Mispricing of debt expansion in the eurozone sovereign credit market

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Abstract

We find evidence consistent with risk mispricing in the eurozone sovereign credit market for crisis and non-crisis countries alike, using a novel variable of sovereign debt expansion (DE) that we construct. DE predicts increased default probability, but panel regressions from 2002 to 2017 show a negative association with risk premia, even when controlling for risk appetite and the known determinants of sovereign risk premia. As expected, the negative association was only briefly interrupted by the 2010 Deauville Summit, but it resumed by the onset of the 2011 eurozone crisis. The introduction of quantitative easing in 2015 mutes the negative association, raising the concern of what will happen once quantitative easing ends. Our finding is robust to several model specifications.

Keywords: CDS, debt expansion, quantitative easing, risk premia, sovereign debt.

JEL Classification: E52, E58, G41, H30, H63.

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1 Introduction

The eurozone sovereign debt crisis of 2011 provides an episode whereby the mispricing of risk destabilized several European economies (Aizenman et al., 2013; Beirne and Fratzscher, 2013). In this paper, we identify a new mispricing channel, namely sovereign debt expansion, which we document to be negatively associated with risk premia over extended periods, even if it predicts increased default probability. Interestingly, this mispricing is documented for crisis and non-crisis countries alike, contrary to the widely held belief that mispricing was of concern to crisis countries only, e.g., De Grauwe and Ji (2012).

We examine sovereign credit risk in a sample of nineteen eurozone sovereigns from January 2002 to December 2017. We define debt expansion (DE) as the positive inter-temporal change of sovereign debt-to-GDP ratio and identify it as a key variable predicting sovereign default risk after controlling for macroeconomic, government, external, and qualitative variables. The construction of this novel variable is motivated by the use of credit expansion by Baron and Xiong (2017) in their study of the mispricing of bank credit in several countries. We surmise that if creditors are mispricing credit expansion in the banking sector, then debt expansion on the borrowers' side is also expected to be mispriced, and we search for such mispricing in sovereigns that are one of the banks' major borrowers.[1] Bassanetti et al. (2018) document that debt dynamics, and not only debt level, is a determinant of sovereign distress, and the international institutional lenders (IMF, ESM) recognized recently that debt flow is a significant determinate of sovereign risk in addition to debt level (Gabriele et al., 2017). We find that sovereign DE predicts an increase in the sovereign probability of default (PD) in line with Bassanetti et al. Surprisingly, in contrast to finance theory, it does not predict an increase in risk premia. Instead, DE predicts a decrease in risk premia.

The negative relation between DE and risk premia is established, even after controlling for the inter-temporal variability of recovery rates that have been documented in both the

[1]Baron and Xiong (2017) assess the risk to banks from credit expansion through equity prices and find that these prices neglect the documented risk of credit expansion, whereas, in the case of sovereign borrowers, we assess the pricing of default risk through risk premia.

corporate (Jankowitsch et al., 2014) and sovereign bond (Sunder-Plassmann, 2018) markets and controlling for determinants of sovereign risk premia, such as market illiquidity and investor risk appetite. Implicit guarantees for sovereign default cannot fully explain the documented mispricing since the impact of such guarantees would still produce positive (or zero) risk premia. Furthermore, the mispricing would likely not be present in non-crisis countries. However, we document that negative risk premia are also present in non-crisis countries.

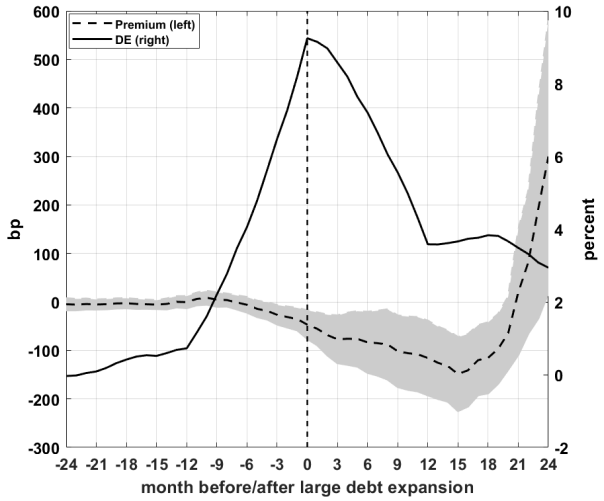
Behavioral reasons could help explain the documented mispricing of sovereign debt by our results, given the evidence against rational explanations provided above. We suggest what these behavioral explanations might be. Our findings are consistent with Baron and Xiong (2017), who document mispricing of credit expansion in bank equity in a sample of twenty developed economies spanning 1920–2012. According to Kindleberger (1978), extended periods of economic growth can nurture optimism, which in turn could lead to more borrowing and potentially disrupt the financial system, and Baron and Xiong (2017) mention three potential channels that can lead to Kindleberger's investor optimism and explain their documented mispricing (a) neglected tail risk (Gennaioli, Shleifer, and Vishny, 2012), (b) positive investor sentiment that builds even more optimistic expectations for the future (Barberis et al., 1998), and (c) a view that past crises cannot be a guide for the future, leading to the misguided expectation that "this time is different" (Reinhart and Rogoff, 2009). Like Baron and Xiong (2017) we do not take a position on the behavioral channel causing the mispricing; this requires investigating transactions at a more granular level. However, we advance Baron and Xiong (2017) in one important aspect. Sovereign risk commonly represents a ceiling for corporate risk (Almeida, Cunha, Ferreira, and Restrepo, 2017), and the mispricing documented by Baron and Xiong (2017) in the international bank equities market tells only part of the story. We show that mispricing is present at the higher (sovereign) level.

To motivate our analysis, we first estimate average sovereign risk premia around large

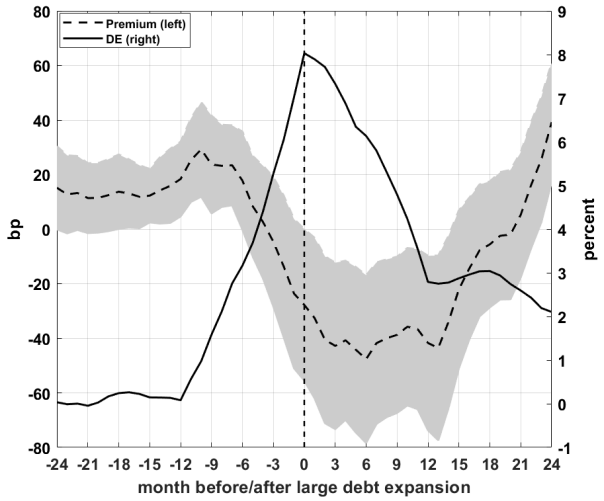
Figure 1: Risk premia and large debt expansion

The figure shows risk premia around large debt expansion (LDE) for the sample of eurozone countries in Panel A. Panel B shows the same relation but excluding the crisis countries (Cyprus, Greece, Ireland, Portugal, and Spain). Despite the increased potential risk due to sovereign debt expansion, risk premia go down and remain negative for 6–15 months.

(a) All eurozone countries



(b) Non-crisis countries



debt expansion (LDE) events, identified as the 95th percentile of historically observed DE. A sovereign risk premium is calculated as the difference between the credit default swap (CDS) spread and the expected loss from the potential default of the sovereign. In Figure 1, we plot the sovereign risk premium 24 months before and after LDE for all eurozone countries (Panel A) and the non-crisis countries (Panel B). We observe negative risk premia around LDE episodes, suggesting that CDS prices do not compensate for the expected loss.

Panel A shows a consistent reduction in average risk premia up to fifteen months following LDE. This result goes against the predictions of finance theory, where an increase in risk premia would be expected with increasing default risk to compensate investors. Moreover, risk premia are not only decreasing with LDE, but they also become negative, thus ruling out a potential explanation that average risk appetite among risk-averse investors might have increased, as in this case, premia would be lower but still positive. This pattern persists when we exclude crisis countries (Panel B), and, importantly, the risk premia remain negative for several months, albeit for a shorter period and with a smaller absolute magnitude than in

Panel A. The mispricing of sovereign risk premia linked to LDE is observed in crisis and non-crisis eurozone sovereigns.

We take this motivating evidence from the LDEs in our sample to the data using two multivariate panel regressions. We test for a potential predictive relation from DE to changes in default probability and risk premia after controlling for the overall state of the economy, investor risk aversion, liquidity, and other unobserved variables. The first regression establishes a positive predictive relation from DE to PD. Hence, empirically, we find that during our sample period, the debt increase predicts distress for eurozone sovereigns that appear to be beyond the tipping point where debt becomes a drag on growth (Mahfouz et al., 2002) instead of a driver of growth through timely and targeted fiscal stimulus (ECB, 2009, pp. 78-80). Contrary to the expectation that DE should predict an increase in risk premia, the second regression shows an economically and statistically significant negative coefficient, consistent with Figure 1.

We further examine the negative relationship by repeating our analysis over the periods before and after the Deauville summit of October 2010, which shocked the eurozone sovereign debt markets and decreased the mispricing. During this summit, German Chancellor Merkel and French President Sarkozy agreed that sovereign bailouts from the (predecessor of) European Stability Mechanism would require that losses be imposed on private creditors (Mody, 2013; Orphanides, 2014). The two leaders signaled against the implicit guarantees of eurozone credit risk, thus surprising markets by informing private investors that they would have to absorb losses from a future bailout of Greece. Using an indicator variable to distinguish the periods before and after the event, we document a negative relation between DE and risk premia before and after. Importantly, we show that in the year after the event, the coefficient of DE interacted with the indicator variable is positive and significant. The net effect of DE on premia seems to be neutralized temporarily after the Deauville political statements.

Finally, we consider the period 2011–2017, which started with the European sovereign debt crisis and includes the introduction of quantitative easing (QE) by the European Central

Bank (ECB) in 2015. We use panel regressions with an indicator variable on the years affected by QE and again find a negative and significant coefficient for DE. However, the negative effect that DE has on premia is neutralized by the QE, as the net effect of DE and QE on premia is not different from zero.

Our findings survive a battery of robustness checks. We rule out redenomination risk as a potential explanation of our findings by repeating the analysis using USD-denominated CDS. We address concerns about the accuracy of PDs and recovery rates and mitigate potential concerns of a mechanical relation between PD and DE by re-running our models using alternative specifications for sovereign PDs and recovery rates. Specifically, we perform a randomized test of recovery rates that is biased against us and also use the constant recovery rates that had been the norm before their inter-temporal variability was documented in the literature. We alleviate concerns about look-ahead bias by running predictive instead of explanatory regressions. We decompose DE to its debt (numerator) and GDP (denominator) components and find that both matter for our analysis, therefore ruling out an interpretation based solely on GDP contraction. We look at the effect of several contractual features of the issued debt, such as collective action clauses (CACs) and legal regimes. While we find them significant, they can not explain the documented mispricing. Further, we rule out debt flow (or gross financing needs) as a potential explanation of the DE mispricing. Finally, we test using alternative debt and DE measures for different sample periods to alleviate concerns about data mining and consider alternative control variables.

We contribute to the empirical literature on sovereign debt in several ways. First, we show that DE is a significant determinant of sovereign default risk, thereby contributing a novel proxy of sovereign likelihood of default. The level of fundamentals, such as public debt and government budget balance, is a well-known determinant of credit risk (Afonso, Furceri, and Gomes, 2012). However, there is scant literature on changes in the fundamentals.[2] Our

[2]Exceptions are Hilscher and Nosbusch (2010), showing that change in terms of trade has an impact on bond yield spread of the emerging markets, and Bassanetti et al. (2018) showing that emerging markets debt changes affect market (re)access.

finding provides direct evidence that DE is a determinant of sovereign risk, lending empirical support to the recent policy of international institutions to use debt flow as a predictor of crises in sovereign debt sustainability analysis (Zenios et al., 2021) since increases in debt-to-GDP ratio imply an increase in refinancing risks. This result has policy implications for the monitoring of fiscal stability. For example, policymakers have increasingly recognized the need to develop early warning systems for future fiscal crises, especially since mispricing associated with large debt expansions suggests that market prices of sovereign debt serve as poor predictors of distress.

Second, we contribute new evidence of mispricing in non-crisis sovereign credit markets. Naturally, there is literature on the mispricing of eurozone periphery debt, documenting disconnection from fundamentals (Aizenman, Hutchison, and Jinjarak, 2013; De Grauwe and Ji, 2012), regime-switching (Arghyrou and Kontonikas, 2012; De Grauwe and Ji, 2012), contagion (Arghyrou and Kontonikas, 2012; Beirne and Fratzscher, 2013; Mink and de Haan, 2013). We add to this strand of literature by showing that mispricing is present not only in crisis countries but also in non-crisis countries.

Our third contribution is testing the relation between DE and risk premia around the Deauville summit. The political decisions at Deauville reminded investors about the "no-bail-out" clause of Article 125 of the Treaty on the functioning of the European Union. This shock to mispricing is associated with a short-lived neutralization of the negative relation between DE and premia.

Our final contribution is to show that the negative relation between DE and risk premia persists even after accounting for QE in 2015. This has public policy implications, as it deals with the pressing question of the sovereign debt market's reaction to a QE termination.

The rest of the paper is organized as follows: Section 2 presents the data. Section 3 explains our methodology and the empirical findings. Section 4 details robustness checks. Section 5 proposes the behavioral explanation of empirical findings, and section 6 concludes.

2 Data

We construct our variables for the nineteen eurozone countries for which there are available data for our analysis. The testing period spans January 2002 to December 2017, and we include a country only for the period after it joined the eurozone. Cyprus, Greece, Ireland, Portugal, and Spain are crisis countries. We describe our main variables here, and all variables with their sources are summarized in the Data Appendix.

Our novel explanatory variable is the country DE (subsection 2.1). The dependent variable in our first regression is the country default probability (subsection 2.2), and the dependent variable in our second regression is the sovereign risk premium, which we construct from CDS spreads according to the literature (subsection 2.3). We also describe the variables we use to capture the two main alternative drivers of sovereign risk premia (liquidity and investor risk appetite) and the control variables (subsection 2.4). In general, given the availability of the higher frequency data, the first regression is run quarterly for 18 countries, and the second is run monthly for 16 countries.[3]

2.1 Sovereign debt expansion

To construct our main explanatory variable (DE), we first construct the debt-to-GDP ratio using sovereign debt and GDP data from the ECB. We use monthly nominal debt stock of the outstanding debt securities of the general government at the end of each month in our sample, denominated in Euro. Among the countries in our sample, Ireland has no available information on debt securities of the general government, whereas, for Cyprus, Estonia, Latvia, Lithuania, and Malta, data are available for at least 36 months. We compute the debt-to-GDP ratio using monthly estimates of GDP (i.e., one-third of the reference quarter GDP), scale debt by the GDP over the preceding twelve months, and compute the year-on-

[3]In testing our analysis, we omit Ireland since there is no data on debt securities of the general government (accessed May 2019). We omit Lithuania and Luxembourg since there are no available CDS data. The number of countries may vary in some tests, depending on the availability of control variables, and we report the total number of observations, i.e., the number of countries times time periods, for each test.

year debt ratio change (see Appendix Table A.1).

We focus on positive changes in debt-to-GDP (i.e., debt expansion) because a negative association between debt expansion and premia would be evidence consistent with mispricing. We then construct DE as the positive change in the year-on-year debt-to-GDP ratios; see the descriptive statistics in online Appendix Table A.2. Overall, most countries in our sample have several episodes of DE. The countries with the highest mean and median DE are Cyprus, Greece, Portugal, Slovakia, Slovenia, and Spain.

2.2 Probability of default and recovery rates

We use daily Bloomberg probabilities of default with a 1-year horizon. The PDs are estimated from a logistic regression model using financial, macroeconomic, and political factors. The inputs are the GDP growth, government surplus, non-performing bank loans, refinancing ability, and political risk (Cai and Stein, 2020). To validate their model, Bloomberg reports an accuracy ratio test with in-sample accuracy of around 89% (Bloomberg, 2020, p. 3). The accuracy ratio tests the model's ability to identify defaulting countries as having higher PD than non-defaulting countries and considers both type I and II errors. A goodness-of-fit test of the ex-ante vs ex-post default probabilities produces a line with a slope close to 45 degrees, indicating that the model is free of bias (Bloomberg, 2020, Figure 4). The default probabilities rise significantly two-to-three years before a sovereign default (Bloomberg, 2020, Figure 5), thus providing an early warning signal.

We use the Bloomberg PD since their model does not infer these probabilities from CDS to avoid a purely mechanical relation with the premia estimates. There is a potential mechanical relation between PD and DE since the former uses GDP growth and the latter uses GDP level, but this is not of concern for testing our research question as our first regression simply establishes that PD and DE are related, corroborating the Bloomberg PD model. Since Bloomberg uses government surplus as a variable to estimate PD, we address a concern that DE may be correlated with government surplus by computing the correlation

coefficient and finding it low, at -0.18.

Summary statistics of the default probabilities for the eurozone countries are given in the online Appendix Table A.3. There is significant variability in PD across countries, ranging from 25% for Greece to lower than 1% for Austria, Finland, France, Germany, and the Netherlands. The crisis countries, Italy and Lithuania, have the highest median default probabilities.

We use the time-varying recovery rates from Markit, with summary statistics in the online Appendix Table A.4. The median recovery is generally assumed to be 40% for investment grade issuers, and for non-investment grade issuers, the medians are custom estimated (Markit, 2014). They start from about 25% for Estonia, Latvia, Slovakia, and Slovenia, exhibiting a bi-modal cross-country distribution. Practitioners consider recovery rate estimates noisy, and we run a robustness test using the ISDA contractually specified recovery rates for senior unsecured bonds, namely 40% for developed countries and 25% for emerging countries. We also perform a randomized test with time-varying recovery rates scaled up to 1.5 times the Markit estimates, implying lower LGD that could potentially explain the reduction of premia. These randomized tests are biased against us.

2.3 Risk premia

We infer risk premia from CDS spreads instead of bond yields, as they lead price discovery (Blanco, Brennan, and Marsh, 2005; Zhu, 2006). We use the 1-year euro-denominated CDS spreads from Markit to match the Bloomberg 1-year PD for the default tier of senior unsecured debt with the characteristic of "old/full restructuring" (CR). Summary statistics are given in the online Appendix Table A.5 (Panel A). The lowest average CDS spreads (less than 30bp) correspond to Austria, Belgium, Finland, France, Germany, Latvia, and the Netherlands, while the highest (more than 100bp and up to 1028bp) are for Cyprus, Greece, Ireland, Malta, and Portugal. The distribution of CDS spreads for crisis countries has high volatility, and it is also skewed right as expected, with a more likely extreme in-

crease in CDS spreads for crisis than non-crisis countries. We also run a robustness test using USD-denominated CDS (subsection 4.1) to rule out redenomination risk as a potential explanation of our findings. Summary statistics are in Table A.5 (Panel B).

From Berndt, Douglas, Duffie, and Ferguson (2018) we obtain the risk premia by

$$\text{Risk premium} = \text{CDS spread} - \text{Expected loss}, \tag{1}$$

and calculate the proxy (ρ) as in Berndt et al. (2018), to capture non-linear effects of sovereign debt on DE by scaling premia by the corresponding expected loss and taking the log

$$\rho = \log\left(1+\text{Risk premium}/\text{Expected loss}\right). \tag{2}$$

The expected loss is the product of PD times expected loss-given-default (LGD) computed as (1 − expected recovery rate).

From the time series of PD, CDS spreads, and recovery rates, we calculate the risk premia from equation (1) and the scaled proxy ρ from (2). We report summary statistics for the risk premia obtained using EUR- and USD-denominated CDS spreads in online Appendix Tables A.6–A.7, respectively. An indication that risk premia do not compensate for the expected loss of default is evident from the negative values of risk premia for seven of the countries in the euro-denominated sample. Specifically, the average risk premia range from -373.36bp (Greece) to -11.29bp (Slovenia), while twelve countries have a significant proportion of non-positive premia during our sample period. The difference between average premia for USD- and EUR-denominated contracts varies from 0.47bp to 73.55bp, with an average of 11.10bp. A two-sample independent t-test indicates that the differences are not statistically significant, anticipating similar test results for both markets.

2.4 Factors impacting risk premia and other control variables

We control for all variables documented in the literature as determinants of sovereign default risk. Following Afonso et al. (2012), we use real GDP growth, inflation, and unemployment (macroeconomic controls), government balance and debt-to-GDP (governmental controls), and current account balance and terms of trade (external controls). We also control for political stability and corruption indices as qualitative country-specific variables (Butler and Fauver, 2006). We convert yearly political stability indices to quarterly by assigning the same values as the reference year to all quarters.

We then use DE as the main explanatory factor of sovereign risk premia, controlling for variables that affect risk premia. The first factor is liquidity risk since the estimated risk premium also accounts for liquidity risk (Berndt et al., 2018), which can be significant in the CDS markets (Badaoui, Cathcart, and El-Jahel, 2013). To capture any liquidity risk impact on risk premia, we use the bid-ask spread on the respective government 1-year benchmark bond (Liu, 2006; Monfort and Renne, 2014). The second factor is investor risk appetite, and following Longstaff et al. (2011); Pan and Singleton (2008), we use the Chicago Board Options Exchange volatility index VIX as a proxy.

The literature also employs several other country-specific factors related to the state of the economy, such as the risk-free rate and the slope of the yield curve. As the risk-free rate, we use the Euribor 3-month. For the slope of the term structure, we use the difference between the respective sovereign 10-year bond mid-yield and Euribor (Fontana and Scheicher, 2016; Zhang, Zhou, and Zhu, 2009). We also use the debt-to-GDP ratio to control for macroeconomic risk (Delatte, Fouquau, and Portes, 2017). VIX, bid-ask spreads, and the term structure slope are reported daily, but since our debt data are monthly, we use the corresponding observations on the last day of each month or quarter when applicable. All control variables and their sources are described in the Data Appendix.

2.5 Descriptive statistics

We report summary statistics of all variables in Table 1, pooled over country and time. The main dependent variables are the log probability of default and the risk premia proxy ρ. Both risk premia and ρ have significant variability. In particular, the 0.01 and 0.99 percentiles of ρ equal -3.86 and 4.19, respectively, with a large standard deviation of 1.79, indicating significant cross-sectional and temporal variability. The average negative ρ is driven mainly by crisis countries (see subsection 2.3), and hence we repeat our analyses excluding crisis countries (see subsection 3.4). Likewise, DE averages 3.9% with a standard deviation of 6.1%. The control variables (VIX, Slope, Debt-to-GDP, Bid-Ask) also have substantial variability.

[Insert Table 1 about here.]

3 Empirical Methodology and Results

Our first step is to document that DE predicts an increase in PD, controlling for macroeconomic, governmental, external, and qualitative factors. Second, we use DE as a proxy for an increase in default risk and test the relation between DE and future risk premia, controlling for liquidity risk, investor risk appetite, and the overall state of the economy. Third, we use the short-lived shock delivered to investor risk perception from the Deauville summit (Mody, 2013; Orphanides, 2014), i.e., that private investors would suffer a haircut of their exposures to Greek debt, to test if the mispricing documented before the summit persists after it. Next, we test for changes in the predictive relation from DE to risk premia over a longer period after Deauville to understand how QE might have affected this relationship.

We start our analysis using the motivating evidence that large debt expansions (LDE) are associated with future decreases in risk premia. We re-examine the evidence of Figure 1 using several thresholds (beyond the 95th percentile used in the figure) for each country's LDE and estimating the risk premium several months later. Table 2 shows the future average risk premia across all countries for four, five, and six months after an LDE for different LDE

thresholds. Figure 2 shows the risk premia dynamics, with confidence intervals, after LDE.

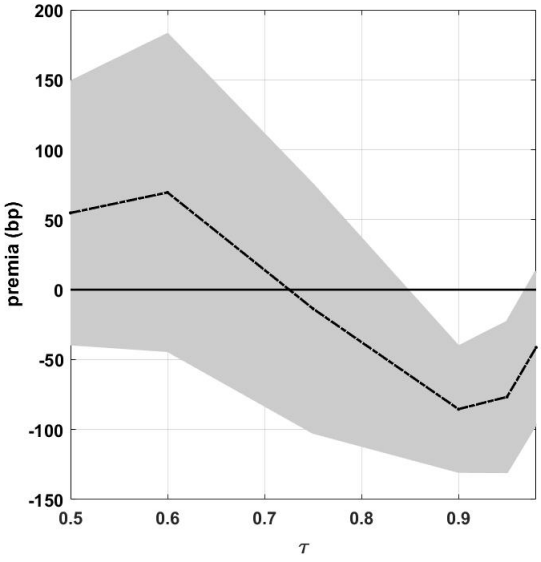
[Insert Table 2 about here.]

Both Table 2 and Figure 2 show that the future average premia are negative and statistically significant for high quantile thresholds (p-values ≤ 0.01 for thresholds $\tau = 0.90$ and 0.95). The negative relationship between LDE and future risk premia persists when removing the crisis countries (unreported); crisis countries do not drive our results.

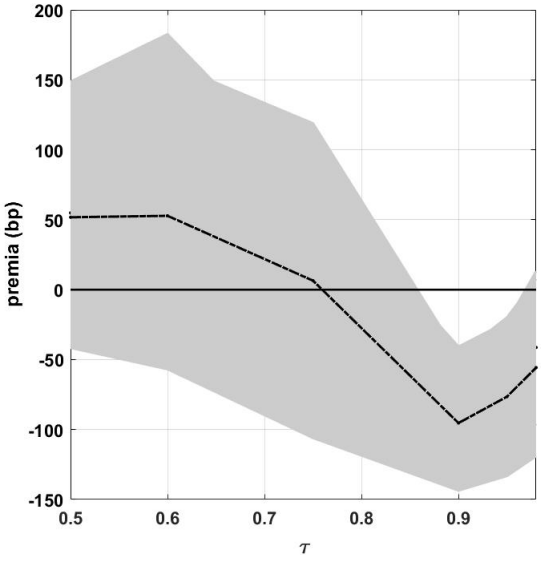
Figure 2: Dynamics of risk premia subsequent to large debt expansion

We plot the dynamics of average risk premia four months (Panel A) and five months (Panel B) after large debt expansion (LDE) for different quantile thresholds (τ) and show shaded the 0.95 confidence interval. The LDE observations are pooled over time and country. Data are monthly observations of our sample of eurozone countries, spanning January 2002 to December 2017.

(a) Four months ahead



(b) Five months ahead



3.1 Debt expansion and default probability

The non-linear effect of debt on growth creates a boom-bust cycle so that sovereign debt crises are more likely during the bust period (Reinhart and Rogoff, 2010), pointing toward positive changes in the debt ratios as a determinant of default risk. Increases in debt-to-GDP ratio

imply an increase in refinancing risks when the debt must be rolled over. The significance of a debt flow variable as a predictor of sovereign risk has been verified empirically (Gabriele et al., 2017) and is incorporated in the debt sustainability analysis of the European Stability Mechanism and the International Monetary Fund (IMF, 2013; Zenios et al., 2021). Hence, a positive change in debt-to-GDP is an ex-post signal of deteriorating debt dynamics, and we define debt expansion (DE) as positive debt-to-GDP change over the preceding twelve months. To test the predictability of PD by DE, we run a panel regression, including several control variables:

$$\log(\mathrm{PD})_{i,t} \quad = \quad \alpha + \beta_{\Delta}\Delta\mathrm{D}^{+}_{i,t-k} + B^{\top}\mathrm{X}_{i,t} + \mathrm{C}_i + \mathrm{Z}_t + \epsilon_{i,t}, \tag{3}$$

where $\log(\mathrm{PD})_{i,t}$ is the natural logarithm of 1-year PD (in %) of country i at time t, $\Delta\mathrm{D}^{+}_{i,t}$ is the respective DE (subscript k denotes lag order in quarters). $\mathrm{X}_{i,t}$ is a vector of control variables, with B a conformable vector of regression coefficients. Specifically, we use inflation and real GDP growth for macroeconomic factors, general government balance for governmental factors, current account as the external factor, and political stability as the qualitative factor. Country (C_i) and year (Z_t) fixed effects control for time-invariant sovereign characteristics and inter-temporal variation within the cross-section, respectively. The natural logarithm of PD accounts for the non-linear relationship with DE.

[Insert Table 3 about here.]

We estimate the model (3) using quarterly observations, compute p-values from robust standard errors clustered by country, and summarize the results in Table 3. Columns (1)-(4) give the results with a lag of one quarter. Column (1) shows the regression results with macroeconomic control variables inflation and real GDP growth, and columns (2)-(4) show results with governmental, external, and qualitative controls, respectively. Columns (5)-(8) give results with two-quarter lag.[4]

[4]Following a request by a referee, we also test if lagged Debt Contractions (DC) predict sovereign PD,

This table shows that DE is significant (p-value ≤ 0.01) in all specifications. After controlling for all explanatory variables (columns 4 and 8), we find that one standard deviation increase in DE increases PD by 29% and 25% in the next one and two quarters, respectively. This economically significant change, implied by the coefficient of DE, increases PD from their average values of 2.5–2.7% to 3.2–3.4%, for one- and two-quarter lags, respectively. Moreover, the coefficients on the control variables are as expected, with the negative coefficient on GDP growth in line with Afonso et al. (2011) (among others).[5]

3.2 Debt expansion and risk premia

We test the predictability of risk premia by DE using another panel regression. Our regression model is

$$\rho_{i,t} = \alpha + \beta_{\Delta}\Delta \mathrm{D}^{+}_{i,t-k} + \beta_V \mathrm{VIX}_t + \beta_S \mathrm{Slope}_{i,t} + \beta_B \mathrm{Spread}_{i,t} + \mathrm{C}_i + \mathrm{Z}_t + \epsilon_{i,t}, \qquad (4)$$

where VIX_t is the volatility index at t, and $\mathrm{Slope}_{i,t}$ and $\mathrm{Spread}_{i,t}$ stand for slope and bid-ask spread for country i at time t, respectively. C_i and Z_t account for country and time fixed effects. We expect positive coefficients on VIX and bid-ask spreads, but the coefficient on Slope can go either way. On the one hand, the steeper the yield curve, the higher the expected spot rate and the better future macroeconomic performance, implying lower default risk. On the other hand, the steeper the yield curve, the higher the expected inflation, which is usually accompanied by tighter monetary policy with likely adverse impact on economic

following the model (3). The coefficient of DC is not statistically significant, a result that is consistent with the documented asymmetry in market reactions to credit improving vs credit-deteriorating events for sovereign risk documented in Michaelides et al. (2015, 2019). We also run a test excluding the LDE from our regression to rule out that potential outliers drive the results without any significant changes worth reporting; results are available from the authors.

[5]Results are robust when standard errors are clustered by country and time. Also, similar qualitative results are observed when debt-to-GDP is included (online Appendix Table B.1). However, variance inflation factor analysis reveals a multicollinearity issue with debt-to-GDP (VIF 20.90), and we, therefore, remove this variable from the main analysis. The analysis with debt-to-GDP inclusion shows a significant and positive debt-to-GDP coefficient, consistent with an extensive body of literature that high government debt puts pressure on future interest and principal payments, increasing default risk (Reinhart and Rogoff, 2010; Reinhart et al., 2003).

growth, inducing higher default risk (Zhang et al., 2009).

[Insert Table 4 about here.]

We estimate (4) with monthly observations over the sample period, compute p-values from robust standard errors clustered by country, and give the results in Table 4.[6] The DE coefficient is negative and statistically significant (p-value ≤ 0.05) in all specifications, which goes against the predictions of finance theory. We find VIX significant in all specifications, consistent with the literature (Augustin and Tédongap, 2010; Doshi et al., 2017; Longstaff et al., 2011). We also find the liquidity bid-ask spread proxy significant, in line with Favero et al. (2010). The slope coefficient is positive and significant, consistent with Zhang et al. (2009), who argue that a steeper yield curve is linked to higher default risk.[7]

The Bloomberg PD estimates are backward-looking, and another potential concern is that they may not be a good predictor of expected defaults, so we also perform a test using next quarter PDs as a proxy of current market expectations of defaults. That is, whatever views the market had in the current period, those must be observed, on average, in the next period. Therefore, we test replacing the current period Bloomberg historical PD with randomized forward-looking PD drawn from a uniform distribution centered around the next quarter PD, with a width of one standard deviation calculated using historical PD values. (If the generated PD value is outside the [0,1] range, we replace it with the closest randomly generated PD value.) We re-estimate our primary model (4) for a 4-month lag where PDs are replaced by the randomized forward-looking PDs and repeat this test 1000 times. The average coefficient of DE is equal to -14.10, with a minimum value of -20.78 and a maximum value of -8.52 (p-values ≤ 0.05), strongly corroborating the results of Table 4.

[6]We report results for lag orders $k = 4$, 5, 6, but the results hold for $k = 3$ and 7 as well. Results are robust when standard errors are clustered by country and time. Also, we need to control for both debt-to-GDP and the risk-free rate. VIF analysis reveals a multicollinearity issue with these two covariates, with VIF for debt-to-GDP and risk-free at 43.92 and 32.04, respectively. Still, nevertheless, the results remain unchanged when we include debt-to-GDP, the risk-free rate, or both variables (online Appendix Table B.1).

[7]Running this regression excluding the LDEs, we obtain almost identical results, ruling out that a few outliers drive the findings.

To summarize, the results from the default probability regression model (3) show that DE increases default risk in the next two quarters, whereas the results from the risk premia regression (4) show that DE predicts a decline in risk premia in the following four to six months.[8]

In particular, the coefficient of lag four of DE is -9.22 (p-value $\leq$0.01). This coefficient implies that one standard deviation increase in DE will decrease risk premia by 28%. Comparing Table 3 (column 4) with Table 4 (column 3), we observe that an increase in DE will increase PD by 0.29%, in the next quarter, but the risk premia decrease by 28% in the next four months. DE predicts lower (instead of higher) risk premia, thus implying that investors in the sovereign credit market do not demand a higher premium as compensation for increased default risk, contrary to the expectations of finance theory.[9]

The main takeaway from Table 4 is that controlling for investor risk appetite, liquidity risk, and the state of the economy in each country, the risk premia and DE are inversely related and, therefore, mispriced.

3.3 The Deauville shock

We examine the effect on our results from the Deauville summit surprise to investors (Mody, 2013; Orphanides, 2014). Arguably, the political statement from the summit, i.e., that sovereign bailouts from the European Stability Mechanism would impose losses on private creditors delivered an unpleasant shock to private investors, dampening the prevailing expectation of an implicit guarantee that they would be bailed out in case of a Greek default.

[8]The results still hold if, following Baron and Xiong (2017), we use debt change instead of debt expansion, including both positive and negative changes, and the result remains qualitatively the same if we replace negative changes with zero. In addition, we interact debt change with a dummy variable D_+, taking the value one if debt change is positive and zero otherwise, and observe that the sum of the coefficients D_+ and the interaction term is negative and significant.

[9]We also use the logarithm of 1-year CDS spread as a market-based credit risk premia proxy to address potential concerns regarding the variability of CDS spreads with DE, and find a statistically significant negative coefficient on DE, consistent with Table 4, thus reinforcing the mispricing evidence. Our use of extracted risk premia from equation (1), following Berndt et al. (2018), takes into account the premia required by risk-averse investors. In another robustness test, we exclude the period of the Great Financial Crisis (2008-2010) and find that both results of Tables 3 and 4 remain qualitatively the same.

[Insert Table 5 about here.]

The Deauville events provide a natural experiment to address a potential concern that Bloomberg PDs might be derived from CDS prices, potentially contaminating our analysis from feedback effects from CDS markets since the estimation of risk premia depends on CDS spreads and PD. We examine the level of PD and CDS spreads before and after the Deauville summit. Table 5 shows the average level and slope of PDs and CDS from one to three weeks pre- and post-Deauville and their difference. A two-sample t-test reveals that the differences in the average levels of PDs and CDS spreads are not statistically different from zero. Importantly, however, the average slopes of these variables, calculated by averaging the daily changes, increase dramatically post-Deauville for CDS spreads but not for PDs. The significant impact of Deauville on CDS and the insignificant impact on PD alleviates potential concerns about a mechanical relationship between PD and CDS.

[Insert Table 6 about here.]

Having established that sovereign PDs are not affected by the Deauville summit, we test if the mispricing documented before the summit persists shortly after the summit. We calculate the average risk premia over the 1-year before and 1-year after the summit for crisis and non-crisis countries and compare the means across periods and country groups. We carry out this test excluding the month of the event or one or two months before and after. In Table 6, we show the average premia and use a two-sample t-test of equality across periods and country groups. Both country groups experience an increase in risk premia following Deauville. The non-crisis group premia are, of course, smaller (in absolute value) both before and after Deauville, but the negative average risk premia reverse sign post-Deauville. The repricing is at least 540bp for crisis countries and 60bp for non-crisis countries (p-values $\leq$ 0.01).

We develop further the univariate analysis using a panel regression around Deauville,

$$\begin{aligned} \rho_{i,t} &= \alpha + \beta_I \Delta \mathrm{D}^{+}_{i,t-k} \times \mathrm{Post}_{i,t} + \beta_P \mathrm{Post}_{i,t} + \beta_\Delta \, \Delta \mathrm{D}^{+}_{i,t-k} \\ &\quad + \beta_V \, \mathrm{VIX}_t + \beta_S \, \mathrm{Slope}_{i,t} + \beta_B \, \mathrm{Spread}_{i,t} + \mathrm{C}_i + \epsilon_{i,t}, \end{aligned} \tag{5}$$

where Post is a dummy variable, equal to one for post-Deauville observations and zero otherwise. Table 7 shows the results obtained with monthly data and lags $k = 4$, 5, 6, as in the main regression model.[10]

[Insert Table 7 about here.]

The coefficient of DE is negative and significant (p-value ≤ 0.01 and 0.05 at 4- and 6-month lags, respectively). However, examining the net effect of debt expansion using an F-test on the sum of the coefficients of DE and the cross-product term, we observe that DE does not predict negative risk premia post-Deauville. The evidence of the strong mispricing before (DE is negative and significant) but not after (the sum of the coefficients of DE and the interaction term is not statistically significant) is consistent with a change in the behavior of investors. Interestingly, this change is short-lived since results with a 6-month lag are weakly significant (F-test p-value 0.09), suggesting the weak re-appearance of mispricing. In summary, our evidence of mispricing before the political statements at Deauville has been briefly interrupted by the summit wake-up call to investors. However, investors returned to their pre-Deauville behavior a few months later, corroborating a conjecture by Mody (2013) that the Deauville effect was short-lived.

We re-run the analysis above using an earlier date than the Deauville summit since some events might have forewarned investors to change their behavior. One such event was the Greek government's announcement on October 20, 2009, that its deficit would soar to

[10]Due to large VIF values, we report results without debt-to-GDP and risk-free rate as regressors, but results remain significant when these variables are included (online Appendix Table B.2). We also observe high VIF for Slope, but the results remain unchanged if we drop this variable. We also test the model excluding only the month of the event, and the interaction term remains qualitatively the same (online Appendix Tables B.3).

almost 12.5% of GDP. We re-run the primary regression using two indicator variables to capture the period before the Greek announcement, after Deauville, and the interim period of high volatility. (We exclude the months of the Greek announcement and the Deauville summit.) We interact these indicator variables with DE and obtain consistent results (online Appendix B.4). An F-test on the sum of the coefficients of DE and the cross-product terms shows a significant negative coefficient of DE in the interim period, suggesting the persistence of mispricing even after the Greek announcement.

3.4 Implicit guarantees

One potential explanation for our finding is the widely held belief that stronger economies implicitly guarantee eurozone crisis countries. Such an explanation would be consistent with DE predicting non-increasing premia but is not consistent with decreasing premia. Increased PD due to DE could lead to zero net effect on the risk premium if the debt is guaranteed but would not lead to a premium decrease. If the guarantees cover all country risks adequately, then DE should not change premia, but if the guarantees only partially offset DE risks, we expect risk premia to increase somewhat. We repeat regressions (3)–(4) on the pre-Deauville data and find that the positive correlation between DE and the future PD of Table 3 is robust (see Table 8, Panel A), and the negative coefficient of DE is consistent with Table 4 (see Table 8, Panel B).

[Insert Table 8 about here.]

Also, we carried out another test using the post-Deauville data (2011–2014) in regressions (3)–(4). The summit explicitly pointed out that markets should stop "deluding themselves" about guarantees, and we expect a positive impact on premia due to DE in post-Deauville if the mispricing phenomena are explained by implicit guarantee. However, the result in Table 9 (Panels A and B) show that a persistent negative relation between DE and future risk premia of Table 4 and positive relation between DE and PD of Table 3. The two

empirical tests above, taken together, imply that the implicit guarantee can only partially explain the mispricing, and other factors must weigh in.

[Insert Table 9 about here.]

To further test the implicit guarantees explanation, we run models (3)–(4) without the crisis countries and find that DE is robust in predicting PD increase (Table 10, Panel A), and risk premia decrease (Table 10, Panel B), thus confirming our results also for non-crisis countries. This suggests that even when guarantees are less likely to apply, i.e., weaker countries do not provide much of a guarantee for the stronger economies, the main result of the negative coefficient on DE persists. This new result adds to the literature that documents mispricing only for crisis countries (Aizenman et al., 2013; De Grauwe and Ji, 2012).

[Insert Table 10 about here.]

3.5 Quantitative easing

The impact of QE from the European Central Bank has direct implications for our research question. Specifically, we examine how introducing the Public Security Purchase Programme (PSPP), announced on January 22, 2015, affects our results. The PSPP adds to the ECB's balance sheet inflation-linked central government bonds, bonds issued by regional and local governments, recognized agencies, international organizations, and multilateral development banks in the euro area. PSPP holdings stood at about EUR 3 trillion as of November 2019, 90% of which are made up of bonds issued by government and recognized agencies.[11]

[Insert Table 11 about here.]

We run models (3)–(4) for the period January 2011–December 2017 that spans the launching of PSPP, including the interaction of DE with a dummy variable W_{QE} indicating the

[11] See `https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html#pspp`, accessed January 2020.

period after launching. We report results in Table 11. In Panel A, we examine the relation between debt expansion and the probability of default. We note that DE consistently predicts increasing PD in all model specifications, with statistically significant coefficients of about the same magnitude as in Table 3. When considering QE, we also observe that the F-test for the net effect of DE on PD can not reject the null of zero net effect. These results show that QE neutralizes the PD increase due to debt expansion.

We next look at the relationship between DE and future risk premia in Panel B. Similar to the results in Table 4, we observe a negative and statistically significant coefficient for DE. However, the coefficient on the interaction term is positive and significant, and the F-test for the net effect of the two coefficients is statistically indistinguishable from zero. These results suggest that QE neutralizes the effect of DE on risk premia.[12] Overall, our findings raise the public policy question of what will happen after QE ends, suggesting the potential re-emergence of mispricing as an issue of concern to policymakers.[13]

4 Robustness Tests

We conduct several robustness tests. First, we re-run our analysis using USD-denominated CDS spreads. Second, we test the sensitivity of our results to the estimates of the probability of default and recovery rates. Third, we test for potential look-ahead bias. Fourth, we follow Baron and Xiong (2017) to decompose the debt expansion variable and test whether increases in debt level or GDP contraction drive our results. Fifth, we look at the effects of contractual characteristics of the issued debt, namely the presence of collective action clauses (CACs), the currency of denomination, and the law of the debt contract. Sixth, we show that the mispricing of DE persists when controlling for gross financing needs as a

[12]The correlation of QE dummy variable and lag DE is -0.10, significant at 5% level, indicating more DE pre-QE than post-QE. Moreover, we conduct a robustness check by replacing W_{QE} with an indicator variable taking the value of 1 after the ECB President's "Whatever it takes" (WIT) moment in July 2012 and our results are similar (Table B.5).

[13]The effects on sovereign debt of unwinding asset purchase programs by central banks is addressed for Bank of Japan and ECB programs in Alberola et al. (2022, 2023).

potential determinant of the documented mispricing. Seventh, we use alternative sources of public debt data beyond debt securities, different time windows to estimate DE and 5-year maturity CDS to estimate the premia. Eighth, we test with additional control variables.

4.1 Redenomination risk

A credit event in a eurozone member can cause a euro depreciation, and the eurozone crisis raised concerns about redenomination risk. USD-denominated CDS provides a hedge against currency risk; hence, these contracts are more costly than the EUR-denominated (Fontana and Scheicher, 2016). This would imply higher premia (cf. equation 1), potentially eliminating our findings using EUR-denominated CDS contracts. To rule out a redenomination risk interpretation of our findings, we re-run regression (4) with ρ calculated from USD-denominated CDSs with identical maturity, default tier, and document clause as the EUR-denominated contracts.

The results (online Appendix Table B.6) show that the DE coefficient is significant and predicts a reduction in premia with 4-, 5-, and 6-month lags, corroborating our main findings in Table 4.

4.2 Probabilities of default and recovery rates

To address a potential concern that our findings are driven by noisy or biased estimates of PD and recovery rates and to rule out a purely mechanical relation between PD and our independent variables, we stress-test our PD values and the recovery rates. Since PD values and recovery rates are used as inputs in our estimation of sovereign risk premia, they affect the estimated ρ coefficient from regression (4).

To address a potential concern that our negative risk premia result from high PD, we recalculate ρ by scaling their original values with a random variable generated from a uniform distribution in the interval [0.5, 1]. Reducing the PD increases the risk premia and makes it more difficult to document premia reduction. We randomly generate a time series of PD for

each country in our sample and run regression (4) with lag 4. We repeat this procedure 1000 times for each country and obtain an average coefficient of DE equal to -9.24, which is very close to the coefficient -9.22 in Table 4 (column 3). The minimum value of DE is -10.78, and its maximum value is -7.73 (p-values ≤ 0.05 for all simulations). The results of Table 4 are robust to PD estimates.

Likewise, we stress-test the values of recovery rates by generating random values from a uniform distribution ranging from 100% to 150% of the time-varying Markit estimates, again increasing the risk premia and biasing the experiment against us. We run the regression model using the simulated recovery rates to estimate ρ, and repeat the experiment 1000 times to obtain an average DE coefficient of -9.23, with a minimum value of -10.11 and maximum value of -8.36 (p-value ≤ 0.05 for all simulations). Following the literature (Badaoui et al., 2013; Singh and Spackman, 2009), we perform an additional test with a constant recovery rate of 40% according to the ISDA contracts. The results (online Appendix Table B.7) are consistent with Table 4. [14] The DE coefficients are negative and significant in all model specifications and very close in magnitude to the coefficients of our main test.

The decision at Deauville would likely increase the probability of default and LGD. LGD must be adjusted before calculating the risk premium to address this eventuality. We run a robustness test where we increase PD and LGD with uniformly generated random noise from 10% to 15%. This test works in our favor since mispricing should be stronger if we assume higher PD and LGD after Deauville. The results of adding random noise do not differ significantly from those of Table 7, and our main findings survive a potential increase of PD and LGD after Deauville.[15]

[14] In another test, we also tested 40% recovery for non-crisis and 25% for crisis countries, without any notable changes.

[15] Results are available from the authors.

4.3 Look-ahead bias

To address the potential concern about look-ahead bias, we repeat our regression results of Table 4 using predictive variables guided by literature. To the best of our knowledge, there is presently no study of the variables predicting the premia embedded in CDS spread, and we rely on the literature on the predictors of CDS spread (or bond yield). In particular, we use VIX based on the results of Srivastava et al. (2016), and we include lags of the dependent variable following Favero (2013). The results are given in Appendix Table B.8 corroborating our main finding of negative and significant coefficient on DE.[16]

4.4 Decomposition of debt expansion

We decompose DE to changes in the numerator (debt) and denominator (GDP). We run model (4), replacing $\beta_{\Delta}\Delta\mathrm{D}^{+}$ by $\beta_D\Delta\log(\mathrm{Debt}) + \beta_G\Delta\log(\mathrm{GDP})$. As in the main test, we consider the positive changes of DE, i.e., when $\Delta\log(\mathrm{Debt}) - \Delta\log(\mathrm{GDP}) > 0$. The results (online Appendix Table B.9) show that both β_D and β_G are statistically significant. This implies that DE's predictive power is driven by debt and GDP changes, in line with the finding of Baron and Xiong (2017) for banking.

4.5 Contractual characteristics

Several features of the debt contract can influence the probabilities of default and risk premia. We test how our results are affected by the currency of denomination, collective action clauses (CACs), and the law governing debt issuance.

4.5.1 Currency

For eighteen euro area member States, all or almost all ($> 99\%$) of their central government debt is denominated in national currency, and only Germany has about 2.5% of government

[16] We also conducted a test introducing a lag to all the independent explanatory variables in our regression, again finding negative coefficient on debt expansion.

debt not denominated in euro.[17] We repeat the main tests excluding Germany from our sample, and the results do not differ materially from those in Tables 3–4.[18]

4.5.2 Collective action clauses

The introduction of CACs for long-term debt issued after January 2013 signifies a significant shift in eurozone debt. Carletti et al. (2021) show that these provisions are "pro- rather than anti-creditor", so their introduction in the debt contracts could potentially explain the risk premia reduction. We introduce the binary variable Post (where the period after CACs was introduced gets a value of one, and zero otherwise) and its interaction with long-term debt expansion in the risk premia regression (4). The DE coefficient remains negative and statistically significant in line with our main Table 4; see online Appendix Table B.10. We also find that the Post variable has a negative and statistically significant coefficient in line with the observation of Carletti et al. that the introduction of CACs reduced bond yields. The cross-term is not statistically significant at the 5- and 6-month horizon. When it is significant, at the 4-month horizon, the overall effect remains statistically significant, as shown by the F-test (p-values less than 0.02). Hence, the mispricing of debt expansion we have identified cannot be explained by the introduction of CACs.

4.5.3 The law

We finally consider the effects of legal regimes on our findings. The overwhelming majority of eurozone bonds are under domestic law (Carletti et al., 2021, footnote 4), so we first split our sample into Civil Law countries (continental EU), British Law (Ireland), and mixed (Cyprus, Malta). We repeat the main tests for the Civil Law countries, and the results do not differ materially from those in Tables 3–4.[19]

We take a step further and use quality of law indicators as proxies for the jurisdiction.

[17] See Eurostat `https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220615-1`.
[18] Results are available from the authors.
[19] Results are available from the authors; the sample size for British and mixed law is very small to test.

Following Carletti et al. (2021), we consider countries with low and high-quality law, using the rule of law index of the World Bank and the property rights index of the Heritage Foundation.[20] The low-quality law countries are Greece, Italy, Latvia, Lithuania, and Slovakia, under both indices, with their historical median/mean indicators over the sample period below the 25th percentile of the sample (over time and countries). We use the dummy W_{QL} (equal to one for low-quality law countries and zero otherwise) and its interaction with DE to determine whether our results can be explained by the quality of law heterogeneity across our sample; see the results in online Appendix Table B.11. Our main findings are robust in that the PDs (premia) increase (decrease) following DE of both low and high-quality law countries. The interaction term is statistically significant in both regressions, with the same sign as DE. This test rules out that our results can be explained away by the quality of law, with more pronounced mispricing for countries with low quality of law.

4.6 Gross financing needs

Bassanetti et al. (2018); Gabriele et al. (2017) show that Debt flow (or gross financing needs GFN) is an important factor in explaining sovereign risk not captured by debt change. We test whether GFN could explain the mispricing of debt expansion we document in our paper. Hence, we add lagged GFN as an independent variable in regression models (3)–(4). We estimate the debt flow variable as $GFN_t = Deficit_t + PR_t$, where $Deficit_t$ is the government deficit (if positive) or surplus (if negative) at time t, and PR_t is the principal amount due, both variables scaled by GDP (Gabriele et al., 2017). While government deficit data are reported quarterly (Eurostat), PR data are reported annually (ECB). Hence, we interpolate annual data into quarterly using five different interpolation methods as explained in online Appendix Tables B.12.

We report the results using the five specifications of lagged GFN (1-quarter lag) in online Appendix Table B.12. Panel A reports the result of regression (3) and Panel B of regression

[20] See, respectively, `https://databank.worldbank.org/source/worldwide-governance-indicators` and `https://www.heritage.org/index`.

(4).[21] We observe from Panel A that GFN is a significant determinant of PD (p-values $\leq$ 0.01), in line with (Gabriele et al., 2017). Importantly, in all specifications, DE remains significant as a predictor of PD (p-values ≤ 0.01), with a coefficient significantly larger than that of GFN. From the regression results on the risk premia in Panel B, we observe that DE is significant and GFN is not. Thus, we rule out that GFN drives the mispricing. These results are robust with a 2-quarter lag.

4.7 Alternative datasets and time-windows of analysis

In our analysis, we use monthly data available only for debt securities. We carry out a robustness test including non-securities debt using quarterly data and fit the regressions (3)–(4) with this alternative measure of country debt. Using lower frequency data reduces the sample size, which weakens the power of the statistical tests, but our main results persist (online Appendix Table B.13). DE predicts a PD increase in the next two quarters, similar to the results in Table 3, and DE remains mostly significant and negative (p-value ≤ 0.05). The findings of Table 4 are robust.

We also test the robustness of our results to the time window over which we estimate DE. We run the two regressions with monthly DE estimated over nine and eighteen months instead of the twelve months used in our main tests. The results (online Appendix Tables B.14–B.15) are consistent with our main findings.

We also test for robustness to estimates of risk premia obtained from 5-year CDS spreads. These CDS are more liquid (Blanco et al., 2005), and this test alleviates potential concerns that our results may be driven by liquidity risk or that debt expansion might not affect the short-maturity spread since it takes time for a government to implement its policies with only long-maturity spreads capturing those impacts.

To obtain the premium associated with 5-year CDS spreads, we need the annualized 5-year probability of default into equation (1). We obtain annualized cumulative 5-year default

[21] We do not include government balance and political stability variables in regression (3). The first is highly correlated with GFN, and the second creates a multicollinearity issue.

rate (PD_{5y}) as $PD_{5y} = 1 - (\Pi_{t=1}^{5}(1 - PD_t))^{\frac{1}{5}}$, where PD_t is the probability of default between years $t-1$ and t, given survival up to $t-1$. Assuming that the annualized probability of default is independent of the time to maturity, the annualized 5-year PD will equal the 1-year PD. Using the spreads obtained from 5-year CDS, we obtain results (see online Appendix Table B.16, Panel A) which are in line with our main findings of Table 4.

Beygi et al. (2018) document a term structure for the probability of default for corporates, with a reversion to the mean. Specifically, low-rated corporate bonds have their PDs improve over longer periods, whereas highly-rated corporates see their PDs deteriorate. We are unaware of similar work with sovereigns, but it is reasonable to assume similar term structures of PDs for sovereigns. This implies that extrapolating constant PDs will underestimate the 5-year PD for non-crisis countries and overestimate the 5-year PD for crisis countries. Underestimating PDs works against us, so we run another robustness test using the 5-year CDS on non-crisis countries only. The results are reported in Table B.16 (Panel B) and corroborate our main finding.

4.8 Control variables

We test the model (3) for robustness to alternative controls. This test also alleviates potential concerns about a mechanical relationship since the Bloomberg PDs come from a multi-factor model using GDP growth and government surplus, and we test for robustness when these two variables are replaced. We use the unemployment rate, terms of trade, and debt-to-GDP instead of real GDP growth, current account, and government balance, respectively. The results (online Appendix Table B.17) are consistent with Table 3.[22]

Evidence shows that macroeconomic conditions may drive risk premia (Amato et al., 2005; Doshi et al., 2017). For this reason, we run (4) controlling for a macroeconomic factor (inflation) and an external factor (current account) and find that DE remains significant in

[22]We ignore the debt-to-GDP multicollinearity issue for this test, but we also test a combination of macroeconomic (GDP-per-capita, inflation, unemployment rate), external (term-of-trades, reserves) and qualitative (political stability, corruption) controls, with robust results.

predicting risk premia reduction for all specifications (online Appendix Table B.17).[23] We also use the European volatility index VSTOXX instead of VIX, with qualitatively identical results. The findings of Table 4 remain robust.

5 Mispricing explanation

Explaining the mispricing finding remains an open question. The control variables we employed leave room for two potential explanations as to why increasing PD comes with lower, not higher, risk premia. One potential explanation would be the implicit guarantees so that even if investors price correctly, the implicit guarantee limits the probability of default and/or the loss given default. As shown in Section 3.4, implicit guarantees affect the premia but do not fully explain the mispricing. This leaves a second potential behavioral explanation, specifically that the mispricing is due to neglected risk and, more generally, optimism.

Our results are consistent with the conjecture by Mody (2013) that neglected risk (Gennaioli, Shleifer, and Vishny, 2012) could explain the eurozone crisis. The neglected risk model of Gennaioli et al. (2012) is based on the psychological foundations of representativeness of Kahneman and Tversky (1972), and Gennaioli, Shleifer, and Vishny (2015) propose a theoretical framework of neglected risk in credit cycles with investor under- and over-reaction. According to this framework, investors overestimate the probability of good states in the sight of good news. In extreme cases, investors with representativeness bias ignore bad news and make decisions based solely on the observed good news. However, once the amount of bad news reaches a threshold, investors weigh in bad news and overreact to it.

Neglected risk is one channel that creates investor optimism, and Baron and Xiong (2017) mention two others (expectations based on extrapolations (Barberis et al., 1998) and the line of reasoning that "this time is different" (Reinhart and Rogoff, 2009)). Neglected risk

[23]Since Debt-to-GDP has a high VIF and the alternative variable to be used, government balance is used by the Bloomberg PD multi-factor model, we test (4) using inflation, current account, and debt-to-GDP, and the results are in line with Table 4. Also, the results are robust when other control variables from the regression model (3) are used as control variables in the regression model (4).

has a well-developed theoretical model based on behavioral explanations, and the other two channels provide plausible explanations whose links to optimism are not distinguishable from those of neglected risk.

Our results are also consistent with optimism, but we do not establish any precise behavioral mechanism among the three channels mentioned. Baron and Xiong (2017) show that credit expansion in their banking sector sample predicts significant negative excess returns for the bank equity index in the subsequent three years. Therefore, even though the credit expansion increases the probability of a bank equity crash, the average predicted equity returns are lower. Their evidence from the banking sector raises a more general research question: Since corporate risk is typically capped by sovereign risk (Almeida et al., 2017), is it possible that the results of Baron and Xiong (2017) also extend into sovereign debt markets? We have shown that this is the case, but, like them, we do not have the data to establish the precise behavioral mechanism, although we can offer a plausible explanation.

The euphoria of introducing the Euro as legal tender in January 2002 by twelve European Union member states, the prolonged period of good state of the economy together with implicit guarantees by the major eurozone members, and the historically low probability of default of European sovereigns, caused investors to ignore the so-called no-bail-out clause Article 125 of the Treaty on the Functioning of the European Union. Specifically, while the eurozone treaties do not foresee any help for insolvent countries, it was widely believed that "in reality, the other states would have to rescue those running into difficulty",[24] and Article 125 was shown not to be an iron-clad no-bailout clause by the Court of Justice of the European Union ruling on the Pringle Case.[25] In other words, there were many signals of optimism in financial markets, as investors appeared to ignore or downplay scenarios of downside risk for sovereign assets. On the other hand, ECB Executive Board member Jurgen

[24]Quote by the German finance minister Peer Steinbrueck in February 2009, See `https://www.ft.com/content/825af89a-fe02-11dd-932e-000077b07658`, accessed January 2020.

[25]The ruling states that "Article 125 TFEU does not prohibit the granting of financial assistance by one or more Member States to a Member State which remains responsible for its commitments to its creditors", see case C-370/12 ECJ of Pringle v. Ireland at `https://curia.europa.eu/juris/document/document.jsf?docid=130381&doclang=en`, accessed January 2021.

Stark warned (January 2010) that "Markets are deluding themselves when they think at a certain point the other member states will put their hands on their wallets to save Greece."[26]

With Stark's statement, the ECB signaled to the markets that they were likely not accurately pricing the risk of sovereign debt. In other words, investors were attaching a negligible probability of default to sovereigns, regardless of their DE.[27] Following this mispricing, the sovereign responds by accumulating more debt, supported by low interest rates, increasing debt even further. As a result, investors are not compensated for unexpected losses, as risk premia are low or even negative.

6 Conclusion

We provide robust evidence consistent with the mispricing of debt expansion in the eurozone sovereign credit market. In particular, we show that debt expansion predicts an increase in the probability of default, whereas it predicts a decrease in future risk premia. We corroborate the evidence of mispricing by assessing the relationship between debt expansion and risk premia around the Deauville summit, which was a wake-up call in the eurozone sovereign credit markets. The results survive several robustness tests. Potential explanations that our results could be driven by an increase in investors' risk appetite and liquidity are ruled out using appropriate control variables from the literature.

Interestingly, our results are not driven by crisis countries. Mispricing appears in crisis and non-crisis countries alike. Importantly, we rule out an explanation of our results due to the implicit guarantees assumed by the markets for eurozone sovereigns.

We also test a sub-period that encompasses the launching of the Public Securities Purchase Program of the European Central Bank QE policies. We find that QE neutralizes the increase in the probability of default due to debt expansion and the effect of debt expansion

[26] See `https://www.ft.com/content/7504f472-fae9-11de-94d8-00144feab49a`, accessed January 2020.

[27] This behavior is consistent with the representativeness bias framework of neglected risk, the extrapolative expectations, or "this time is different" channels of optimism.

on risk premia. These findings raise the public policy question of what will happen when/if QE ends, suggesting that a re-emergence of risk mispricing must concern policymakers.

Another policy implication follows from identifying debt expansion as a significant factor of sovereign risk. This lends support to recent work by international institutions in incorporating debt flow, in addition to debt stock, as a critical determinant of debt sustainability. Investors and policymakers should be aware of the implications of debt expansion on the pricing of sovereign debt.

Given that we have addressed potential rational explanations of our results, the mechanism associated with the documented mispricing is likely behavioral. Our findings are consistent with optimism and neglected risk, although we do not have the data to establish the precise mechanism empirically. This is left open for further research.

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Data Appendix

Variable description and source

Variable	Source	Description
Dependent variables		
log (PD)	Bloomberg	log transformation of the 1-year probability of default, where PD is expressed as %.
Risk Premia	Estimated	CDS spread - PD×(1-recovery rate), where recovery rate and CDS spread are from Markit, with 1-year CDS spread, default tier SNRFOR (senior unsecured debt) , and document clause CR (old/full restructuring).
ρ	Estimated	log (1+ ((Risk premia)/ (PD×(1-recovery rate)))).
Main independent variable		
Debt Expansion (DE)	Estimated	1-year positive change of debt-to-GDP.
Control variables		
VIX	Thomson Reuters Eikon	implied volatility of the S&P 500 index.
Slope	Thomson Reuters Eikon	10-year benchmark bond mid-yield - 3-month Euribor.
Debt-to-GDP	ECB	Debt-to-GDP. For debt, we use total debt outstanding (all types or only debt securities) of general government. For GDP, we use GDP and the main expenditure components.
Bid-Ask	Thomson Reuters Eikon	(Ask price - Bid price)/(Ask price) with bid and ask prices of 1-year benchmark bond.
Inflation	IMF	Inflation rate.
Real GDP Growth	IMF	Percent change of real GDP constant prices.
Current Account	Eurostat	Current account-to-GDP.
Government Balance	Eurostat	General government fiscal balance-to-GDP.
Political Stability	WB	-2.5 corresponds to the lowest and 2.5 to the highest levels.
Robustness variables		
GDP-per-capita	OECD	GDP-per-capita at constant prices in USD.
Unemployment	ECB	Unemployment rate.
Reserves	WB	Ratio between reserves (including gold) and imports.
Terms of Trade	Datastream	Ratio between exports and imports.
Corruption	Transparency International	0 corresponds to the highest level and 100 to the lowest level.
VSTOXX50	Thomson Reuters Eikon	Implied volatility of the STOXX 50 index.

Table 1: Descriptive statistics.

We report the summary statistics of debt expansion (DE), risk premium, ρ, default probability (PD), and control variables for eurozone countries over the period spanning January 2002 to December 2017. All statistics are pooled over country and time. The variable definitions are as in the Data Appendix.

						Quantiles					
Variables	Frequency	N	Mean	Median	StdDev	0.01	0.05	0.10	0.90	0.95	0.99
Dependent variables											
log (PD)	Monthly	2448	-1.281	-1.511	2.311	-5.128	-4.871	-4.151	1.891	2.961	4.071
Risk Premia	Monthly	1977	-0.006	0.000	0.074	-0.201	-0.055	-0.032	0.009	0.017	0.115
ρ	Monthly	1977	-0.117	-0.142	1.793	-3.860	-3.105	-2.505	2.180	2.798	4.187
Independent variables											
Debt Expansion (DE)	Monthly	1548	0.039	0.028	0.061	0.000	0.002	0.005	0.086	0.108	0.171
VIX	Monthly	192	19.300	16.800	8.367	10.214	11.108	11.905	29.729	36.304	51.529
Slope	Monthly	2228	2.240	1.609	2.803	-0.550	-0.282	0.111	4.448	6.615	12.465
Debt-to-GDP	Monthly	2760	0.548	0.522	0.272	0.003	0.015	0.189	0.909	0.974	1.192
Bid-Ask	Monthly	1140	0.003	0.000	0.041	0.000	0.000	0.000	0.003	0.008	0.023
Inflation	Quarterly	984	1.666	1.690	1.526	-2.173	-0.683	-0.180	3.541	3.976	5.213
Real GDP Growth	Quarterly	984	1.644	1.870	3.485	-8.599	-4.220	-2.520	4.925	6.246	10.340
Current Account	Quarterly	975	0.253	0.400	6.478	-16.425	-11.150	-8.200	8.000	9.600	16.575
Government Balance	Quarterly	984	-2.896	-2.200	5.173	-18.098	-10.800	-8.600	2.600	4.330	6.600
Political Stability	Quarterly	984	0.815	0.886	0.447	-0.318	-0.122	0.237	1.364	1.451	1.640

Table 2: Effect of large debt expansion on risk premia

We report the average risk premia estimated (4-, 5-, and 6-) months after the observed LDE. LDE are defined at varying percentile thresholds ranging from 0.50 (column 1) to 0.98 (column 6). We also report the number of identified large debt expansion (LDE) observations for each threshold. The dataset comprises monthly observations for eurozone countries from January 2002 to December 2017. $*p < 0.1$; $**p < 0.05$; $***p < 0.01$.

	Threshold quantile τ					
	(1)	(2)	(3)	(4)	(5)	(6)
Threshold	0.50	0.60	0.75	0.90	0.95	0.98
4-month ahead						
Premia	54.86	69.47	-13.59	-85.39***	-76.67***	-41.34
	(0.252)	(0.230)	(0.764)	(0.000)	(0.006)	(0.141)
Observations	557	457	313	176	135	100
5-month ahead						
Premia	51.75	52.79	6.421	-95.35***	-76.48***	-55.72*
	(0.278)	(0.346)	(0.911)	(0.000)	(0.009)	(0.088)
Observations	561	456	309	173	129	100
6-month ahead						
Premia	44.72	45.47	4.086	-97.13***	-84.19***	-69.90*
	(0.334)	(0.413)	(0.939)	(0.000)	(0.01)	(0.079)
Observations	559	454	309	171	127	96

Table 3: Effect of debt expansion on future probability of default

We report the coefficients of regression (3) estimated with lags of DE. The dependent variable is log (PD). Columns (1)-(4) present the regression coefficients with a 1-quarter lag of DE where we control for macroeconomic, external, governmental, and qualitative control variables, respectively. Columns (5)-(8) report the same results for a 2-quarter lag. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are quarterly observations of our sample of eurozone countries, spanning January 2002 to December 2017. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

	1-quarter lag				2-quarter lag			
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Debt Expansion	7.679***	7.669***	7.454***	7.089***	6.977***	6.977***	6.684***	6.302***
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Inflation	-0.082	-0.076	-0.077	-0.080	-0.096*	-0.096	-0.095	-0.097
	(0.170)	(0.210)	(0.201)	(0.195)	(0.096)	(0.109)	(0.112)	(0.109)
Real GDP Growth	-0.094**	-0.095**	-0.095**	-0.087**	-0.105***	-0.105***	-0.104***	-0.093***
	(0.023)	(0.022)	(0.022)	(0.022)	(0.006)	(0.006)	(0.006)	(0.009)
Current Account		0.011	0.013*	0.015*		0.000	0.002	0.005
		(0.108)	(0.087)	(0.068)		(0.972)	(0.793)	(0.604)
Government Balance			-0.015*	-0.013*			-0.018**	-0.015**
			(0.054)	(0.088)			(0.011)	(0.027)
Political Stability				-0.383				-0.488
				(0.340)				(0.177)
Constant	-1.200***	-1.201***	-1.250***	-0.931**	-1.084***	-1.084***	-1.147***	-0.750*
	(0.000)	(0.000)	(0.000)	(0.034)	(0.000)	(0.000)	(0.000)	(0.050)
Observations	442	442	442	442	441	441	441	441
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.233	0.239	0.248	0.256	0.252	0.252	0.265	0.278
Number of countries	18	18	18	18	18	18	18	18

Table 4: Effect of debt expansion on future risk premia

We report the coefficients of regression (4) estimated with lags of DE. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with a 4-month lag of DE where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. Columns (4)-(6) and (7)-(9) report the same results for 5- and 6-month lags of DE, respectively. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are monthly observations of our sample of eurozone countries, spanning January 2002 to December 2017. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

	4-month lag			5-month lag			6-month lag		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Debt Expansion	-5.273***	-6.478***	-9.215***	-4.998**	-6.103***	-7.496**	-4.266**	-5.471***	-7.381**
	(0.009)	(0.002)	(0.003)	(0.016)	(0.004)	(0.012)	(0.044)	(0.009)	(0.018)
VIX	0.051***	0.048***	0.055***	0.047***	0.046***	0.054***	0.047***	0.046***	0.049***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Slope		0.088**	0.314**		0.090**	0.303**		0.091**	0.289**
		(0.013)	(0.023)		(0.013)	(0.036)		(0.012)	(0.042)
Bid-Ask			16.998**			14.005			15.943*
			(0.043)			(0.105)			(0.087)
Constant	-0.754***	-1.038***	-1.275***	-0.721***	-1.023***	-1.318***	-0.765***	-1.062***	-1.206***
	(0.000)	(0.000)	(0.004)	(0.000)	(0.000)	(0.005)	(0.000)	(0.000)	(0.009)
Observations	1,149	977	461	1,149	977	459	1,145	976	456
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.169	0.239	0.279	0.148	0.221	0.246	0.130	0.206	0.217
Number of countries	16	14	9	16	14	9	16	14	9

Table 5: Probabilities of default and CDS around the Deauville summit

We report the average level and slope of PDs and CDS (in bp) before and after Deauville (19 October 2010) using up to three weeks of data before and after the summit, excluding two days around the event. We also report their differences across time. *, **, and *** represent significance levels 0.10, 0.05, and 0.01, respectively.

		PD			CDS		
		Pre	Post	Difference	Pre	Post	Difference
1 week	level	412.024	412.024	0.000	147.994	136.508	-11.486
	slope	0.000	0.000	0.000	-6.683	2.050	8.733***
2 weeks	level	412.024	412.825	0.801	162.286	147.541	-14.745
	slope	0.000	0.200	0.200	-4.086	3.154	7.240***
3 weeks	level	412.069	413.169	1.100	170.331	155.230	-15.101
	slope	-0.015	0.143	0.158*	-3.084	2.979	6.063***

Table 6: Average risk premia around the Deauville summit

We report the average premia before and after Deauville (19 October 2010) for crisis and non-crisis eurozone countries using 1-year data before and after the summit, excluding the month of the event, one and two months around the event. We also report their differences across time and country groups. *, **, and *** represent significance levels 0.10, 0.05, and 0.01, respectively.

Window in months	Crisis countries	Non-crisis countries	Difference Non-crisis - Crisis
$[-12, -1]$	-286.98	-15.60	271.39***
$[+1, +12]$	255.19	43.70	-211.49*
Difference	542.17***	59.30***	
$[-13, -2]$	-266.48	-14.97	251.51***
$[+2, +13]$	504.17	56.51	-447.66**
Difference	770.65**	71.48***	
$[-14, -3]$	-246.03	-14.21	231.82***
$[+3, +14]$	755.48	65.95	-689.53***
Difference	1001.51***	80.16***	

Table 7: Effect of Deauville on the relation between debt expansion and future risk premia

We report the coefficients of regression (5) estimated with lags of DE. The dependent variable is ρ. We present the regression coefficients of 3-, 4-, and 5-month lags of DE and its interaction with dummy Post indicating the post-Deauville period where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. The F-test p-value tests that the sum of the coefficients on DE and interaction term is equal to zero. We include country fixed effect and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are monthly observations over the two years around the summit, excluding one month before and after the event. $*p < 0.1$; $**p < 0.05$; $***p < 0.01$.

Independent variable	4-month lag	5-month lag	6-month lag
Debt Expansion × Post	13.800***	9.695*	5.285
	(0.009)	(0.097)	(0.413)
Debt Expansion	-13.848***	-11.024***	-10.269*
	(0.000)	(0.010)	(0.052)
Post	-0.313	-0.091	0.121
	(0.181)	(0.799)	(0.782)
VIX	0.065***	0.065***	0.064***
	(0.000)	(0.000)	(0.000)
Slope	0.406**	0.347*	0.317*
	(0.030)	(0.059)	(0.056)
Bid-Ask	11.711	7.122	5.051
	(0.236)	(0.552)	(0.717)
Constant	-1.079*	-1.089*	-1.006*
	(0.056)	(0.092)	(0.096)
Observations	128	128	130
Country FE	Yes	Yes	Yes
Within R-squared	0.577	0.539	0.556
Number of countries	8	8	8
Impact of DE (Post-Deauville)	-0.048	-1.329	-4.9840*
F-test (p-value)	(0.988)	(0.710)	(0.093)

Table 8: Effect of debt expansion on future probability of default and risk premia before Deauville

We report in Panel A the coefficients of regression (3) estimated for pre-Deauville sub-sample. The dependent variable is ρ. Columns (1)-(4) present the regression coefficients with a 1-quarter lag of DE where we control for macroeconomic, external, governmental, and qualitative control variables, respectively. Columns (5)-(8) report the same results for the 2-quarter lag of DE. In Panel B, we report the coefficients of regression (4) estimated for the pre-Deauville sub-sample. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with a 4-month lag of DE where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. Columns (4)-(6) and (7)-(9) report the same results for 5- and 6-month lags of DE, respectively. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are quarterly (for Panel A) and monthly (for Panel B) observations of our sample of eurozone countries, spanning January 2002 to December 2009. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

(a) Debt expansion and probability of default (dependent variable log(PD))

	1-quarter lag				2-quarter lag			
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Debt Expansion	11.556***	11.707***	11.600***	10.309***	12.923***	13.099***	12.844***	12.017***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	-0.009	-0.019	-0.018	-0.017	-0.025	-0.034	-0.031	-0.027
	(0.903)	(0.804)	(0.804)	(0.823)	(0.715)	(0.642)	(0.682)	(0.728)
Real GDP Growth	0.024	0.023	0.021	0.025	0.011	0.007	0.006	0.012
	(0.304)	(0.341)	(0.356)	(0.278)	(0.485)	(0.689)	(0.717)	(0.488)
Current Account		-0.015*	-0.013	-0.013		-0.027*	-0.024	-0.022
		(0.077)	(0.119)	(0.117)		(0.057)	(0.117)	(0.150)
Government Balance			-0.012	-0.007			-0.013	-0.009
			(0.247)	(0.531)			(0.451)	(0.596)
Political Stability				-0.716**				-0.412
				(0.038)				(0.230)
Constant	-1.623***	-1.674***	-1.731***	-1.080***	-1.448***	-1.558***	-1.613***	-1.243***
	(0.000)	(0.000)	(0.000)	(0.007)	(0.000)	(0.000)	(0.000)	(0.006)
Observations	118	118	118	118	106	106	106	106
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.374	0.384	0.389	0.404	0.399	0.426	0.431	0.436
Number of countries	14	14	14	14	13	13	13	13

Table 8: (continued)

(b) Debt expansion and future risk premia (dependent variable ρ)

	4-month lag			5-month lag			6-month lag		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Debt Expansion	-6.656***	-6.772**	-14.496***	-6.512***	-6.201***	-11.902***	-5.335***	-5.416***	-9.763***
	(0.000)	(0.011)	(0.001)	(0.001)	(0.009)	(0.000)	(0.003)	(0.007)	(0.005)
VIX	0.051***	0.048***	0.043***	0.049***	0.049***	0.039***	0.053***	0.053***	0.033**
	(0.000)	(0.000)	(0.008)	(0.000)	(0.000)	(0.006)	(0.000)	(0.000)	(0.031)
Slope		-0.010	0.385		0.042	0.348		0.092	0.375
		(0.942)	(0.210)		(0.762)	(0.209)		(0.437)	(0.247)
Bid-Ask			2.884			-2.963			-5.797
			(0.829)			(0.863)			(0.753)
Constant	-1.717***	-1.853***	-0.399	-1.804***	-2.110***	-0.457	-2.041***	-2.399***	-0.522
	(0.000)	(0.000)	(0.647)	(0.000)	(0.000)	(0.536)	(0.000)	(0.000)	(0.548)
Observations	307	272	81	296	264	78	287	257	73
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.454	0.474	0.580	0.425	0.451	0.423	0.403	0.431	0.266
Number of countries	13	12	7	13	12	7	13	12	7

Table 9: Effect of debt expansion on future probability of default and risk premia after Deauville

We report in Panel A the coefficients of regression (3) estimated for post-Deauville sub-sample. The dependent variable is log (PD). Columns (1)-(4) present the regression coefficients with a 1-quarter lag of DE where we control for macroeconomic, external, governmental, and qualitative control variables, respectively. Columns (5)-(8) report the same results for the 2-quarter lag of DE. In Panel B, we report the coefficients of regression (4) estimated for the post-Deauville sub-sample. Columns (1)-(3) present the regression coefficients with a 4-month lag of DE where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. Columns (4)-(6) and (7)-(9) report the same results for 5- and 6-month lags of DE, respectively. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are quarterly (for Panel A) and monthly (for Panel B) observations of our sample of eurozone countries, spanning January 2011 to December 2014. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

(a) Debt expansion and probability of default (dependent variable log(PD))

	1-quarter lag				2-quarter lag			
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Debt Expansion	7.119***	7.131***	6.931***	7.054***	6.355**	6.333**	5.735**	5.896**
	(0.007)	(0.007)	(0.006)	(0.004)	(0.031)	(0.037)	(0.047)	(0.037)
Inflation	-0.184	-0.185	-0.206	-0.219	-0.134	-0.139	-0.155	-0.168
	(0.185)	(0.206)	(0.156)	(0.121)	(0.336)	(0.391)	(0.331)	(0.282)
Real GDP Growth	-0.059	-0.058	-0.061	-0.053	-0.087	-0.087	-0.086	-0.078
	(0.220)	(0.212)	(0.160)	(0.268)	(0.180)	(0.188)	(0.170)	(0.239)
Current Account		-0.002	0.000	0.000		-0.005	-0.003	-0.002
		(0.889)	(1.000)	(0.972)		(0.838)	(0.894)	(0.910)
Government Balance			-0.022***	-0.022***			-0.026***	-0.024***
			(0.000)	(0.000)			(0.000)	(0.000)
Political Stability				-0.566				-0.656
				(0.568)				(0.466)
Constant	-1.069***	-1.065***	-1.104***	-0.617	-1.076***	-1.059**	-1.106***	-0.542
	(0.003)	(0.005)	(0.004)	(0.481)	(0.003)	(0.013)	(0.008)	(0.513)
Observations	158	158	158	158	150	150	150	150
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.188	0.188	0.224	0.228	0.170	0.171	0.215	0.221
Number of countries	16	16	16	16	16	16	16	16

Table 9: (continued)

(b) Debt expansion and future risk premia (dependent variable ρ)

	4-month lag			5-month lag			6-month lag		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Debt Expansion	-6.141**	-7.516**	-5.909*	-7.834**	-9.012**	-4.964*	-7.639**	-8.611**	-4.729
	(0.031)	(0.015)	(0.070)	(0.024)	(0.014)	(0.074)	(0.046)	(0.030)	(0.110)
VIX	0.070***	0.063***	0.083***	0.045***	0.046***	0.074***	0.023***	0.032***	0.056***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)
Slope		0.152***	0.443***		0.181***	0.536***		0.192***	0.542***
		(0.006)	(0.000)		(0.006)	(0.001)		(0.004)	(0.002)
Bid-Ask			5.532			-10.451			-7.685
			(0.699)			(0.531)			(0.698)
Constant	-0.432***	-0.808***	-2.109***	0.050	-0.598**	-2.213***	0.426**	-0.406	-1.919***
	(0.006)	(0.004)	(0.000)	(0.710)	(0.049)	(0.001)	(0.017)	(0.120)	(0.001)
Observations	511	407	200	451	360	172	441	353	167
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.219	0.308	0.363	0.129	0.257	0.338	0.0764	0.212	0.256
Number of countries	16	13	9	15	13	9	15	13	9

Table 10: Effect of debt expansion on future probability of default and risk premia in non-crisis countries

We report in Panel A the coefficients of regression (3) estimated for non-crisis countries. The dependent variable is ρ. Columns (1)-(4) present the regression coefficients with a 1-quarter lag of DE where we control for macroeconomic, external, governmental, and qualitative control variables, respectively. Columns (5)-(8) report the same results for the 2-quarter lag of DE. In Panel B, we report the coefficients of regression (4) estimated for non-crisis countries. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with a 4-month lag of DE where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. Columns (4)-(6) and (7)-(9) report the same results for 5- and 6-month lags of DE, respectively. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are quarterly (for Panel A) and monthly (for Panel B) observations of our sample of non-crisis countries, spanning January 2002 to December 2017. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

(a) Debt expansion and probability of default (dependent variable log(PD))

	1-quarter lag				2-quarter lag			
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Debt Expansion	6.677**	6.591**	6.403**	6.405**	5.489**	5.471**	5.068**	5.114**
	(0.017)	(0.018)	(0.016)	(0.015)	(0.040)	(0.038)	(0.042)	(0.038)
Inflation	-0.073	-0.067	-0.066	-0.068	-0.055	-0.054	-0.049	-0.052
	(0.178)	(0.221)	(0.216)	(0.217)	(0.293)	(0.338)	(0.382)	(0.363)
Real GDP Growth	0.011	0.011	0.008	0.009	-0.011	-0.012	-0.012	-0.010
	(0.656)	(0.675)	(0.726)	(0.714)	(0.735)	(0.732)	(0.724)	(0.771)
Current Account		0.007	0.007	0.007		0.002	0.002	0.003
		(0.348)	(0.365)	(0.352)		(0.789)	(0.797)	(0.763)
Government Balance			-0.020**	-0.020**			-0.022**	-0.021**
			(0.019)	(0.019)			(0.011)	(0.011)
Political Stability				-0.162				-0.316
				(0.634)				(0.377)
Constant	-2.018***	-2.032***	-2.085***	-1.939***	-1.963***	-1.969***	-2.024***	-1.743***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Observations	314	314	314	314	313	313	313	313
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.180	0.184	0.209	0.210	0.116	0.116	0.146	0.150
Number of countries	14	14	14	14	14	14	14	14

Table 10: (continued)

(b) Debt expansion and future risk premia (dependent variable ρ)

	4-month lag			5-month lag			6-month lag		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Debt Expansion	-7.061***	-8.684***	-7.759***	-6.498**	-7.713***	-5.371***	-5.355*	-6.585**	-4.850**
	(0.004)	(0.000)	(0.005)	(0.014)	(0.001)	(0.009)	(0.060)	(0.012)	(0.024)
VIX	0.052***	0.057***	0.060***	0.046***	0.053***	0.058***	0.046***	0.052***	0.053***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Slope		0.407***	0.372**		0.400***	0.370**		0.408***	0.364**
		(0.005)	(0.017)		(0.004)	(0.022)		(0.007)	(0.023)
Bid-Ask			13.327*			11.330			14.491
			(0.080)			(0.147)			(0.107)
Constant	-0.176	-1.124***	-1.348***	-0.110	-1.081***	-1.423***	-0.172	-1.112***	-1.330***
	(0.352)	(0.003)	(0.002)	(0.515)	(0.002)	(0.001)	(0.259)	(0.001)	(0.002)
Observations	774	637	404	775	640	401	772	639	397
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.180	0.294	0.278	0.143	0.260	0.242	0.121	0.237	0.210
Number of countries	12	10	8	12	10	8	12	10	8

Table 11: Effect of quantitative easing on the relation between debt expansion and future probability of default and risk premia

We report in Panel A the coefficients of regression (3) estimated for post-Deauville sub-sample, including the interaction of DE with dummy variable W_{QE} to indicate the post-QE period. The dependent variable is log(PD). We report the regression coefficients where we control for macroeconomic, external, governmental, and qualitative control variables. In Panel B, we report the coefficients of regression (4) estimated for the post-Deauville sub-sample, including the interaction of DE with dummy variable W_{QE}. The dependent variable is ρ. We present the regression coefficients where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. The p-value in the last row of each panel is from the F-test, which shows that the sum of the coefficients on DE and interaction term equals zero. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are quarterly (for Panel A) and monthly (for Panel B) observations of our sample of eurozone countries, spanning January 2011 to December 2017. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

(a) Debt expansion and probability of default (dependent variable log(PD))

Independent variable	1-quarter lag	2-quarter lag
Debt Expansion $\times$ W_{QE}	-3.163	-3.453
	(0.306)	(0.327)
Debt Expansion	6.790***	6.287***
	(0.002)	(0.006)
Inflation	-0.132	-0.111
	(0.113)	(0.147)
Real GDP Growth	-0.030	-0.055
	(0.401)	(0.257)
Current Account	0.001	0.000
	(0.893)	(0.996)
Government Balance	-0.013**	-0.014***
	(0.019)	(0.005)
Political Stability	-0.866**	-0.969**
	(0.030)	(0.019)
Constant	-0.428	-0.305
	(0.195)	(0.327)
Observations	253	248
Country & Year FE	Yes	Yes
Within R-squared	0.290	0.329
Number of countries	17	17
Impact of DE (Post-QE)	3.627	2.825
F-test (p-value)	(0.118)	(0.209)

Table 11: (continued)

(b) Debt expansion and future risk premia (dependent variable ρ)

Independent variable	4-month lag	5-month lag	6-month lag
Debt Expansion × W_{QE}	9.570	9.854	8.282
	(0.227)	(0.130)	(0.267)
Debt Expansion	-10.186**	-9.754**	-9.696*
	(0.022)	(0.047)	(0.053)
VIX	0.054***	0.046***	0.028***
	(0.000)	(0.000)	(0.000)
Slope	0.293**	0.313**	0.322**
	(0.015)	(0.021)	(0.014)
Bid-Ask	22.018	15.269	-5.357
	(0.239)	(0.407)	(0.811)
Constant	-1.479***	-1.429***	-1.115***
	(0.000)	(0.001)	(0.001)
Observations	296	290	285
Country & Year	Yes	Yes	Yes
Within R-squared	0.247	0.216	0.158
Number of countries	9	9	9
Impact of DE (Post-QE)	-0.616	0.100	-1.414
F-test (p-value)	(0.923)	(0.979)	(0.769)

Online Appendix

A Descriptive statistics

Table A.1: Summary statistics of debt-to-GDP ratios

We report statistics of monthly debt-to-GDP ratios in %. We use monthly nominal debt stock of the outstanding amount of debt securities of the general government from the ECB at the end of each month in our sample and compute the debt-to-GDP ratio, using monthly estimates of GDP (i.e., one-third of the reference quarter GDP) and scaling outstanding debt by the GDP over the preceding twelve months. Ireland has no monthly observation of debt securities. The outstanding debt for Cyprus, Estonia, Latvia, and Malta is available for at least 36 months over the sample period. Data are for our sample of eurozone countries, spanning January 2002 to December 2017.

Country	Start	Obs.	Mean	Std.dev	Median	Min	Max
Austria	1/31/2002	192	61.95	6.31	60.19	51.28	73.35
Belgium	1/31/2002	192	90.18	5.14	91.98	77.93	99.23
Cyprus	1/31/2008	120	40.17	5.66	40.20	26.18	50.91
Estonia	1/31/2011	84	0.86	0.17	0.89	0.60	1.12
Finland	1/31/2002	192	39.36	7.03	39.72	24.63	51.80
France	1/31/2002	192	65.41	12.75	65.96	45.00	84.51
Germany	1/31/2002	192	50.51	6.49	50.52	37.12	63.01
Greece	1/31/2002	192	79.42	28.48	80.99	36.49	135.14
Italy	1/31/2002	192	96.89	11.30	95.26	81.37	115.14
Latvia	1/31/2014	48	26.92	2.88	26.61	20.79	31.41
Lithuania	1/30/2015	36	34.13	1.58	33.90	31.85	37.23
Luxembourg	1/31/2002	192	6.81	5.56	5.41	0.00	17.67
Malta	1/31/2008	120	59.76	4.80	60.44	47.45	67.42
Netherlands	1/31/2002	192	44.66	5.81	44.34	34.07	55.61
Portugal	1/31/2002	192	63.91	14.24	67.09	40.97	84.87
Slovakia	1/30/2009	108	41.80	6.59	44.52	24.43	50.44
Slovenia	01/31/2007	132	48.18	20.05	42.16	20.06	76.81
Spain	1/31/2002	192	56.23	20.09	47.65	30.54	86.09

Table A.2: Summary statistics of debt expansions

We report statistics of monthly debt expansions in %. We define debt expansion as the positive year-on-year debt-to-GDP ratio change. Ireland has no observation since there is no monthly observation of debt securities for this country. Data are for our sample of eurozone countries, spanning January 2002 to December 2017.

Country	Start	Obs.	Mean	Std.dev	Median	Min	Max
Austria	1/31/2002	128	2.28	2.51	1.31	0.02	11.38
Belgium	7/31/2003	79	2.37	2.77	1.17	0.01	11.31
Cyprus	3/31/2009	52	6.25	5.51	4.65	0.23	21.03
Estonia	7/31/2015	5	0.15	0.01	0.15	0.13	0.15
Finland	6/30/2003	89	3.16	2.49	2.41	0.02	11.12
France	1/31/2002	167	2.87	2.18	2.33	0.10	10.14
Germany	1/31/2002	112	2.77	1.82	2.46	0.00	9.74
Greece	2/28/2002	108	6.42	5.24	4.50	0.06	20.14
Italy	8/30/2002	108	3.42	2.72	3.04	0.03	11.49
Latvia	1/31/2014	45	3.59	2.15	3.42	0.02	7.61
Lithuania	2/27/2015	27	1.69	1.03	1.59	0.04	4.43
Luxembourg	12/31/2008	63	3.52	1.77	3.42	0.05	6.24
Malta	6/30/2008	59	2.47	1.90	2.08	0.07	6.86
Netherlands	1/31/2002	101	2.68	2.33	2.00	0.04	10.50
Portugal	1/31/2002	151	4.13	3.06	3.46	0.04	11.58
Slovakia	1/30/2009	65	4.62	2.37	4.77	0.12	9.49
Slovenia	01/31/2007	92	7.09	5.42	6.24	0.24	22.72
Spain	10/31/2008	97	6.66	3.84	7.61	0.04	13.47

Table A.3: Summary statistics of 1-year probabilities of default

We report statistics of monthly 1-year probabilities of default estimated by Bloomberg in %. The Bloomberg sovereign risk function estimates the 1-year probability of sovereign default using a multi-factor model, and its inputs are GDP growth, the Economist Intelligence Unit political risk score, non-performing bank loans, government surplus, and refinancing ability. We report the monthly probabilities of default on the last day of the reference month. Data are for our sample of eurozone countries, spanning January 2002 to December 2017.

Country	Start	Obs.	Mean	StdDev	Median	Min	Max
Austria	07/31/2006	136	0.04	0.02	0.04	0.01	0.07
Belgium	06/30/2006	137	0.15	0.06	0.16	0.04	0.26
Cyprus	12/31/2010	84	11.89	9.44	6.18	1.07	26.35
Estonia	01/31/2011	83	0.19	0.02	0.19	0.16	0.24
Finland	07/31/2006	136	0.01	0.01	0.01	0.01	0.02
France	06/30/2006	137	0.07	0.03	0.08	0.02	0.11
Germany	06/30/2006	137	0.04	0.01	0.04	0.01	0.06
Greece	01/31/2002	188	25.35	25.85	24.56	0.56	82.11
Ireland	07/31/2006	136	3.05	5.38	0.91	0.04	19.77
Italy	01/31/2002	188	4.10	3.15	2.79	1.13	11.30
Latvia	01/31/2014	48	0.33	0.09	0.28	0.25	0.49
Lithuania	01/30/2015	36	1.38	0.18	1.48	1.12	1.53
Luxembourg	06/30/2006	137	0.01	0.00	0.01	0.01	0.02
Malta	01/31/2008	118	0.21	0.11	0.23	0.05	0.39
Netherlands	08/31/2006	135	0.04	0.02	0.05	0.01	0.07
Portugal	01/31/2002	188	3.45	3.51	2.53	0.33	11.34
Slovakia	01/30/2009	106	0.43	0.30	0.33	0.18	1.34
Slovenia	01/31/2007	130	1.28	1.91	0.77	0.11	7.52
Spain	01/31/2002	188	1.58	2.10	0.90	0.06	7.44

Table A.4: Summary statistics of recovery rates

We report statistics of monthly recovery rates in %. We report the monthly recovery rate on the last day of the reference month. There are no observations on recovery rates for Lithuania and very limited for Luxembourg. The last available observation for Estonia, Latvia, Malta, Slovenia, and Slovakia is on 9/30/2014. Data are for our sample of eurozone countries, spanning January 2002 to December 2017.

Country	Start	Obs.	Mean	StdDev	Median	Min	Max
Austria	01/31/2003	179	39.76	1.57	40.00	35.00	48.00
Belgium	01/31/2002	192	39.32	3.35	40.00	21.67	46.00
Cyprus	01/31/2008	120	39.24	2.54	40.00	25.00	42.00
Estonia	01/31/2011	44	25.00	0.00	25.00	25.00	25.00
Finland	09/30/2002	184	40.03	1.68	40.00	32.50	50.00
France	08/30/2002	185	40.02	1.67	40.00	33.72	45.13
Germany	10/31/2002	183	39.83	2.13	40.00	28.00	46.67
Greece	01/31/2002	175	36.59	5.95	39.36	17.50	50.33
Ireland	11/28/2003	167	39.69	1.73	40.00	25.00	43.60
Italy	01/31/2002	192	39.16	4.02	40.00	20.00	47.86
Latvia	01/31/2014	8	25.00	0.00	25.00	25.00	25.00
Malta	01/31/2008	80	38.22	3.21	40.00	32.50	40.00
Netherlands	10/31/2005	146	39.54	1.46	40.00	35.00	45.00
Portugal	05/31/2002	188	39.58	1.94	40.00	32.00	45.08
Slovakia	01/30/2009	68	24.70	0.90	25.00	21.67	25.00
Slovenia	01/31/2007	92	25.11	1.59	25.00	23.75	40.00
Spain	01/31/2002	192	39.44	2.91	40.00	21.67	43.85

Table A.5: Summary statistics of 1-year CDS spreads

We report statistics of monthly CDS spreads (bp) for contracts denominated in euro (Panel A) and USD (Panel B). We report the monthly CDS spreads on the last day of the reference month. There are no CDS data for Lithuania and Luxembourg, and the last available observation for Estonia, Latvia, Malta, Slovenia, and Slovakia is on 9/30/2014. Data are for our sample of eurozone countries, spanning January 2002 to December 2017.

Country	Start	Obs.	Mean	StdDev	Median	Min	Max
(a) EUR-denominated CDS							
Austria	08/30/2002	182	15.42	28.08	4.10	0.60	205.62
Belgium	06/28/2002	184	22.01	38.84	5.06	0.97	199.68
Cyprus	01/31/2008	119	434.91	510.93	175.81	12.25	2013.43
Estonia	01/31/2011	44	31.48	25.33	19.83	10.51	119.26
Finland	09/30/2002	158	8.45	10.95	4.24	0.75	68.40
France	08/30/2002	177	12.79	19.54	4.90	0.83	122.42
Germany	10/31/2002	177	6.41	8.83	2.66	0.43	47.42
Greece	02/28/2002	173	1028.04	2751.99	107.54	1.31	20185.31
Ireland	01/31/2003	171	121.51	231.24	11.69	0.56	1045.87
Italy	01/31/2002	192	56.03	83.81	28.74	1.15	451.44
Latvia	01/31/2014	8	25.18	5.34	22.77	17.69	32.95
Malta	01/31/2008	71	149.04	106.50	136.96	7.66	380.57
Netherlands	12/31/2003	121	14.37	19.07	5.84	0.93	105.74
Portugal	08/30/2002	185	168.33	336.47	41.28	0.63	2122.97
Slovakia	01/30/2009	68	53.32	53.65	37.71	5.77	208.27
Slovenia	01/31/2007	90	81.23	86.27	42.03	0.88	324.40
Spain	01/31/2002	192	53.37	80.19	17.63	0.56	352.36
(b) USD-denominated CDS							
Austria	01/31/2002	189	18.27	31.73	5.14	0.60	205.62
Belgium	06/28/2002	184	26.86	48.80	6.33	0.97	257.60
Cyprus	01/31/2008	119	454.28	527.33	192.55	12.25	1789.47
Estonia	01/31/2011	45	34.90	27.75	20.79	10.47	122.42
Finland	09/30/2002	169	9.39	11.66	5.61	0.75	68.40
France	08/30/2002	179	15.94	24.52	5.90	0.83	131.59
Germany	10/31/2002	179	8.02	10.89	3.60	0.43	64.87
Greece	02/28/2002	176	1107.34	2819.19	124.18	1.31	21125.86
Ireland	01/31/2003	174	128.72	245.18	12.96	0.56	1088.40
Italy	01/31/2002	192	64.85	96.99	32.78	1.15	518.09
Latvia	01/31/2014	9	26.15	6.82	24.60	17.49	34.78
Malta	01/31/2008	72	148.72	105.66	135.96	7.66	380.57
Netherlands	12/31/2003	126	16.86	20.51	7.65	0.93	105.74
Portugal	02/28/2002	191	177.75	358.89	41.28	0.63	2228.49
Slovakia	01/30/2009	69	59.56	60.49	39.26	8.18	246.56
Slovenia	01/31/2007	93	88.59	93.40	44.47	0.88	335.46
Spain	01/31/2002	192	64.49	99.37	22.01	0.56	453.57

Table A.6: Summary statistics of risk premia using EUR-denominated CDS

We report statistics of monthly risk premia (in bp) and their scaled proxy ρ. We estimate the risk premium and ρ using (CDS spread - probability of default$\times$(1-recovery rate)) and log (1+Risk premium/Expected loss), respectively, where we use monthly data on CDS spreads and recovery rates, and monthly probabilities of default. The last column gives the proportion of non-positive observations in our sample with a probability 0.90. There are no CDS data for Lithuania and Luxembourg, and the last available observation for Estonia, Latvia, Malta, Slovenia, and Slovakia is on 9/30/2014. Data are for our sample of eurozone countries, spanning January 2002 to December 2017.

Country	Start	Obs.	Mean	StdDev	Median	Min	Max	$< \epsilon$
(a) Premia								
Austria	07/31/2006	133	17.73	31.31	2.87	-0.93	203.32	0.00
Belgium	06/30/2006	134	20.12	43.21	0.15	-11.07	192.57	0.31
Cyprus	12/31/2010	84	-156.86	702.15	-200.95	-1180.45	1433.36	0.71
Estonia	01/31/2011	43	18.14	25.63	7.55	-4.42	105.16	0.00
Finland	07/31/2006	118	9.75	12.06	4.44	0.39	67.53	0.00
France	06/30/2006	130	11.97	21.36	2.52	-4.77	117.05	0.11
Germany	06/30/2006	131	5.41	9.64	1.01	-2.34	45.36	0.13
Greece	02/28/2002	170	-373.36	2403.72	-148.10	-4202.95	14317.36	0.41
Ireland	07/31/2006	130	-33.06	179.86	-4.81	-564.28	508.72	0.35
Italy	01/31/2002	188	-192.04	195.10	-126.76	-649.83	320.24	0.91
Latvia	01/31/2014	8	1.08	5.55	-1.40	-6.80	9.08	0.13
Malta	01/31/2008	69	132.71	104.04	119.02	-2.01	359.60	0.00
Netherlands	03/31/2008	115	12.21	19.47	3.83	-1.71	104.37	0.00
Portugal	08/30/2002	182	-45.55	315.00	-44.62	-532.84	1495.76	0.64
Slovakia	01/30/2009	66	16.95	65.31	-4.78	-66.95	192.51	0.47
Slovenia	01/31/2007	88	-11.29	177.78	0.74	-549.73	285.44	0.23
Spain	01/31/2002	188	-42.46	120.96	-5.35	-403.94	188.57	0.37
(b) Scaled premia proxy, ρ								
Austria	07/31/2006	133	1.25	1.30	0.75	-0.89	4.73	0.09
Belgium	06/30/2006	134	0.33	1.42	0.01	-1.75	3.34	0.48
Cyprus	12/31/2010	84	-0.28	1.36	-0.75	-2.14	3.13	0.68
Estonia	01/31/2011	43	0.60	0.70	0.46	-0.31	2.14	0.16
Finland	07/31/2006	118	2.22	1.18	1.80	0.54	4.83	0.00
France	06/30/2006	130	0.72	1.19	0.58	-1.30	3.42	0.31
Germany	06/30/2006	131	0.65	1.15	0.39	-1.78	3.67	0.27
Greece	02/28/2002	170	-1.64	1.18	-1.67	-4.24	1.57	0.89
Ireland	07/31/2006	130	-0.33	1.34	-0.35	-3.05	4.33	0.57
Italy	01/31/2002	188	-2.27	1.29	-2.46	-4.45	1.24	0.91
Latvia	01/31/2014	8	0.02	0.22	-0.06	-0.33	0.32	0.13
Malta	01/31/2008	69	1.87	0.77	2.07	-0.23	2.90	0.01
Netherlands	03/31/2008	115	1.26	1.21	1.10	-0.76	4.71	0.13
Portugal	08/30/2002	182	-1.41	1.41	-1.62	-3.92	1.88	0.82
Slovakia	01/30/2009	66	0.13	1.24	-0.23	-1.75	2.73	0.50
Slovenia	01/31/2007	88	-0.04	1.56	0.05	-3.68	2.96	0.44
Spain	01/31/2002	188	-0.84	1.11	-1.19	-2.99	2.73	0.72

Table A.7: Summary statistics of risk premia using USD-denominated CDS

We report statistics of monthly risk premia (in bp) and their scaled proxy ρ. We estimate the risk premium and ρ using (CDS spread - probability of default×(1-recovery rate)) and log (1+Risk premium/Expected loss), respectively, where we use monthly data on CDS spreads denominated in USD and recovery rates, and monthly probabilities of default. The last column gives the proportion of non-positive observations in our sample with a probability 0.90. There are no CDS data for Lithuania and Luxembourg, and the last available observation for Estonia, Latvia, Malta, Slovenia, and Slovakia is on 9/30/2014. Data are for our sample of eurozone countries, spanning January 2002 to December 2017.

Country	Start	Obs.	Mean	StdDev	Median	Min	Max	$< \epsilon$
(a) Premia								
Austria	07/31/2006	133	22.44	35.57	4.95	-0.93	203.32	0.00
Belgium	06/30/2006	134	26.73	54.20	1.48	-10.49	250.50	0.11
Cyprus	12/31/2010	84	-124.27	725.61	-200.73	-1173.30	1424.69	0.70
Estonia	01/31/2011	44	21.40	28.17	6.63	-4.74	108.32	0.00
Finland	07/31/2006	121	11.43	12.77	6.41	0.39	67.53	0.00
France	06/30/2006	131	16.17	26.85	4.43	-3.86	126.21	0.04
Germany	06/30/2006	133	7.52	11.83	2.15	-2.34	62.03	0.05
Greece	02/28/2002	173	-299.81	2452.25	-147.93	-4112.29	15257.90	0.41
Ireland	07/31/2006	130	-21.44	180.09	-2.29	-514.28	551.98	0.34
Italy	01/31/2002	188	-183.23	199.33	-126.12	-646.45	386.90	0.91
Latvia	01/31/2014	9	1.56	7.83	0.74	-11.06	10.91	0.33
Malta	01/31/2008	70	132.39	103.19	119.02	-2.01	359.60	0.00
Netherlands	03/31/2008	116	15.29	20.95	5.90	-1.18	104.37	0.00
Portugal	05/31/2002	185	-30.29	332.15	-41.32	-515.88	1598.73	0.59
Slovakia	01/30/2009	67	23.49	71.56	1.66	-65.92	217.56	0.46
Slovenia	01/31/2007	91	-8.06	187.55	3.87	-548.65	297.01	0.19
Spain	01/31/2002	188	-31.24	127.45	-5.25	-390.01	265.13	0.37
(b) Scaled premia proxy, ρ								
Austria	07/31/2006	133	1.51	1.27	1.14	-0.89	4.73	0.03
Belgium	06/30/2006	134	0.51	1.40	0.18	-1.91	3.59	0.46
Cyprus	12/31/2010	84	-0.22	1.38	-0.69	-1.97	3.11	0.69
Estonia	01/31/2011	44	0.68	0.73	0.40	-0.33	2.16	0.14
Finland	07/31/2006	121	2.42	1.10	2.07	0.67	5.00	0.00
France	06/30/2006	131	0.93	1.18	0.80	-1.15	3.42	0.24
Germany	06/30/2006	133	0.91	1.12	0.75	-1.78	3.67	0.13
Greece	02/28/2002	173	-1.59	1.21	-1.63	-4.24	1.55	0.88
Ireland	07/31/2006	130	-0.20	1.29	-0.28	-2.97	4.33	0.55
Italy	01/31/2002	188	-2.18	1.34	-2.36	-4.45	1.37	0.91
Latvia	01/31/2014	9	0.03	0.31	0.03	-0.49	0.38	0.33
Malta	01/31/2008	70	1.87	0.77	2.08	-0.23	2.90	0.01
Netherlands	03/31/2008	116	1.54	1.10	1.44	-0.47	4.71	0.03
Portugal	05/31/2002	185	-1.36	1.42	-1.53	-3.92	1.96	0.83
Slovakia	01/30/2009	67	0.25	1.22	0.08	-1.44	2.73	0.49
Slovenia	01/31/2007	91	0.02	1.56	0.20	-3.60	2.96	0.38
Spain	01/31/2002	188	-0.73	1.10	-1.07	-2.85	2.73	0.71

B Robustness tests

Table B.1: Effect of debt expansion on future probability of default and risk premia with debt-to-GDP control

We report in Panel A the coefficients of regression (3) when we add debt-to-GDP as a control variable. The dependent variable is log (PD). Columns (1)-(2) present the regression coefficients with a 1-quarter lag of DE when we control for macroeconomic, external, governmental, and qualitative variables. Columns (3)-(4) report the same results for a 2-quarter lag. In Panel B, we report the coefficients of regression (4) when we add debt-to-GDP as a control variable. The dependent variable is ρ. Columns (1)-(2) present the regression coefficients with a 4-month lag where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, macroeconomic risk as estimated by debt-to-GDP, and liquidity risk measured by bid-ask spread of the 1-year benchmark bond. Columns (3)-(4) and (5)-(6) report the same results for 5- and 6-month lags. We country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are quarterly (for Panel A) and monthly (for Panel B) observations of our sample of eurozone countries, spanning January 2002 to December 2017. $*p < 0.1$; $**p < 0.05$; $***p < 0.01$.

(a) Debt expansion and probability of default (dependent variable log(PD))

	1-quarter lag		2-quarter lag	
Independent variable	(1)	(2)	(3)	(4)
Debt Expansion	6.142***	5.379***	5.865***	5.132***
	(0.001)	(0.003)	(0.000)	(0.001)
Inflation	-0.090	-0.097	-0.114*	-0.120*
	(0.147)	(0.125)	(0.066)	(0.055)
Real GDP Growth	-0.089**	-0.075**	-0.101***	-0.084**
	(0.012)	(0.020)	(0.005)	(0.014)
Current Account	0.007	0.009	-0.002	0.001
	(0.264)	(0.187)	(0.805)	(0.908)
Government Balance	-0.010	-0.007	-0.016**	-0.011*
	(0.154)	(0.305)	(0.014)	(0.069)
Debt-to-GDP	2.425***	2.733***	1.586*	1.951**
	(0.000)	(0.001)	(0.056)	(0.046)
Political Stability		-0.625***		-0.694**
		(0.009)		(0.011)
Constant	-2.682***	-2.342***	-2.071***	-1.719**
	(0.000)	(0.001)	(0.002)	(0.024)
Observations	442	442	441	441
Country & Year FE	Yes	Yes	Yes	Yes
Within R-squared	0.308	0.329	0.294	0.319
Number of countries	18	18	18	18

Table B.1: (continued)

(b) Debt expansion and future risk premia (dependent variable ρ)

	4-month lag		5-month lag		6-month lag	
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Debt Expansion	-5.214**	-9.368***	-4.916**	-7.680***	-4.306**	-7.485**
	(0.017)	(0.002)	(0.026)	(0.008)	(0.041)	(0.014)
VIX	0.047***	0.056***	0.045***	0.055***	0.045***	0.050***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Slope	0.112***	0.337**	0.113***	0.330**	0.114***	0.317**
	(0.002)	(0.025)	(0.002)	(0.034)	(0.002)	(0.039)
Debt-to-GDP	-2.323*	1.450	-2.316*	1.753	-2.317*	1.761
	(0.062)	(0.440)	(0.063)	(0.370)	(0.055)	(0.350)
Bid-Ask		17.725**		14.680		16.465*
		(0.043)		(0.102)		(0.098)
Constant	0.516	-2.402	0.531	-2.676	0.495	-2.572
	(0.521)	(0.156)	(0.503)	(0.129)	(0.513)	(0.124)
Observations	977	461	977	459	976	456
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.261	0.284	0.244	0.253	0.228	0.224
Number of countries	14	9	14	9	14	9

Table B.2: Effect of Deauville on the relation between debt expansion and future risk premia controlling for debt-to-GDP

We report the coefficients of regression (5), adding debt-to-GDP as a control variable. The dependent variable is ρ. We present the regression coefficients of DE and its interaction with Post indicating the post-Deauville period where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, macroeconomic risk as estimated by debt-to-GDP, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. The F-test p-value tests that the sum of the coefficients on DE and interaction term is equal to zero. We include country fixed effect and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are monthly observations over the two years around the summit, excluding one month before and after the event. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Independent variable	4-month lag	5-month lag	6-month lag
Debt Expansion × Post	15.076*	9.583	4.962
	(0.080)	(0.168)	(0.441)
Debt Expansion	-14.110***	-11.008**	-10.487**
	(0.002)	(0.013)	(0.036)
Post	-0.310	-0.096	0.040
	(0.179)	(0.769)	(0.916)
VIX	0.065***	0.065***	0.063***
	(0.000)	(0.000)	(0.000)
Slope	0.388**	0.351*	0.350**
	(0.038)	(0.080)	(0.049)
Debt-to-GDP	-1.738	0.303	2.790
	(0.774)	(0.960)	(0.625)
Bid-Ask	10.687	7.259	5.710
	(0.391)	(0.583)	(0.674)
Constant	0.076	-1.290	-2.833
	(0.985)	(0.764)	(0.478)
Observations	128	128	130
Country FE	Yes	Yes	Yes
Within R-squared	0.578	0.539	0.559
Number of countries	8	8	8
Impact of DE (Post-Deauville)	0.966	-1.425	-5.525
F-test (p-val)	(0.861)	(0.725)	(0.108)

Table B.3: Effect of Deauville on the relation between debt expansion and future risk premia with a different time window

We report the coefficients of regression (5) where we exclude only the month of the event. The dependent variable is ρ. We present the regression coefficients of DE and its interaction with Post indicating the post-Deauville period where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. The F-test p-value tests that the sum of the coefficients on DE and interaction term is equal to zero. We include country fixed effect and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are monthly observations over the two years around the summit, excluding only the month of the event. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Independent variable	4-month lag	5-month lag	6-month lag
Debt Expansion × Post	8.852*	4.962	4.535
	(0.071)	(0.260)	(0.365)
Debt Expansion	-12.542***	-10.690***	-11.050**
	(0.002)	(0.004)	(0.015)
Post	-0.219	-0.035	-0.016
	(0.409)	(0.902)	(0.965)
VIX	0.066***	0.066***	0.063***
	(0.000)	(0.000)	(0.000)
Slope	0.409**	0.330**	0.296**
	(0.022)	(0.029)	(0.040)
Bid-Ask	-6.198	-10.440	-7.184
	(0.458)	(0.329)	(0.482)
Constant	-1.141**	-1.004**	-0.813*
	(0.021)	(0.028)	(0.068)
Observations	130	131	131
Country FE	Yes	Yes	Yes
Within R-squared	0.537	0.512	0.520
Number of countries	8	8	8
Impact of DE (Post-Deauville)	-3.690	-5.728	-6.515*
F-test (p-val)	(0.413)	(0.175)	(0.083)

Table B.4: Effect of the Greek government deficit announcement and the Deauville shock on the relation between debt expansion and future risk premia

We report the coefficients of a regression model akin to (5) with two included dummy variables and their interaction with DE. The D_1 equals one for the period between the Greek announcement and Deauville and zero otherwise. D_2 is equal to one for the post-Deauville period and zero otherwise. The dependent variable is ρ. We present the regression coefficients of DE and its interaction with dummy variables where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. The F-test p-values test that the sum of the coefficients on DE and interaction terms equals zero. We include country fixed effect and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are monthly observations over the three years around the Greek event and Deauville summit, excluding the month of the events. $^*p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Independent variable	4-month lag	5-month lag	6-month lag
Debt Expansion × D_1	5.015	4.674	6.151
	(0.353)	(0.399)	(0.313)
Debt Expansion × D_2	14.054*	10.225	10.783*
	(0.053)	(0.101)	(0.083)
Debt Expansion	-15.982***	-13.806**	-15.680**
	(0.007)	(0.023)	(0.024)
D_1	-0.030	0.107	0.239
	(0.916)	(0.701)	(0.437)
D_2	-0.185	0.123	0.288
	(0.601)	(0.730)	(0.456)
VIX	0.064***	0.066***	0.066***
	(0.000)	(0.000)	(0.000)
Slope	0.535***	0.488***	0.455***
	(0.004)	(0.004)	(0.004)
Bid-Ask	0.126	-3.708	-9.899
	(0.989)	(0.712)	(0.362)
Constant	-1.430**	-1.589**	-1.585***
	(0.023)	(0.012)	(0.006)
Observations	164	159	154
Country FE	Yes	Yes	Yes
Within R-squared	0.595	0.549	0.534
Number of countries	8	8	8
Impact of DE (Post-Greek-pre-Deauville)	-10.967**	-9.132**	-9.529**
F-test (p-value)	(0.0121)	(0.015)	(0.0197)
Impact of DE (Post-Deauville)	-1.928	-3.581	-4.897
F-test (p-value)	(0.727)	(0.494)	(0.247)

Table B.5: Effect of ECB President's "Whatever it takes" moment on the relationship between debt expansion and future risk premia

We report the coefficients of regression model akin to (4) estimated with dummy variable W_{WIT} and its interaction of DE. The W_{WIT} is equal to one for the period after the "whatever it takes" statement of the ECB President. The dependent variable is ρ. We present the regression coefficients of DE and its interaction with dummy variable W_{WIT} where we control for investor expectations using VIX, the overall state of the economy using the slope of the term structure, and liquidity risk using the bid-ask spread of the 1-year benchmark bond. The F-test p-value tests that the sum of the coefficients on DE and interaction term is equal to zero. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are monthly observations of our sample of eurozone countries, spanning January 2011 to December 2017. $*p < 0.1$; $**p < 0.05$; $***p < 0.01$.

Independent variable	4-month lag	5-month lag	6-month lag
Debt Expansion × W_{WIT}	3.134	5.279	5.712
	(0.410)	(0.141)	(0.110)
Debt Expansion	-10.978**	-13.222***	-13.112***
	(0.012)	(0.002)	(0.006)
W_{WIT}	-1.587***	-1.687***	-1.679***
	(0.003)	(0.001)	(0.002)
VIX	0.046***	0.037***	0.019***
	(0.000)	(0.000)	(0.001)
Slope	0.288**	0.300**	0.301***
	(0.012)	(0.010)	(0.009)
Bid-Ask	32.380	27.115	24.377
	(0.145)	(0.260)	(0.503)
Constant	-0.054	0.194	0.485
	(0.870)	(0.519)	(0.174)
Observations	296	290	285
Country & Year FE	Yes	Yes	Yes
Within R-squared	0.454	0.428	0.398
Number of countries	9	9	9
Impact of DE (Post-WIT)	-7.844*	-7.943	-7.400
F-test(p-value)	(0.090)	(0.121)	(0.154)

Table B.6: Effect of debt expansion on future risk premia using USD-denominated CDS

We report the coefficients of regression (4) where the risk premia is calculated using USD-denominated CDS. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with a 4-month lag of DE where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. Columns (4)-(6) and (7)-(9) report the same results for 5- and 6-month lags of DE. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are monthly observations of our sample of eurozone countries, spanning January 2002 to December 2017. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

	4-month lag			5-month lag			6-month lag		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Debt Expansion	-6.020***	-6.984***	-9.232***	-5.734***	-6.625***	-7.702***	-5.129**	-6.064***	-7.397**
	(0.005)	(0.002)	(0.004)	(0.008)	(0.003)	(0.009)	(0.023)	(0.008)	(0.020)
VIX	0.048***	0.046***	0.051***	0.045***	0.044***	0.050***	0.045***	0.044***	0.045***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Slope		0.072**	0.240*		0.073**	0.226*		0.075**	0.211
		(0.017)	(0.056)		(0.016)	(0.088)		(0.015)	(0.108)
Bid-Ask			16.757*			13.347			15.945*
			(0.055)			(0.134)			(0.095)
Constant	-0.509***	-0.767***	-0.811**	-0.483***	-0.755***	-0.850**	-0.516***	-0.787***	-0.736**
	(0.001)	(0.000)	(0.024)	(0.001)	(0.000)	(0.022)	(0.000)	(0.000)	(0.047)
Observations	1,162	989	463	1,160	987	461	1,156	986	458
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.182	0.238	0.258	0.162	0.220	0.222	0.142	0.203	0.191
Number of countries	16	14	9	16	14	9	16	14	9

Table B.7: Effect of debt expansion on future risk premia with the ISDA constant recovery rates

We report the coefficients of regression (4) when the risk premia are calculated using constant recovery rates of 40%, according to the ISDA contract specifications for CDS on senior unsecured debt. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with a 4-month lag of DE where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. Columns (4)-(6) and (7)-(9) report the same results for 5- and 6-month lags of DE. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are monthly observations of our sample of eurozone countries, spanning January 2002 to December 2017. $*p < 0.1$; $**p < 0.05$; $***p < 0.01$.

	4-month lag			5-month lag			6-month lag		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Debt Expansion	-5.258***	-6.480***	-9.190***	-4.988**	-6.118***	-7.479**	-4.251**	-5.502***	-7.376**
	(0.009)	(0.002)	(0.003)	(0.016)	(0.004)	(0.012)	(0.044)	(0.008)	(0.018)
VIX	0.051***	0.049***	0.055***	0.047***	0.046***	0.054***	0.047***	0.046***	0.049***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Slope		0.093***	0.315**		0.095***	0.305**		0.096***	0.291**
		(0.007)	(0.022)		(0.007)	(0.035)		(0.007)	(0.041)
Bid-Ask			16.885**			13.891			15.807*
			(0.042)			(0.104)			(0.086)
Constant	-0.726***	-1.034***	-1.256***	-0.693***	-1.018***	-1.300***	-0.739***	-1.058***	-1.188***
	(0.000)	(0.000)	(0.005)	(0.000)	(0.000)	(0.005)	(0.000)	(0.000)	(0.009)
Observations	1,149	977	461	1,149	977	459	1,145	976	456
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.169	0.246	0.280	0.148	0.229	0.246	0.130	0.214	0.217
Number of countries	16	14	9	16	14	9	16	14	9

Table B.8: Effect of debt expansion on future risk premia with a predictive regression model

We report the coefficients of a predictive regression model akin to the regression model (4). The dependent variable is ρ. Columns (1)-(2) present the predictive regression coefficients with a 4-month lag of the main independent variable, DE, investor expectations, and ρ. Columns (3)-(4) and (5)-(6) report the same results for 5- and 6-month lags of all independent variables. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are monthly observations of our sample of eurozone countries, spanning January 2002 to December 2017. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

	4-month lag		5-month lag		6-month lag	
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Debt Expansion	-5.008**	-3.286*	-5.277**	-4.079**	-4.449**	-3.797*
	(0.019)	(0.064)	(0.011)	(0.026)	(0.034)	(0.062)
VIX	0.027***	0.007	0.017***	0.002	0.017**	0.005
	(0.000)	(0.138)	(0.007)	(0.705)	(0.015)	(0.521)
ρ		0.541***		0.466***		0.369***
		(0.000)		(0.000)		(0.000)
Constant	-0.341*	-0.065	-0.146	0.055	-0.212	-0.025
	(0.068)	(0.644)	(0.396)	(0.724)	(0.236)	(0.893)
Observations	1,149	1,098	1,149	1,083	1,145	1,073
Country & Year FE	YES	YES	YES	YES	YES	YES
Within R-squared	0.0856	0.308	0.0555	0.232	0.0419	0.149
Number of countries	16	16	16	15	16	15

Table B.9: Effects of the debt and growth components of debt expansion on future risk premia

We report the coefficients of regression (4) estimated with $\Delta\log(\text{Debt})$ and $\Delta\log(\text{GDP})$ instead of debt expansion. The dependent variable is ρ. Columns (1)-(3) presents the regression coefficients with 4-month lag of $\Delta\log(\text{Debt})$ and $\Delta\log(\text{GDP})$ where we control for investor expectations by VIX, the overall state of economy by the slope of the term structure, and liquidity risk measured by bid-ask spread of the 1-year benchmark bond. Columns (4)-(6) and (7)-(9) report the same results for 5- and 6-month lags of $\Delta\log(\text{Debt})$ and $\Delta\log(\text{GDP})$. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are monthly observations of our sample of eurozone countries, spanning January 2002 to December 2017. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

	4-month lag			5-month lag			6-month lag		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\Delta\log(\text{Debt})$	-1.864*	-1.585	-1.455**	-1.963*	-1.591	-1.153**	-1.963*	-1.591	-1.153**
	(0.097)	(0.213)	(0.016)	(0.092)	(0.181)	(0.044)	(0.092)	(0.181)	(0.044)
$\Delta\log(\text{GDP})$	6.639*	15.147***	16.380***	6.897*	15.785***	15.896***	6.897*	15.785***	15.896***
	(0.056)	(0.000)	(0.002)	(0.056)	(0.000)	(0.004)	(0.056)	(0.000)	(0.004)
VIX	0.049***	0.045***	0.054***	0.046***	0.043***	0.052***	0.046***	0.043***	0.052***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Slope		0.165***	0.433***		0.168***	0.423***		0.168***	0.423***
		(0.001)	(0.004)		(0.000)	(0.006)		(0.000)	(0.006)
Bid-Ask			5.433			0.424			0.424
			(0.313)			(0.948)			(0.948)
Constant	-0.898***	-1.586***	-1.943***	-0.851***	-1.582***	-1.938***	-0.851***	-1.582***	-1.938***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	1,149	977	461	1,149	977	459	1,149	977	459
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.177	0.311	0.365	0.161	0.304	0.337	0.161	0.304	0.337
Number of countries	16	14	9	16	14	9	16	14	9

Table B.10: Effect of Collective Action Clauses introduction on the relation between debt expansion and future risk premia

We report the coefficients of a regression model akin to (5) estimated with dummy variable Post indicating the post-CAC introduction period and where DE is calculated using only debt securities with maturity above one year. The dependent variable is ρ. We present the regression coefficients of DE and its interaction with dummy Post where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. The F-test p-value tests that the sum of the coefficients on DE and interaction term is equal to zero. We include country fixed effect and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are monthly observations over the two years around the summit, excluding the event month. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Independent variable	4-month lag	5-month lag	6-month lag
Debt Expansion × Post	21.897*	20.895	17.999
	(0.073)	(0.162)	(0.214)
Debt Expansion	-30.377**	-29.573*	-26.063*
	(0.011)	(0.050)	(0.083)
Post	-1.328***	-1.316**	-1.365**
	(0.008)	(0.020)	(0.018)
VIX	0.191***	0.161***	0.125***
	(0.002)	(0.000)	(0.002)
Slope	0.378*	0.394**	0.379**
	(0.060)	(0.022)	(0.016)
Bid-Ask	-73.440**	-60.659*	-24.187
	(0.044)	(0.066)	(0.564)
Constant	-2.362**	-1.954***	-1.466**
	(0.021)	(0.002)	(0.025)
Observations	96	92	94
Country FE	YES	YES	YES
Within R-squared	0.687	0.672	0.635
Number of countries	8	8	8
Impact of CACs	-8.480**	-8.678***	-8.064**
F-test (p-val)	(0.021)	(0.004)	(0.013)

Table B.11: Effect of quality of law on the relation between debt expansion and future probability of default and risk premia

We report in Panel A the coefficients of regression (3) including the interaction of DE with dummy variable W_{QL} to indicate the countries with low quality of law according to the rule of law index. The dependent variable is log(PD). We report the regression coefficients when we control for macroeconomic, external, governmental, and qualitative control variables. In Panel B, we report the coefficients of regression (4), including the interaction of DE with dummy variable W_{QL}. The dependent variable is ρ. We present the regression coefficients when we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are quarterly observations of our sample of eurozone countries, spanning January 2002 to December 2017. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

(a) Debt expansion and probability of default (dependent variable log(PD))

Independent variable	1-quarter lag	2-quarter lag
Debt Expansion $\times$ W_{QL}	3.385*	3.859**
	(0.070)	(0.019)
Debt Expansion	6.119**	5.208**
	(0.015)	(0.016)
Inflation	-0.083	-0.105*
	(0.186)	(0.095)
Real GDP Growth	-0.087**	-0.091**
	(0.027)	(0.012)
Current Account	0.015*	0.006
	(0.058)	(0.527)
Government Balance	-0.013*	-0.015**
	(0.090)	(0.029)
Political Stability	-0.339	-0.455
	(0.352)	(0.166)
Constant	-0.961**	-0.764**
	(0.025)	(0.042)
Observations	442	441
Country & Year FE	YES	YES
Within R-squared	0.264	0.288
Number of countries	18	18

Table B.11: (continued)

(b) Debt expansion and future risk premia (dependent variable ρ)

Independent variable	4-month lag	5-month lag	6-month lag
Debt Expansion × W_{QL}	-10.435***	-10.928**	-11.130**
	(0.010)	(0.014)	(0.026)
Debt Expansion	-7.503**	-5.808*	-5.718*
	(0.013)	(0.059)	(0.084)
VIX	0.054***	0.053***	0.048***
	(0.000)	(0.000)	(0.000)
Slope	0.266**	0.250*	0.234*
	(0.032)	(0.052)	(0.068)
Bid-Ask	16.318**	15.858*	19.580*
	(0.043)	(0.077)	(0.073)
Constant	-1.133***	-1.168***	-1.039**
	(0.006)	(0.006)	(0.015)
Observations	461	459	456
Country & Year FE	YES	YES	YES
Within R-squared	0.302	0.271	0.245
Number of countries	9	9	9

Table B.12: Effect of gross financing need on the relation between debt expansion and future probability of default and risk premia

We report in Panel A the coefficients of regression (3) where we additionally include a 1-quarter lag of gross financing need. The dependent variable is log (PD). Column (1) presents the regression coefficients with a 1-quarter lag of DE where we control for macroeconomic, external, and governmental control variables, respectively. Columns (2)-(6) report the same results when we include five different estimates of gross financing needs. Panel B reports the coefficients of regression (4) where we additionally include a 1-quarter lag of gross financing need. The dependent variable is ρ. Column (1) presents the regression coefficients with a 1-quarter lag of DE where we control for investor expectations by VIX and the overall state of the economy by the slope of the term structure. Columns (2)-(6) report the same results when we include five different estimates of gross financing needs. The gross financing needs estimates are as follows. GFN_s assumes equal quarterly values such that their sum equals the annual value. GFN_u assumes the value of GFN goes up to the annual value in the first quarter. GFN_d assumes the quarterly values increase to the current value in the last quarter. GFN_{ln} and GFN_{sp} use the linear and spline interpolations, respectively. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are quarterly observations of our sample of eurozone countries, spanning January 2002 to December 2017. $^*p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

(a) Debt expansion and probability of default (dependent variable log(PD))

Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Debt Expansion	7.669***	7.485***	7.113***	6.645***	7.517***	7.774***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)
Inflation	-0.076	-0.065	-0.062	-0.064	-0.060	-0.062
	(0.210)	(0.319)	(0.325)	(0.313)	(0.317)	(0.311)
Real GDP Growth	-0.095**	-0.089**	-0.088**	-0.085**	-0.106**	-0.107**
	(0.022)	(0.042)	(0.036)	(0.038)	(0.011)	(0.011)
Current Account	0.011	0.017	0.016	0.015	0.010	0.011
	(0.108)	(0.169)	(0.217)	(0.198)	(0.337)	(0.295)
GFN_s		1.343**				
		(0.016)				
GFN_u			1.908***			
			(0.002)			
GFN_d				1.806**		
				(0.015)		
GFN_{ln}					2.208***	
					(0.002)	
GFN_{sp}						1.722**
						(0.017)
Constant	-1.201***	-1.094***	-1.354***	-1.315***	-1.361***	-1.273***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	442	381	381	379	398	398
Country & Year FE	YES	YES	YES	YES	YES	YES
Within R-squared	0.239	0.233	0.248	0.219	0.300	0.291
Number of countries	18	16	16	16	16	16

Table B.12: (continued)

(b) Debt expansion and future risk premia (dependent variable ρ)

Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Debt Expansion	-8.583***	-7.463***	-7.638***	-7.550***	-8.469***	-8.439***
	(0.000)	(0.004)	(0.005)	(0.006)	(0.000)	(0.000)
VIX	0.044***	0.044***	0.044***	0.044***	0.044***	0.044***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Slope	0.073**	0.095**	0.094**	0.098**	0.070**	0.070**
	(0.044)	(0.020)	(0.019)	(0.021)	(0.044)	(0.046)
GFN_s		-0.785				
		(0.287)				
GFN_u			-0.294			
			(0.757)			
GFN_d				-0.001		
				(0.999)		
GFN_{ln}					-0.062	
					(0.942)	
GFN_{sp}						-0.116
						(0.873)
Constant	-0.909***	-0.830***	-0.831**	-0.886**	-0.930***	-0.918***
	(0.000)	(0.001)	(0.011)	(0.012)	(0.004)	(0.004)
Observations	295	268	268	266	285	285
Country & Year FE	YES	YES	YES	YES	YES	YES
Within R-squared	0.291	0.322	0.320	0.321	0.298	0.299
Number of countries	13	12	12	12	12	12

Table B.13: Effect of debt expansion on future probability of default and risk premia with comprehensive debt measure

We report in Panel A the coefficients of regression (3) where we estimate DE using public debt data. The dependent variable is log (PD). Columns (1)-(4) present the regression coefficients with a 1-quarter lag of DE where we control for macroeconomic, external, governmental, and qualitative control variables, respectively. Columns (5)-(8) report the same results for the 2-quarter lag of DE. In Panel B, we report the coefficients of regression (4) where we estimate DE using public debt data. The dependent variable is ρ. Columns (1)-(3) presents the regression coefficients with a 1-quarter lag of DE where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. Columns (4)-(6) report the same results for 2-quarter lags of DE. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are quarterly observations of our sample of eurozone countries, spanning January 2002 to December 2017. $*p < 0.1$; $**p < 0.05$; $***p < 0.01$.

(a) Debt expansion and probability of default (dependent variable log(PD))

	1-quarter lag				2-quarter lag			
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Debt Expansion	8.221***	8.097***	7.937***	7.621***	7.624***	7.589***	7.458***	7.093***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	-0.103**	-0.094**	-0.092**	-0.094**	-0.081	-0.073	-0.072	-0.073
	(0.020)	(0.032)	(0.044)	(0.039)	(0.115)	(0.165)	(0.187)	(0.161)
Real GDP Growth	-0.020	-0.021	-0.021	-0.015	-0.020	-0.021	-0.021	-0.013
	(0.477)	(0.467)	(0.464)	(0.594)	(0.414)	(0.375)	(0.394)	(0.565)
Current Account		0.019**	0.020***	0.021**		0.014*	0.016*	0.018*
		(0.011)	(0.009)	(0.012)		(0.078)	(0.059)	(0.061)
Government Balance			-0.007	-0.006			-0.008	-0.007
			(0.271)	(0.299)			(0.178)	(0.232)
Political Stability				-0.505				-0.563*
				(0.194)				(0.083)
Constant	-1.222***	-1.217***	-1.241***	-0.830**	-1.179***	-1.185***	-1.217***	-0.762**
	(0.000)	(0.000)	(0.000)	(0.022)	(0.000)	(0.000)	(0.000)	(0.012)
Observations	475	475	475	475	474	474	474	474
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.303	0.317	0.319	0.328	0.285	0.293	0.297	0.311
Number of countries	19	19	19	19	19	19	19	19

Table B.13: (continued)

(b) Debt expansion and future risk premia (dependent variable ρ)

	1-quarter lag			2-quarter lag		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Debt Expansion	-3.016*	-6.125***	-6.160**	-2.629	-6.115**	-7.503***
	(0.071)	(0.009)	(0.019)	(0.137)	(0.016)	(0.010)
VIX	0.044***	0.043***	0.054***	0.037***	0.039***	0.046***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Slope		0.153***	0.118		0.158***	0.139
		(0.000)	(0.362)		(0.001)	(0.233)
Bid-Ask			-6.400			2.642
			(0.856)			(0.939)
Constant	-0.618***	-1.090***	-0.958**	-0.573***	-1.070***	-0.778**
	(0.002)	(0.000)	(0.034)	(0.000)	(0.000)	(0.032)
Observations	408	316	125	401	316	131
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.130	0.252	0.351	0.0988	0.234	0.329
Number of countries	16	15	10	16	15	10

Table B.14: Effect of 9-month debt expansion on future probability of default and risk premia

We report in Panel A the coefficients of regression (3) where we estimate the DE over 9 months. The dependent variable is log (PD). Columns (1)-(4) present the regression coefficients with a 1-quarter lag of DE where we control for macroeconomic, external, governmental, and qualitative control variables, respectively. Columns (5)-(8) report the same results for the 2-quarter lag of DE. In Panel B, we report the coefficients of regression (4), where we estimate the DE over nine months. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with a 4-month lag of DE where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. Columns (4)-(6) and (7)-(9) report the same results for 5- and 6-month lags. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are quarterly (for Panel A) and monthly (for Panel B) observations of our sample of eurozone countries, spanning January 2002 to December 2017. $*p < 0.1$; $**p < 0.05$; $***p < 0.01$.

(a) Debt expansion and probability of default (dependent variable log(PD))

	1-quarter lag				2-quarter lag			
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Debt Expansion	4.277**	4.232**	4.110**	3.776**	5.007***	5.039***	4.772***	4.541***
	(0.025)	(0.023)	(0.023)	(0.044)	(0.000)	(0.000)	(0.000)	(0.001)
Inflation	-0.114*	-0.103	-0.106	-0.104	-0.107*	-0.100	-0.099	-0.100*
	(0.097)	(0.144)	(0.133)	(0.142)	(0.075)	(0.105)	(0.104)	(0.100)
Real GDP Growth	-0.091**	-0.090**	-0.090**	-0.081**	-0.102***	-0.101***	-0.100**	-0.090**
	(0.032)	(0.033)	(0.032)	(0.031)	(0.009)	(0.009)	(0.010)	(0.011)
Current Account		0.015**	0.017**	0.019**		0.012	0.013	0.015
		(0.028)	(0.027)	(0.024)		(0.199)	(0.186)	(0.163)
Government Balance			-0.017	-0.016			-0.011*	-0.008
			(0.106)	(0.120)			(0.081)	(0.213)
Political Stability				-0.456				-0.465
				(0.306)				(0.290)
Constant	-0.952***	-0.958***	-1.012***	-0.656	-0.934***	-0.940***	-0.974***	-0.607
	(0.000)	(0.000)	(0.000)	(0.138)	(0.000)	(0.000)	(0.000)	(0.163)
Observations	448	448	448	448	441	441	441	441
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.166	0.177	0.187	0.199	0.215	0.221	0.226	0.238
Number of countries	18	18	18	18	18	18	18	18

Table B.14: (continued)

(b) Debt expansion and future risk premia (dependent variable ρ)

	4-month lag			5-month lag			6-month lag		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Debt Expansion	-3.941**	-4.921***	-9.102***	-3.470**	-4.458**	-6.633***	-3.163*	-4.282**	-5.886***
	(0.021)	(0.005)	(0.000)	(0.049)	(0.010)	(0.001)	(0.088)	(0.015)	(0.008)
VIX	0.054***	0.053***	0.061***	0.053***	0.051***	0.059***	0.052***	0.050***	0.056***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Slope		0.082**	0.329**		0.084**	0.313**		0.088**	0.295**
		(0.025)	(0.015)		(0.021)	(0.033)		(0.015)	(0.044)
Bid-Ask			5.462			6.092			17.187*
			(0.318)			(0.506)			(0.054)
Constant	-0.907***	-1.216***	-1.365***	-0.911***	-1.211***	-1.400***	-0.900***	-1.207***	-1.353***
	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.004)	(0.000)	(0.000)	(0.006)
Observations	1,154	980	451	1,152	977	448	1,148	974	442
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.184	0.253	0.339	0.167	0.230	0.274	0.157	0.227	0.252
Number of countries	16	14	9	16	14	9	16	14	9

Table B.15: Effect of 18-month debt expansion on future probability of default and risk premia

We report in Panel A the coefficients of regression (3) where we estimate the DE over 18 months. The dependent variable is log (PD). Columns (1)-(4) present the regression coefficients with a 1-quarter lag of DE where we control for macroeconomic, external, governmental, and qualitative control variables, respectively. Columns (5)-(8) report the same results for the 2-quarter lag of DE. In Panel B, we report the coefficients of regression (4), where we estimate the DE over 18 months. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with a 4-month lag of DE where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 1-year benchmark bond. Columns (4)-(6) and (7)-(9) report the same results for 5- and 6-month lags of DE. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are quarterly (for Panel A) and monthly (for Panel B) observations of our sample of eurozone countries, spanning January 2002 to December 2017. $*p < 0.1$; $**p < 0.05$; $***p < 0.01$.

(a) Debt expansion and probability of default (dependent variable log(PD))

	1-quarter lag				2-quarter lag			
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Debt Expansion	8.390***	8.308***	8.176***	7.851***	7.023***	6.996***	6.868***	6.453***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Inflation	-0.123**	-0.121**	-0.119**	-0.122**	-0.144**	-0.139**	-0.130**	-0.135**
	(0.022)	(0.026)	(0.024)	(0.021)	(0.018)	(0.025)	(0.030)	(0.022)
Real GDP Growth	-0.092**	-0.092**	-0.092**	-0.084**	-0.107***	-0.107***	-0.105***	-0.092***
	(0.013)	(0.013)	(0.012)	(0.019)	(0.003)	(0.004)	(0.004)	(0.007)
Current Account		0.007	0.009	0.011		0.010	0.013	0.016
		(0.388)	(0.237)	(0.193)		(0.308)	(0.228)	(0.169)
Government Balance			-0.023***	-0.021**			-0.019**	-0.016**
			(0.007)	(0.010)			(0.019)	(0.035)
Political Stability				-0.335				-0.552*
				(0.322)				(0.099)
Constant	-1.167***	-1.164***	-1.252***	-0.973**	-1.024***	-1.028***	-1.113***	-0.664*
	(0.000)	(0.000)	(0.000)	(0.013)	(0.000)	(0.000)	(0.000)	(0.057)
Observations	459	459	459	459	453	453	453	453
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.217	0.219	0.241	0.247	0.225	0.230	0.245	0.262
Number of countries	18	18	18	18	18	18	18	18

Table B.15: (continued)

(b) Debt expansion and future risk premia (dependent variable ρ)

	4-month lag			5-month lag			6-month lag		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Debt Expansion	-7.698**	-8.147**	-9.374**	-6.676**	-7.515**	-7.269	-5.829*	-7.072**	-6.270
	(0.016)	(0.011)	(0.049)	(0.030)	(0.017)	(0.127)	(0.062)	(0.018)	(0.171)
VIX	0.053***	0.049***	0.056***	0.052***	0.049***	0.055***	0.051***	0.048***	0.055***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Slope		0.080**	0.245*		0.082**	0.224*		0.081**	0.215
		(0.015)	(0.054)		(0.012)	(0.100)		(0.011)	(0.128)
Bid-Ask			14.109*			16.302*			17.551**
			(0.057)			(0.053)			(0.022)
Constant	-0.726***	-0.985***	-1.177**	-0.755***	-1.011***	-1.198**	-0.762***	-1.016***	-1.206**
	(0.000)	(0.000)	(0.012)	(0.000)	(0.000)	(0.017)	(0.000)	(0.000)	(0.022)
Observations	1,170	1,001	470	1,165	1,000	469	1,159	994	463
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.189	0.252	0.268	0.171	0.236	0.235	0.149	0.214	0.205
Number of countries	16	13	9	16	13	9	16	14	9

Table B.16: Effect of debt expansion on future risk premia using 5-year CDS spread

We report the coefficients of regression (4) where we use 5-year CDS spread in calculating ρ. Panel (A) and (B) report results for the sample of (i) all countries and (ii) non-crisis countries, respectively. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with a 4-month lag of DE where we control for investor expectations by VIX, the overall state of the economy by the slope of the term structure, and liquidity risk measured by the bid-ask spread of the 5-year benchmark bond. Columns (4)-(6) and (7)-(9) report the same results for 5- and 6-month lags of DE. We include country and year fixed effects and report the p-values (in parentheses) estimated from robust standard errors clustered by country. Data are monthly observations of our sample of eurozone countries, spanning January 2002 to December 2017. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

(a) All countries

	4-month lag			5-month lag			6-month lag		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Debt Expansion	-5.359***	-6.197***	-6.161***	-5.180***	-5.873***	-5.891***	-4.883***	-5.654***	-5.413***
	(0.001)	(0.000)	(0.001)	(0.002)	(0.001)	(0.003)	(0.007)	(0.002)	(0.006)
VIX	0.031***	0.030***	0.029***	0.030***	0.029***	0.029***	0.030***	0.029***	0.029***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Slope		0.010	-0.014		0.011	-0.010		0.011	-0.008
		(0.440)	(0.630)		(0.379)	(0.732)		(0.352)	(0.761)
Bid-Ask			2.849			2.333			2.074
			(0.232)			(0.313)			(0.359)
Constant	0.529***	0.434***	0.507***	0.531***	0.429***	0.466***	0.508***	0.404***	0.437***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Observations	1,172	998	790	1,172	998	797	1,167	996	791
Country & Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Within R-squared	0.154	0.183	0.210	0.142	0.164	0.198	0.127	0.149	0.175
Number of countries	16	14	11	16	14	11	16	14	11

Table B.16: (continued)

(b) Non-crisis countries

	4-month lag			5-month lag			6-month lag		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Debt Expansion	-5.978***	-7.104***	-7.179***	-5.619***	-6.556***	-6.807***	-4.922**	-5.892***	-5.721**
	(0.003)	(0.000)	(0.001)	(0.008)	(0.000)	(0.003)	(0.039)	(0.003)	(0.016)
VIX	0.029***	0.032***	0.032***	0.027***	0.030***	0.031***	0.028***	0.031***	0.033***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Slope		0.168**	0.169*		0.154**	0.170**		0.155*	0.193**
		(0.039)	(0.060)		(0.047)	(0.047)		(0.057)	(0.038)
Bid-Ask			3.362			1.654			2.059
			(0.260)			(0.708)			(0.732)
Constant	1.236***	0.831***	0.916***	1.245***	0.845***	0.894***	1.194***	0.809***	0.792***
	(0.000)	(0.001)	(0.003)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.004)
Observations	794	655	502	796	659	507	793	658	501
Country & Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Within R-squared	0.172	0.240	0.293	0.146	0.205	0.268	0.125	0.183	0.242
Number of countries	12	10	8	12	10	8	12	10	8

Table B.17: Effect of debt expansion on future probability of default and risk premia with alternative control variables

We report in Panel A the coefficients of regression (3) with alternative control variables for macroeconomic and governmental factors. We replace real GDP growth, current account, and government balance with the unemployment rate, terms of trade, and debt-to-GDP, respectively. The dependent variable is log (PD). Columns (1)-(4) present the regression coefficients with a 1-quarter lag of DE when we control for macroeconomic, external, governmental, and qualitative variables, respectively. Columns (5)-(8) report the same results for a 2-quarter lag. In Panel B, we report the coefficients of regression (4), with additional macroeconomic and external factors as controls. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with a 1-quarter lag of DE when we add inflation (macroeconomic) and current account (external) factors. Columns (4)-(6) report the same results for a 2-quarter lag. All models include country and year fixed effects, and the p-values (in parentheses) are estimated from robust standard errors clustered by country. Data are quarterly observations of our sample of eurozone countries, spanning January 2002 to December 2017. $*p < 0.1$; $**p < 0.05$; $***p < 0.01$.

(a) Debt expansion and probability of default (dependent variable log(PD))

	1-quarter lag				2-quarter lag			
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Debt Expansion	6.426***	6.470***	5.415***	4.775***	5.821***	5.861***	4.954***	4.327***
	(0.001)	(0.001)	(0.002)	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)
Inflation	0.001	0.002	-0.013	-0.028	0.000	0.000	-0.023	-0.041
	(0.988)	(0.966)	(0.797)	(0.561)	(0.997)	(0.996)	(0.627)	(0.369)
Unemployment	0.209***	0.210***	0.201***	0.188***	0.202***	0.208***	0.210***	0.193***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Terms of Trade		0.119	-0.256	0.033		-0.341	-0.669*	-0.343
		(0.783)	(0.575)	(0.943)		(0.377)	(0.091)	(0.366)
Debt-to-GDP			1.948***	2.201***			1.781***	2.066***
			(0.002)	(0.000)			(0.001)	(0.000)
Political Stability				-0.620***				-0.671***
				(0.006)				(0.005)
Constant	-3.375***	-3.488***	-4.183***	-3.972***	-3.260***	-2.954***	-3.698***	-3.462***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	442	436	436	436	441	433	433	433
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.426	0.410	0.447	0.470	0.425	0.403	0.440	0.467
Number of countries	18	18	18	18	18	18	18	18

Table B.17: (continued)

(b) Debt expansion and future risk premia (dependent variable ρ)

	1-quarter lag			2-quarter lag		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Debt Expansion	-6.700***	-8.440***	-8.886**	-5.403**	-7.354***	-6.983*
	(0.005)	(0.000)	(0.013)	(0.036)	(0.004)	(0.074)
Inflation	0.125	0.107	0.104	0.177	0.162	0.149
	(0.323)	(0.307)	(0.411)	(0.128)	(0.138)	(0.128)
Current Account	0.020*	0.007	0.029	0.035***	0.022	0.014
	(0.099)	(0.697)	(0.257)	(0.009)	(0.229)	(0.675)
VIX	0.042***	0.042***	0.050***	0.034***	0.038***	0.044***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
Slope		0.070**	0.183		0.081**	0.141
		(0.022)	(0.257)		(0.014)	(0.434)
Bid-Ask			28.542			36.007**
			(0.134)			(0.045)
Constant	-0.731**	-1.048***	-1.161**	-0.741**	-1.126***	-1.090*
	(0.026)	(0.000)	(0.020)	(0.011)	(0.001)	(0.067)
Observations	376	295	121	373	297	123
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.215	0.301	0.430	0.174	0.255	0.355
Number of countries	14	13	9	15	13	9

List of Tables