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The Relation between Corporate and Government Debt Maturity in Europe

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Abstract

This article investigates the gap-filling explanation for corporate debt maturity choices in a multi-country setting. We argue that companies adjust their debt maturity in response to shocks in government debt maturity both at home and abroad; the difference between the two effects depends on the markets' relative size and level of integration. Focusing on the European case and treating the Economic and Monetary Union as a shock in market integration, we find strong empirical support for our predictions. Our results have relevant implications for the opportunity for individual governments to use their debt maturity structure as a policy tool.

I. Introduction

Companies' debt maturity choices can be influenced by government debt maturity choices. In this article, we investigate the relative importance of decisions made by the domestic government versus those made by governments in foreign but (highly) correlated markets. We use the European countries in the Economic and Monetary Union (EMU) as an emblematic case of such a multi-country setting. As we predict, companies' debt choices are more highly correlated with decisions made by other EMU governments as a whole than with decisions made by their own domestic governments. This situation is particularly true for small countries and after the introduction of a common currency and monetary policy. The ability of individual European governments to steer corporate decisions thus appears to be hampered by the effect of shocks occurring in other EMU countries, making a case for the importance of coordinating government debt management at the European level.

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The literature on capital structure has traditionally focused on firm-level determinants to explain how corporations decide the maturity structure of their debt (e.g., Diamond (1991), Hart and Moore (1995), among others). A complementary stream of literature focuses instead on market conditions at the time firms raise capital (e.g., Faulkender (2005)), particularly on firms' ability to predict bond market returns (Butler, Grullon, and Weston (2006)). Baker, Greenwood, and Wurgler (2003) and Greenwood and Vayanos (2014), among others, argue that such predictability is (also) the result of shocks in the maturity of debt issued, particularly by governments. An increase in government debt maturity can increase the expected return of long-term over short-term bonds; it can thus stimulate firms to "fill the gap" and decrease their debt maturity in order to reduce their expected cost of debt. Greenwood, Hanson, and Stein (2010) and Badoer and James (2016) provide compelling empirical evidence in support of this "gap-filling" argument for the U.S. case. An interesting implication of gap filling is that government debt maturity can be seen as an effective policy tool, empowering governments to, for example, incentivize long-term financing among firms (Greenwood, Hanson, and Stein (2015)). This possibility is all the more relevant because corporate debt maturity can play an important role in the real economy. The roll-over risk associated with short-term debt can exacerbate a firm's financial constraints during a downturn, which translates into a lower level of real investments that further depresses economic growth. Almeida, Campello, Laranjeira, and Weisbenner (2011), for example, show that firms with debt largely maturing at the onset of the 2007 crisis cut their investments significantly more than otherwise-comparable firms. Gorton and Metrick (2012) and Gorton, Metrick, and Xie (2014) provide empirical evidence for the pivotal role played by the repo market in short-term financing and by the shortening of debt maturity in the dynamics of the crisis. How shocks in the maturity of debt issued by governments can influence corporate debt maturity choices is thus also a relevant question for policy makers.

The aforementioned literature has focused on the relation between corporate and government debt maturity, assuming that shocks occurring abroad are marginal to some extent. To date, empirical tests have focused on the United States, where this assumption can be deemed realistic due to the size of the U.S. bond market and its partial segmentation from other bond markets. In this article, we argue and show empirically that for relatively small countries in a context of highly correlated markets, this assumption is not realistic. We expect corporate debt maturity to be negatively correlated with both domestic *and* foreign government debt maturity. The underpinning reason is simple: Even if companies obtain financing only domestically, the rebalancing effect of international investors caused by a shock occurring in one country will also indirectly produce a similarly directed shock in the other countries. A partial correlation entails that foreign shocks have a smoothed indirect effect compared with domestic shocks. However, the magnitude of aggregated foreign shocks (in monetary terms) is larger on average than the magnitude of domestic shocks, especially if the domestic country is relatively small. All in all, for sufficiently small countries and a sufficiently high level of correlation, the role of foreign shocks is likely to become predominant. With perfectly correlated markets, we can expect government domestic debt to influence corporate choices only to the extent that it contributes to the “global” supply of long-term and short-term debt.

EMU countries constitute an ideal setting to empirically test these conjectures. Each country is relatively small compared with the rest of the EMU as a whole. More importantly, the introduction of a common currency and monetary policy in 1999 constitutes a unique shock to the level of correlation among markets. European debt management agencies are in general independent from treasuries. The pursuing of fiscal policies agreed upon by European countries does not include explicit goals of debt management, and agencies simply try to optimize the balance between the cost of debt and the roll-over risk (Wolswijk and De Haan (2005)). To the best of our knowledge, each European country decides its government debt maturity independently from other countries. The goal of this article is to investigate the relation between these choices and the debt maturity structure of firms located in EMU countries.

Our main empirical analyses are based on a firm-year panel data set of 4,252 corporations from 9 European countries, all of which joined the EMU in 1999, observed between 1990 and 2014. We combine firm-level data with country-level data on government debt from the European Central Bank (ECB). As a robustness check, we also test our main prediction using a country-year panel data set, where both government and corporate debt maturity are computed using country-level data from the ECB. The reason we focus primarily on firm-level analyses is that, as discussed by Becker and Ivashina (2014) in a similar context, changes in the composition of corporate debt at the country level over time may reflect changes in the set of firms raising debt capital. Using firm-level data and including firm-level fixed effects allows us to address this concern because estimates reflect the within-firm effect of changes in the maturity of government debt over time.

Our empirical results are aligned with our expectations. We find a strong negative correlation between the share of long-term debt issued by firms in a given country and the share of long-term government debt in the other 8 EMU countries as a whole. The magnitude of the estimated coefficient is larger in general than it is for the share of long-term domestic government debt; the difference has been even more pronounced since the introduction of the EMU. Estimated coefficients for the maturity of domestic and other European government debt are increasing and decreasing in the relative size of the domestic country, respectively. For the EMU period, different tests fail to reject the null hypothesis that differences in the estimated coefficients are merely reflective of differences in size. Finally, firms characterized by a relatively low cost of deviating from their target debt maturity react more aggressively to shocks in government debt maturity occurring both at home and in other European countries as a whole.

All in all, our results suggest that, especially since the introduction of the euro, the influence of individual European governments’ debt management choices on the debt maturity choices of their domestic firms is somewhat limited; the latter is affected predominantly by aggregated shocks at the EMU level. Therefore, coordination among the different debt management agencies would be advisable.

The article proceeds as follows: Section II illustrates in more formal terms the arguments culminating in our key predictions. Section III describes the data set used in the empirical part. Empirical results are presented in Section IV. Section V concludes.

II. Formalizing the Argument

To better illustrate our argument, we use a very simple, two-country extension of the model in Greenwood et al. (2010). We discuss here the main elements of the model and the resulting predictions. A more detailed description can be found in the Appendix. Let us consider the original, one-country version of the model first. Short-term interest rates are exogenous and can be considered to be driven by monetary policy, whereas long-term rates are determined endogenously. Government and corporate debt with the same maturity are seen as viable substitutes from investors' point of view. The government produces an excess supply of, for example, long-term debt. The resulting downward pressure on long-term bond prices constitutes a speculative opportunity that risk-averse arbitrageurs in general only partially exploit. In this scenario, companies can "fill the gap" and reduce their cost of borrowing (including the cost of deviating from their target debt maturity) by tilting toward short-term debt. A negative relation between the share of long-term debt issued by companies and the share issued by the government is thus predicted.

Our two-country extension of this model is characterized by two key parameters. The first one, ρ, is the correlation among the short-term interest rates in the two countries. A situation where countries adopt a common currency and monetary policy, such as the EMU, can thus be represented in this simple model as $\rho = 1$; Cappiello, Engle, and Sheppard (2006) provide compelling empirical evidence in support of this characterization of the EMU.

The second parameter, ω, represents the size of the government debt in one country (d) as a fraction of that of the other country (e). From the point of view of country d, country e represents the rest of Europe as a whole. We can thus assume, without any loss of generality, that $\omega < 1$. Governments and companies issue securities at the prevailing interest rates in their domestic markets. Arbitrageurs can borrow and invest in each of the two markets. Long-term interest rates in the two countries are still endogenous. The output of interest is the share of long-term debt issued by a company in country d (f_d). β_d and β_e indicate, respectively, the marginal effects of the share of long-term over total government debt at home ($g_d^{\%}$) on the optimal share of long-term corporate debt (f_d^*) and the marginal effects of the share of long-term government debt in other European countries as a whole ($g_e^{\%}$). The equilibrium β_d and β_e are

$$(1) \qquad \beta_d = \frac{\partial f_d^*}{\partial g_d^{\%}} = \frac{-\omega[\theta A + (1-\rho^2)B]}{\omega(1-\rho^2)\lambda B + (1+\omega)\lambda\theta A + \gamma^2\theta^2},$$

$$(2) \qquad \beta_e = \frac{\partial f_d^*}{\partial g_e^{\%}} = \frac{-\rho\theta A}{\omega(1-\rho^2)\lambda B + (1+\omega)\lambda\theta A + \gamma^2\theta^2},$$

where θ, λ, γ, A, and B are all strictly positive, exogenous (combinations of) parameters in the model. The parameter θ is associated with the cost for a firm of deviating from its optimal debt maturity structure; higher values of θ indicate more financially constrained firms. The following predictions for the European case are immediately derivable by analyzing the sign of β_d and β_e, as well as the sign of their first differences with respect to ρ, ω, and θ.

Prediction 1. European firms respond by shortening the maturity of their debt in response to positive changes in the share of long-term debt issued not only by their domestic governments but also by other European governments as a whole.

The prediction that $\beta_d < 0$ is consistent with the one-country model in Greenwood et al. (2010). Here, we predict that as long as $\rho > 0$, $\beta_e < 0$. It is interesting to note that the latter prediction is obtained while assuming that firms can finance themselves only at prevailing *domestic* interest rates. Firms do not need to be directly exposed to interest rates in other countries. As long as $\rho > 0$, the rebalancing activity of risk-averse arbitrageurs will (partially) transmit the shock from one country to the other.

Prediction 2. With the advent of the monetary union, European firms have become more sensitive to shocks occurring in other EMU countries. The difference in magnitude between the effects of external and domestic shocks is larger and strictly positive for the EMU period.

β_e is strictly increasing (in absolute terms) in ρ, as is the difference between $|\beta_e|$ and $|\beta_d|$. As previously stated, the EMU is represented as $\rho = 1$. Pre-EMU years can be considered to be characterized by a correlation of $0 < \rho < 1$. The importance of shocks occurring in other countries is predicted to increase in both absolute and relative (to domestic shocks) terms once a common currency and monetary policy are adopted. In general, the difference in magnitude between β_e and β_d can be positive or negative. On the one hand, the other countries combined are bigger than any individual country ($\omega < 1$), which suggests that they would have a larger impact because gap filling is a "euro-to-euro" phenomenon. On the other hand, imperfect correlation ($\rho < 1$) entails that the indirect effect of shocks occurring in e is smoothed in comparison to the direct effect of domestic shocks. When $\rho = 1$, $|\beta_e|$ is bound to be strictly larger than $|\beta_d|$. The next predictions focus more specifically on the moderating role of size.

Prediction 3. For a given change in the share of long-term government debt, the effect of this shock is increasing in the relative size of the country in which it is generated.

$|\beta_d|$ and $|\beta_e|$ are increasing and decreasing in ω, respectively. Prediction 2 says that $|\beta_e| - |\beta_d| > 0$, at least when $\rho = 1$. Prediction 3 implies that the difference between $|\beta_e|$ and $|\beta_d|$ is expected to decrease with the relative size of the domestic country.

Prediction 4. With the EMU, the difference between the marginal effects of changes in the maturity of domestic versus nondomestic government debt is exactly proportional to the difference in size between the two debt markets.

When $\rho < 1$, the model predicts that the domestic government can influence companies more than proportionally to its size (i.e., $|\beta_d| > \omega|\beta_e|$). However, $\rho = 1$

implies that $|\beta_d| = \omega|\beta_e|$. In this case, it is no longer relevant where the shock originates. Each country simply matters to the extent to which it contributes to the overall share of long-term government debt outstanding in Europe.

Prediction 5. Firms facing a lower cost of deviating from their optimal debt maturity structure react more aggressively both to shocks in the maturity of domestic government debt and to shocks occurring in other European countries as a whole.

As already predicted by Greenwood et al. (2010), $|\beta_d|$ is larger for less financially constrained firms (lower θ). We predict that the same also generally holds for $|\beta_e|$.[1]

III. Data

In this section, we present the data set and variables used in this study. Section III.A presents country-level variables; firm-level data are presented in Section III.B.

A. Country-Level Data

We retrieve government and aggregated corporate debt data from the ECB Data Warehouse (http://sdw.ecb.europa.eu/). Amounts of debt outstanding and issued are retrieved from the securities (SEC) database. Interest rate data are from the annual macroeconomic (AMECO) database. Data for debt issued by entities identified as general government or nonfinancial corporations and interest rate data are available for the 1990–2014 period (25 years) for 9 of the EU-19 countries: Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Portugal, and Spain. All of these countries joined the third stage of the EMU in 1999. These countries and years thus constitute the focus of our analysis. We henceforth refer to these 225 country-year observations as the country-level data set used in this study.

1. Government Debt Maturity

Similar to Greenwood et al. (2010), we proxy for the maturity of government debt by looking at the proportion of long-term (D_L^{GOV}) over total debt (D^{GOV}) outstanding, expressed as a percentage (L^{GOV}). Debt is defined as long term if its maturity is longer than 1 year. Short-term debt is defined in the opposite fashion. These definitions of long- and short-term debt apply to all of the government and corporate debt variables considered in this study.[2] Descriptive statistics are presented in Table 1.

Panel A of Table 1 reports the minimum, maximum, and median values of L^{GOV} over the period studied for each of the 9 countries considered. It also reports the median relative size (RS) over time of the government debt of each

[1]The exact condition on ρ for this prediction to hold is reported in the Appendix; the condition generally holds for reasonable (positive) values of ρ.

[2]Our definition of short- and long-term debt is driven by data availability, but it does not lack theoretical underpinning. The proportion of debt maturing within 1 year arguably captures the exposure to roll-over risk better than other proxies for debt maturity used in the literature; it is therefore adequate to address the potential role of government debt management as a policy tool.

TABLE 1
Debt Maturity, Country-Year ECB Data

Table 1 presents the distribution of the debt maturity of governments (Panel A) and nonfinancial firms (Panel B) over the 1990–2014 period ($T=25$) for each of the $N=9$ countries considered. L and I are the share of long-term debt (European Central Bank (ECB) item code F33200) over total debt (F33000) outstanding (N.1) and issued (N.2), respectively, expressed in percentage points. Debt is defined as long term if its maturity is longer than 1 year. Securities denominated in all currencies (Z01) are included. The superscripts GOV and C–ECB refer to government (1300) and corporate (1100) debt, respectively. RS is the ratio of domestic government debt outstanding over the sum of government debt outstanding for the other 8 countries, expressed in percentage points. All data are from the securities (SEC) database of the ECB. Panel C reports correlations over time on L^{GOV} for each pair of countries. * indicates statistical significance at the 5% level.

	Austria	Belgium	Finland	France	Germany	Italy	Netherlands	Portugal	Spain
Panel A. Government Debt Maturity by Country									
RS (median)	3.26	7.44	1.44	24.59	29.59	43.47	5.38	1.67	9.06
L^{GOV}									
Minimum	87.79	76.73	80.59	80.79	89.06	90.10	70.34	65.83	33.18
Median	97.94	86.25	90.31	89.59	96.71	69.04	93.79	86.73	85.39
Maximum	100	91.81	99.26	94.22	99.99	93.02	99.90	99.30	94.70
Panel B. Corporate Debt Maturity by Country									
$L^{C\text{–ECB}}$									
Minimum	95.36	46.90	54.19	75.79	66.53	98.30	87.95	35.77	49.66
Median	99.84	74.11	75.54	88.42	85.21	100.00	95.79	55.56	69.92
Maximum	100.00	91.47	85.82	95.44	100.00	100.00	99.93	99.65	96.13
$I^{C\text{–ECB}}$									
Minimum	38.32	1.68	0.46	4.58	0.39	93.14	3.33	0.61	3.62
Median	91.37	6.34	3.81	8.14	9.85	100.00	54.80	2.51	21.68
Maximum	100.00	28.87	20.54	31.36	100.00	100.00	95.76	98.36	63.52
Panel C. L^{GOV} Pairwise Correlations over Time									
Austria		0.782*	−0.264	−0.175	−0.450*	0.861*	0.915*	0.677*	0.822*
Belgium			−0.161	−0.149	−0.466*	0.915*	−0.336	0.717*	0.909*
Finland				0.575*	0.440*	−0.336	−0.241	−0.044	−0.349
France					0.767*	−0.241	−0.526*	0.186	−0.184
Germany						−0.526*	0.679*	−0.065	−0.423*
Italy							−0.546*	0.774*	0.971*
Netherlands								−0.134	−0.499*
Portugal									0.787*

country i as a share of the other countries' government debt as a whole; that is, $\text{RS}_{i,t}=D^{\text{GOV}}_{i,t}/\sum_{q\neq i}D^{\text{GOV}}_{q,t}$, where $q\in Q$, with Q being the set of 9 European countries considered.

Government debt maturity exhibits a significant degree of heterogeneity both between countries and across time within countries. The median value of L^{GOV} ranges between 97.94% (Austria) and 69.04% (Italy); the difference between the minimum and maximum values for L^{GOV} over time varies between approximately 11 percentage points for Germany to more than 60 percentage points for Spain. This variability is of course important to be able to properly estimate the relation between government and corporate debt maturity. The heterogeneity of government debt maturity decisions among European countries is also confirmed when looking at pairwise correlations, which are reported in Panel C of Table 1. Of the 36 possible country pairs, less than half (15) exhibit a statistically (at the 5% confidence level) significant positive correlation on L^{GOV} over time, 7 exhibit a significant negative correlation, and the correlation is not significantly different from 0 for the remaining 14 pairs. The 9 countries considered also vary considerably in terms of their relative debt size, with the median values of RS ranging between 1.44% (Finland) and 43.47% (Italy).

To address the role played by the debt maturity of the other 8 European governments as a whole, we use the variable L^{EU} defined as in equation (3):

$$(3) \qquad L_{i,t}^{\text{EU}} = \frac{\sum_{q \neq i} D_{L,q,t}^{\text{GOV}}}{\sum_{q \neq i} D_{q,t}^{\text{GOV}}}.$$

2. Aggregated Corporate Debt Maturity

For analyses based on our country-year panel data set, we measure corporate debt maturity using country-level debt data for nonfinancial corporations from the ECB. Panel B of Table 1 reports descriptive statistics for the share of long-term corporate debt issued ($l^{C-\text{ECB}}$) and outstanding ($L^{C-\text{ECB}}$). The median share of long-term corporate debt outstanding over time varies between 55.56% (Portugal) and 100.00% (Italy). Between-country heterogeneity is even stronger when $l^{C-\text{ECB}}$ is considered, with the median shares of long-term debt varying between 2.51% (Portugal) and 100% (Italy).

3. Macro Control Variables

Our analysis includes some control variables at the country level. We control for the level of short-term nominal interest rates ($y_{S,i,t}$) and for the difference between long- and short-term rates ($y_{L,i,t} - y_{S,i,t}$). Controlling for the level of interest rates is important because companies may have a strong incentive to reduce the maturity of their debt when the cost of short-term debt is relatively low (e.g., Faulkender (2005)). Finally, to allow for a structural change in the maturity of corporate debt with the advent of the euro, we include an indicator (EMU_t) that is equal to 1 from 1999 on, and 0 otherwise.

B. Firm-Level Data

Our main empirical analyses make use of a firm-year panel data set. Firm-level data come from Worldscope, accessed via Datastream. The initial data set includes 4,578 nonfinancial (i.e., 1-digit Standard Industrial Classification (SIC) code different from 6) firms based in the 9 countries considered over the 1990–2014 period. We remove observations for which it is not possible to compute a meaningful (i.e., comprised between 0 and 100) share of long-term debt issued and outstanding (defined in Section III.B.1). We also exclude observations where the sum of long-term debt outstanding (D_L^C) and the level of debt maturing within 12 months (D_S^C) is different from the level of total debt (D^C). Finally, we exclude observations where total assets are missing. We are then left with 29,524 observations for 4,252 firms. We henceforth refer to this sample as the firm-level data set used in this study. Table 2 reports the distribution of the data set by country and period (i.e., before and since the introduction of the EMU).

1. Firm-Level Debt Maturity

As done with the country-level data, the firm-level maturity of debt is proxied by the share of long-term debt over total debt. We consider the share of long-term corporate debt outstanding (L^C), computed as D_L^C / D^C, as a robustness check for our main analyses. Our inference is, however, based largely on the maturity of

TABLE 2
Distribution of Firm-Year Observations by Country and Period

Table 2 reports the number of observations and individual firms included in the firm-level data set for each country. The sample distribution is presented for the whole data set and for subsamples divided by period (pre-Economic and Monetary Union (EMU) and EMU).

	Whole Sample		Pre-EMU		EMU	
Country	No. of Obs.	No. of Firms	No. of Obs.	No. of Firms	No. of Obs.	No. of Firms
Austria	1,031	148	296	93	735	116
Belgium	1,432	207	440	125	992	171
Finland	1,725	206	485	136	1,240	174
France	9,082	1,397	2,523	786	6,559	1,126
Germany	8,504	1,198	2,247	703	6,257	1,024
Italy	2,894	427	719	206	2,175	343
Netherlands	2,276	315	758	212	1,518	256
Portugal	771	114	266	80	505	86
Spain	1,809	240	500	155	1,309	191
Total	29,524	4,252	8,234	2,496	21,290	3,487

corporate debt *issued* (l^C) because companies more realistically react to changes in the maturity of government debt using a partial adjustment mechanism.

Our proxy for the issues of short- and long-term corporate debt is similar to the one proposed by Greenwood et al. (2010) for U.S. firms. The amount of short-term corporate debt (d_S^C) issued is proxied by the level of short-term debt for the same company and year (D_S^C). The amount of long-term corporate debt issued by firm u in year t is computed as in equation (4):

$$d_{L,u,t}^C = (D_{L,u,t}^C - D_{L,u,t-1}^C) + a \times D_{L,u,t-1}^C, \tag{4}$$

where the parameter a represents the share of long-term debt assumed to be rolled over every year. Greenwood et al. (2010) set $a=0.1$ based on the results by Guedes and Opler (1996). However, Harford, Klasa, and Maxwell (2014) show that the average maturity of long-term debt capital raised by U.S. nonfinancial companies has significantly decreased over time, from approximately 11 years in the 1980s to 5–6 years in the 2000s. Cortina, Didier, and Schmukler (2018) find an average maturity of 6.2 years for 39 developed countries over the 1991–2014 period; according to their estimates, the average maturity of long-term debt raised by nonfinancial corporations from the 9 European countries included in our study is 6.0 years.[3] We therefore set $a=0.17$ (i.e., one-sixth roll over) to compute d_L^C. Using alternative values for a (e.g., 0.1) leads to results that are fully consistent with those presented in Section IV. The share of long-term corporate debt issued (l^C) is then computed as in equation (5):

$$l^C = \frac{d_L^C}{d_L^C + d_S^C}. \tag{5}$$

2. Firm-Level Control Variables

We include in our analyses a series of firm-level control variables that have been found in the literature to significantly influence corporate debt maturity choices (see, e.g., Barclay and Smith (1995), Berger, Espinosa-Vega, Frame, and

[3]We are grateful to the authors of Cortina et al. (2018) for providing us with this piece of information.

Miller (2005), Billett, King, and Mauer (2007), Demirgüç-Kunt and Maksimovic (1999), Fan, Titman, and Twite (2012), Guedes and Opler (1996), Johnson (2003), and Stohs and Mauer (1996)). Definitions of each firm-level control variable and their descriptive statistics are reported in Table 3. For all continuous variables based on Worldscope data, observations that are characterized by suspicious extreme values, as defined by the World Bank (2006), are treated as missing. As is customary, we winsorize these control variables at the 1st and 99th percentiles to further reduce the impact of potential outliers.

TABLE 3
Descriptive Statistics, Firm-Year Panel Data Set

Table 3 presents summary statistics for the variables included in the firm-level data set. Panel A includes variables relative to the share of level (L) and issues (I) of government and corporate long-term debt. Debt is defined as long term if its maturity is longer than 1 year. The superscript GOV refers to the debt of the government of the firm's country; EU refers to the value-weighted government debt of the other 8 European countries considered; C refers to corporate debt (measured at the firm level using Worldscope data). L^C is the ratio between long-term debt (D_L^C, Worldscope item 03251) and total debt (03255) outstanding. I^C is the ratio between d_L^C and the sum of d_L^C and short-term debt (03051), where d_L^C is computed for firm u in year t as $(D_{L,u,t}^C - D_{L,u,t-1}^C) + 0.17 \times D_{L,u,t-1}^C$. Panel B includes macro control variables. EMU is an indicator equal to 1 from 1999 on, and 0 otherwise. y_S is the nominal 1-year yield of the government debt (ISN); $y_L - y_S$ is the difference between 10-year (ILN) and 1-year yields (from the European Central Bank (ECB)). Panel C includes firm-level control variables. LNTA is the natural logarithm of the firm's total assets (02999), expressed in thousands of euros. LEVERAGE is the ratio between total liabilities (03351) and total assets. TOBIN_Q is the ratio between M and total assets, where M is equal to market capitalization (08001) plus total assets minus the book value of equity (03051) and deferred taxes (03263). MARGIN is the ratio of earnings before interest and taxes (EBIT) (18191) over revenues (01001). ASSET_MATURITY is expressed in years and is computed as the ratio between property, plant, and equipment (02501) over depreciation and amortization (01151). All firm-level variables (unless otherwise stated) are expressed in percentage points.

Variable	N	Mean	Std. Dev.	P25	P50	P75
Panel A. Government and Corporate Debt Maturity						
L^{EU}	29,524	88.65	4.64	86.91	90.31	91.95
L^{GOV}	29,524	90.62	7.57	87.66	90.99	96.20
L^C	29,524	59.71	30.99	39.13	66.22	84.95
I^C	29,524	54.22	36.80	19.67	53.06	98.10
Panel B. Government Controls						
EMU	29,524	0.72	0.45	0.00	1.00	1.00
y_S	29,524	1.19	1.25	0.68	1.22	1.93
$y_L - y_S$	29,524	3.78	3.01	2.11	3.30	4.39
Panel C. Firm Controls						
LNTA	29,524	12.43	2.25	10.84	12.25	13.92
LEVERAGE	29,459	61.83	22.70	48.84	62.63	74.76
TOBIN_Q	26,436	1.53	1.10	1.01	1.21	1.62
MARGIN	27,991	6.84	18.92	2.22	6.08	11.30
ASSET_MATURITY	29,194	8.23	72.73	2.70	4.93	7.83

IV. Empirical Results

In this section, we present our empirical results. In Section IV.A, we address the general relation between corporate debt maturity and the maturity of government debt issued by domestic and other European governments. Section IV.B illustrates the differences between the pre-EMU and EMU periods. Section IV.C focuses on the moderating role of the relative size of each country. Finally, Section IV.D addresses the differences in the gap-filling behavior of firms characterized by different degrees of financial constraints.

A. Government and Corporate Debt Maturity

In this section, we present analyses testing our main prediction (Prediction 1) that European firms also exhibit gap-filling behavior in response to shocks in government debt maturity occurring in other European countries as a whole. Empirically, Prediction 1 translates into a predicted negative coefficient for L^{EU}. Models are estimated using both the country-level data set, where corporate debt maturity is measured using aggregated ECB data, and the firm-level data set.

The gap-filling theory aims to explain variations in corporate debt maturity over time, rather than cross-sectional differences at one point in time. To estimate this "within" effect, models 1–5 in Table 4 include fixed effects (FEs) at the firm level or country level, depending on the data set used. The resulting estimated coefficients thus reflect the average change in corporate debt maturity associated with a change in government debt maturity over time.

For both country-level (models 1 and 2 of Table 4) and firm-level (models 3–5) analyses, we consider models for the share of long-term corporate debt issued (models 1, 3, and 4) and outstanding (models 2 and 5). As already discussed in Sections I and III, country-level corporate debt data could reflect changes in the identity of firms raising debt capital, and firms more realistically adopt a partial adjustment mechanism to changes in the maturity of government debt. As such, our preferred models for inference are those for the share of long-term corporate debt issued estimated using firm-level data (i.e., models 3 and 4). Finally, as a robustness check, we also estimate a system generalized method of moments

TABLE 4

The Maturity of Corporate and Government Debt

Table 4 presents estimates for a model of the share of corporate long-term debt. Models 1 and 2 are estimated on the country-year panel data set and include country-level fixed effects (FEs). Models 3–5 are estimated on the firm-year panel data set and include firm-level FEs. Model 6 is a system generalized method of moments (GMM) model estimated on the firm-year panel data set. The dependent variable is I^{C-ECB} for model 1; L^{C-ECB} for model 2; I^{C} for models 3, 4, and 6; and L^{C} for model 5. LAG_1 and LAG_2 are the 1-year and 2-year lags of the dependent variable, respectively. All other variables are as defined in Tables 1 and 3. $b^{EU} - b^{GOV}$ is the difference between the estimated coefficients for L^{EU} and L^{GOV}. Prediction 1 predicts that b^{EU} is negative. Standard errors robust to heteroscedasticity are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Panel A. Country Level		*Panel B. Firm Level*			
	FE Issue	FE Level	FE Issue	FE Issue	FE Level	System GMM Issue
Variable	1	2	3	4	5	6
L^{EU}	−1.027**	−0.432	−1.116***	−1.200***	−0.665***	−0.583***
	(0.454)	(0.273)	(0.100)	(0.107)	(0.086)	(0.116)
L^{GOV}	0.158	0.035	−0.290***	−0.367***	−0.061	−0.294***
	(0.180)	(0.108)	(0.057)	(0.062)	(0.048)	(0.060)
$y_L - y_S$	−0.010	−0.592	−1.740***	−1.845***	−0.882***	−0.066
	(1.123)	(0.674)	(0.328)	(0.353)	(0.270)	(0.370)
y_S	0.276	−0.937*	−3.075***	−3.170***	−0.865***	−1.463***
	(0.802)	(0.481)	(0.219)	(0.236)	(0.192)	(0.257)
EMU	0.889	−6.673***	6.568***	7.527***	1.998**	5.508***
	(4.047)	(2.430)	(0.934)	(1.009)	(0.819)	(1.274)
LNTA			4.187***	4.870***	3.981***	−1.698***
			(0.526)	(0.637)	(0.563)	(0.528)
Other firm controls	No	No	No	Yes	Yes	Yes
LAG_1 and LAG_2	No	No	No	No	No	Yes
$b^{EU} - b^{GOV}$	−1.185**	−0.467	−0.826***	−0.833***	−0.604***	−0.289**
	(0.482)	(0.289)	(0.123)	(0.131)	(0.105)	(0.131)
No. of obs.	225	225	29,524	25,103	25,103	11,155
No. of countries	9	9	9	9	9	9
No. of firms			4,252	3,826	3,826	2,636

(GMM) model (Blundell and Bond (1998)) for the share of corporate debt issued (model 6); all the explanatory variables, with the exception of EMU, are treated as (potentially) endogenous. Model 6 is estimated for the firm-level data set and includes 1- and 2-year lags (LAG_1 and LAG_2) of the dependent variable.[4]

All models include as control variables the level of short-term interest rates (y_S), the difference between long- and short-term interest rates ($y_L - y_S$), and an indicator for the EMU period. Model 3 includes LNTA (natural logarithm of firm's total assets) as the only firm-level control variable; Models 4–6 also include the additional firm-level control variables included in Panel C of Table 3.

All four regressions on firm-level data produce strong empirical evidence in support of our main prediction. The estimated coefficient for L^{EU} (b^{EU}) is always negative and highly statistically significant, with t-statistics ranging between approximately 5.0 and 11.2. In addition to statistical significance, the estimated effects are also economically relevant. A 1-percentage-point increase over time in the share of long-term government debt outstanding in the rest of Europe is associated with a decrease in the share of long-term corporate debt outstanding of approximately 0.67 percentage points on average; the estimated decrease in the share of long-term corporate debt issued is approximately 1.20 percentage points according to estimates for model 4. Estimated coefficients for L^{EU} are very similar in magnitude for models estimated using the country-level data set, albeit less statistically significant (t-statistics are 1.6 for the level model and 2.3 for the issue model).

Evidence on the role of changes in the share of long-term domestic government debt is more mixed. Estimated coefficients for L^{GOV} (b^{GOV}) are negative, as expected, for models based on-firm level data; they are also statistically significant at the 1% confidence level for issue models. The coefficients are not statistically significant at customary confidence levels for the remaining models; they are even positive, albeit small, for models estimated on country-level data.

Together, b^{EU} and b^{GOV} point toward a predominant role of shocks in government debt maturity occurring in the rest of Europe as a whole in explaining changes in corporate debt maturity over time. As discussed in Section II, over the whole sample, the difference between the marginal effects of L^{EU} and L^{GOV} can be positive or negative: The domestic country is relatively small, but domestic and nondomestic short-term interest rates are less than perfectly correlated before the EMU. Looking at coefficient estimates for our preferred models (models 3 and 4), the difference between b^{EU} and b^{GOV} is negative and significant at the 1% confidence level. A consistent result is obtained with a system GMM model. This finding implies that, on average, a change in the share of long-term government debt outside the domestic country over time has a larger impact on corporate behavior than an equal change in the share of long-term domestic government debt. We address in Sections IV.B and IV.C how the level of market integration and size moderate the difference between the two marginal effects.

[4]To limit instrument proliferation, we set the maximum number of lags used as GMM-type instruments to 2. Very similar results are obtained when all the usable lags are included as instruments. The choice of the number of lags of the dependent variable is based on the results of an Arellano–Bond test. In unreported analyses, we also estimate system GMM models for all the subsamples described in Tables 5–8. The results are fully consistent with those presented in the article.

Table 4 also reports coefficient estimates for the basic control variables included in our models. The sign of coefficients is aligned with what has been found in previous studies. As in Greenwood et al. (2010), estimated coefficients for y_S and $y_L - y_S$ are generally negative. Estimated coefficients for additional firm-level control variables (omitted to save space) are almost always positive, a result largely consistent with findings reported in, among others, Billett et al. (2007), Stohs and Mauer (1996), and Fan et al. (2012).

B. Before versus Since the EMU

To address the difference between the years before and since the introduction of the EMU, we use two complementary approaches. First, we estimate models for the two samples separately. Observations since (before) 1999 are part of the (pre-) EMU sample. Empirically, Prediction 2 predicts i) a larger negative coefficient for L^{EU} for the EMU sample than for the pre-EMU sample and ii) a larger and strictly negative difference between the L^{EU} and L^{GOV} coefficients ($b^{\mathrm{EU}} - b^{\mathrm{GOV}}$) for the EMU sample compared with the pre-EMU sample. A larger negative $b^{\mathrm{EU}} - b^{\mathrm{GOV}}$ indicates a stronger negative effect of changes in the share of long-term nondomestic government debt maturity compared with a similar change in domestic government debt.

The second approach is to estimate models including interaction terms between L^{EU} and EMU and L^{GOV} and EMU. In this case, Prediction 2 translates into an expected negative coefficient for $L^{\mathrm{EU}} \times$ EMU and a negative difference between the coefficients of the two interaction terms (i.e., the difference between the two marginal effects is larger when EMU = 1). Results for these two approaches are presented in Table 5.[5]

Columns i and ii of Table 5 present estimated coefficients for the models of the share of long-term corporate debt issued estimated for each period separately. Column iii presents the difference in the estimated coefficients between the two samples. All estimates are highly supportive of Prediction 2. For otherwise-identical FE models, the estimated coefficient for L^{EU} is approximately 2.5 times larger for the EMU sample than for the pre-EMU sample. The difference between the two coefficients is statistically significant at the 1% confidence level. Conversely, the estimated coefficient of L^{GOV} is smaller in the EMU sample compared with the pre-EMU sample, albeit the difference (0.007) is not statistically significant at customary confidence levels. As a result, the difference between b^{EU} and b^{GOV} is almost 4 times larger for the EMU sample. $b^{\mathrm{EU}} - b^{\mathrm{GOV}}$ is highly statistically significant for the EMU sample (t-statistic of approximately 5), whereas it is not statistically significant at customary confidence levels for the pre-EMU sample. The difference in $b^{\mathrm{EU}} - b^{\mathrm{GOV}}$ between the two samples is approximately 0.8 percentage points (in absolute terms), and it is statistically significant at the 1% confidence level.

Fully consistent results are obtained for the model including interaction terms between L^{GOV} and EMU and L^{EU} and EMU, presented in columns iv–vi

[5]The presented models are estimated including all control variables. Excluding other firm controls does not materially affect the results. Estimating models including only one of the two interaction terms leads to virtually identical estimated coefficients for the interaction term included.

TABLE 5
Moderating Role of the EMU

Table 5 presents estimates for a model of the share of long-term corporate debt. The dependent variable is l^C. Models 1-i and 1-ii are estimated for samples before and since 1999, the year the Economic and Monetary Union (EMU) was effectively introduced. Column iii reports the difference in the estimated coefficients for L^{EU} and L^{GOV} between the two samples. Model 2 is estimated for the whole sample and includes interaction terms between L^{EU} and EMU and L^{GOV} and EMU; the estimated coefficients for these two interaction terms are reported in column vi. Column v reports the estimated coefficient for L^{EU} and L^{GOV} when EMU = 1, computed for each of the two variables as the sum of the coefficients reported in columns iv and vi. $b^{EU} - b^{GOV}$ is the difference between the estimated coefficients for L^{EU} and L^{GOV}. Prediction 2 implies that $b^{EU} - b^{GOV}$ is larger (in absolute terms) when EMU = 1. All variables are as defined in previous tables. All models include firm-level fixed effects. Standard errors robust to heteroscedasticity and clustered by firm are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	1. Split Sample			2. Interaction		
	Pre-EMU	EMU	Difference	Pre-EMU	EMU	Difference
Variable	i	ii	iii	iv	v	vi
L^{EU}	−0.513** (0.212)	−1.313*** (0.181)	−0.800*** (0.279)	−1.071*** (0.140)	−1.598*** (0.172)	−0.527*** (0.203)
L^{GOV}	−0.245* (0.133)	−0.238*** (0.091)	0.007 (0.161)	−0.366*** (0.078)	−0.215** (0.088)	0.151 (0.105)
$y_L - y_S$	−1.205** (0.489)	−2.113*** (0.504)		−1.917*** (0.361)		
y_S	−1.869*** (0.453)	−3.687*** (0.344)		−3.138*** (0.264)		
EMU				40.901** (20.320)		
LNTA	0.796 (1.730)	6.481*** (0.822)		4.884*** (0.638)		
Other firm controls	Yes	Yes		Yes		
$b^{EU} - b^{GOV}$	−0.269 (0.224)	−1.075*** (0.240)	−0.807** (0.328)	−0.705*** (0.142)	−1.383*** (0.227)	−0.678*** (0.232)
No. of obs.	6,767	18,336		25,103		
No. of firms	2,031	3,178		3,826		

of Table 5. Column iv reports the estimated coefficients for the baseline model. The estimated coefficients for the two interaction terms are reported in column vi. The estimated marginal effects when EMU = 1 are reported in column v. The latter values are computed as the sum of the estimated coefficients for L^{EU} and $L^{EU} \times$ EMU and the sum of the estimated coefficients for L^{GOV} and $L^{GOV} \times$ EMU.

As predicted, the coefficient for $L^{EU} \times$ EMU is negative and statistically significant at the 1% confidence level. Compared with the baseline case (i.e., EMU = 0), when EMU = 1, an increase in the share of long-term nondomestic government debt by 1 percentage point over time is associated with an additional reduction of approximately one-half of a percentage point on average in the share of long-term corporate debt issued. Instead, the estimated coefficient for $L^{GOV} \times$ EMU is positive, indicating a weaker marginal effect of changes in the maturity of domestic government debt since the introduction of the EMU. As a result, the difference between the estimated marginal effects of a 1-percentage-point change in the maturity of domestic versus nondomestic government debt is significantly (at the 1% confidence level) larger when EMU = 1.

In summary, with the introduction of the monetary union, i) the influence on corporate debt maturity of changes in government debt maturity occurring in the rest of Europe as a whole has increased, ii) the influence of changes in the maturity of domestic government debt has (slightly) decreased, and iii) the difference between the two effects has also increased as result. The introduction of the monetary union has thus hampered the relative impact of the debt maturity choices made by individual governments on the maturity of debt issued by their domestic companies.

C. Moderating Role of Size

In this section, we discuss the results of analyses testing Predictions 3 and 4. Prediction 3 states that the magnitude of the effect of changes in the share of long-term government debt should increase with the relative size of the country in which the change occurs. Empirically, we expect the negative coefficients for L^{GOV} and L^{EU} to be respectively larger and smaller for firms located in countries with relatively larger domestic government debt. As done for the analyses on the moderating role of the EMU, we test Prediction 3 using two complementary approaches. First, we estimate models for the share of long-term corporate debt issued for two samples based on the relative size of the domestic country (RS). Each observation is assigned to the "small" ("large") sample if it is characterized by a value of RS below (above) the sample median for the same year. Computing threshold median values at the year level ensures that the proportion of pre-EMU and EMU observations in each subsample is the same as that in the whole sample. Second, we estimate a model including interaction terms between L^{EU} and LARGE and between L^{GOV} and LARGE, where LARGE is an indicator equal to 1 for observations included in the large sample and equal to 0 for observations included in the small sample. Results are reported in Table 6.

Regardless of the approach used, the negative coefficient for L^{GOV} is noticeably smaller when LARGE = 0; the difference in the estimated marginal effect of L^{GOV} for small versus large countries is statistically significant at the 1% confidence level. The opposite is true for L^{EU}: The estimated coefficient is 0.4–0.8 percentage points larger (in absolute terms) for small domestic countries. The difference is also statistically significant at the 1% confidence level when the model including interaction terms is considered.

As a result, $b^{\mathrm{EU}} - b^{\mathrm{GOV}}$ is large and highly statistically significant (t-statistics of approximately 6.5–8.5) only for small countries. For large countries, the difference is not statistically significant at customary confidence levels, suggesting a similar marginal effect of changes in domestic and nondomestic government debt maturity. The relative size of domestic and nondomestic government debt therefore appears to significantly moderate the difference between b^{EU} and b^{GOV}.

Is the magnitude of this moderating effect of size consistent with our model? Prediction 4 says that once a common currency and monetary policy are adopted, the share of long-term domestic government debt matters only to the extent to which it contributes to the general share at the EMU level. Before the monetary union, the relative effect of changes in the maturity of nondomestic government debt is instead expected to be smoothed due to less-than-perfect correlation in short-term interest rates. Operationalizing this prediction, we expect that $\bar{\omega} b^{\mathrm{EU}} - b^{\mathrm{GOV}} = 0$ when EMU = 1 and $\bar{\omega} b^{\mathrm{EU}} - b^{\mathrm{GOV}} > 0$ when EMU = 0, where $\bar{\omega}$ is a parameter set equal to the sample average of RS expressed in decimals. Positive values of $\bar{\omega} b^{\mathrm{EU}} - b^{\mathrm{GOV}}$ indicate that the negative coefficient of L^{GOV} is relatively large compared with the coefficient of L^{EU} once differences in size are taken into account.

TABLE 6

Disaggregated Results by Country Size

Table 6 presents estimates for models of the share of corporate long-term debt issued. The dependent variable is I^C. Models 1-i and 1-ii are estimated, respectively, including only observations characterized by a value of RS (the relative size of a country's government debt compared to that of the other 8 countries) below (small) or above (large) the sample median for the same year. Model 2 is estimated for the whole sample and includes interaction terms between L^{EU} and LARGE and L^{GOV} and LARGE, where LARGE is an indicator equal to 1 for observations included in the large sample and equal to 0 for observations included in the small sample. Estimated coefficients for these two interaction terms are reported in column vi. Column v reports the estimated coefficient for L^{EU} and L^{GOV} when LARGE = 1, computed for each of the two variables as the sum of the coefficients reported in columns iv and vi. $b^{EU} - b^{GOV}$ is the difference between the estimated coefficients for L^{EU} and L^{GOV}. Prediction 3 predicts that b^{EU} and b^{GOV} are smaller and larger (in absolute terms), respectively, for the large sample and that, accordingly, $b^{EU} - b^{GOV}$ is larger (in absolute terms) for the small sample. All variables are as defined in previous tables. All models include firm-level fixed effects. Standard errors robust to heteroscedasticity and clustered by firm are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	1. Split Sample			2. Interaction		
	Small	Large	Difference	Small	Large	Difference
Variable	i	ii	iii	iv	v	vi
L^{EU}	−1.605***	−1.216***	0.389	−1.897***	−1.113***	0.784***
	(0.196)	(0.144)	(0.244)	(0.171)	(0.130)	(0.183)
L^{GOV}	−0.146**	−1.522***	−1.376***	−0.188**	−1.345***	−1.158***
	(0.074)	(0.146)	(0.164)	(0.074)	(0.145)	(0.162)
$y_L - y_S$	0.184	−4.945***		−1.961***		
	(0.512)	(0.569)		(0.394)		
y_S	−2.069***	−5.186***		−3.456***		
	(0.355)	(0.372)		(0.264)		
EMU	10.607***	6.142***		9.471***		
	(1.680)	(1.657)		(1.185)		
LNTA	6.380***	3.345***		4.762***		
	(1.071)	(1.067)		(0.753)		
Other firm controls	Yes	Yes		Yes		
$b^{EU} - b^{GOV}$	−1.459***	0.306	1.765***	−1.709***	0.232	1.942***
	(0.222)	(0.207)	(0.294)	(0.202)	(0.203)	(0.273)
No. of obs.	7,905	9,382		17,287		
No. of firms	1,129	1,800		2,929		

To test Prediction 4, we compute $\bar{\omega} b^{EU} - b^{GOV}$ conditional on EMU = 0 or EMU = 1 based on coefficient estimates for the models presented in Table 5. Table 7 reports for each period and model the estimated value of $\bar{\omega} b^{EU} - b^{GOV}$ and the sample values for $\bar{\omega}$.

The results are generally aligned with Prediction 4. With both approaches, a t-test does not reject the null hypothesis that $\bar{\omega} b^{EU} - b^{GOV} = 0$ when EMU = 1.

TABLE 7

Difference in Marginal Effects, Country Size, and EMU

Table 7 presents a series of t-tests for $\bar{\omega} b^{EU} - b^{GOV} = 0$ based on coefficients and standard error estimates for models 1 and 2 of Table 5. Prediction 4 implies that $\bar{\omega} b^{EU} - b^{GOV} > 0$ for the pre-Economic and Monetary Union (EMU) period and $\bar{\omega} b^{EU} - b^{GOV} = 0$ for the EMU period, where $\bar{\omega}$ is a parameter set equal to the sample average of RS (the relative size of a country's government debt compared to that of the other 8 countries) expressed in decimals. Standard errors are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	1. Split Sample			2. Interaction		
	Pre-EMU	EMU	Difference	Pre-EMU	EMU	Difference
Variable	i	ii	iii	iv	v	vi
$\bar{\omega}$	0.179	0.216		0.179	0.216	
$\bar{\omega} b^{EU} - b^{GOV}$	0.153	−0.045	−0.198	0.175**	−0.130	−0.304***
	(0.130)	(0.116)	(0.174)	(0.076)	(0.111)	(0.116)

$\bar{\omega}b^{EU} - b^{GOV}$ is positive as expected when EMU = 0; it is also statistically significant at the 5% confidence level, at least when computed based on model 2 estimates (the difference in $\bar{\omega}b^{EU} - b^{GOV}$ between the two groups is also statistically significant at the 1% confidence level). Since the introduction of the monetary union, debt maturity choices operated by the domestic government can thus influence debt maturity choices by firms in that country only to the extent to which they contribute to the general supply of long- and short-term government debt in the EMU.

D. Moderating Role of Firm Characteristics

As a final test of gap-filling behavior in a multi-country setting, in this section we present the results of analyses investigating how firms characterized by different costs of deviating from their target debt maturity react to changes in domestic and nondomestic government debt maturity. Prediction 5 predicts that changes in government debt maturity occurring both at home and abroad have a stronger impact on the maturity of debt issued by less financially constrained firms.

As in Greenwood et al. (2010), firms are classified based on alternative proxies, each considered individually. We categorize firms based on market capitalization and on four other variables identified by Kaplan and Zingales (1997) as relevant proxies for a firm's level of financial constraints (low or high). Observations are included in the low sample if the firm pays dividends (DIV = 1), exhibits above-median values of market capitalization (LNMC) or cash flows over total assets (CFTA), or is characterized by below-median values of TOBIN_Q or LEVERAGE. The high sample is defined in a converse fashion. Threshold median values are computed at the country-year level. For each explanatory variable of interest (i.e., L^{EU} and L^{GOV}) and proxy used for categorization, Table 8 reports

TABLE 8

Disaggregated Results by Firm Characteristics

Table 8 presents estimates for models of the share of corporate long-term debt issued for subsamples based on firm characteristics. The dependent variable is I^C. Observations are classified based on the sample median of the following variables for a given country and year: market capitalization (LNMC), cash flow (Worldscope item 04201) over total assets (CFTA), TOBIN_Q, or LEVERAGE. Observations are included in the low sample if they are associated with above-median values for LNMC and CFTA and with below-median values for TOBIN_Q and LEVERAGE. The high sample is defined in the opposite fashion. Observations are also categorized according to whether the firm pays (DIV = 1, low sample) or does not pay dividends in a given year. All models include all control variables for model 4 of Table 4 and firm-level fixed effects. All variables are as defined in previous tables. For each model and sample, the table reports coefficient estimates for L^{EU} and L^{GOV}. Differences between estimated coefficients for the two samples are also reported; Prediction 5 predicts larger negative coefficients for the low sample. Standard errors robust to heteroscedasticity and clustered by firm are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	L^{EU}			L^{GOV}		
	High	Low	Difference	High	Low	Difference
Classified by:						
DIV	−0.618***	−1.430***	−0.812***	0.056	−0.373***	−0.430***
	(0.226)	(0.127)	(0.259)	(0.124)	(0.073)	(0.144)
LNMC	−0.897***	−1.410***	−0.513**	−0.154	−0.526***	−0.372***
	(0.167)	(0.145)	(0.221)	(0.102)	(0.080)	(0.130)
CFTA	−1.189***	−1.232***	−0.043	−0.290***	−0.352***	−0.062
	(0.150)	(0.148)	(0.211)	(0.084)	(0.082)	(0.117)
TOBIN_Q	−1.017***	−1.408***	−0.391*	−0.313***	−0.400***	−0.088
	(0.159)	(0.152)	(0.220)	(0.090)	(0.093)	(0.129)
LEVERAGE	−1.282***	−1.082***	0.199	−0.278***	−0.307***	−0.029
	(0.148)	(0.163)	(0.221)	(0.077)	(0.095)	(0.123)

the estimated coefficient for the low sample, the estimated coefficient for the high sample, and the difference between the two. Empirically, Prediction 5 predicts larger negative values of b^{EU} and b^{GOV} for the low sample.

The results are generally in line with our prediction. With the exception of b^{EU} for samples based on LEVERAGE, both b^{EU} and b^{GOV} are larger (in absolute terms) for the low sample. The differences in estimated coefficients between the two samples are statistically significant at least at the 5% confidence level when observations are classified by DIV or by LNMC.

V. Conclusions

In this article, we study how European firms adjust their debt maturity structure in response to a change in the maturity of government debt. Building on the gap-filling theory proposed by Greenwood et al. (2010), we argue and demonstrate empirically that in a multi-country setting such as the European one, supply shocks in the long-term debt issued by both domestic and other European governments as a whole will affect corporate debt maturity choices. With short-term interest rates across countries (almost) perfectly correlated, such as is the case within the EMU, the role of each domestic government's debt is at best proportional to its (relatively small) size.

Government debt management policies do not have nudging corporate financing decisions among their explicit goals (Greenwood et al. (2015)). European debt management agencies are independent from treasuries, and their mandate is simply to minimize the government's cost of debt financing while keeping roll-over risk under control (Wolswijk and De Haan (2005)). However, the empirical evidence of gap-filling behavior presented in this and related studies (Greenwood et al. (2010), Badoer and James (2016)) shows that government debt management could be considered an effective policy tool to increase corporate debt maturity, and therefore financial stability, because roll-over risk in the private sector is significantly reduced. Although it is not an explicit goal, debt management agencies may therefore want to take these externalities in the private sector into account.

Our findings suggest that the individual government's ability to influence corporate financing decisions could be hampered by the decisions undertaken by governments in other European countries. This is all the more relevant because in some European countries, the maturity of corporate debt has become a main point of concern since the advent of the crisis. For example, the International Monetary Fund (2013) mentions the increase in the share of short-term debt issued by Italian firms as a key factor of financial instability in the country. A coordinated European policy on government debt management could encourage a more resilient recovery by favoring long-term financing for private firms.

Appendix. Two-Country Model of Gap-Filling Behavior

In this Appendix, we present a detailed, formal description of our simple two-country model discussed in Section II. The description culminates in a set of observations underpinning the predictions tested in this study.

1. Countries, Periods, and Interest Rates

There are three periods of time (labeled as 0, 1, and 2) and two countries, indicated by d and e. From the point of view of country d, country e can be considered to represent the rest of the EMU. The short-term interest rate from time 0 to 1 (r_1) is known at time 0, and for simplicity, it is set to be equal in d and e (i.e., $r_1^d = r_1^e = r_1$). The short-term interest rates from 1 to 2 in d (r_2^d) and in e (r_2^e) follow a multivariate normal distribution with mean $\mathrm{E}[r_2]$, variance σ^2, and correlation ρ. In each country, there is also a long-run zero-coupon bond maturing at time 2. A time 0, the price of the long-term bond traded in country d (e) is P_d (P_e). P_d and P_e are determined endogenously.

2. Preferred-Habitat Investors, Arbitrageurs, and Governments

Akin to Greenwood et al. (2010), Vayanos and Vila (2009), and Greenwood and Vayanos (2014), among others, we begin by considering three types of agents: preferred-habitat investors, governments, and arbitrageurs. Preferred-habitat investors demand a fixed (i.e., not depending on prevailing interest rates) amount of long-term bonds issued in country i (L_i), where i is equal to either d or e. The government of each country i exogenously decides to issue a quantity G_i of sovereign long-term bonds. The difference between G_i and L_i, g_i represents the excess supply of long-term government bonds in country i.

Arbitrageurs are investors with no initial wealth endowment. They can operate in both countries with no boundaries. At time 0, they buy in each market i a euro amount h_i of long-term bonds by borrowing at short-term rates. When $h_i < 0$, they borrow at long-term rates and invest in short-term securities. At time 2, the wealth of the arbitrageurs (w) is equal to

$$\text{(A-1)} \qquad w = h_d[P_d^{-1} - (1+r_1)(1+r_2^d)] + h_e[P_e^{-1} - (1+r_1)(1+r_2^e)].$$

The arbitrageurs maximize a mean-variance problem of the form $\mathrm{E}[w] - (2\gamma)^{-1}\sigma_w^2$, where σ_w^2 is the variance in w, and γ indicates their risk tolerance. Therefore, in each market i, the optimal demand for long-term bonds by the arbitrageurs is given by

$$\text{(A-2)} \qquad h_i^*(P_i) = \frac{[P_i^{-1} - (1+r_1)(1+\mathrm{E}[r_2])] - \gamma^{-1}(1+r_1)^2\sigma^2\rho h_j}{\gamma^{-1}(1+r_1)^2\sigma^2},$$

where $j = e$ when $i = d$, and vice versa. With no firms, the clearing conditions for the two markets are $h_d = g_d$ and $h_e = g_e$. In the domestic country d, this situation implies

$$\text{(A-3)} \qquad I_d \equiv [P_d^{-1} - (1+r_1)(1+\mathrm{E}[r_2])] = [\gamma^{-1}(1+r_1)^2\sigma^2](g_d + \rho g_e).$$

A positive (negative) shock in the level of long-term government bonds thus translates into an expected increase in the return premium (discount) for long-term bonds. The relative influence of g_e over g_d on this premium (or discount) is moderated by ρ. When $\rho = 0$, the marginal effect of g_e is null, and equation (A-3) simplifies into the one illustrated by Greenwood et al. (2010). When $\rho = 1$, the effect of a given shock (in euro amount) in the level of long-term government bonds in country d does not depend on where (d or e) the shock originates. The transmission channel from g_e to P_d^{-1} is the rebalancing activity of the arbitrageurs. When a positive shock g_e occurs in country e, arbitrageurs increase their exposure h_e in said country. Because they are risk averse and $\rho > 0$, they contextually reduce their exposure in d (h_d), leading to an increase in I_d. As shown in the following discussion, this situation leads to gap-filling behavior among companies in country d.

3. Including Firms

Firms from country i need to borrow an exogenous euro amount C_i. Over two periods, they face a cost of long-term financing equal to P_i^{-1} and an (expected) cost of short-term financing equal to $(1+r_1)(1+\mathrm{E}[r_2])$. Note that, similar to Greenwood et al. (2010), we implicitly assume here that corporate and government bonds with similar maturities can be treated as substitutes. For a more realistic model of partially segmented markets, see Greenwood, Hanson, and Liao (2018). Firms raise a fraction f_i of capital by issuing long-term bonds and a fraction $(1-f_i)$ by borrowing at short-term rates. Their target fraction of long-term debt over total debt is z; they face quadratic costs of deviating from this optimal capital structure of the form $\theta C_i(f-z)^2/2$, where θ can be seen as representing the financial strength of the firm. For simplicity, parameters z and θ are assumed to be the same for representative firms based in different countries. Companies aim at minimizing their costs of financing; those costs also include the cost of deviating from their optimal capital structure z. The optimal fraction f_i of long-term borrowing for firms in country i is given by

$$\text{(A-4)} \qquad f_i^*(P_i) = \left[z - \frac{P_i^{-1} - (1+r_1)(1+\mathrm{E}[r_2])}{\theta}\right].$$

In the presence of firms, the clearing conditions for markets d and e are $h_d = g_d + f_d C_d$ and $h_e = g_e + f_e C_e$, respectively. Given the optimal responses in the two markets by arbitrageurs and firms as expressed in equations (A-2) and (A-4), it can be shown that the optimal fraction of long-term debt over total debt for firms in country d is given by

$$\begin{aligned} f_d^* = {} & \frac{(1+r_1)^2\sigma^2\gamma\theta C_e z(1-\rho) + \gamma^2\theta^2 z}{\sigma^4(1+r_1)^4 C_d C_e(1-\rho^2) + \gamma^2\theta^2 + (1+r_1)^2\gamma\theta\sigma^2(C_d+C_e)} \\ & - \frac{[\sigma^2(1+r_1)^2\gamma\theta + \sigma^4(1+r_1)^4 C_e(1-\rho^2)]g_d}{\sigma^4(1+r_1)^4 C_d C_e(1-\rho^2) + \gamma^2\theta^2 + (1+r_1)^2\gamma\theta\sigma^2(C_d+C_e)} \\ & - \frac{[\sigma^2(1+r_1)^2\gamma\theta\rho]g_e}{\sigma^4(1+r_1)^4 C_d C_e(1-\rho^2) + \gamma^2\theta^2 + (1+r_1)^2\gamma\theta\sigma^2(C_d+C_e)}. \end{aligned}$$

As explained by Greenwood et al. (2010), gap filling is a "euro-by-euro" phenomenon; that is, the size in euros of corporate and government debt affects how aggressively firms adjust their debt maturity structure in response to shocks in the maturity of government debt. To better address the effect of size, without any loss of generality, we now express the long-term government debt shocks in euro amounts for each country i as a fraction $g_i^{\%}$ of the total government debt (T_i) (i.e., $g_i = g_i^{\%} T_i$). Because $g_i = G_i - L_i$, we have that $g_i^{\%} = G_i/T_i - L_i/T_i$; that is, $g_i^{\%}$ is equal to the share of long-term debt over total government debt (minus a constant term). We define the total government debt in country e as $T_e = T$. The total debt in d can be stated as a fraction ω of T_e; that is, $T_d = \omega T_e = \omega T$, where $0 < \omega < 1$ because we assume country d to be small compared with country e. We can also restate the borrowing needs of firms in country i as a fraction of the government's borrowing needs. For simplicity, we assume that this fraction λ is the same in d and e, such that $C_d = \lambda T_d = \lambda\omega T$ and $C_e = \lambda T$. The marginal effects of $g_d^{\%}$ and $g_e^{\%}$ on f_d^* can thus be expressed as

$$\text{(A-5)} \qquad \beta_d = \frac{\partial f_d^*}{\partial g_d^{\%}} = \frac{-\omega[\theta A + (1-\rho^2)B]}{\omega(1-\rho^2)\lambda B + (1+\omega)\lambda\theta A + \gamma^2\theta^2},$$

$$\text{(A-6)} \qquad \beta_e = \frac{\partial f_d^*}{\partial g_e^{\%}} = \frac{-\rho\theta A}{\omega(1-\rho^2)\lambda B + (1+\omega)\lambda\theta A + \gamma^2\theta^2},$$

where $A = T\sigma^2(1+r_1)^2\gamma$, and $B = \lambda T^2\sigma^4(1+r_1)^4$. Excluding cases where parameters assume extreme values, A and B are both strictly positive. The difference between β_d and β_e is given by

$$\text{(A-7)} \qquad \Delta = \frac{-\omega[\theta A + (1-\rho^2)B] + \rho\theta A}{\omega(1-\rho^2)\lambda B + (1+\omega)\lambda\theta A + \gamma^2\theta^2}.$$

Positive values of Δ indicate that the (negative) marginal effect of $g_e^{\%}$ is stronger than the marginal effect of $g_d^{\%}$. The sign of Δ depends on the values assumed by the various parameters, albeit it can be expected to be positive in general.[6] More precise expectations can be formulated once we impose $\rho=1$. In what follows, we state the main first- and second-order effects determined by equations (A-5)–(A-7) that constitute the theoretical underpinning of our predictions presented in Section II of the main text.

Observation 1. $\beta_d<0$ and $\beta_e<0$. Unless $\rho=0$, companies in country d tilt their debt structure toward short-term debt in response to positive shocks in the amount of long-term government debt issued in both d and e (and vice versa).

Observation 2. $\partial\beta_e/\partial\rho<0$, $\partial\beta_d/\partial\rho>0$, and $\partial\Delta/\partial\rho>0$. Ceteris paribus, a higher level of correlation among short-term interest rates is associated with a stronger (negative) marginal effect of $g_e^{\%}$ and a weaker negative marginal effect of $g_d^{\%}$. The (positive) difference between the marginal effect of $g_e^{\%}$ and $g_d^{\%}$ also widens with the increase in ρ.

Observation 3. $\partial\beta_d/\partial\omega<0$. This observation is always true as long as $\lambda<1$. The assumption is realistic: Using ECB aggregated data for EU-19 countries, the average proportion of corporate (nonfinancials) over government debt outstanding over the year considered is 0.12, with a maximum of 0.15. Ceteris paribus, the magnitude of β_d increases with the (relative) size of country d.

Observation 4. $\partial\beta_e/\partial\omega>0$. This observation is simply the equivalent of Observation 3 for country e. The (negative) marginal effect of $g_e^{\%}$ becomes relatively small when country d becomes relatively large compared with country e.

Observation 5. $\rho\rightarrow1\Rightarrow\beta_d-\omega\beta_e\rightarrow0$. With less-than-perfectly correlated markets, the relative effect of domestic shocks versus foreign shocks can be more than proportional to their size. With perfectly (positively) correlated short-term interest rates, shocks in the domestic market contribute only to the total effect proportionally to their relative size.

Observation 6. $\partial\beta_d/\partial\theta>0$; $\partial\beta_e/\partial\theta>0$ *if* $\rho>\sqrt{(\lambda\omega B-\gamma^2\theta^2)/(\lambda\omega B)}$. Firms facing a lower cost of deviating from their optimal debt maturity structure (lower θ) react more aggressively to shocks occurring in their domestic markets. When correlation among short-term interest rates ρ is sufficiently high, more flexible firms also react more aggressively to shocks occurring in foreign markets. With reasonable parameter values, the condition is met for any positive value of ρ; it is surely met for $\rho=1$.

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[6]For example, with $\rho=0.8$, $\gamma=5$, $\theta=2$, $\lambda=0.12$, and $T=3$, ω should be as high as 0.79 to have a negative Δ.

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