Neglected Risk:

Evidence from the eurozone sovereign credit market

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Abstract

We find evidence consistent with neglected risk 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. Even though DE predicts increased default probability, panel regressions from 2002–2017, show a negative association between DE and premia. Risk neglect was briefly interrupted by the 2010 Deauville Summit, but resumed by the onset of the 2011 Eurozone crisis. The introduction of quantitative easing since 2015 has muted the impact of neglected risk, therefore raising the concern of what will happen once quantitative easing ends.

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 triggered a mispricing credit risk episode among several European economies. We show that the "neglected risk hypothesis" of Gennaioli, Shleifer, and Vishny (2012) could provide an explanation for this mispricing. The theoretical model underlying this hypothesis postulates that neglecting the risk of a specific asset class leads to its excessive issuance, and once investors realize the true risk of their exposure, they flee to safe assets and financial instability might follow. Baron and Xiong (2017) find evidence of neglected risk among bank equity investors, in a sample of twenty developed economies spanning 1920–2012. Since sovereign risk commonly represents a ceiling for corporate risk (e.g., Almeida, Cunha, Ferreira, and Restrepo (2017)), the identification of neglected risk in sovereign markets can have an effect on the corporate sector of the sovereign (including banking). Whereas Baron and Xiong (2017) provide evidence for the international banking sector equities market, we show that neglected risk is also present at the sovereign level and provides a potential explanation for the eurozone crisis.

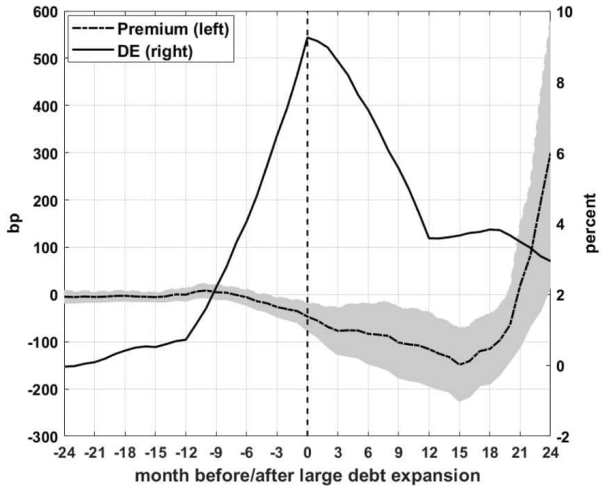
In this paper, we examine credit risk in a sample of nineteen eurozone sovereigns over the period January 2002 to December 2017. The common currency in this sample, and the developing, common regulatory framework reduces the heterogeneity that might be present in a broader sample of sovereigns. We construct a novel variable of sovereign debt expansion (DE) —defined as the positive inter-temporal change of debt-to-GDP ratio— to test for the effect of DE on sovereign risk premia. We show that sovereign DE predicts an increase in sovereign default risk, as proxied by the probability of default (PD), after controlling for macroeconomic, government, external, and qualitative variables. We also show that DE does not predict an increase in risk premia, but, in contrast to finance theory, it predicts a reduction in risk premia, after controlling for liquidity and investor risk appetite, among other variables.

We motivate our analysis by estimating average sovereign risk premia around events of

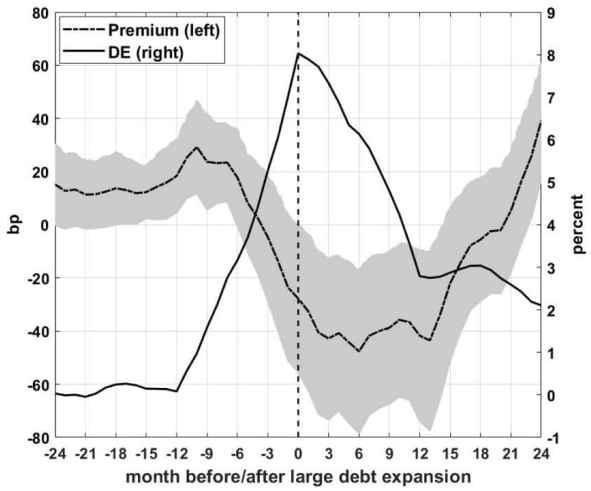
Figure 1: Risk premia and large debt expansion

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). We observe that despite the increased potential risk due to sovereign debt expansion, risk premia go down and remain negative for 6–15 months, consistent with the neglected risk hypothesis.

(a) All eurozone countries



(b) Non-crisis countries



large debt expansion (LDE), identified as the 95th percentile of historically observed DE.[1] 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 separately for non-crisis countries (Panel B).[2] The figures show the presence of negative risk premia around LDE episodes, a finding suggesting that CDS prices do not compensate for expected loss, consistent with the neglected risk hypothesis.

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 for increased risk. Moreover, risk premia are not only decreasing with LDE, but they also become

[1]Observations are pooled over time and country, and include only countries with at least 50 observations over the corresponding time period.

[2]The crisis countries are Cyprus, Greece, Ireland, Portugal, and Spain.

negative. This pattern persists when we exclude crisis countries, as observed from Panel B. Importantly, the risk premia remain negative for several months, but for a shorter period and a smaller absolute magnitude than in Panel A. In summary, both panels suggest that neglected risk might have been observed in both crisis and non-crisis eurozone sovereigns.

We take the motivating evidence for neglected risk to the data using two multivariate panel regressions. Our model tests for a potential predictive relation from DE to changes in default probability and risk premia over several months, 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. The second regression finds, contrary to the expectation that DE should predict an increase in risk premia, an economically and statistically significant negative coefficient, consistent with Figure 1. The predictive positive relation from DE to PD, and the negative relation from DE to future risk premia, provide evidence consistent with the neglected risk hypothesis in the eurozone sovereign debt market.

We provide further evidence consistent with neglected risk, by examining the effects of the Deauville summit in October 2010, that shocked the eurozone sovereign debt markets. During this summit, the German Chancellor Merkel and French President Sarkozy made a political statement acknowledging the crisis of the Greek sovereign debt which would require a restructuring (Mody, 2013; Orphanides, 2014). The two leaders sent a signal against the implicit guarantees of eurozone credit risk, thus surprising the markets that private investors 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 from DE to risk premia both before and after, thus providing evidence consistent with neglected risk. Importantly, we show that in the year following the event, the coefficient of DE interacted with the indicator variable is positive and significant, thus the net effect of DE on premia seems to be neutralized for a short time after the political statements at Deauville. We examine the robustness of our results around the Deauville summit, by introducing also the

shock of the Greek government updating its budget deficit estimates that precipitated the crisis and led to the Deauville decision. Our results are robust to this specification. Finally, we carry out additional tests to rule out an implicit guarantee interpretation for the reduction in risk premia, including testing the sub-sample of non-crisis countries, and obtain similar results.

The last part of our analysis relates to the most recent period (2011–2017), which started with the 2011 European sovereign debt crisis and also included the introduction of the quantitative easing (QE) policy of 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 presence of the QE program, as the net effect of DE and QE on premia is not different from zero.

We conduct a battery of robustness checks for our analysis. First we use CDS contracts denominated in US dollar to rule out an alternative explanation of redenomination risk. Second, we address accuracy concerns related to PD and recovery rates, but also mitigate potential concerns of a mechanical relation between PD and DE. We do this by re-running the models using random sampling of PDs and recovery rates. Third, we decompose DE to its debt (numerator) and GDP (denominator) component and find that both matter for our analysis, therefore ruling out an interpretation based solely on GDP contraction. Finally, we conduct robustness checks based on alternative debt and DE measures for different sample periods and alternative control variables. The negative relation from DE to future average risk premia survives all tests.

To the best of our knowledge, this is the first empirical study documenting neglected risk in sovereign credit markets. It adds to the scant empirical evidence of conditional neglected risk within some corporate asset classes,[3] and lends empirical support to the theoretical

[3]See Chernenko, Hanson, and Sunderam (2016) for neglected risk in asset-backed securities, conditioning on mutual funds managers' experience, and Arnold, Schuette, and Wagner (2018); Zhang, Zhao, and Zhao (2019) for neglected risk in structured products and residential mortgage-backed securities, conditioning on retail investors or insurance issuers.

model of Gennaioli et al. (2012).

We contribute to the literature in several ways. First, we show that DE is a significant determinant of sovereign default risk, thereby contributing also a novel proxy of sovereign default risk. 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 little literature on changes in the fundamentals.[4] Closer to this aspect of our work is the evidence in Reinhart and Rogoff (2011), showing that changes in public debt level in a panel of countries explain banking crises, which, in turn, predict sovereign crises. However, not all sovereign crises are preceded by banking crises and our work provides direct evidence of the DE effect on sovereign default probability.

Our second contribution is to present evidence consistent with the neglected risk hypothesis of Gennaioli et al. (2012) in sovereign credit markets, confirming the conjecture of Mody (2013) that risk neglect could provide an explanation for the eurozone crisis. Evidence consistent with neglected risk is presented for both crisis and non-crisis eurozone sovereign debt markets.[5] Empirical evidence consistent with the behavioural bias of neglected risk is scant, and non-existent for sovereigns. Baron and Xiong (2017) provide such evidence for the international bank equity markets. Given the sovereign risk ceiling assumed by credit rating agencies, the presence of neglected risk at the sovereign level is likely to have an impact on the corporate debt markets (including banking) within each sovereign.

Our third contribution is the testing of the relation between DE and risk premia around the Deauville summit. The political decisions at Deauville reminded investors that the "no-bail-out" clause of the Treaty on the functioning of the European Union should not be

[4]For instance, Hilscher and Nosbusch (2010) show that a change in the terms of trade has a significant impact on bond yield spreads of emerging market.

[5]Naturally, there is literature on the mis-pricing 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). Aizenman et al. (2013) also suggests two possible explanations for the disconnect from fundamentals, one of which ("these economies switched to a "pessimistic" self-fulfilling equilibrium") is consistent with our evidence on neglected risk. We inform this literature by showing, among other things, that mispricing was also present in non-periphery countries and that it conforms to the neglected risk hypothesis.

ignored. This short-lived shock to neglected risk allows us to show further evidence consistent with neglected risk, since the presence of neglected risk in the short-period after the event disappeared. We also show that the negative relation between DE and risk premia persists over the period starting in 2011, even after accounting for QE in 2015. This contribution also has public policy implications, as it raises the obvious question on what will the sovereign debt market's reaction be, if/when the QE program is terminated.

The rest of the paper is organized as follows: Section 2 develops our hypotheses for neglected risk and section 3 presents the data. Section 4 explains our methodological approach and the main empirical findings. Section 5 details robustness checks and section 6 concludes.

2 Hypotheses Development

2.1 Debt expansion and default risk

We consider the public debt dynamics equation

$$D_{t+1} = D_t(1 + R_{t+1}) - S_{t+1}, \tag{1}$$

where D_t, S_t, and R_t, denote outstanding government debt, primary balance, and nominal interest rate, respectively, at time t. Assuming $g_t = \frac{Y_t}{Y_{t-1}} - 1$, where Y denotes GDP, the equation is written in terms of debt-to-GDP (d_t) and primary balance-to-GDP (s_t) as

$$d_{t+1} = d_t \frac{1 + R_{t+1}}{1 + g_{t+1}} - s_{t+1}. \tag{2}$$

Setting $\Delta D_{t+1} = d_{t+1} - d_t$, we have

$$\Delta D_{t+1} = d_t \mu_{t+1} - s_{t+1}, \tag{3}$$

where $\mu_t = \frac{1+R_t}{1+g_t} - 1$. During deficit years ($s_{t+1} \leq 0$) we observe a debt surge ($\Delta D_{t+1} > 0$), while for surplus years ($s_{t+1} > 0$) we have a debt increase only if the overall interest payment exceeds the surplus. Positive change of outstanding debt-to-GDP is an ex-post signal of deteriorating debt dynamics, and we define debt expansion (DE) as any positive debt-to-GDP change over the preceding twelve months.[6]

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 towards 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 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). Reinhart and Rogoff (2011) find that changes in public debt level explain banking crises on a panel of 70 countries, with banking crises predicting sovereign crises since the banking debt surge increases the costs of the sovereigns through an adverse effect on liquidity. From this literature we postulate our first hypothesis:

H_1: Sovereign debt expansion predicts increasing default risk.

We test for a positive coefficient on debt expansion in a predictive panel regression, controlling for variables that are important determinants of default risk (Afonso, Furceri, and Gomes, 2012), namely debt-to-GDP, GDP growth, current account balance, government balance, inflation, and political stability. Using DE as a significant sovereign default predictor we test empirically our main hypothesis of neglected risk, which we postulate next.

2.2 Neglected risk

The neglected risk hypothesis model of (Gennaioli et al., 2012), is based on the psychological foundations of representativeness of Kahneman and Tversky (1972), and Gennaioli, Shleifer,

[6]Our results are robust to nine- and eighteen-month changes (online Appendix Tables B.9-B.10).

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 expected probability of good states in the sight of good news. In the extreme case, investors with representativeness bias ignore bad news and make decision based solely on the observed good news. However, once the amount of bad news reaches a threshold, investors weigh in bad news and over-react to it.

Baron and Xiong (2017) provide presently the only evidence of neglected risk in an international setting, but at an aggregate corporate index level. They show that large credit expansion in the banking sector of a sample of 20 developed countries 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 bank equity crash, the average predicted equity returns are lower, consistent with the neglected risk hypothesis.

The evidence of neglected risk in banking raises a more general question: Since corporate risk is typically capped by sovereign risk (Almeida et al., 2017), does neglected risk also exist in sovereign debt markets?

We hypothesize that the euphoria of introducing the Euro banknotes and coins as legal tender on 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, incentivized 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",[7] 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.[8]

[7]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.

[8]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 `http://curia.europa.eu/juris/celex.jsf?celex=62012CJ0370&lang1=en&type=TXT&ancre`, accessed January 2021.

On the other hand, ECB Executive Board member Jurgen Stark clearly 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."[9]

With Stark's statement, the ECB signalled to the markets that they were likely ignoring the risk of sovereign debt. In other words, investors behaved in a way consistent with the representativeness bias framework, in which they attach an almost zero probability of default to sovereigns, regardless of their DE. Given the neglect of sovereign risk, the sovereign then accumulates more debt, supported by low interest rates, therefore increasing debt even further. As a result, investors neglecting the risks from the rate of increase of debt stock, end up not being compensated for unexpected losses, as risk premia are low or even negative.

To test for neglected risk in the eurozone market, we use the DE variable, which has predictive ability of an increase in default risk according to H_1. If there is no neglected risk associated with DE, we expect to find a positive coefficient on DE in a regression of risk premia over the months following DE. Non-significant, or, in the strong case, significant negative coefficient, would be evidence consistent with neglected risk associated with DE. Accordingly, we propose our main hypothesis:

H_2: Debt expansion predicts decreasing risk premia of eurozone sovereign debt.

3 Data

We construct our variables for the nineteen eurozone countries for which there are available data for our analysis.[10] The testing period spans January 2002 to December 2017, and we

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

[10]The number of countries may be less than nineteen in some tests, depending on the availability of control variables, and we report the total number of observations, i.e., countries times time-periods, for each test. In testing our hypotheses, we omit Ireland since there is no data on debt securities of general government (accessed May 2019). In testing H_2, we omit Lithuania and Luxembourg since there are no available CDS data. In general, given the availability of the higher frequency data, the first regression is run quarterly for 18 countries, the second is run monthly for 16 countries, but we also run robustness tests with lower frequency (quarterly) data with 19 countries for the first regression and 17 for the second.

include a country only for the period after it joined the eurozone.[11] Cyprus, Greece, Ireland, Portugal, and Spain are the crisis countries. We describe here our main variables, and all variables with their sources are summarized in the Data Appendix.

Our novel explanatory variable is the country DE (subsection 3.1). The dependent variable in our first regression is the country default probability (subsection 3.2), and the dependent variable in our second regression is the sovereign risk premium, which we construct from CDS spreads according to the literature (subsection 3.3). We also discuss several control variables that are documented in published studies to be determinants of the default probability and risk premium (subsection 3.4).

3.1 Sovereign debt expansion

To construct our main explanatory variable (DE), we first construct the debt-to-GDP ratio. Sovereign debt and GDP data are from the ECB website.[12] We use monthly nominal debt stock of the outstanding amount of debt securities of general government at the end of each month in our sample, denominated in Euro.[13] Among the countries in our sample, Ireland has no available information on debt securities of 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-year debt ratio change (see Appendix Table A.1).

We then construct DE as the positive change in the year-on-year debt-to-GDP ratios. Descriptive statistics are given in online Appendix Table A.2. Overall, we find that 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.

[11] Slovenia, Slovakia, Estonia, Latvia, and Lithuania joined the eurozone on January 2007, 2009, 2011, 2014, and 2015, respectively; Cyprus and Malta joined in January 2008.

[12] See `https://sdw.ecb.europa.eu/browse.do?node=9691433`, accessed January 2020.

[13] We also estimate quarterly debt-to-GDP for all public debt, and not just debt securities, for a robustness test; see subsection 5.4.

3.2 Probability of default and recovery rates

We use daily Bloomberg probabilities of default with 1-year horizon.[14] The PDs are estimated from a multi-factor model using as inputs the GDP growth, government surplus, non-performing bank loans, refinancing ability, and political risk. To validate their model, Bloomberg reports an accuracy ratio test with an 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 takes into account both type I and II errors. A goodness-of-fit test of the ex-ante vs ex-post default probabilities, produces a line with slope close to 45 degrees, indicating that the model is free of bias (Bloomberg, 2020, Figure 4). Moreover, 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 mechanical relation with the premia estimates. However, potential concerns about a mechanical relation between PD and DE can be raised, since the former uses GDP growth and the later use GDP level. We carry out a decomposition of DE to it components: debt (numerator) and GDP (denominator) (subsection 5.3) and find that our main hypothesis holds for the debt growth component. An additional robustness test based on a randomized draw of PD values (section 5.2) rules out the possibility that our results are driven by biased or noisy Bloomberg estimates.

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

Recovery rates are obtained from Markit. For investment grade issuers, recovery is generally assumed to be 40%. On the other hand, recovery rates for non-investment grade issuers are estimated more precisely (Markit, 2014). Since recovery rates are considered noisy by

[14] We obtain the data from a Bloomberg terminal with the function "SRSK<GO>".

practitioners, we also employ the ISDA contractually specified recovery rates. Specifically, we use the stated recovery rate for senior unsecured bonds of 40% for developed countries and 25% for emerging countries (subsection 5.2). Summary statistics of the Markit recovery rates are given in the online Appendix Table A.4. They range from about 25% for Estonia, Latvia, Slovakia and Slovenia, to 40% for Finland, France, and Germany, with bi-modal cross-country distribution and very low standard deviation per country.

3.3 Risk premia

We infer risk premia from CDS spreads. We use CDS spreads instead of bond yields, as they lead the price discovery process (Blanco, Brennan, and Marsh, 2005; Zhu, 2006). We use the spreads of 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 —the mean is greater than the median— as expected, with more likely extreme increase in CDS spreads for crisis than non-crisis countries. For robustness, we also use the spreads on USD-denominated CDS, with summary statistics given in Table A.5 (Panel B).

We follow Berndt, Douglas, Duffie, and Ferguson (2018), and obtain the risk premia from

$$\text{Risk premium} = \text{CDS spread} - \text{Expected loss}. \tag{4}$$

We also calculate another proxy of risk premia (ρ) used by Berndt et al. (2018), to capture any non-linear effects of sovereign debt on DE, by scaling premia by the corresponding

expected loss and taking the logarithm:

$$\rho = \log\left(1+\text{Risk premium/Expected loss}\right). \tag{5}$$

The expected loss is the product of PD and expected loss-given-default (LGD), where expected LGD is (1 − expected recovery rate).

Given the time series of PD, CDS spreads, and recovery rates, we calculate the risk premia from equation (4) and the scaled proxy ρ from (5). Summary statistics are in online Appendix Tables A.6–A.7 for the EUR- and USD-denominated CDS, respectively. For the euro data we observe seven countries with negative average risk premia, ranging from -373.36bp for Greece to -11.29bp for Slovenia, and twelve countries with a significant proportion of non-positive premia during our sample period. Such values imply that CDS prices do not compensate for expected loss, and suggest under-estimation of credit risk consistent with the neglected risk hypothesis. The difference between average premia for USD- and EUR-denominated contracts varies from 0.47bp to 73.55bp, with average 11.10bp.[15] A two-sample independent t-test indicates that the differences are not statistically significant, anticipating similar test results for both markets.

3.4 Control variables

To test H_1, we follow the literature to control for the potential determinants of default risk. Specifically, we follow Afonso et al. (2012) and use real GDP growth, inflation, and unemployment (macroeconomic controls), government balance and debt-to-GDP (governmental controls), and current account balance and foreign reserves (external controls). We also control for terms-of-trade (external controls; Hilscher and Nosbusch (2010)), and political stability and corruption indices as qualitative country-specific variables (Butler and Fauver, 2006).

[15] Only Malta has negative difference of -0.32bp.

To test H_2 we control for variables explaining risk premia. The first control variable we use 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). We control for liquidity risk using the bid-ask spread on the respective government 1-year benchmark bond (Liu, 2006; Monfort and Renne, 2014), measured in percentage points. To control for global risk appetite we follow Longstaff et al. (2011); Pan and Singleton (2008) and use the Chicago Board Options Exchange volatility index VIX. To control for country specific factors on the state of the economy we use the Euribor 3-month as the risk free rate. We also use the slope of the term structure, computed as the difference between the respective sovereign 10-year bond mid-yield and the Euribor (Fontana and Scheicher, 2016; Zhang, Zhou, and Zhu, 2009). Finally, we use the debt-to-GDP ratio to control for macroeconomic risk (Delatte, Fouquau, and Portes, 2017).[16] A description of all control variables and their sources is given in the Data Appendix.

3.5 Descriptive statistics

We report summary statistics of the independent variable DE, and our dependent and control 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. Risk premia have a large standard deviation of 7.40 compared to the average value of -0.57, indicating significant cross-sectional and temporal variability. Similarly, DE has an average value of 3.88% and a standard deviation of 3.55%. The monthly control variables (VIX, Slope, Debt-to-GDP, and Bid-Ask) also have substantial variability.

[Insert Table 1 about here.]

[16] VIX, bid-ask spreads, and the slope of the term structure are reported on a daily basis, but since our debt data are monthly we use the corresponding observations on the last day of each month.

4 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 overall state of the economy.[17] Third, we use the shock to sovereign default risk from the Deauville summit, to show that neglected risk was neutralized by the policy articulated at this summit that private investors would suffer a haircut of their exposures to Greek debt. Finally, we test for changes in the predictive relation from DE to risk premia for the period after Deauville to cover the introduction of quantitative easing and account for its effect on the DE-premia relation.

To motivate our main tests, we first provide evidence consistent with neglected risk of large debt expansions. We re-examine the evidence of Figure 1, where LDE was defined as the 95th percentile of historically observed debt expansion for each country. We estimate risk premia subsequent to LDE, and find that future risk premia go contrary to the prediction of finance theory as they are negative, statistically significant, for a wide range of thresholds defining large debt expansions.

We use the following OLS regression model:

$$\text{Risk premium}_{i,t} \;=\; \alpha + \beta\, \mathbf{1}_{\text{LDE}_{i,t-k}} + \epsilon_{i,t}, \tag{6}$$

where $\mathbf{1}_{\text{LDE}_{i,t}}$ is an LDE indicator function,

$$\mathbf{1}_{\text{LDE}_{i,t}} = \begin{cases} 1, & \text{if } \ \text{DE}_{\text{i,t}} > \tau\text{th threshold}, \\ 0, & \text{otherwise}, \end{cases} \tag{7}$$

[17] For H_1 we use quarterly data as most control variables are quarterly. Quarterly debt-to-GDP is obtained from monthly data as the last month observation of debt-to-GDP within the reference quarter. For H_2 we use higher frequency monthly debt-to-GDP, since all variables are available monthly.

where τ is a quantile threshold. We find LDE for country i and time t, using only past observations. That is, an observation of DE for a country is labeled as LDE if it is greater than the τth quantile of all previous observations for that country. From model (6) we obtain premia estimates subsequent to LDE as the sum of α and β.

[Insert Table 2 about here.]

We report in Table 2 the future average premia for four, five, and six months after LDE. Surprisingly, the future average premia are negative and statistically significant for the extreme quantile thresholds (p-values ≤ 0.01 for thresholds $\tau = 0.90$ and 0.95) while they are not statistically significant for lower quantile thresholds.[18] In Figure 2 we illustrate risk premia dynamics subsequent to LDE and the confidence intervals.

Overall, Figure 2 and Table 2 show that subsequent to LDE, risk premia are negative and significant for the higher quantile thresholds, and not different than zero for lower thresholds. The negative relationship between LDE and negative future risk premia remains when we remove LDE observations of crisis countries and re-run (6), thus addressing potential concerns that results are driven by crisis countries.

4.1 Debt expansion and default probability

To test the hypothesis H_1, we run the following panel regression of each country's PD on DE and several control variables:[19]

$$\log(\mathrm{PD})_{i,t} \;=\; \alpha + \beta_{\Delta}\Delta\mathrm{D}^{+}_{i,t-k} + B^{\top}\mathrm{X}_{i,t} + \mathrm{C}_i + \mathrm{Z}_t + \epsilon_{i,t}, \tag{8}$$

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

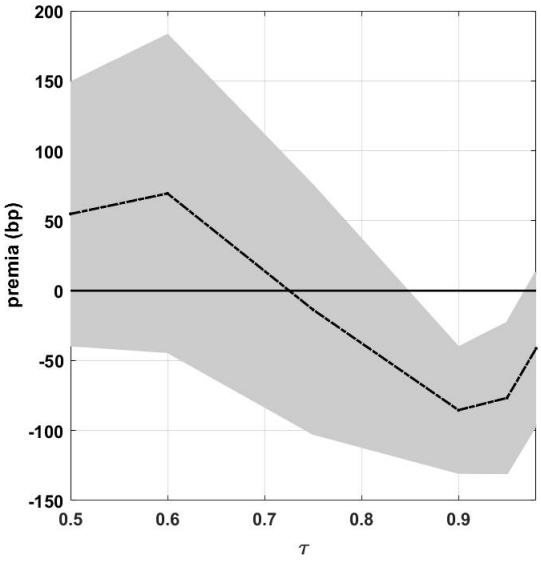
[18] Notice a trade-off between τ and the number of identified LDEs, with fewer LDEs for extreme quantiles.

[19] Since Bloomberg uses government surplus as a variable to estimate PD, we a address a concern that DE may be correlated with government surplus by computing the correlation coefficient, and find it a low -0.18.

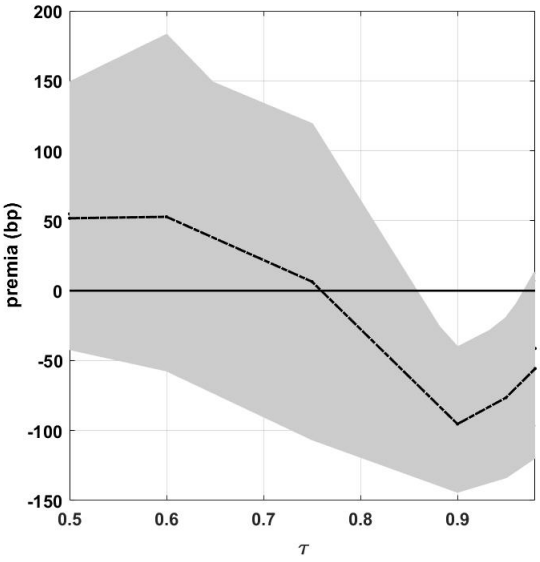
Figure 2: Dynamics of risk premia subsequent to large debt expansion

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



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 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 lag of one quarter. Column (1) shows the regression results with macroeconomic control variables inflation and real GDP growth, and columns (2)-(4) show the results with governmental, external, and qualitative controls, respectively. Columns (5)-(8) give the

corresponding results with two-quarter lag.

From this table we observe that DE is significant (p-value ≤ 0.01) in all specifications, and H_1 can not be rejected. 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% and 2.7%, for one- and two-quarter lags, respectively, to 3.2% and 3.4%, respectively. Moreover, the coefficients on the control variables are as expected. The statistically significant negative coefficient on GDP growth is consistent with Afonso et al. (2011) (among others).[20]

4.2 Debt expansion and risk premia

To test hypothesis H_2, we use a panel regression of sovereign risk premia on DE. Risk premia price the risks associated with investor expectations (international risk aversion) as captured by VIX, which is considered to be a barometer of investor sentiment and market volatility (Blommestein, Eijffinger, and Qian, 2016). The premia also price the overall state of the economy as measured by the risk free interest rate and the slope of the term structure (Alexander and Kaeck, 2008; Fontana and Scheicher, 2016), liquidity risk measured by bid-ask spread of the 1-year benchmark bond, and sovereign macroeconomic risk captured through debt-to-GDP ratio (Delatte et al., 2017). The main regression model is given by

$$\rho_{i,t} = \alpha + \beta_{\Delta}\Delta \mathrm{D}^{+}_{i,t-k} + \beta_V \mathrm{VIX}_t + \beta_S \mathrm{Slope}_{i,t} + \beta_B \mathrm{Spread}_{i,t} + \mathrm{C}_i + \mathrm{Z}_t + \epsilon_{i,t}, \qquad (9)$$

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 again account for country and

[20]The results are qualitatively the same 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).

time fixed effects. We expect positive coefficients on VIX and bid-ask spreads. However, the coefficient on Slope can be either positive or negative. 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 tightening of monetary policy with likely adverse impact on economic growth, inducing higher default risk (Zhang et al., 2009).

[Insert Table 4 about here.]

We estimate model (9) with monthly observations over the sample period, and give the results in Table 4.[21] The DE coefficient is negative and statistically significant (p-value $\leq$ 0.05) in all specifications, and H_2 can not be rejected. We find VIX to be significant in all specifications, which is 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 to be significant, in line with Favero et al. (2010). The slope coefficient is positive and significant, consistently with Zhang et al. (2009) who argue that steeper yield curve is linked to higher default risk.[22]

To summarize, the results from the default probability regression model (equation 8) show that DE increases default risk in the next two quarters, whereas the results from the risk premia regression (equation 9) show that DE predicts a decline in risk premia in the following four to six months.[23] 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

[21]We report results for lag orders $k = 4$, 5, 6, but the results hold for $k = 3$ and 7, which we also tested but do not report here.

[22]We also need to control for both debt-to-GDP and 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, but nevertheless, the results remain unchanged when we include debt-to-GDP, or the risk free rate, or both variables (online Appendix Table B.1).

[23]This result still holds if we use debt change, instead of debt expansion, to include both positive and negative changes, as in Baron and Xiong (2017). The result remains qualitatively the same if we use debt change, where negative changes are replaced by zero. In addition, we interact debt change with a dummy variable D_+, taking the value 1 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. This reinforces our main result.

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 that decreases the risk premia by 28%, in the next 4 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. The results from Tables 3 and 4, taken together, are consistent with neglected risk in the eurozone sovereign credit market.[24]

4.3 Deauville shock to sovereign risk

Our tests thus far provide evidence of a negative relation between DE and future risk premia in the eurozone sovereign debt market. Our results add to the results of Baron and Xiong (2017), who find a negative correlation between credit expansion and future risk premia in international banking indices, since sovereign credit risk acts as a cap for corporate risk. We take our analysis a step further by showing what happens to changes in sovereign risk around the Deauville summit. The decisions at Deauville were a systemic shock to the credit risk in the eurozone market, providing an opportunity to investigate the dynamics of risk premia before and after this wakeup call.

[Insert Table 5 about here.]

Before proceeding with the analysis around Deauville, we address the potential concern that Bloomberg PDs might be derived from CDS prices, therefore potentially contaminating our analysis from feedback effects from CDS markets, since the estimation of risk premia depends on CDS spreads and PD. To do this, we examine the level of PD and CDS spreads before and after the Deauville summit. Table 5 shows the average of level and slope of PDs

[24]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 evidence consistent with neglected risk. Our use of extracted risk premia from equation (4), following Berndt et al. (2018), takes into account the premia required by risk-averse investors.

and CDS from one to three weeks pre- and post-Deauville, and their difference. From a two-sample t-test we find that the differences in the average levels of PDs and CDS are not statistically different than 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.[25] The significant impact of Deauville on CDS and the insignificant impact on PD, is consistent with the no mechanical relationship between PD and CDS.

[Insert Table 6 about here.]

Next, we test whether neglected risk is priced in after the summit. We calculate the average risk premia over the 2-year period before and after the summit (i.e. 1-year before and 1-year after), for crisis and non-crisis countries, and compare the means across time periods and country groups. We carry out this test excluding the month of the event, and also one or two months before and after the event. In Table 6 we show the average premia, and use a two-sample t-test of equality across time periods and country groups. Both country groups experience an increase in risk premia following Deauville. The non-crisis group premia are smaller (in absolute value) both before and after Deauville, as expected, but the negative average risk premia reverse sign post-Deauville. The repricing is at least 540bp for crisis countries and at least 60bp for non-crisis countries (p-values ≤ 0.01). The smaller (negative) premia for non-crisis countries are expected, and may suggest that what appears as neglected risk may be due to the implicit guarantees, which are more impactful for crisis than non-crisis countries. We rule out an implicit guarantee interpretation in the next section.

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

$$\begin{aligned} \rho_{i,t} &= \alpha + \beta_I \Delta \mathrm{D}^{+}_{i,t-k} \times \mathrm{Post}_{i,t} + \beta_P \mathrm{Post}_{i,t} + \beta_\Delta \, \Delta \mathrm{D}^{+}_{i,t-k} \\ &\quad + \beta_V \, \mathrm{VIX}_t + \beta_S \, \mathrm{Slope}_{i,t} + \beta_B \, \mathrm{Spread}_{i,t} + \mathrm{C}_i + \epsilon_{i,t}, \end{aligned} \tag{10}$$

where Post is a dummy variable, equal to one for post-Deauville observations and zero

[25] A minor exception is the increase of PD slope for the 6-week interval, with p-value ≤ 0.10.

otherwise. Table 7 shows the results obtained with monthly data and lag orders $k = 4, 5, 6$, as in the main regression model.[26]

[Insert Table 7 about here.]

The coefficient of DE is negative and significant (p-value ≤ 0.01 and 0.10 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 of the cross-product term, we observe that DE does not predict negative risk premia post-Deauville. The evidence of DE predicting neglected risk before but not after this wake-up call for eurozone sovereign credit risk, is consistent with a change in the behavior of investors. Interestingly however, this change in behavior is short-lived, since results with a 6-month lag can not reject the hypothesis that the net effect is not zero, (F-test p-value 0.09), suggesting the weak re-appearance of neglected risk. In summary, our evidence of neglected risk in the period before the political statements at the Deauville summit seems to have been briefly interrupted by the wake-up call that risk should not be neglected, however, this wake-up call seems to have slightly waned a few months later, when investors returned to their pre-Deauville behavior of neglecting the risk, as we discuss in subsection 4.5.

We re-run the analysis above by also using an earlier date than the Deauville summit, since some events might have signalled to markets to change their behavior. On such event is the announcement on October 20, 2009 by the Greek government that its deficit would soar to almost 12.5% of GDP. Hence, we run the main regression by having two indicator variables to capture the period before the Greek announcement, the period after Deauville and the interim period of high volatility. We interact these indicator variables with DE and obtain consistent results (online Appendix B.4). (We exclude the months of the Greek announcement and the Deauville summit.) An F-test on the sum of the coefficients of DE and

[26]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 again 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).

the cross-product terms, shows significant negative coefficient of DE in the interim period, suggesting the persistence of neglected risk in the period after the Greek announcement and before the Deauville summit.

4.4 Implicit guarantees

One potential explanation for our finding is due to implicit guarantees, i.e., the widely held belief that eurozone crisis countries are implicitly guaranteed by the stronger economies. Such an explanation would be consistent with DE predicting non-decreasing premia but is not consistent with decreasing premia. Increased PD due to DE could lead to zero net effect on the risk premium if debt is guaranteed, but would not lead to a premium decrease, and if the guarantees cover adequately all country risks, then DE should not change premia. If the guarantees partially offset DE risks, then we would expect risk premia to increase somewhat. We repeat regressions (8) and (9) on pre-Deauville data (from 2002 to 2009) 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). Hence, the market does not anticipate that the implicit guarantees fully offset country risks due to DE.

[Insert Table 8 about here.]

[Insert Table 9 about here.]

To further test the implicit guarantees explanation, we run models (8)–(9) without the crisis countries, and find that DE is robust in predicting PD increase (Table 9, Panel A), and risk premia decrease (Table 9, Panel B), so that the neglected risk hypothesis can not be rejected for non-crisis countries. This suggests that even when guarantees are less likely to apply —the weaker countries are not expected to provide much of a guarantee for the stronger economies—, the neglected risk evidence is still present. We consider it an interesting finding that evidence consistent with neglected risk is also present in non-crisis countries.

[Insert Table 10 about here.]

Finally, to rule out implicit guarantees for the major eurozone economies by the weaker economies, we carry out another test using the post-Deauville data (2011–2014) in regressions (8)–(9). The Deauville summit explicitly introduced credit risk in the eurozone sovereign debt market, highlighting that markets should stop "deluding themselves" about guarantees, and we expect a positive impact on premia due to DE. However, the result shows that the negative relation between DE and future risk premia of Table 4 and the positive relation between DE and PD of Table 3 persist, see Table 10 (Panels A and B).

4.5 Quantitative easing

The impact of the European Central Bank's (ECB) quantitative easing program, has direct implications for the neglected risk hypothesis we examine. Specifically, we examine how the introduction of the Public Security Purchase Programme (PSPP), which was 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, as well as 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 is made up from bonds issued by government and recognized agencies.[27]

[Insert Table 11 about here.]

We run models (8)–(9) for the period from January 2011 to December 2017 that spans the launching of PSPP, including the interaction of DE with a dummy variable W_{QE} indicating the period after the 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

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

about the same magnitude as in Table 3. We also observe that the F-test for the net effect of DE on PD when taking QE into consideration can not reject the null of zero net effect. 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.[28] These findings raise the public policy question of what will happen after QE ends, suggesting the potential re-emergence of neglected risk as an issue of concern to policymakers.

5 Robustness Tests

We conduct several robustness tests. First, we test for the evidence of neglected risk in USD-denominated CDS spreads. Second, we test the sensitivity of our results to the measures of probability of default and recovery rates we use. Third, following Baron and Xiong (2017) we perform a decomposition of the debt expansion variable to test whether our results are driven by changes in debt level or GDP contraction. Fourth, we use alternative sources of public debt data, beyond debt securities, and also use different time windows to estimate DE. Our fifth test uses a set of additional control variables.

5.1 Neglected risk in USD-denominated contracts

A credit event in a eurozone member can cause a depreciation of the euro, and redenomination risk was heightened during the eurozone crisis. USD-denominated CDS provide a hedge to currency risk, hence these contracts are more costly than the EUR-denominated (Fontana and Scheicher, 2016). This would imply higher premia (cf. equation 4), potentially

[28] The correlation of QE dummy variable and lag DE is -0.10, significant at 5 percent level, indicating that there is more DE pre-QE than post-QE.

eliminating the evidence on neglected risk. To rule out a redenomination risk interpretation of our findings, we re-run regression (9) 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.5) show that the DE coefficient is significant and predicts a reduction in premia with 4-, 5-, and 6-month lags. Our main findings in Table 4 are robust to the currency of denomination.

5.2 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 perform a randomized experiment to examine the robustness of the coefficients from regression (9) to ρ estimates from noisy PD and recovery rates.

We calculate ρ using randomly generated values of PD, uniformly in the range 50% to 100% of their Bloomberg values. By reducing randomly the PD by up to 50% we increase the risk premia, making it more difficult to document premia reduction and biasing the experiment against us. We randomly generate time series of PD for all the countries in our sample and run regression (9) with lag 4. We repeat this procedure 1000 times, 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 generate random values of recovery rates, uniformly in the range 100% to 150% of the Markit estimates, again increasing the risk premia and biasing the experiment against us. We run the regression model using the noisy recovery rates to estimate ρ, and repeat the experiment 1000 times to obtain an average DE coefficient -9.23, with a minimum value -10.11 and maximum value -8.36 (p-value ≤ 0.05 for all simulations). We perform an additional test with constant recovery rate 40% according to the ISDA contract specifications, following the literature (Badaoui et al., 2013; Singh and Spackman, 2009).

The results (online Appendix Table B.6) are consistent with Table 4.[29] The DE coefficient are negative and significant in all model specifications, and very close in magnitude to the coefficients of our main test.

5.3 Decomposition of debt expansion

We decompose DE to changes of the numerator (debt) and denominator (GDP). We run model (9), replacing $\beta_{\Delta}\Delta D^{+}$ by $\beta_D \Delta \log(\text{Debt}) + \beta_G \Delta \log(\text{GDP})$. As in the main test we consider the positive changes of DE, i.e., when $\Delta \log(\text{Debt}) - \Delta \log(\text{GDP}) > 0$. The results (online Appendix Table B.7) show that both β_D and β_G are statistically significant. This implies that the predictive power of DE is driven by changes in both debt and GDP. This is in line with the finding of Baron and Xiong (2017) for banking.

5.4 Comprehensive debt data and the time window

In our analysis we use monthly data, which are available only for debt securities. We carry out a robustness test including non-securities debt using quarterly data, and fit the regression equations (8)–(9) with this alternative measure of a country's 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.8). 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 level), establishing the robustness of the results in Table 4.

We also test the robustness 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.9–B.10) corroborate that both hypotheses H_1 and H_2 can not be rejected.

[29] Using 40% recovery for non-crisis and 25% for crisis countries, does not produce any notable changes.

5.5 Control variables

We test model (8) for its 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 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.11) are consistent with Table 3.[30]

There is evidence that risk premia may be driven by macroeconomic conditions (Amato et al., 2005; Doshi et al., 2017). For this reason, we run (9) controlling for a macroeconomic factor (inflation) and an external factor (current account), and find that DE remains significant in predicting risk premia reduction for all specifications (online Appendix Table B.11).[31] We also use the European volatility index VSTOXX instead of VIX, with qualitatively identical results. The results of Table 4 remain robust.

6 Conclusion

We provide robust evidence consistent with neglected risk in the eurozone sovereign credit market using a novel variable of debt expansion. 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 neglected risk by assessing the relationship between debt expansion and risk premia around the Deauville summit, which served as a wake-up call against neglected risk in eurozone sovereign credit markets. The results survive several robustness tests (currency of contract denomination, alternative data sources, debt measures and time windows in estimating debt expansion, control variables, and sample period).

[30] We ignore the debt-to-GDP multi-collinearity 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.

[31] Since Debt-to-GDP has a high VIF and the alternative variable to be used, government balance, is used by Bloomberg PD multi-factor model, we test (9) using inflation, current account, and debt-to-GDP, and the results are in line with Table 4.

Interestingly, we find that our results are not driven by crisis countries. Risk seems to have been neglected in non-crisis countries as well. 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 quantitative easing policies. We find that QE neutralizes the increase of probability of default due to debt expansion and the effect of debt expansion on risk premia. These findings raise the public policy question of what will happen when/if QE ends, suggesting that potential re-emergence of neglected risk must be of concern to policymakers.

Our identification of debt expansion as a significant factor of sovereign risk lends support to recent work by the international institutions in incorporating debt flow, in addition to debt stock, as a key determinant of debt sustainability. Investors and policymakers should be aware of the implications of debt expansion on the pricing of debt, including the likelihood of neglected risks in assessing market conditions.

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Data Appendix

Variable description and source

Variable	Source	Description
Dependent variables		
log (PD)	Bloomberg	log transformation of 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 due to 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 as a percentage of GDP. For debt we use total debt outstanding (all types or only debt securities) of general government. For GDP we use GDP and main expenditure components of country.
Bid-Ask	Thomson Reuters Eikon	(Ask price - Bid price)/Ask price, where bid and ask prices are due to Thomson Reuters Eikon and correspond to bid and ask prices of 1-year benchmark bond, respectively.
Inflation	IMF	Inflation rate.
GDP growth	IMF	Real growth rate of GDP at constant prices.
Current account	Eurostat	Current account as a percentage of GDP.
Government balance	Eurostat	General government fiscal balance as a percentage of GDP.
Political stability	WB	-2.5 corresponds to lowest level and 2.5 to highest level. We convert yearly political stability indices to quarterly by assigning to all quarters the same values as the reference year.
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 highest level and 100 to 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
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 using regression (6) estimated with 4-, 5-, and 6-month lags of LDE defined at quantile thresholds varying 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. We report the F-test p-value that tests the sum of the coefficients α and β is equal to zero. Data are monthly observations of our sample of eurozone countries, spanning January 2002 to December 2017. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

	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
F-test (p-value)	(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*
F-test (p-value)	(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*
F-test (p-value)	(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 (8) estimated with 1- and 2-quarter lags of DE. The dependent variable is log (PD). Columns (1)-(4) present the regression coefficients with 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 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 (9) estimated with 4-, 5-, and 6-month lags of DE. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with 4-month lag of DE where we control for investor expectations (international risk aversion) 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 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	-5.273***	-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 of level and slope of PDs and CDS (in bp) before and after Deauville (19 October 2010) using up to three weeks 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 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 (10) estimated with 4-, 5-, and 6-month lags of DE. The dependent variable is ρ. We present the regression coefficients of DE and its interaction with dummy Post indicating the post-Deauville period where we control for investor expectations (international risk aversion) 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 2-year period 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

Panel A of this table is similar to Table 3 and reports the coefficients of regression (8) estimated with 1- and 2-quarter lags of DE in pre-Deauville sub-sample. Columns (1)-(4) present the regression coefficients with 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 2-quarter lag of DE. Panel B is similar to Table 4 and reports the coefficients of regression (9) estimated with 4-, 5-, and 6-month lags of DE in pre-Deauville sub-sample. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with 4-month lag of DE where we control for investor expectations (international risk aversion) 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 DE. All models 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 in non-crisis countries

Panel A is similar to Table 3 and reports the coefficients of regression (8) estimated with 1- and 2-quarter lags of DE where we remove the crisis countries. Columns (1)-(4) present the regression coefficients with 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 2-quarter lag of DE. Panel B is similar to Table 4 and reports the coefficients of regression (9) estimated with 4-, 5-, and 6-month lags of DE where we remove the crisis countries. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with 4-month lag of DE where we control for investor expectations (international risk aversion) 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 DE. All models 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	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 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	-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 10: Effect of debt expansion on future probability of default and risk premia after Deauville

Panel A is similar to Table 3 and reports the coefficients of regression (8) estimated with 1- and 2-quarter lags of DE in post-Deauville sub-sample 2011-2014. The dependent variable is log (PD). Columns (1)-(4) present the regression coefficients with 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 2-quarter lag of DE. Panel B reports the coefficients of regression (9), estimated with 4-, 5- and 6-month lags of DE in post-Deauville sub-sample. Columns (1)-(3) present the regression coefficients with 4-month lag of DE where we control for investor expectations (international risk aversion) 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 DE. All models 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 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	-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 11: Quantitative easing and the effect of debt expansion on future probability of default and risk premia

We report in Panel A the coefficients of regression (8) estimated with 1- and 2-quarter lags in post-Deauville sub-sample, include 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 when we control for macroeconomic, external, governmental, and qualitative control variables. The p-value listed in the last row is from the F-test that the sum of the coefficients on DE and the interaction term is equal to zero. In Panel B we report the coefficients of regression (9) estimated with 4-, 5- and 6-month lags of DE. The dependent variable is ρ. We present the regression coefficients when we control for investor expectations (international risk aversion) 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. The p-value listed in the last row is from the F-test 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 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 × 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-val)	(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-val)	(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 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 spanning the period 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 expansion

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 spanning the period 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 default of sovereign 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 spanning the period 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 spanning the period 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 spanning the period 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 observations in our sample that are non-positive with 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 spanning the period 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$\times$(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 observations in our sample that are non-positive with 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 spanning the period 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

Panel A is similar to Table 3 and reports the coefficients of regression (8) when we add debt-to-GDP as a control variable. The dependent variable is log (PD). Columns (1)-(2) present the regression coefficients with 1-quarter lag of DE when we control for macroeconomic, external, governmental, and qualitative variables. Columns (3)-(4) report the same results for 2-quarter lag. Panel B is similar to Table 4 and reports the coefficients of regression (9), estimated with 4-, 5- and 6-month lags when we add debt-to-GDP as a control variable. The dependent variable is ρ. Columns (1)-(2) present the regression coefficients with 4-month lag where we control for investor expectations (international risk aversion) by VIX, the overall state of 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. All models 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) 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: Deauville shock on the relation between debt expansion and future risk premia controlling for debt-to-GDP

This table is similar to Table 7 and reports the coefficients of regression (10), estimated with 4-, 5-, and 6-month lags of DE, and its interaction with dummy variable Post, adding debt-to-GDP as a control variable. The dependent variable is ρ. We present the regression coefficients with 4-, 5- and 6-month lag of DE and its interaction with Post where we control for investor expectations (international risk aversion) 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 p-value listed in the last row is from the F-test 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 2-year period 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: Deauville shock on the relation between debt expansion and future risk premia with a different time window

This table is similar to Table 7 and reports the coefficients of regression (10) estimated with 4-, 5-, and 6-month lags of DE, and its interaction with dummy variable Post where we exclude only the month of the event. The dependent variable is ρ. We present the regression coefficients with 4-, 5-, and 6-month lag of DE and its interaction with dummy Post where we control for investor expectations (international risk aversion) 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 listed in the last row is from the F-test 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 2-year period 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 (10) with two included dummy variables and their interaction with DE. The D_1 is equal to one for the period between the Greek announcement and Deauville and zero otherwise. D_2 is equal to one for post-Deauville period and zero otherwise. The dependent variable is ρ. Coefficients are reported with 4-, 5-, and 6-month lag of DE and its interaction with dummy variables, when control for investor expectations (international risk aversion) 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 use an F-test that the sum of the coefficients on DE and the interaction term is equal to zero, and report the sum and F-test p-value in the last rows. 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 3-year period 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: Debt expansion and future risk premia calculated using USD-denominated CDS

This table is similar to Table 4 and reports the coefficients of regression (9), estimated with 4-, 5-, and 6-month lags of DE where the premia is calculated using USD-denominated CDS. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with 4-month lag of DE where we control for investor expectations (international risk aversion) by VIX, the overall state of 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 (4)-(6) and (7)-(9) report the same results for 5- and 6-month lags of DE. Similarly, 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.6: Effect of debt expansion on future risk premia with the ISDA constant recovery rates

This table is a robustness test on Table 4 and reports the coefficients of regression (9) estimated with 4-, 5-, and 6-month lags of DE, when 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 4-month lag of DE where we control for investor expectations (international risk aversion) 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 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 non-crisis 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.7: Effects of the debt and growth components of debt expansion on future risk premia

This table is similar to Table 4 and reports the coefficients of regression (9) estimated with 4-, 5-, and 6-month lags of $\Delta\log(\text{Debt})$ 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 (international risk aversion) 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 $\Delta\log(\text{GDP})$. Similarly, 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.8: Effect of debt expansion on future probability of default and risk premia with comprehensive debt measure

Panel A is similar to Table 3 and reports the coefficients of regression (8) estimated with 1- and 2-quarter lags of DE where we use debt-to-GDP and DE that are calculated using public debt data. The dependent variable is log (PD). Columns (1)-(4) present the regression coefficients with 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 2-quarter lag of DE. Panel B is similar to Table 4 and reports the coefficients of regression (9) estimated with 1- and 2-quarter lags of DE where debt-to-GDP and DE are calculated using public debt data. The control variables are obtained on the last day of the reference quarter. The dependent variable is ρ. Columns (1)-(3) presents the regression coefficients with 1-quarter lag of DE where we control for investor expectations (international risk aversion) 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) report the same results for 2-quarter lags of DE. All models 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.8: (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.9: Effect of 9-month debt expansion on future probability of default and risk premia

Panel A is similar to Table 3 and reports the coefficients of regression (8) when we estimate the DE over a 9-month period. The dependent variable is log (PD). Columns (1)-(4) present the regression coefficients with 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 2-quarter lag of DE. Panel B is similar to Table 4 and reports the coefficients of regression (9) when we estimate the DE over a 9-month period. The dependent variable is ρ. Columns (1)-(3) presents the regression coefficients with 4-month lag of DE where we control for investor expectations (international risk aversion) 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. All models 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.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	-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.10: Effect of 18-month debt expansion on future probability of default and risk premia

Panel A is similar to Table 3 and reports the coefficients of regression (8) when we estimate the DE over an 18-month period. The dependent variable is log (PD). Columns (1)-(4) present the regression coefficients with 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 2-quarter lag of DE. Panel B is similar to Table 4 and reports the coefficients of regression (9) when we estimate the DE over an 18-month period. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with 4-month lag of DE where we control for investor expectations (international risk aversion) 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 DE. 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 (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.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	-7.698**	-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.11: Effect of debt expansion on future probability of default and risk premia with alternative control variables

Panel A is similar to Table 3 and reports the coefficients of regression (8) with alternative control variables for macroeconomic and governmental factors. We replace real GDP growth, current account, and government balance with unemployment rate, terms of trade, and debt-to-GDP, respectively. The dependent variable is log (PD). Columns (1)-(4) present the regression coefficients with 1-quarter lag of DE when we control for macroeconomic, external, governmental, and qualitative variables, respectively. Columns (5)-(8) report the same results for 2-quarter lag. Panel B is similar to Table 4 and reports the coefficients of regression (9), with additional macroeconomic and external factors as controls. The control variables VIX, Slope, and bid-Ask are obtained on the last day of the reference quarter. The dependent variable is ρ. Columns (1)-(3) present the regression coefficients with 1-quarter lag when we add inflation (macroeconomic) and current account (external) factors. Columns (4)-(6) report the same results for 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.11: (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