The Benevolence of Time, Sound Macroeconomic Environment and Governance Quality on the Duration of Sovereign Ratings Phases

This paper uses data on sovereign ratings for developed and emerging countries to understand the dynamics of investment-grade and speculative-grade phases.

Luca Agnello
University of Palermo
Vitor Castro
Loughborough University
Ricardo M. Sousa
European Stability Mechanism

Disclaimer
This Working Paper should not be reported as representing the views of the ESM. The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the ESM or ESM policy.

European Stability Mechanism

The Benevolence of Time, Sound Macroeconomic Environment and Governance Quality on the Duration of Sovereign Ratings Phases

Luca Agnello [1] University of Palermo
Vitor Castro [2] Loughborough University
Ricardo M. Sousa [3] European Stability Mechanism

Abstract

Using long-term sovereign ratings data for a panel of 130 countries over the last three decades, we rely on discrete-time Weibull models to investigate the duration and determinants of sovereign ratings phases. We find that the likelihood of the end of the 'speculative-grade' phase increases as time goes by (i.e. positive duration dependence), but the 'investment-grade' phase is not duration dependent. Thus, for sovereigns rated as speculative, the build-up of reputation as good borrowers is a gradual process, whereas the reputation of investment-grade sovereigns solidifies and remains unchanged as time passes. However, the length of both phases has proven to be significantly dependent on the country's economic conditions and the quality of governance. In particular, lower inflation, better economic performance and sounder fiscal policies shorten (prolong) the speculative- (investment-) grade phase. In addition, a better perception of the quality of public services and the ability of the government to formulate and implement sound policies and regulations help to reduce the duration of speculative-grade phases.

Keywords: Duration analysis, Weibull model, duration dependence, sovereign ratings, speculative-grade, economic environment, fiscal position, quality of governance.

JEL codes: G10, G15, G24, C23, C25

1 Email: luca.agnello01@unipa.it
2 Emai: V.M.Q.Castro@lboro.ac.uk
3 Email: r.sousa@esm.europa.eu

Disclaimer

This Working Paper should not be reported as representing the views of the ESM. The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the ESM or ESM policy. No responsibility or liability is accepted by the ESM in relation to the accuracy or completeness of the information, including any data sets, presented in this Working Paper.

© European Stability Mechanism, 2019 All rights reserved. Any reproduction, publication and reprint in the form of a different publication, whether printed or produced electronically, in whole or in part, is permitted only with the explicit written authorisation of the European Stability Mechanism.

ISSN 2443-5503
ISBN 978-92-95085-64-0
doi:10.2852/439951
EU catalog number DW-AB-19-001-EN-N

The Benevolence of Time, Sound Macroeconomic Environment and Governance Quality on the Duration of Sovereign Ratings Phases*

Luca Agnello† *Vítor Castro*‡ *Ricardo M. Sousa*§

Abstract

Using long-term sovereign ratings data for a panel of 130 countries over the last three decades, we rely on discrete-time Weibull models to investigate the duration and determinants of sovereign ratings phases. We find that the likelihood of the end of the 'speculative-grade' phase increases as time goes by (i.e. positive duration dependence), but the 'investment-grade' phase is not duration dependent. Thus, for sovereigns rated as speculative, the build-up of reputation as good borrowers is a gradual process, whereas the reputation of investment-grade sovereigns solidifies and remains unchanged as time passes. However, the length of both phases has proven to be significantly dependent on the country's economic conditions and the quality of governance. In particular, lower inflation, better economic performance and sounder fiscal policies shorten (prolong) the speculative- (investment-) grade phase. In addition, a better perception of the quality of public services and the ability of the government to formulate and implement sound policies and regulations help to reduce the duration of speculative-grade phases.

Keywords: duration analysis, Weibull model, duration dependence, sovereign ratings, investment-grade, speculative-grade, economic environment, fiscal position, quality of governance.
JEL codes: G10, G15, G24, C23, C25

---

* The views expressed in this paper are those of the authors and do not necessarily reflect those of the ESM or ESM policy. We are grateful to participants to the 5th International Symposium in Computational Economics and Finance (ISCEF), seminars and discussions at the Loughborough University and the University of Minho, and to Alan Kirman, Julien Chevallier, Gilles Dufrénot, Fredj Jawadi, Wael Louhichi, Stefan Lyocsa, Anders Rahbek and António Santos, for their constructive comments and suggestions that considerably improved this paper.
† University of Palermo, Faculty of Economics, Department of Economics, Business and Statistics, Viale delle Scienze, 90128 Palermo, Italy. Email: luca.agnello01@unipa.it.
‡ Loughborough University, School of Business and Economics, Loughborough, Leicestershire LE11 3TU, United Kingdom; University of Minho, Economic Policies Research Unit (NIPE), Campus of Gualtar, 4710-057 - Braga, Portugal. Email: V.M.Q.Castro@lboro.ac.uk.
§ European Stability Mechanism (ESM), 6a Circuit de la Foire Internationale, L-1347 Luxembourg; University of Minho, Department of Economics and Economic Policies Research Unit (NIPE), Campus of Gualtar, 4710-057 - Braga, Portugal; University of Minho, Department of Economics and Economic Policies Research Unit (NIPE), Campus of Gualtar, 4710-057 - Braga, Portugal; London School of Economics and Political Science, LSE Alumni Association, Houghton Street, London WC2 2AE, United Kingdom. E-mails: r.sousa@esm.europa.eu, rjsousa@eeg.uminho.pt, rjsousa@alumni.lse.ac.uk. NIPE's work is carried out within the funding with COMPETE reference nº POCI-01-0145-FEDER-006683, with the FCT/MEC's (Fundação para a Ciência e Tecnologia, I.P.) financial support through national funding and by the ERDF through the Operational Programme on "Competitiveness and Internationalization - COMPETE 2020" under the PT2020 Partnership Agreement.

1. Introduction

Credit rating agencies (CRAs) play a crucial role in the development of financial markets. By publishing information on the ability of entities (such as, banks, firms and sovereigns) to meet their financial obligations, CRAs contribute to the correction of market failures caused by asymmetric information between lenders and borrowers.

Updates of credit risk ratings also influence market participants' behaviour with implications for international capital flows and borrowing costs. Hence, in response to new information provided by CRAs, capital can move away from 'risky' investments and towards 'high-grade' investments (i.e. the so-called 'flight to quality') and low-credit ratings entities pay higher interest rates than those with better credit standards.

On the one hand, the reporting activity of CRAs stimulate borrowers to pursue sounder financial and economic policies aimed at enhancing their capability to access international capital markets (Agnello et al., forthcoming). On the other hand, it could inadvertently destabilize financial markets and generate spillover effects.[1]

These concerns emerged dramatically during the euro area sovereign debt crisis, when the financial stress faced by countries like Greece, Ireland and Portugal spilled to other EU countries leading to a significant rise in sovereign bond yield spreads. In this context, CRAs were often blamed for being somewhat pro-cyclical in their ratings assessments, thus, potentially exacerbating contagion (Michaelides et al., 2015).[2]

These episodes have revived the interest among academics and practitioners on the behaviour of sovereign credit ratings and their impact on global financial markets. In

[1] Duggar et al. (2009) analyse crises in Indonesia (1997-2002), Russia (1998-1999) and Argentina (2001-2002), and find that 61% of default episodes by rated corporations occurred during sovereign crises.
[2] In practice, once financial problems of Greece, Portugal and Ireland emerged, CRAs also downgraded the creditworthiness of other major Eurozone economies (e.g. France, Austria) putting in motion a process driving yield spreads to higher levels and creating a self-fulfilling prophecy of potential default (Aizenman et al., 2013).

particular, the opacity of the methodology underlying the determination of sovereign ratings[3] led many authors to empirically assess their main drivers.[4]

Yet, the existing works leave some relevant questions about an important dimension of sovereign ratings open: Does the likelihood of exiting a specific phase increase or decrease as time goes by? What are the determinants of the *duration* of sovereign ratings phases? How do economic developments and the quality of institutions influence the length of sovereign ratings phases?

To address these questions, we follow a three-step strategy. First, we consider the history of long-term sovereign ratings for a sample of 130 developed and emerging economies over the last three decades. Thus, we rely on the identification of 'speculative-grade' and 'investment-grade' using Fitch's convention to construct phases (or spells of time) over which sovereign issuers have been given a specific rating (risk) class. Second, we consider a set of macroeconomic and qualitative indicators, which are expected to affect the duration of sovereign ratings phases. Third, we estimate discrete-time Weibull duration models to test for the presence of duration dependence and identify those variables influencing the length of each sovereign ratings phase.

Our main empirical findings can be summarised as follows. We show that sovereign credit ratings phases are characterised by significant differences in their duration dependence. In particular, the likelihood of a speculative-grade phase' ending increases as time goes by (i.e. there is positive duration dependence), while the investment-grade phase is not duration dependent. This is consistent with the idea that "time" matters for the build-up of reputation and the view that sovereign ratings exhibit greater stability at higher ratings levels than at lower ratings.

[3] Credit Rating agencies underline that they do not use a specific formula to combine the various political and economic factors in deciding on a specific rating.

[4] See, for instance, Cantor and Packer (1996), Juttner and McCarthy (1998), Ferri et al. (1999), Kaminsky and Schmukler (2002), Sy (2002), Mora (2006), Hu et al. (2002), Afonso et al. (2011) and Broto and Molina (2016).

Concerning the role played by economic and institutional factors in determining the length of sovereign rating phases, we find that lower inflation, better economic performance and sounder fiscal positions shorten (protract) the speculative- (investment-) grade phases.

Interestingly, we also show that the quality of governance plays a key role. In particular, for sovereigns experiencing a speculative-grade phase, a positive perception of the quality of public services and the ability of the government to formulate and implement sound policies and regulations can help to accelerate their ratings upgrade, especially in the case of sovereign debt denominated in foreign currency. For instance, in the case of (domestic-) foreign currency-denominated debt, a one point rise in the composite index of governance quality increases the probability of a speculative-grade ratings phase ending by, approximately, 25% (39%). By contrast, institutional factors are, from a statistical point of view, much less important for the duration of sovereigns' investment-grade spells, which reflects the fact that these countries are typically developed and already benefit from a strong institutional framework.

Finally, we find that being part of OECD group of countries is associated with a lower probability that an investment-grade phase ends. The length of the speculative-grade phase is also shorter for advanced economies than for emerging markets.

The rest of this paper is organised as follows. In Section 2, we present a brief review of the related literature. Section 3 details the econometric strategy. In Section 4, we describe the data. Section 5 discusses the empirical results, while Section 6 provides the sensitivity analysis. Finally, in Section 7, we conclude and draw the main policy implications.

2. Literature Review

There is a large body of the literature looking at the main drivers of sovereign ratings. Using cross-sectional data for 49 countries as of September 1995, Cantor and Packer (1996) find that sovereign ratings are generally consistent with economic fundaments. In particular, the estimates of a simple linear regression model indicate that their dynamics can largely be explained by variables, such as per capita income, GDP growth, inflation and external debt. The authors also show that sovereign ratings impact on sovereign bond spreads. More specifically, US Treasury bond spreads rise by 0.9 percentage points after negative rating announcements, and fall by 1.3 percentage points in the case of positive announcements. Sy (2002) also finds a negative correlation for emerging market bond spreads over the US Treasury bill rate.

Juttner and McCarthy (1998) extend the analysis by Cantor and Packer (1996), and examine the determinants of Moody's and S&P's sovereign ratings for a range of mature and emerging market economies in the mid-1990s. They conclude that the linear relationship between the variables identified by Cantor and Packer (1996) and sovereign ratings was stable until 1997. After the outbreak of the Asian crisis, additional controls (such as the ratio of problematic bank assets over GDP and the interest rate differentials) seem to play a major role in explaining sovereign ratings.

Using Moody's data for 17 countries, Ferri et al. (1999) find that, during the Asian crisis, credit ratings of East Asian countries behaved in a pro-cyclical way as a result of ratings downgrades more than macroeconomic fundamentals would justify. This, in turn, impacted market expectations and aggravated the crisis.

Other works draw similar conclusions on the pro-cyclical nature of sovereign ratings. For example, Kaminsky and Schmukler (2002) use a panel of 16 emerging markets including East Asian, Eastern European, and Latin American economies, and

find that CRAs upgrade countries in good times and downgrade them in bad times. They also find that changes in sovereign ratings contribute to contagion and spillover effects, with rating changes among emerging markets triggering fluctuations in both yield spreads and stock returns in foreign countries. Mora (2006) revisits the results by Ferri et al. (1999) and reaches different conclusions. By extending the sample to the post-Asian crisis period from 1999 to 2001, the author finds that sovereign credit ratings are sticky rather than pro-cyclical and remained over-conservative after the crisis. In addition, the author finds that sovereign ratings react passively to market sentiment (as proxied by spreads) and are driven by political factors.

Hu et al. (2002) rely on ordered probit models to assess the determinants of sovereign ratings and estimate the rating transition matrices. The empirical findings suggest that default history, lower reserves, higher inflation, higher debt to GNP ratio, being a non-industrial country and higher ratio of debt service to exports lower the quality of credit. A similar methodological approach is used by Afonso et al. (2011). Considering sovereign ratings for a large panel of countries over the period 1995-2005, they find that per capita GDP, real GDP growth, external debt and external reserves, and government debt and effectiveness are the most important sovereign debt rating drivers.

A recent paper by Broto and Molina (2016) departs from the traditional empirical literature in that it focuses on the characteristics and determinants of sovereign rating 'cycles', instead of ratings *per se*. The authors assume that a credit cycle consists of two phases: 1) a 'downgrade' phase, where the rating goes from peak to trough; and an 'upgrade' phase, where the rating improves. Estimating logit and ordered models for a sample of 67 emerging and developed countries over the period 1994:Q1-2013:Q1, they show that rating cycles are characterised by strong asymmetry. More specifically, downgrade phases are shorter than upgrade phases, as rating agencies are

faster at updating ratings in response to the economic recovery (during downgrade phases) and more prudent at revising ratings even in case of strong economic performance (during upgrade phases). Consequently, downgrade phases behave in a pro-cyclical way, whereas upgrade periods tend to be relatively sticky.

Our paper contributes to this strand of research on the determinants of sovereign ratings phases. In this respect, it is inspired by the work of Broto and Molina (2016). Yet, from a conceptual point of view and an empirical perspective, it departs from existing studies in two main aspects. First, we pay close attention to the *duration* of sovereign ratings phases rather than the *occurrence* of a particular rating change. From a policy perspective, this distinction is important because welfare implications can be quite different. For instance, the welfare losses due to a rating downgrade are relatively small if a (subsequent) upgrade takes place shortly afterwards. By contrast, welfare losses can be particularly high if the average duration of a (lower) rating class is long.

Second, we test for the presence of duration dependence, that is, we assess how time (i.e. own age) affects the length of sovereigns ratings phases. From an operational point of view, this provides valuable information to market participants both about the timing of sovereign ratings revisions and, most importantly, the transition across different credit risk classes. To give some economic intuition, we highlight that the passage of time gives sovereigns the opportunity to build up and/or solidify their reputation as good or bad borrowers. If a certain sovereign seizes (misses) such opportunity, then, the probability of a rating upgrade increases (declines) over time. And, obviously, for sovereigns with an already fairly solidified reputation as excellent borrowers (e.g., AAA-rated sovereign bonds), we might even expect that the probability of exiting the investment-grade phase does not significantly change as time passes by.

3. Econometric Methodology

We rely on the class of hazard-based duration models. These econometric frameworks have been used to analyse the duration of business cycle phases and unemployment spells (Kiefer, 1988; Sichel, 1991; Castro, 2010). In financial economics, they were employed to investigate the existence of duration dependence in stock markets cycles (Lunde and Timmermann, 2004), the determinants of housing booms and busts (Agnello et al., 2015a; Bracke, 2013) and the length of periods of financial markets' shutdown and re-access (Agnello et al., 2018). Agnello et al. (2013) also make use of duration analysis to assess the drivers of the duration of fiscal consolidation programs. Agnello et al. (2015b) move one step forward and formulate duration models with a change-point in duration dependence parameter to test for the presence of fiscal fatigue. Agnello et al. (forthcoming) rely on the same empirical methodology to evaluate the impact of the "legacy" and the "tyranny" of time on the duration of exit and re-entry of sovereigns to international capital markets.

Because of their properties, duration models are particularly well-suited to test whether the likelihood of a sovereign rating phase ending depends (or not) on its own age. In addition, their applicability to discrete-time model specifications accommodates external covariates and, therefore, allows one to assess the main determinants of the duration of each phase.

To better understand the theoretical reasons behind the use of hazard models, we start by introducing two key concepts, namely: the hazard function and the survival functions. Let T be a non-negative continuous random variable measuring the time span between the beginning of a sovereigns rating phase and the moment it ends with probability distribution $F(t) = \Pr(T<t)$, i.e. the probability of T being smaller than a certain value t. Then, we can define the survivor function at time t, $S(t) = \Pr(T\geq t) = 1-$

$F(t)$ as the probability that the duration of sovereign rating phase is at least equal to t. From this and the density function, $f(t)$, we get the the hazard function at time t as $h(t) = f(t)/S(t)$. This function measures the conditional probability of a sovereign rating phase ending at time t given that it lasted until to that point in time.

Depending on the sign of the derivative of $h(t)$ with respect to t, we may have: *(i)* positive duration dependence, if $dh(t)/dt>0$; *(ii)* negative duration dependence, if $dh(t)/dt<0$; or *(iii)* no duration dependence, if $dh(t)/dt=0$. Positive (negative) duration dependence means that the likelihood of a sovereign rating phase ending increases (decreases) as the time goes by.

The shape of the hazard function has important implications for the duration dynamics. The proportional hazard model is one of most popular parametric forms for the hazard function, as it can accommodate the effect of time-varying covariates:

$$h(t,x) = h_0(t)\exp(\mathbf{x\beta}) \tag{1}$$

where $h_0(t)$ is the baseline hazard, $\boldsymbol{\beta}$ is a (k×1) vector of parameters that need to be estimated and $\mathbf{x}$ is a vector of time-invariant covariates. We impose a specific parametric form for the function $h_0(t)$ using a Weibull model:

$$h_0(t) = \gamma p t^{p-1}, \tag{2}$$

where γ is a constant while p is a non-negative parameter providing information about the nature of duration dependence. A value of p greater (lower) than 1 indicates the existence of positive (negative) duration dependence. If p equal to one, there is no evidence of duration dependence. Replacing (2) into (1), we have:

$$h(t,\mathbf{x}) = \gamma p t^{p-1}\exp(\mathbf{x\beta}). \tag{3}$$

So far, we have assumed that the duration variable T is continuous and the hazard function $h(t)$ varies on a continuous-time scale. Thus, $h(t)$ can be interpreted as

the instantaneous probability that a sovereigns rating phase ends in an infinitesimally small time period T after time t, given that the duration has not elapsed until time t.

Nevertheless, from a practical point of view, data collected in our study are discrete and organised on yearly frequency basis. It follows that continuous-time duration models are not the most adequate to use (Allison, 1982).

However, their discretisation, as proposed by Prentice and Gloeckler (1978), Allison (1982), and Jenkins (1995), is viewed as a valid solution to the problem and is commonly used in the empirical literature. In addition, discrete-time duration models have the important advantage of allowing for the inclusion of time-varying covariates.

Following Prentice and Gloeckler (1978), a discrete-time version of the proportional hazards model can be written as:

$$\begin{aligned} P_{it} &= \Pr\left[T_i = t \mid T_i \geq t, \mathbf{x}_{it}\right] = 1 - e^{-h_t e^{\boldsymbol{\beta}'\mathbf{x}_{it}}} = 1 - e^{-e^{\lambda_t + \boldsymbol{\beta}'\mathbf{x}_{it}}} \\ &\Leftrightarrow \ln\left[-\ln(1 - P_{it})\right] = \lambda_t + \boldsymbol{\beta}'\mathbf{x}_{it} \end{aligned} \tag{4}$$

which is equivalent to the complementary log-log (or *cloglog*) function, where λ_t $(= \ln h_t)$ represents the logarithm of an unspecified (baseline hazard) function of time and $\mathbf{x}_{it}$ is a vector of time-varying control variables. A popular specification for λ_t is the discrete-time analogue to the continuous-time Weibull model, which yields:[5]

$$\lambda_t = \ln h_t = \alpha + (p-1)\ln t \tag{5}$$

Prentice and Gloeckler (1978) and Allison (1982) show that discrete-time log-likelihood function for a sample of $i = 1,...,n$ spells can be written as follows:

$$\ln L = \sum_{i=1}^{n}\sum_{j=1}^{t_i} y_{it} \ln\left(\frac{P_{ij}}{1-P_{ij}}\right) + \sum_{i=1}^{n}\sum_{j=1}^{t_i} \ln\left(1 - P_{ij}\right), \tag{6}$$

[5] Note that $\lambda_t = \ln h_t = \ln(\gamma p t^{p-1}) = \alpha + (p-1)\ln t$, with $\alpha = \ln(\gamma p)$ and t denotes the duration of each phase.

where the dummy variable y_{it} is equal to 1 if the end of a sovereign rating phase for a country i ends at time t, and 0 otherwise. The model is estimated by Maximum Likelihood substituting P_{ij} by (4) and λ_t by (5).

4. Data

We use a sample of 130 industrialized and emerging countries for which long-term sovereign ratings are reported by Fitch Ratings Inc. since the eighties. Depending on the likelihood of repayment of their obligations, each rated sovereign is assigned a specific rating category over a scale mapping from AAA (i.e. the highest credit quality) to D (i.e. default). Either plus (+) or minus (-) signs are added to further refine the rating, thus, leading to a rating system that consists of twenty-four grades of risk.

Given the scope of the paper, we group sovereigns into two broad categories. Specifically, according with Fitch Ratings Inc.'s conventions (Fitch, 2017), sovereign borrowers are assigned to: *(i)* the Investment-grade category, if their obligations are rated BBB- or higher, thereby, indicating relatively low to moderate credit risk; and *(ii)* the Speculative-grade category, if they issue bonds with a credit rating BB+ or below, thus, signalling either a higher level of risk or that a default has occurred (or it is likely to occur). We construct both categories of risk using both local currency- and foreign currency-denominated debt ratings with the objective of checking whether the gap between the two ratings affects the results of our analysis.[6, 7]

[6] As documented in Fitch (2017, p. 17), the local currency ratings are assigned based on the sovereign's ability to meet its obligations regardless of the currency in which those obligations are denominated and in the absence of transfer and convertibility (T&C) restrictions. By contrast, foreign currency ratings consider the profile of the sovereign entity, which is called to fulfil its foreign currency-denominated financial obligations, after taking into account the willingness of the government to impose restrictions on the conversion of local currency to foreign currency or on the transfer of foreign currency to residents and non-residents (T&C risk).

[7] The rationale behind the use of both domestic and foreign currency ratings is that the former is often higher than the latter reflecting the presumed greater ability and willingness of sovereigns to service debt denominated in their own currency. In fact, as highlighted in Packer (2003), while many sovereigns can

Then, we organize annual observations in spells, where a spell denoted by *Dur_rank* represents the number of consecutive years that a sovereign is assigned the Speculative-grade or the Investment-grade category.

As the second objective of the paper is to identify the main variables affecting the length of sovereign ratings phases, we consider a set of macroeconomic and institutional determinants. Based on the empirical literature exploring the factors behind sovereign ratings (Broto and Molina, 2016; Cantor and Packer, 1996; Hu et al., 2002; Afonso et al., 2011), we use a selection of relatively standard variables that are expected to influence credit ratings and that can be grouped as follows:

- *Macroeconomic indicators*, which track the country's economic performance, namely: *(i)* the inflation rate; and *(ii)* the real GDP growth.
- *Fiscal variables*, which account for the ability of the country to service its debt, including: *(iii)* the budget balance to GDP ratio; *(iv)* the public debt to GDP ratio; and *(v)* the trade balance (as percentage of GDP).
- *Governance quality indicators*, which cover six broad dimensions, such as: *a)* Control of Corruption; *b)* Government Effectiveness; *c)* Political Stability and Absence of Violence; *d)* Regulatory Quality; *e)* Rule of Law; and *f)* Voice and Accountability. By aggregating all six indicators, we also construct a composite index (labelled as *'Quality of Governance'*), which summarises the strength of institutional quality.
- An *OECD dummy variable*, which takes the value of one if a country is an OECD member, and zero otherwise. This allows us to test whether sovereign credit phases are longer (or shorter) in advanced countries than in emerging countries.

---

print money to meet domestic currency obligations, it must generate foreign exchange to repay foreign currency debts.

All macroeconomic and fiscal variables are retrieved from the World Economic Outlook (WEO) of the International Monetary Fund (IMF). Governance quality indicators are gathered from the World Bank's Worldwide Governance Indicators (WGI). Each indicator ranges from -2.5 to 2.5, with higher values denoting a higher quality in a specific field of governance (Kaufmann et al., 2010).

We remark that, even though the original dataset consists of annual data for 130 countries until 2017, the presence of missing values for fiscal variables and the limited WGI coverage (which is confined to the period of 1996-2016) reduce the number of usable observations. This - together with the awareness that duration models are computationally demanding -, explains why we opt for a parsimonious model specification that privileges the use of a "core" set explanatory variables.

A summary of the descriptive statistics of all variables included in the empirical analysis can be found in Table 1. For local currency-denominated debt, we identify 13 spells of speculative-grade rating phases, which vary in length from one year to 21 years, thereby, generating 566 observations for our discrete-time duration analysis. Concerning foreign currency-denominated debt, we distinguish 28 spells of speculative-grade rating phases, which vary in length from one year to 22 years, thus, generating 690 observations. The mean duration of speculative-grade rating phases is about 7 years for both domestic and foreign currency-denominated debt.

Regarding investment-grade rating phases, we identify 19 spells (or 1273 observations) for local currency-denominated debt, and 20 spells (or 1260 observations) for foreign currency-denominated debt. Investment-grade rating phases have an average duration of around 10.5 years, with the length ranging between one and 48 years.

[TABLE 1 HERE.]

In Figure 1, we plot the survival function for speculative-grade rating phases (top panel) and investment-grade rating phases (bottom panel). Left-hand side diagrams refer to local currency-denominated debt, while right-hand side diagrams correspond to foreign currency-denominated debt. It can be seen that the probability of speculative-grade rating phase surviving after a certain duration substantially decreases over time, especially in the case of foreign currency ratings. Thus, in the next Section, we empirically assess if this decline is consistent with the presence of duration dependence. By contrast, the survivor function for investment-grade rating phases displays less variation over time, which suggests absence of duration dependence.

[FIGURE 1 HERE.]

5. Empirical Findings

In this section, we report results of the *cloglog* models as defined by equations (4)-(5). In practice, we estimate the model $\ln[-\ln(1-P_{it})] = \alpha + q\ln t + \boldsymbol{\beta}'\mathbf{x}_{it}$, where t = *Dur_rank* measures the duration of a sovereigns rating phase and its coefficient q allows us to test for the presence of duration dependence. As demonstrated in Section 3, $q = p - 1 \Leftrightarrow p = q + 1$, where p is the duration dependence parameter. In section 5.1, we present results for the speculative-grade phase, while the empirical findings for the investment-grade phase are reported in section 5.2.

5.1. The phase of speculative-grade

Table 2 summarises the main results from the estimation of discrete-time *Cloglog* duration models applied to the speculative-grade phase. It focuses on local currency-denominated debt. In column (1), we present estimates from a very basic

model which only includes time-effects (not reported for sake of space) and the OECD dummy variable. Then, we assess the role played by a vector of time-varying control variables as described in Section 4. Specifically, we first control for the importance of macroeconomic indicators (columns 2-3); then, we include fiscal variables in the model (columns 4-5); and, finally, we enlarge the model specification to account for governance quality indicators (columns 6-12). To keep the model parsimonious, we add one indicator of the quality of governance at time to the set of explanatory variables.

Looking at the results in Table 2, we note that, regardless of the model specification, the coefficient associated with the variable *Dur_rank* (q) is always positive and statistically significant. This implies that the estimate of the duration dependence parameter ($p = q + 1$) is statistically greater than 1 (positive duration dependence) and, therefore, the likelihood of a speculative-grade phase ending increases as it becomes "older". This evidence can be interpreted as supporting the view that, for speculative-rated sovereigns, building up the reputation as a good borrower can be thought as a gradual (sometimes, long-lasting) process.

Regarding the role played by quantitative control variables, we find that favourable economic performance significantly reduces the length of time spent by a sovereign in a speculative-grade phase. Specifically, a fall in inflation, a rise in GDP growth and an improvement of the trade balance are key for sovereigns to exit such phase. For instance, a one percentage point rise in GDP growth increases the likelihood of speculative-grade ratings phase ending by between 12.5% and 18.9%. These results corroborate the view that sound macroeconomic conditions increase a country's ability to service its local-currency commitments and favour an upgrade of its credit risk rating.

Moreover, our findings indicate that the quality of governance matters: a one point rise in the composite index of governance quality boosts the hazard rate of a

speculative-grade ratings phase ending by close to 25%. In particular, a positive perception of the quality of public services (as measured by the government effectiveness) and greater capability of the government to formulate and implement sound policies and regulations (as proxied by regulatory quality) are the most important qualitative aspects that speed up the end of a speculative-grade phase.

Finally, we note that the coefficient associated with the OECD dummy variable is statistically significant in most of the cases, which suggests that the length of speculative rating phases for debt denominated in domestic currency is shorter for OECD countries than for non-OECD countries.

[TABLE 2 HERE.]

Table 3 describes the evidence for duration of speculative-rating phases in the case of foreign currency-denominated debt. The results are in line with those shown in Table 2. Despite this, the magnitude and statistical significance of the estimated parameters point to sovereigns being rated differently depending on whether their ratings are based on the ability to meet domestic or foreign currency-denominated financial obligations (Packer, 2003).

In general, the empirical findings confirm the presence of positive duration dependence, but this evidence is less significant than in Table 2. Thus, speculative rating phases based on foreign currency-denominated debt tend to be less sensitive to the passage of time than those based on domestic currency-denominated debt. This result lends support to the idea that the presumed ability and willingness of sovereigns to meet financial obligations denominated in their own currency is greater than in the case of debt denominated in foreign currency (Packer, 2003). Consequently, as time

goes by, the likelihood of the end of a speculative-grade phase is more (less) significantly affected for debt denominated in domestic (foreign) currency.

Looking at other explanatory variables, we note that higher public debt, more inflation and trade balance deterioration undermine the ability of sovereigns to meet their obligations denominated in foreign currency. Therefore, such macroeconomic developments lead to longer speculative-grade phases. For example, a one percentage point increase in the debt-to-GDP ratio is associated with a fall in the odds of a speculative-grade ratings phase of between 2% and 5%. Interestingly, GDP growth is not statistically significant. This finding is consistent with speculative ratings reflecting the existence of structural problems that prevent domestic authorities to speed up the transition to an investment grade by means of good economic performance.

We also find that institutional quality impacts positively the probability that a speculative-grade phase ends, with the effect being even more important for foreign currency-denominated debt than that found for debt denominated in domestic currency (see Table 2). Indeed, in the case of foreign currency-denominated debt, a one point rise in the composite index of governance quality increases the probability of a speculative-grade ratings phase ending by, approximately, 39%. Government effectiveness and regulatory quality improvements are especially relevant for shortening the length of the speculative-grade phase, thus, promoting the transition to an investment-grade phase.

Finally, the OECD dummy variable is significant in the majority of model specifications, which indicates that, for foreign currency-denominated debt, the duration of speculative-grade phases is shorter in advanced economies than in emerging markets.

[TABLE 3 HERE.]

5.2. The phase of investment-grade

The empirical findings for the duration of the investment-grade phase are presented in Tables 4-5. Table 4 presents the evidence for ratings on debt denominated in local currency, while Table 5 provides a summary of the findings for ratings on foreign currency-denominated debt.

Table 4 shows that, for local currency-denominated debt, the evidence in favour of duration dependence in the investment-grade phase is, from a statistical view point, weak. Indeed, despite the fact that the sign of the coefficient associated with the variable *Dur_rank* is always negative (which can be interpreted as a signal of negative duration dependence, as $p = q + 1 < 1$), this variable is either insignificant or only significant at the 10% level. This result suggests that, once a sovereign's reputation as an excellent borrower has solidified, it generally remains unchanged as time goes by. Putting this finding in conjunction with that for the speculative-grade phase, we can conclude that higher sovereign ratings exhibit greater stability than lower sovereign ratings.

In what concerns the significance of control variables, we find that, improvements in economic growth and sounder fiscal positions (as reflected by lower public debt-to-GDP ratio and higher fiscal budget balance-to-GDP ratio) reduce the probability of investment-grade phase ending. For example, a one percentage point rise in the fiscal surplus (expressed in percentage of GDP) reduces the hazard rate of an investment-grade phase ending by between 22.1% and 27.1%.

Contrary to the speculative-grade phase, the importance of governance quality is rather limited. That is, compared to the duration of speculative-grade spells, the length of the investment-grade phase appears to be less sensitive to the quality of governance. In fact, only improvements in the control of corruption and political stability appear to significantly contribute to longer investment-grade spells. This is in line with the view

that investment-grade rated sovereigns are, generally, developed economies with strong macroeconomic performance and stable fiscal policies. The sign and statistical significance of the OECD dummy variable aligns with this interpretation: being part of OECD group is associated with longer investment-grade phases.

[TABLE 4 HERE.]

Table 5 summarises the results for the duration of investment-grade ratings on foreign currency-denominated debt. They are broadly similar to those obtained for local currency debt ratings. However, two major differences emerge. First, trade balance (as percentage of GDP) is now statistically significant. Its coefficient is negative, which shows that an improvement in net exports prolongs the duration of investment-grade phases. This is consistent with the evidence that persistent trade deficits are normally associated with growth in foreign indebtedness levels, which can ultimately undermine the creditworthiness of "net exporting" countries. Second, among the set of fiscal variables, we note that the government budget balance (as percentage of GDP) outweighs the statistical significance of the public debt-to-GDP ratio. Thus, the consolidation of the public finances increases the so-called "fiscal space", thus, providing the necessary resources to meet their financial obligations.

[TABLE 5 HERE.]

6. Sensitivity Analysis

In Section 5.1., we did not find a clear support for the presence of duration dependence in investment-grade rating phases. Nevertheless, the coefficient associated

with the variable *Dur_rank* was always negative (regardless of the model specification used in the analysis) and, in six out of twelve specifications, it was also significant (albeit only at the 10% level). Thus, this evidence can (weakly) signal a (latent) negative duration dependence. In particular, for top-rated sovereigns, rating agencies may be less prone to downgrade their ratings as time goes by.

To empirically explore this possibility, we perform an assessment of the determinants of the duration of investment-grade spells for sovereigns with an exceptionally strong capacity to meet their financial commitments. More specifically, we focus on sovereigns whose domestic currency- and foreign currency-denominated debt is rated by Fitch as AA- or higher over the entire sample period.

We include all these sovereigns in a category labelled as "high-grade", and investigate whether the likelihood of exiting this rating class changes as time passes by, that is, we evaluate the presence of duration dependence therein. We expect that the longer the permanence in this "top" rating category, the lower the probability of a downgrade and the longer the duration of the "high-grade" rating phase.

We identify 16 spells of high-grade rating phases for local currency-denominated debt, which generate 667 observations (see Table 1). These spells have an average duration of 11 years. We also identify 12 spells of high-grade rating phases for foreign currency-denominated debt, thus, generating 610 observations. These spells' average duration is 11.6 years. Finally, high-grade rating phases have a duration ranging between one and 48 years for both domestic and foreign currency-denominated debt.

The empirical results associated with the duration analysis on high-grade rating phases are presented in Table 6. In columns (1)-(6), we report the estimates of the duration model based on domestic currency ratings, while columns (7)-(12) summarise the findings for foreign currency ratings.

We find that the variable *Dur_rank* is significant and the sign of its coefficient is always negative, that is, $p = q+1 < 1$, which corroborates the presence of negative duration dependence. Thus, the likelihood of a "high-grade" phase ending declines with the passage of time, in line with the consolidation of the borrower's strong reputation.

As expected, this evidence is stronger when sovereigns' creditworthiness is evaluated using domestic currency ratings. And, interestingly, the length of the "high-grade" rating phase is less sensitive to economic developments than the duration of the investment-grade rating phase.

Yet, fiscal conditions continue to play a very important role, with fiscal surpluses significantly prolonging the duration of "high-grade" spells. This effect is especially pronounced in the case of debt denominated in foreign currency: a one percentage point rise in the government budget balance-to-GDP ratio is associated with a fall in the likelihood of a "high-grade" rating phase of between 15.8% and 20.2% in the case of domestic currency-denominated debt, and of between 29.5% and 32.7% in the case of foreign currency-denominated debt.

[TABLE 6 HERE.]

7. Conclusions

We use data on sovereign ratings for a sample of 130 developed and emerging countries to understand the dynamics of investment-grade and speculative-grade phases. Compared to the existing literature, the two major novel aspects of the paper are: *(i)* to explore the presence of duration dependence in such phases; and *(ii)* to investigate the determinants of their length using discrete-time Weibull duration models.

The empirical findings indicate that the speculative-grade rating phase displays positive duration dependence, while the investment-grade rating phase is not duration dependent. This is consistent with greater stability of sovereign ratings at top of the distribution of the bond credit tier than at the bottom of the distribution.

Conditioning the duration of both phases on a set of control variables, we find that lower inflation, stronger growth and sounder fiscal positions shorten (prolong) the speculative- (investment-) grade phase. Moreover, improvements in the quality of governance (especially, concerning government effectiveness and regulatory quality) reduce the length of speculative-grade rating phases. Finally, we show that, for local currency-denominated debt, investment-grade phases are longer in OECD countries than in non-OECD countries; and, for foreign currency-denominated debt, speculative-grade phases are shorter in OECD countries compared to non-OECD countries

From a policy perspective, our empirical findings have important implications. First, the evidence on duration dependence confirms that time plays an key role not only for understanding the duration of sovereign rating phases, but also for assessing the transition across different sovereign rating classes. Thus, building up a good reputation as a borrower is naturally a gradual process for speculative-rated sovereign bonds in the sense that it requires time until the upgrade to the investment-class takes place. By contrast, investment-rated sovereign bonds appear to be more immune to changes in their rating tiers even as time goes by. Interestingly, sovereign issuers rated AA- or higher - i.e. borrowers with a very strong or extremely strong capacity to meet their financial commitments - typically display longer investment-grade spells.

Second, domestic and foreign currency-denominated debt ratings behave in a way that promotes domestic bond market development (Packer, 2003). This helps governments to shield against volatile foreign currency-denominated investment flows.

Third, the analysis on the determinants of the duration of sovereign ratings phases reveals that growth-friendly economic policies coupled with fiscal discipline and strong quality of governance can shorten (prolong) the speculative- (investment-) grade rating phases. Therefore, such policies are welfare-improving.

References

Afonso, A., Gomes, P., and P. Rother, 2011. Short and long-run determinants of sovereign debt credit ratings. *International Journal of Finance and Economics*, 16(1), 1-15.

Agnello, L., Castro, V., and R.M. Sousa, 2013. What determines the duration of a fiscal consolidation program? *Journal of International Money and Finance*, 37, 113-134.

Agnello, L., Castro, V., and R.M. Sousa, 2015a. Booms, busts and normal times in the housing market. *Journal of Business & Economic Statistics*, 33(1), 25-45.

Agnello, L., Castro, V., and R.M. Sousa, 2015b. Is fiscal fatigue a threat to consolidation programmes? *Environment and Planning C: Government and Policy*, 33, 765-779.

Agnello, L., Castro, V., and R.M. Sousa, 2018. Financial markets' shutdown and re-access. *Economic Inquiry*, 56(1), 562-571.

Agnello, L., Castro, V., and R.M. Sousa, forthcoming. The legacy and the tyranny of time: Exit and re-entry of sovereigns to international capital markets. *Journal of Money Credit and Banking.*

Aizenman, J., Pinto, B., and V. Sushko, 2013. Financial sector ups and downs and the real sector in the open economy: up by the stairs, down by the parachute. *Emerging Markets Review*. 16, 1-30.

Allison, P., 1982. Discrete-time methods for the analysis of event histories. *Sociological Methodology*, 13, 61-98.

Bracke, P., 2013. How long do housing cycles last? A duration analysis from 19 OECD countries. *Journal of Housing Economics*, 22(3), 213-230.

Broto, C., and L. Molina, 2016. Sovereign ratings and their asymmetric response to fundamentals. *Journal of Economic Behavior & Organization* 130, 206-224

Cantor, R., and F. Packer, 1996. Determinants and impact of sovereign credit ratings. *Federal Reserve Bank N. Y. Economic Policy Review*, October, 1-15.

Castro, V., 2010. The duration of economic expansions and recessions: More than duration dependence. *Journal of Macroeconomics*, 32, 347-365.

Duggar, E., Emery, K., Gates, D., Paulo, S., Lemay, Y., and P. Cailleteau, 2009. Emerging market corporate and sub-sovereign defaults and sovereign crises: Perspectives on country risk. *Moody's Investors Service*, February.

Ferri, G., Liu, L.G., and J.E. Stiglitz, 1999. The procyclical role of rating agencies: evidence from the East Asian crisis. *Economic Notes*, 28, 335-355.

Fitch, 2017. *Ratings Definitions*. Technical Document available at: https://www.fitchratings.com/site/definitions.

Hu, Y.T., Kiesel, R., and W. Perraudin, 2002. The estimation of transition matrices for sovereign credit ratings. *Journal of Banking and Finance*, 26, 1383-1406.

Jenkins, S. 1995. Easy estimation methods for discrete-time duration models. *Oxford Bulletin of Economics and Statistics* 57, 129-138.

Juttner, J.D., and J. McCarthy, 1998. Modelling a rating crisis. Macquarie University, unpublished manuscript.

Kaminsky, G., and S. Schmukler, 2002. Emerging markets instability: Do sovereign ratings affect country risk and stock return. *World Bank Economic Review*, 16, 171-195.

Kaufmann, D., Kraay, A., and M. Mastruzzi, 2010. The Worldwide Governance Indicators: Methodology and analytical issues. World Bank Policy Research Working Paper no. 5430, September.

Kiefer, N., 1988. Economic duration data and hazard functions. *Journal of Economic Literature*, 26, 646-679.

Lunde, A., and A. Timmermann, 2004. Duration dependence in stock prices: An analysis of bull and bear markets. *Journal of Business & Economic Statistics*, 22(3), 253-273.

Michaelides, A., Milidonis, A., Nishiotis, G., and P. Papakyriakou, 2015. The adverse effects of systematic leakage ahead of official sovereign debt rating announcements. *Journal of Financial Economics*, 116(3), 536-547.

Mora, N., 2006. Sovereign credit ratings: guilty beyond reasonable doubt? *Journal of Banking and Finance* 30, 2041-2062.

Packer, F., 2003. Mind the gap: domestic versus foreign currency sovereign ratings. *BIS Quarterly Review*, September.

Prentice, R., and L. Gloeckler, 1978. Regression analysis of grouped survival data with application to the breast cancer data. *Biometrics*, 34, 57-67.

Sichel, D., 1991. Business cycle duration dependence: A parametric approach. *Review of Economics and Statistics*, 73, 254-260.

Sy, A., 2002. Emerging market bond spreads and sovereign credit ratings: Reconciling market views with economic fundamentals. *Emerging Markets Review* 3, 380-408.

List of Tables

Table 1. Descriptive statistics.

Variable	Source	Obs.	Mean	Std. Dev	Min.	Max.
Speculative-grade (local currency) - duration	Fitch Ratings Inc.	566	7.07	4.75	1	21
Speculative-grade (foreign currency) - duration	Fitch Ratings Inc.	690	7.19	4.97	1	22
Investment-grade (local currency) - duration	Fitch Ratings Inc.	1273	10.56	7.19	1	48
Investment-grade (foreign currency) - duration	Fitch Ratings Inc.	1260	10.49	7.39	1	48
Investment-grade (local currency) - duration	Fitch Ratings Inc.	667	11.05	8.01	1	48
Investment-grade (foreign currency) - duration	Fitch Ratings Inc.	610	11.62	8.32	1	48
Inflation	IMF-WEO	4784	30.23	315.17	-20.81	11749.64
GDP growth	IMF-WEO	4155	3.29	4.94	-54.81	60.34
Trade Balance (%GDP)	IMF-WEO	4305	-2.55	14.21	-107.29	75.68
Government balance (% GDP)	IMF-WEO	3241	-2.10	6.07	-151.31	43.30
Government debt (% GDP)	IMF-WEO	2885	51.12	33.96	0	242.11
Quality of governance	WGI	2606	1.79	5.01	-9.16	11.82
Control of Corruption	WGI	2629	0.29	1.00	-1.54	2.47
Government Effectiveness	WGI	2622	0.37	0.91	-1.64	2.44
Political Stability	WGI	2623	0.19	0.85	-2.81	1.76
Regulatory Quality	WGI	2622	0.38	0.87	-2.13	2.26
Rule of Law	WGI	2647	0.29	0.93	-2.18	2.10
Voice & Accountability	WGI	2638	0.28	0.88	-2.26	1.80
OECD	OECD	6192	0.26	0.44	0	1

Notes: Table 1 reports the number of observations (Obs.), the mean duration (Mean), the standard deviation (S.D.), the minimum (Min.) and the maximum (Max.) duration for each spell. Similar statistics are reported for the various regressors.

Table 2. Duration of the speculative-grade phase: Local currency ratings.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dur_rank	0.903**	0.942**	0.869*	1.231**	1.658***	1.509***	1.566***	1.393***	1.661***	1.691***	1.638***	1.466***
	(0.455)	(0.447)	(0.499)	(0.530)	(0.501)	(0.514)	(0.517)	(0.534)	(0.510)	(0.561)	(0.521)	(0.543)
Inflation		-0.062*	-0.089**	-0.113***	-0.108***	-0.122***	-0.121***	-0.122***	-0.108***	-0.124**	-0.129***	-0.123***
		(0.034)	(0.044)	(0.036)	(0.036)	(0.041)	(0.039)	(0.044)	(0.037)	(0.056)	(0.044)	(0.041)
GDP growth			0.121***	0.130***	0.118**	0.145***	0.140**	0.149***	0.118**	0.137**	0.137**	0.173***
			(0.044)	(0.049)	(0.052)	(0.054)	(0.056)	(0.053)	(0.051)	(0.057)	(0.054)	(0.065)
Trade balance (% GDP)				0.122***	0.132***	0.157***	0.149***	0.172***	0.132***	0.170***	0.159***	0.154***
				(0.029)	(0.032)	(0.036)	(0.037)	(0.045)	(0.028)	(0.037)	(0.036)	(0.038)
Government balance (% GDP)					-0.024	-0.001	-0.001	0.003	-0.024	0.007	0.008	0.000
					(0.071)	(0.075)	(0.076)	(0.093)	(0.070)	(0.081)	(0.061)	(0.081)
Government debt (% GDP)					-0.002	-0.010	-0.007	-0.020	-0.002	-0.008	-0.007	-0.011
					(0.008)	(0.012)	(0.010)	(0.016)	(0.009)	(0.011)	(0.010)	(0.011)
Quality of governance						0.218*						
						(0.121)						
Control of Corruption							0.849					
							(0.540)					
Government Effectiveness								2.397**				
								(1.003)				
Political Stability									-0.011			
									(0.469)			
Regulatory Quality										2.058***		
										(0.784)		
Rule of Law											1.245**	
											(0.635)	
Voice & Accountability												1.110**
												(0.558)
OECD	0.788*	0.846*	1.112**	1.169*	1.332**	1.146	1.131*	0.526	1.328**	0.604	0.796	1.665**
	(0.403)	(0.437)	(0.451)	(0.609)	(0.614)	(0.754)	(0.643)	(0.746)	(0.595)	(0.754)	(0.792)	(0.747)
Constant	-6.243***	-5.832***	-6.057***	-6.060***	-6.987***	-6.059***	-6.222***	-5.313***	-6.999***	-6.442***	-6.223***	-6.463***
	(1.257)	(1.178)	(1.203)	(1.237)	(1.395)	(1.516)	(1.474)	(1.761)	(1.532)	(1.563)	(1.487)	(1.429)
Observations	544	492	492	464	450	450	450	450	450	450	450	450
Time effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
N_s	13	13	13	13	12	12	12	12	12	12	12	12
LogL	-58.73	-56.38	-53.64	-45.26	-41.24	-39.58	-40.17	-38.32	-41.24	-37.15	-39.50	-39.58

Notes: Robust standard errors (clustered by country) in parentheses. Significance level at which the null hypothesis is rejected: * significant at 10%, ** significant at 5%, *** significant at 1%. *N_s* is the number of censored observations. *LogL* is the log-likelihood of the estimated model.

Table 3. Duration of the speculative-grade phase: Foreign currency ratings.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dur_rank	0.156	0.280	0.293	0.523**	0.336	0.636*	0.519	0.550	0.614*	0.655*	0.705*	0.496
	(0.245)	(0.247)	(0.234)	(0.252)	(0.285)	(0.357)	(0.325)	(0.337)	(0.317)	(0.351)	(0.366)	(0.308)
Inflation		-0.056**	-0.055**	-0.068**	-0.087**	-0.110***	-0.108***	-0.113**	-0.091***	-0.092*	-0.121***	-0.097***
		(0.027)	(0.025)	(0.031)	(0.035)	(0.041)	(0.038)	(0.048)	(0.033)	(0.052)	(0.043)	(0.036)
GDP growth			-0.018	-0.011	-0.036	-0.014	-0.020	0.013	-0.041	-0.026	-0.010	-0.026
			(0.048)	(0.043)	(0.045)	(0.046)	(0.050)	(0.054)	(0.045)	(0.045)	(0.042)	(0.052)
Trade balance (% GDP)				0.095***	0.097***	0.126***	0.110***	0.121***	0.117***	0.124***	0.124***	0.116***
				(0.027)	(0.026)	(0.032)	(0.030)	(0.037)	(0.026)	(0.028)	(0.033)	(0.031)
Government balance (% GDP)					-0.036	0.001	-0.012	0.015	-0.031	0.019	-0.002	-0.010
					(0.044)	(0.043)	(0.048)	(0.049)	(0.046)	(0.058)	(0.040)	(0.044)
Government debt (% GDP)					-0.020**	-0.039***	-0.032***	-0.050***	-0.026**	-0.043***	-0.035***	-0.030***
					(0.008)	(0.013)	(0.012)	(0.016)	(0.010)	(0.015)	(0.011)	(0.010)
Quality of governance						0.328***						
						(0.108)						
Control of Corruption							1.151***					
							(0.405)					
Government Effectiveness								2.738***				
								(0.834)				
Political Stability									0.817**			
									(0.376)			
Regulatory Quality										2.673***		
										(0.717)		
Rule of Law											1.677***	
											(0.529)	
Voice & Accountability												1.159**
												(0.509)
OECD	1.345***	1.586***	1.563***	1.389***	1.830***	1.281**	1.393***	0.684	1.700***	0.929	1.048*	1.666***
	(0.502)	(0.422)	(0.432)	(0.461)	(0.411)	(0.511)	(0.526)	(0.578)	(0.423)	(0.620)	(0.608)	(0.463)
Constant	-3.940***	-3.842***	-3.818***	-3.756***	-2.357**	-1.890*	-1.802	-1.280	-2.490**	-1.796*	-1.953*	-2.389**
	(0.693)	(0.686)	(0.694)	(0.692)	(0.980)	(1.143)	(1.135)	(1.188)	(1.068)	(0.977)	(1.137)	(1.036)
Observations	690	631	631	603	551	550	550	550	550	550	550	550
Time effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
N_s	28	28	28	28	26	25	25	25	25	25	25	25
LogL	-112.2	-105.9	-105.8	-95.31	-84.23	-72.58	-76.46	-71.06	-77.79	-67.97	-73.21	-77.29

Notes: Robust standard errors (clustered by country) in parentheses. Significance level at which the null hypothesis is rejected: * significant at 10%, ** significant at 5%, *** significant at 1%. *N_s* is the number of censored observations. *LogL* is the log-likelihood of the estimated model.

Table 4. Duration of the investment-grade phase: Local currency ratings.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dur_rank	-0.417*	-0.231	-0.437	-0.421	-0.761*	-0.828*	-0.850*	-0.746*	-0.779*	-0.757*	-0.790	-0.851*
	(0.224)	(0.271)	(0.282)	(0.361)	(0.422)	(0.451)	(0.446)	(0.450)	(0.435)	(0.432)	(0.502)	(0.478)
Inflation		0.075	0.060	0.044	0.039	0.012	0.012	0.006	-0.002	0.012	0.003	0.047
		(0.052)	(0.054)	(0.068)	(0.101)	(0.100)	(0.100)	(0.105)	(0.107)	(0.106)	(0.103)	(0.092)
GDP growth			-0.168***	-0.168***	-0.175***	-0.213***	-0.195***	-0.199***	-0.212***	-0.198***	-0.220***	-0.192***
			(0.040)	(0.043)	(0.052)	(0.058)	(0.057)	(0.058)	(0.060)	(0.056)	(0.057)	(0.059)
Trade balance (% GDP)				-0.044*	-0.047	-0.042	-0.037	-0.028	-0.053	-0.040	-0.037	-0.051
				(0.025)	(0.035)	(0.036)	(0.038)	(0.038)	(0.037)	(0.034)	(0.035)	(0.034)
Government balance (% GDP)					-0.236***	-0.228***	-0.233***	-0.221***	-0.225***	-0.227***	-0.271***	-0.231***
					(0.042)	(0.042)	(0.043)	(0.042)	(0.042)	(0.044)	(0.051)	(0.040)
Government debt (% GDP)					0.026***	0.026***	0.028***	0.028***	0.026***	0.024***	0.031***	0.026***
					(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)
Quality of governance						-0.166*						
						(0.091)						
Control of Corruption							-0.809**					
							(0.409)					
Government Effectiveness								-0.936				
								(0.754)				
Political Stability									-0.656**			
									(0.288)			
Regulatory Quality										-0.604		
										(0.616)		
Rule of Law											-1.584*	
											(0.878)	
Voice & Accountability												-0.295
												(0.321)
OECD	-2.324***	-2.113**	-2.127***	-2.047**	-4.032**	-3.181**	-3.381**	-3.411**	-3.586**	-3.450*	-3.287**	-3.619**
	(0.802)	(0.826)	(0.825)	(0.872)	(1.597)	(1.580)	(1.464)	(1.719)	(1.429)	(1.840)	(1.661)	(1.654)
Constant	-13.711***	-13.988***	-1.844***	-1.884**	-3.375***	-2.885**	-3.059***	-2.914**	-3.125***	-2.878**	-3.278***	-3.121***
	(1.263)	(1.419)	(0.670)	(0.873)	(1.094)	(1.172)	(1.124)	(1.217)	(1.163)	(1.218)	(1.222)	(1.189)
Observations	1,263	1,187	1,166	1,110	924	924	924	924	924	924	924	924
Time effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
N_s	19	18	18	17	14	14	14	14	14	14	14	14
LogL	-86.07	-78.35	-74.22	-68.82	-47.92	-46.73	-46.74	-47.11	-46.70	-47.54	-45.63	-47.66

Notes: Robust standard errors (clustered by country) in parentheses. Significance level at which the null hypothesis is rejected: * significant at 10%, ** significant at 5%, *** significant at 1%. *N_s* is the number of censored observations. *LogL* is the log-likelihood of the estimated model.

Table 5. Duration of the investment-grade phase: Foreign currency ratings.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dur_rank	0.046	0.238	-0.094	0.168	0.174	0.013	0.073	0.127	-0.036	0.020	0.045	-0.015
	(0.297)	(0.301)	(0.265)	(0.327)	(0.311)	(0.369)	(0.352)	(0.366)	(0.409)	(0.390)	(0.364)	(0.376)
Inflation		0.147***	0.135***	0.135**	0.139**	0.096	0.107	0.100	0.104	0.096	0.100	0.116*
		(0.056)	(0.050)	(0.056)	(0.064)	(0.080)	(0.076)	(0.079)	(0.074)	(0.076)	(0.079)	(0.068)
GDP growth			-0.214***	-0.254***	-0.228***	-0.242***	-0.227***	-0.233***	-0.238***	-0.252***	-0.238***	-0.248***
			(0.047)	(0.058)	(0.066)	(0.066)	(0.065)	(0.064)	(0.066)	(0.074)	(0.066)	(0.068)
Trade balance (% GDP)				-0.084**	-0.079**	-0.081**	-0.078**	-0.072**	-0.083**	-0.074**	-0.078**	-0.090***
				(0.035)	(0.033)	(0.034)	(0.034)	(0.033)	(0.035)	(0.034)	(0.034)	(0.034)
Government balance (% GDP)					-0.165***	-0.169***	-0.170***	-0.164***	-0.169***	-0.164***	-0.176***	-0.166***
					(0.048)	(0.049)	(0.050)	(0.047)	(0.046)	(0.054)	(0.048)	(0.047)
Government debt (% GDP)					0.001	0.001	0.001	0.002	0.001	-0.001	0.001	0.002
					(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.007)	(0.007)
Quality of governance						-0.132						
						(0.112)						
Control of Corruption							-0.532					
							(0.470)					
Government Effectiveness								-0.776				
								(0.775)				
Political Stability									-0.320			
									(0.427)			
Regulatory Quality										-0.958		
										(0.845)		
Rule of Law											-0.671	
											(0.520)	
Voice & Accountability												-0.532
												(0.498)
OECD	-1.038*	-0.809	-0.753	-0.679	-0.981	-0.200	-0.422	-0.356	-0.611	-0.143	-0.279	-0.351
	(0.594)	(0.588)	(0.566)	(0.695)	(0.841)	(1.224)	(1.017)	(1.197)	(1.122)	(1.339)	(1.072)	(1.207)
Constant	-15.840***	-17.439***	-3.057***	-3.558***	-4.316***	-3.711***	-3.982***	-3.858***	-3.759***	-3.408**	-3.859***	-3.853***
	(1.006)	(1.301)	(0.689)	(0.817)	(1.062)	(1.236)	(1.137)	(1.194)	(1.264)	(1.510)	(1.189)	(1.172)
Observations	1,260	1,168	1,144	1,065	1,028	991	991	991	991	991	991	991
Time effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
N_s	20	20	20	19	18	18	18	18	18	18	18	18
LogL	-98.39	-92.52	-84.76	-74.74	-64.31	-62.62	-62.85	-62.84	-63.20	-62.49	-62.73	-62.91

Notes: Robust standard errors (clustered by country) in parentheses. Significance level at which the null hypothesis is rejected: * significant at 10%, ** significant at 5%, *** significant at 1%. *N_s* is the number of censored observations. *LogL* is the log-likelihood of the estimated model.

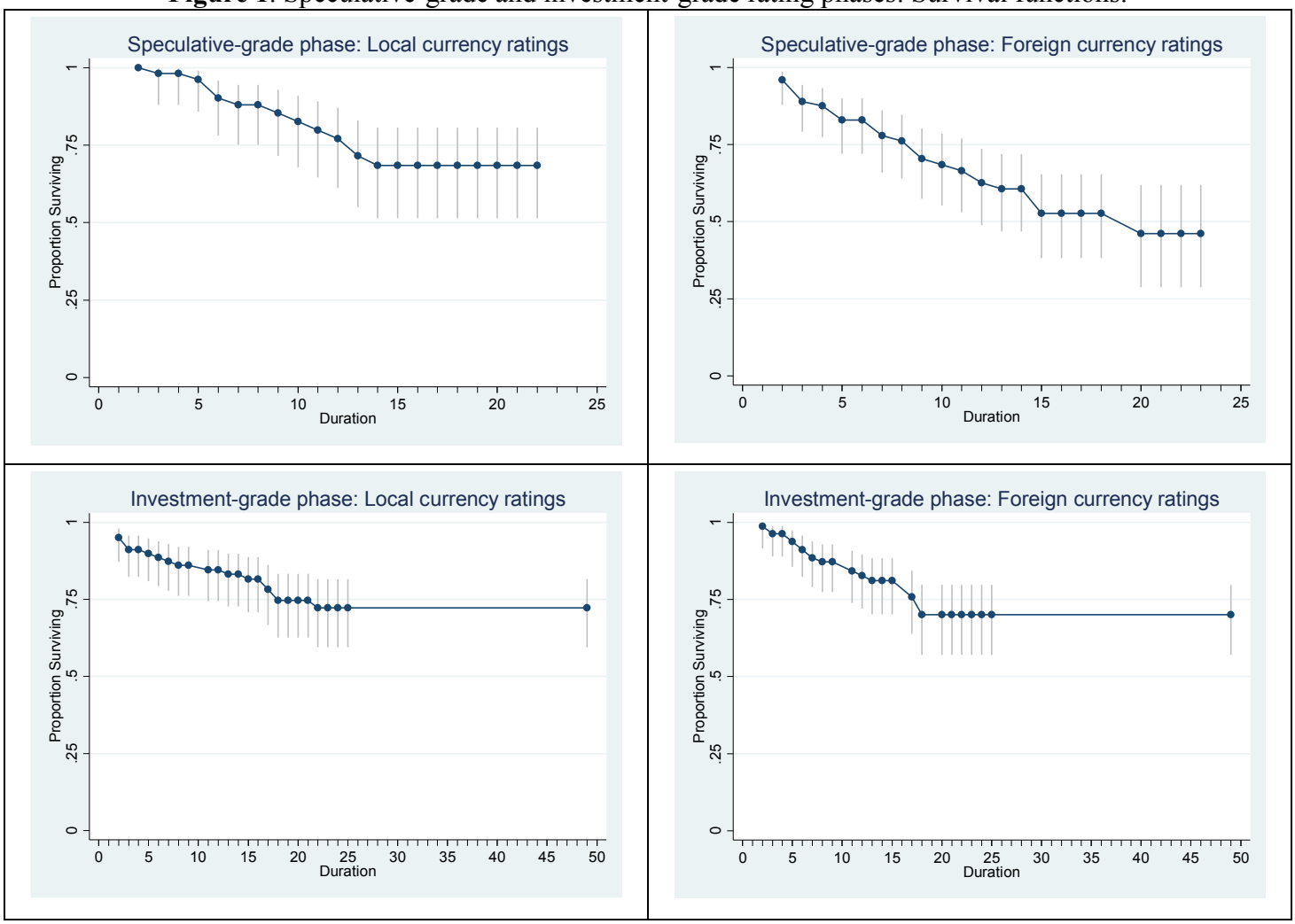
Table 6. Duration of "high-grade" phase: Local and foreign currency ratings.

	Local currency ratings						Foreign currency ratings					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dur_rank	-0.531**	-0.443**	-0.541***	-0.617**	-0.632*	-0.636*	-0.415	-0.344	-0.470*	-0.580	-1.311*	-1.710***
	(0.228)	(0.201)	(0.206)	(0.255)	(0.349)	(0.335)	(0.270)	(0.274)	(0.268)	(0.356)	(0.786)	(0.596)
Inflation		0.052	0.083	0.015	0.084	0.040		0.151	0.203	0.065	-0.084	-0.039
		(0.201)	(0.174)	(0.173)	(0.223)	(0.215)		(0.246)	(0.222)	(0.210)	(0.375)	(0.558)
GDP growth			-0.150	-0.192*	-0.104	-0.110			-0.242***	-0.392***	-0.240**	-0.291**
			(0.110)	(0.099)	(0.122)	(0.106)			(0.087)	(0.117)	(0.107)	(0.137)
Trade balance (% GDP)				-0.088*	-0.099	-0.128				-0.212**	-0.273*	-0.381**
				(0.049)	(0.074)	(0.091)				(0.091)	(0.152)	(0.169)
Government balance (% GDP)					-0.226***	-0.172***					-0.396***	-0.350***
					(0.055)	(0.055)					(0.107)	(0.084)
Government debt (% GDP)					-0.003	-0.001					0.001	0.008
					(0.011)	(0.011)					(0.009)	(0.016)
Quality of governance						-0.253*						-0.548
						(0.144)						(0.345)
OECD	0.194	0.104	-0.033	-0.480	-0.513	0.427	-0.395	-0.432	-0.451	-1.130*	0.004	1.808**
	(0.590)	(0.600)	(0.620)	(0.718)	(0.976)	(1.268)	(0.665)	(0.794)	(0.786)	(0.671)	(1.559)	(0.917)
Constant	-16.238***	-15.600***	-1.406	-0.288	-1.187	0.011	-16.636***	-17.921***	-1.666*	0.271	-0.799	1.905
	(1.119)	(1.851)	(0.949)	(1.059)	(1.178)	(1.549)	(1.126)	(2.379)	(0.994)	(0.815)	(1.211)	(1.505)
Observations	657	618	605	569	553	534	600	557	547	528	514	481
Time effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
N_s	16	16	16	15	15	15	12	12	12	11	10	10
LogL	-71.90	-70.69	-69.53	-61.93	-55.74	-52.55	-56.53	-54.74	-52.41	-39.22	-29.82	-24.29

Notes: Robust standard errors (clustered by country) in parentheses. Significance level at which the null hypothesis is rejected: * significant at 10%, ** significant at 5%, *** significant at 1%. *N_s* is the number of censored observations. *LogL* is the log-likelihood of the estimated model.

List of Figures

Figure 1. Speculative-grade and investment-grade rating phases: Survival functions.



European Stability Mechanism

6a Circuit de la Foire Internationale
L-1347 Luxembourg

Tel: +352 260 292 0

www.esm.europa.eu

info@esm.europa.eu

©European Stability Mechanism 01/2019