxembourg. The euro area average debt stock was slightly higher than the Stability and Growth Pact benchmark. I calculate the contribution of debt stock in excess of the 60 percent ratio on both the entry and exit hazards. Three high-debt countries, namely, Belgium, Greece, and Italy, went 40 to 50 percentage points over the Pact benchmark. Table 2 presents average debt ratios between 1999 and 2005 in these countries, and the contribution of excessive debt to the entry hazards. For example, the average likelihood of going into an excessive deficit state in the same period in Greece is predicted to be 0.365. However, had the debt ratio of Greece during that period been 60 percent of GDP, the average likelihood would have been 0.068, other things being equal. Similarly, the average likelihood of ending an excessive deficit spell would have increased from 0.193 to 0.392 (not reported in tables). This considerable effect of debt on hazard rates makes a strong case for the view that there should be stronger emphasis in the Stability and Growth Pact on limiting excessive accumulation of debt by governments.

GDP growth has significant and sizeable effect on transition to an excessive deficit state. If GDP growth increases by one percentage point, starting from the sample average level, the probability of a transition into an excessive deficit state decreases from 0.255 to 0.205. Interestingly, the unemployment coefficient carries a negative sign for both the whole sample consisting of EU25 countries and the euro area sub-sample. This is a puzzle because automatic stabilizers are expected to operate in response to higher unemployment, hence increasing the probability of starting an excessive deficit spell. The puzzle is also robust when I use deviations from the structural rate of unemployment as the unemployment variable (not reported in tables).

The interest rate set by the central bank is also important in explaining the entry hazards. One percentage point higher central bank rate raises the likelihood of entering an excessive deficit spell to 0.325 from the sample average of 0.255. The positive sign is in line with *a priori* expectations. Note that higher central bank rates usually coincide with stronger aggregate demand. Hence, we may expect to see a negative effect on the probability of transition into the excessive deficit state. However, this effect, arising from the co-movement of central bank rates and aggregate economy, is effectively controlled for by the inclusion of GDP growth rate. Therefore, the positive sign of the central bank rate may be attributed to the effect of central bank rates on the debt servicing costs of the government. A rise in the central bank rate is expected to operate via the term structure of interest rates and lead to an increase in the cost of new borrowing as well as the cost of servicing the existing debt stock.

As for the transition from excessive to non-excessive deficit spells, only debt, GDP growth, and central bank rate are the statistically significant variables. They also carry the expected signs. Government revenue, primary expenditure, real interest rate, and unemployment rate do not have statistically significant effect on exit hazards.

One of the most significant findings in the estimation of exit hazards is that neither government revenue nor expenditure has a statistically significant effect on the probability of exiting the excessive deficit state. Historically, governments of member countries have either failed to adequately address or been ineffective in eliminating excessive deficits through fiscal policy at their discretion. It was cyclical conditions and monetary policy that actually worked to end excessive deficits. The main priority for governments during economic slowdowns is to stimulate the economy as much as possible by fiscal policy. Hence, these periods usually coincide with fiscal expansions and budget deficits. When already in an excessive deficit state, a government's expansionary fiscal policy response to a slowdown might have two opposite outcomes. First, budget deficit, and hence, the budget deficit as a ratio of GDP, immediately deteriorate. Second, the fiscal expansion, if successful, may deliver an improvement in GDP growth. Therefore, the resulting effect on the budget deficit as a ratio of GDP is ambiguous and depends ultimately on the fiscal multiplier. This may explain regression results for the exit hazard in which coefficients of government revenue and expenditure are statistically insignificant.

Government debt also carries a significant and negative coefficient in the exit hazard regression; but it may not be appropriate to consider it as a policy variable in the short-run, as it is difficult for any government to obtain sizeable variation in the debt stock from one year to another.

One important distinction between the regressions of entry and exit hazards is the asymmetry in magnitude of estimated coefficients. Especially, estimations suggest that discretionary fiscal policy has not been effective (that is, statistically insignificant) to end excessive deficits, yet it has been a decisive factor to affect the likelihood of starting excessive deficits. Another difference is that point estimates of the coefficients for debt and central bank rate are greater in entry regressions than in exit regressions for the whole sample. These findings lead us to conclude that pre-emptive policies aimed at avoiding excessive deficits are relatively more effective in maintaining fiscal austerity throughout the European Union.

In order to see whether the results change between the EU25 and euro area samples, I present at the bottom panel of Table 1 the same regression over the sample of euro area countries. The main findings for the EU25 still hold for the euro area. The main difference between the EU25 and euro area results arises in both entry and exit regressions where most of the significant coefficients are slightly greater in magnitude in the euro area. The other noteworthy difference is that the coefficient of long-term real interest rate is positive and statistically significant at 5 percent level in the exit regression for the euro area.

4. After the Stability and Growth Pact

The time span of our sample allows for a formal test of the success of the Stability and Growth Pact in restraining national governments from pursuing policies leading to excessive deficits. Aside from the adoption of the Stability and Growth Pact, there are also structural changes in the way in which monetary policy is conducted in the EMU due to the adoption of the euro and common monetary policy. The full provisions of the Pact took effect when the euro was launched on 1 January 1999. According to the Pact, those member countries that participate in the third stage of the EMU (euro area members) undertook to provide the Council and Commission with a stability programme by 1 March 1999, while other members outside the euro area were required to submit a convergence programme.

In order to facilitate this test I construct a binary dummy variable, dum1999, which takes the value of 1 starting from 1999, and 0 otherwise. I also include interaction terms (GDP dummy, unemployment dummy, and CB rate dummy) between the dummy variable and GDP growth, unemployment, and central bank rate in order to estimate possible behavioural changes that took effect after the Stability and Growth Pact. Estimation results are presented in Table 3.

Table 3
Complementary Log-log Estimation of Excessive Deficit Spells: After the Stability and Growth Pact

Dependent variable y_{ik}	Entry			Exit		
Euro area	Coef.	Exp. Coef.	Pr > |*z*|	Coef.	Exp. Coef.	Pr > |*z*|
Revenue	-0.501	0.606	0.001	-0.094	0.911	0.600
Non-int. expenditure	0.405	1.499	0.004	0.001	1.001	0.996
Debt	0.051	1.052	0.000	-0.013	0.987	0.300
Interest rate	0.232	1.261	0.200	0.249	1.283	0.133
GDP growth	-0.434	0.648	0.011	0.411	1.509	0.037
GDP dummy	-0.117	0.889	0.807	0.034	1.034	0.949
Unemployment	-0.493	0.611	0.001	-0.001	0.999	0.993
Unemp. dummy	0.456	1.578	0.015	-0.538	0.584	0.136
Central bank rate	0.380	1.462	0.000	-0.388	0.678	0.001
CB rate dummy	0.732	2.079	0.255	0.453	1.573	0.185
Dum1999	-3.928	0.020	0.081	2.095	8.126	0.402
Constant	1.250	3.490	0.703	4.211	67.445	0.138
Number of obs.	162 (140 zero outcomes)			126 (103 zero outcomes)		
LR $\chi^2(11)$	44.32 (Pr > χ^2 = 0.0000)			34.40 (Pr > χ^2 = 0.0003)		

Notes: The columns Pr > |*z*| show the probability of the estimated coefficient being different from zero. The rows LR $\chi^2(11)$ show the likelihood ratio test statistic for the null hypothesis that all coefficients except for the constant are jointly insignificant.

The 1999 dummy (dum1999), which introduces a shift in the mean, is statistically significant at 10 percent level in the entry regression with a very large (in absolute value) coefficient. This finding implies that the likelihood of entering an excessive deficit spell has decreased to a very large extent since 1999. The rise in the constant term represents the part of the decrease in the predicted entry hazard after the Stability and Growth Pact that may be more related to political economy or institutional factors such as possibly higher commitment to fiscal discipline by national governments, increased centralization of fiscal policymaking and more stringent fiscal rules across EU members, etc.

The sensitivity of the entry hazard with respect to the covariates in the regression has not significantly changed since 1999. Neither the GDP dummy nor the central bank rate dummy is significant in the entry regression. The puzzle of negative and significant relationship between the entry hazard and unemployment takes another form after the Stability and Growth Pact. The unemployment dummy variable in the entry hazard regression is positive and very close to the unemployment coefficient in absolute value. The sum of the unemployment coefficient and the interaction term is -0.018 and its statistical significance is rejected decisively, hence the puzzling result disappears with the start of the Stability and Growth Pact. One possible explanation may be that increased harmonization of labour market policies among the EU countries (e.g., Luxembourg Process, Lisbon Strategy, etc.) has changed the functioning of automatic stabilizers associated with unemployment benefits or other employment-related fiscal transactions.

The effect of the Stability and Growth Pact on the exit hazard seems to be negligible. Neither the 1999 dummy nor the interaction terms are significant. The differences in point estimates between two sets of regressions are trivial.

The time series of predicted probabilities of either entering or exiting excessive deficit spells reveal a slight improvement after the Stability and Growth Pact. For the euro area countries as a whole, the *average* probability of entering excessive deficits has decreased with the Stability and Growth Pact from 0.373 to 0.195, and the *average* probability of exiting excessive deficits has increased from 0.320 to 0.453. A country-by-country list of the predicted probability values is presented in Table 4. The most notable country as an exception is Germany with the average probability of entry into excessive deficits has risen from 0.220 before the Pact to 0.309 after the Pact. In addition, Germany, Finland France, and Spain experienced considerable decreases in the probability of exiting excessive deficits after the Pact.

Table 4
Predicted Hazard Rates for the Euro Area

	Entry		Exit	
	<1999	1999-2005	<1999	1999-2005
a. Whole sample				
Austria	0.384	0.149	0.409	0.789
Belgium	0.713	0.183	0.211	0.165
Finland	0.074	0.003	0.261	0.149
France	0.134	0.142	0.206	0.133
Germany	0.220	0.309	0.567	0.286
Greece	0.970	0.517	0.004	0.095
Ireland	0.094	0.007	0.479	1.000
Italy	0.853	0.583	0.043	0.060
Luxembourg	0.140	0.002	0.793	0.982
Netherlands	0.196	0.072	0.299	0.914
Portugal	0.713	0.308	0.229	0.710
Spain	0.004	0.065	0.511	0.149
Euro area	0.373	0.195	0.320	0.453
b. Depending on the actual state				
Austria	0.357	0.149	0.315	n.a.
Belgium	0.381	0.183	0.157	n.a.
Finland	0.021	0.003	0.149	n.a.
France	0.141	0.124	0.220	0.094
Germany	0.129	0.178	0.325	0.156
Greece	n.a.	n.a.	0.004	0.095
Ireland	0.027	0.007	0.163	n.a.
Italy	0.146	0.502	0.039	0.075
Luxembourg	0.140	0.002	n.a.	n.a.
Netherlands	0.200	0.054	0.239	0.805
Portugal	0.270	0.275	0.181	0.469
Spain	n.a.	0.065	0.511	n.a.
Euro area	0.150	0.110	0.182	0.186

Note: In-sample predictions are calculated using coefficient estimates in Table 3.

Predicted probabilities in the top panel of Table 4 are estimated regardless of the actual state the country is in. It may be more appropriate to filter the probabilities by splitting the sample into excessive and non-excessive deficit states. Bottom panel of Table 4 presents average predicted probability of entering an excessive deficit spell conditional on the country being actually in the non-excessive deficit state, and vice versa. Note, for example, that average entry probabilities for Greece were not reported because Greece has never been in a non-excessive deficit state during the sample period. Table 4 reveals a less favourable picture in account of the

Stability and Growth Pact's success. The decrease in the euro area conditional probability of entry after the Pact is less impressive compared to the decrease in the top panel of Table 4. Also, the euro area conditional probability of exiting excessive deficits has increased only very little after the Pact.

5. Concluding Remarks

This study was aimed at improving our understanding of one particular aspect of fiscal policymaking, that is, transitions between excessive and non-excessive budget deficit states, in the European Union. National governments are faced with *de jure* limits on the use of fiscal policy in order to ensure fiscal discipline throughout the European Union. One of the main objectives of this paper, therefore, was to find out to what extent macro policy variables and cyclical factors account for the transitions between the two states of excessive deficits. Another question was whether the Stability and Growth Pact has been able to reduce the intensity of transition to an excessive deficit state or to shorten the duration of excessive deficits.

Empirical results show that variables such as general government debt and central bank rates account for a significant part of estimated conditional likelihood functions of both starting and ending excessive deficit spells, while government revenue and primary expenditure work only in the entry hazard regression. Government revenue and primary expenditure variables are cyclically adjusted so that they are isolated from cyclical variations, such as taxes varying with income or expenditure, or unemployment benefits, etc. Therefore, they represent only the discretionary fiscal policy actions.

As for cyclical factors, GDP growth is found to be significant in both entry and exit hazards, whereas the effect of unemployment was less straightforward to evaluate. Empirical results suggest a negative relationship between the entry hazard and unemployment. This puzzle is stronger in the euro area sample, and surprisingly, disappeared after the Stability and Growth Pact took effect in 1999.

Our results lend some support to the view that the Stability and Growth Pact has succeeded in maintaining discipline in public finances of member countries. The baseline hazard of transition to the excessive deficit state in the euro area, which is assumed to be constant and country-invariant, becomes smaller after the Stability and Growth Pact. The conditional probability of transition to the excessive deficit state has decreased in the euro area countries except for Germany, Italy and Spain, while the conditional probability of transition to the non-excessive deficit state has increased in the euro area countries except for Belgium, Finland, France, and Germany.

The asymmetric impact of government revenue and expenditure on entry and exit hazards highlights the importance of preserving fiscal austerity. It is easier to enter the excessive deficit state either by discretionary fiscal policy or because of a cyclical downturn, but neither an increase in government receipts nor a reduction in primary expenditure is as effective to take the country out of the excessive deficit state as they are in triggering excessive deficits.

Major cross-sectional variation in gross public debt across European Union member countries introduces significant differences in transition intensities. High-debt countries such as Belgium, Greece, and Italy have considerably higher entry hazard rates (and also smaller exit hazard rates) compared to countries having debt ratios around the Stability and Growth Pact reference value of 60 percent. Therefore, we may conclude that the design of the Pact should place more emphasis on prohibiting excessive debt, even for the sake of a deficit-based fiscal-discipline measure such as the current excessive deficit procedure of the European Union.

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