The Effect of Rollover Risk on Default Risk: Evidence from Bank Financing

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Abstract

This empirical examination of the effect of rollover risk on default risk uses a database of U.S. industrial firms during 1986–2011.This article represents the most comprehensive empirical study to date tosupport the existence of a rollover risk effect on default risk. New empirical evidence reveals the extent to which financing sources affect the influence of rollover risk on default risk. A onestandarddeviation increase in the change in the rollover risk variable leads to a 5.9% increase in default rates. Furthermore, firms that depend on bank financing suffer the strongest rollover risk, especially if they are small and of poor credit quality. However, firms with relatively poor credit quality or small firms that are not dependent on bank financing are not affected by rollover risk, even during economic recessions.

Keywords: Rollover Risk, Default Risk, Credit Risk, Bank-Dependent Firms, Publicly Traded Debt-Dependent Firms

JEL classification:G00; G18; G21; G32; G33

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I. Introduction

Rollover (refinancing) risk arises when a firm faces difficulties trying to roll over its maturing short-term debt,must refinance a maturing debt of low credit quality (Diamond (1991)), or needs to refinance debt affected by a high liquidity premium (He and Xiong (2012)).[1]The default risk instead represents the likelihood of firms' insolvency. Some evidence suggests that rollover risk may interact with default risk; for example, during the financial crisis of 2007–2009, the deterioration in debt market liquidity caused severe financing difficulties for many firms, which had negative impacts on the rollover of maturing debt, thus exacerbating many firms' default risk.

Some recent theoretical literature also argues that rollover risk could be a source of credit risk, because it increases the possibility of a run on the firm (Morris and Shin (2009)) and sharpens conflicts of interest between shareholders and debtholders (He and Xiong (2012)). Therefore, equity holders declare the firm insolvent when the value of the assets of the firm is higher thanwould be in the standard situation. Forte and Peña (2011) offer the theoretical result that debt refinancing generates systematic rating downgrades, unless a minimum value of firm value growth exists. They also show that even when higher firm value growth generates upgrades, downgrades tend to be greater in absolute terms. The key implication of these theoretical models is that rollover risk tends to increase default risk, on average, which we refer to as the rollover risk effect (RRE). Empirical evidence on RRE is in its early stage; as far as we know, only one published article by Gopalan, Song, and Yerramilli (2013) documents that firmsthat experience large increases in rollover risks likely also suffer a strong deterioration in their credit quality.[2]

[1]Diamond (1991) shows that firms may struggle to roll over maturing short-term debt, especially if the refinancing coincides with a deterioration in the firm's fundamentals or credit market conditions.
[2]Chen, Xu, and Yang (2012), Hu (2010), and Valenzuela (2011) have working papers pertaining to this topic.

However, extant studies reveal only some of the rollover risk effect, because their samples are limited, restricted to firms with credit ratings, bond prices, or credit default swap spreads. We consider it is important to study other firms that have not been contained, such as non-rated firms, which represent almost 60% of the U.S. market.These firms usually are considered bankdependent.[3]This paper investigatesthe impact of rollover risk on default risk, by asking two questions: (1) Do firms with high rollover risk experience greater default probabilities than otherwise comparable firms that do not face rollover risk? and (2) Do financing sources matter in the interaction between rollover risk and default risk? Although financing sources, debt maturity, and default risk are mutually correlated, extant studies only cite the relationship between two of these three factors;[4] none of them considers the three factors simultaneously. We aim to fill this gap.

In particular, we ask whether bank-dependent firms suffer greater rollover risk than otherwise similar firms that do not rely on bank financing (i.e., firms that depend on publicly traded debt). We focus on these two types of firms because they differon some key factors. In particular, firms that depend on bank financing tend to face more difficulties in long-term borrowing, have lower debt capacity, and suffer greater liquidity risk (Carey, Prowse, Rea, and Udell (1993); Diamond (1991); Lemmon and Zender(2010); Mian and Santos (2011)). All these attributes suggest that bank-dependent firms may have higher rollover risk, which in turn may imply higher default risk.

[3] As we discuss in Section III.B, our sample contains approximately 60% of firm-year observations of bank-dependent firms, and 40% of firm-year observations of firms that do not depend on bank financing (i.e., publicly traded, debt-dependent firms).

[4]For example, Chiu, Peña, and Wang (2014) suggest that alternative financing sources have differential impacts on default risk. During the 2007–2010 crisis, firms that depend on bank loans as main financing sources tend to suffer more default risk than firms that use publicly traded debt as their main financing source. Barclay and Smith (1995) find that the firm's debt maturity is positively correlated with credit risk for rated firms, whereas evidence of nonmonotonicity is driven solely by unrated firms in their sample.

To test our hypotheses, we investigate industrial firms in the U.S. market in the period from 1986 to 2011. Similar to Gopalan et al. (2013), we employ a regression in first differences to eliminate firm-specific fixed effects. The dependent variable is the change in default risk, and the key explanatory variable is the change in the rollover risk variable. We also control for relevant default risk factors, other than rollover risk, as we detail in Section III.

Our proxy for default risk is the expected default frequency (EDF), based on Merton's (1974) model. The EDF is a continuous, absolute measure of default risk that changes over the course of the credit cycle, reflecting changes in the level of default risk, which is exactly what we seek want to capture in this study.[5]Furthermore, the computation of the EDF measure only requires publicly available information (stock price and accounting information). As a robustness test, we compute the distance-to-default (DD) and use credit ratings provided by rating agencies as alternative default risk measures.

To measure rollover risk, we compute the amount of the firm's long-term debt outstanding at the end of year *t – 1*, due for repayment in year *t*. This variable is suitable for studying the rollover risk effect (Almeida, Campello, Laranjeira, and Weisbenner (2012); Gopalan et al. (2013)). The variable only depends on long-term debt maturity decisions made previously by the firm and is less likely to correlate with the firm's current risk characteristics or credit quality, and is therefore unlikely to be affected by possible endogeneity concerns.

Empirical evidence strongly supports the rollover risk effect, in that it exacerbates default risk, consistent with our hypotheses. In particular, we show that a onestandarddeviation increase in the change in the rollover risk variable leads to a

[5]Credit ratings can only reflect "relative" rankings of credit risk across firms at each time(see the discussion by Hovakimian, Kayhan, and Titman (2012)).

5.9% increase in default rates. Furthermore, we examine if the RRE is higher for firms that depend on bank financing, compared with firms without this dependence. Our results confirm this prediction, consistent with our hypothesis.

Next, we study the extent to which the RREmight be conditional on key financial variables of the firm, such as its credit quality and size, and we consider the overall economic situation (i.e., recessions or normality). The RRE has material effects for firms with relatively poor credit quality. In contrast, firm size and the overall economic situation do not seem to affect rollover risk. Digging deeper, we find that the RRE is significant only for bank-dependent firms: Firms dependent on bank financing suffer the strongest rollover risk, particularly if they are small and exhibit low credit quality. However, other firms with relatively poor credit quality or small sizes that do not depend on bank financing are not affected by rollover risk, even during economic recessions.

Thus, our study adds to extant literature in several ways. First, we contribute toliterature on both debt maturity and credit risk, by providing empirical validation of the theoretical prediction that rollover risk, arising from a firm's debt maturity structure, increases the firm's overall credit risk (e.g., He and Xiong (2012); Morris and Shin (2009)). Compared with most previous studies of the RRE that use restricted samples (e.g., Gopalan et al. (2013)), we provide more comprehensive empirical evidence, by including all levered firms in the U.S. market.

Second, this article complements several recent studies that exploit the global crisis of 2007–2009 to highlight its adverse impact on real-economy firms. In our case, this negative impact refers to the difficulties firms face when they try to roll over their maturing debt. Almeida et al. (2012) show that firms for which a larger proportion of their long-term debt matured right after August 2007 experience larger drops in their real investment rates. Duchin, Ozbas, and Sensoy (2010) find that the decline in corporate investment following the global crisis is more pronounced among firms that had more net short-term debt. The key contribution of our study is that whereas other articles examine the effect of rollover risk on the investment decisions of the firms, we investigate the impact of rollover risk on a firm's default risk andconclude that rollover risk likely exacerbates default risk.

Third, Chiu et al. (2014) study the mechanism by which a financial crisis affects the default risk of real-economy levered firms, using the 2007–2009 crisis as a natural experiment, and find that firms that depend strongly on bank financing tend to suffer higher increases in default risk than other, similar firms with no dependence on bank financing. However, they do not explore the economic reasons for these results. We instead provide new evidence that rollover risk constitutes an economic factor that helps explain why bank-dependent firms suffer higher default risks than publicly traded, debt-dependent firms.

The results in turn have important implications for academics and policy makers alike. For academics, our findings suggest a potential means to improve current credit risk models, namely, through a better understanding of the interaction between default risk and rollover risk (which relates closely to liquidity risk). Furthermore, we show that it is important to account for financing sources when assessing the interaction between rollover risk and default risk, because a firm’s borrowing channel largely determines how rollover risk affects default risk. For policy makers, responsible for stabilizing economic situations, our results suggest a way to reduce the default risk of industrial firms,namely, bygiving them incentives to adjust their debt maturity structure and thus minimize the impact of rollover risk.

The remainder of this article proceeds as follows:We present related literature and our hypotheses in Section II. Section IIIcontains the main variables for our study and the data. In Section IVwe discuss the empirical results, and in Section V, weconclude with some limitations of this study and suggestions for further research.

II. Literature Review and Hypothesis Development

In this section, we outline both theoretical and empirical research into the effect of the rollover risk on default risk and discuss the potential impact of a reliance on bank borrowing.

A. Rollover Risk Effect on Default Risk

1. Theoretical Background

Some recent studiespropose theoretical modelsin which rollover (refinancing) risk increasesdefault risk. Morris and Shin (2009) incorporate insights from bank-run literature (Diamond and Dybvig (1983)) into a stylized model and examine the interaction, showing that a negative fundamental shock can increase the probability that short-term debt holders decide not torefinance, which then increases the bank's default probability. He and Xiong (2012) apply Myers's (1977) notions to Leland and Toft's (1996) model and find that when debt market liquidity deteriorates, firms face rollover losses if they issue new bonds to replace maturing bonds. To avoid default, equity holders must bear rollover losses. The intrinsic conflict of interest between debt and equity holders may force equity holders to choosea higher fundamental firm value as a default barrier. In thepresence of refinancing risk, a firm has a lower probability of survival. Forte and Peña (2011) also investigate the long-run effects of refinancing and find that debt refinancing increases default risk and systematic rating downgrades, unless some minimum level of firm value growth occurs. Deviations from this growth path imply asymmetric results:Lower firm value growth generates downgrades, and higher firm value growth generates upgrades. However, downgrades tend to be greater in absolute terms.A key implication of these theoretical contributions is that the amount of firm debt that is maturing in the short term increasesthe firm's overall default probability, beyond traditional default risk factors (e.g., operating risk, leverage ratio), causing the RREwe define herein. Furthermore, these models aim to study the interaction between default risk and rollover risk in the banking sector, or for firms that issue corporate bonds, but we posit that a similar logic applies to any levered firm, because once firms have debts, they face refinancing risk.

2. Empirical Evidence

Some recent empirical evidence indicates the existence of a RRE. Gopalanet al. (2013) find that firms with greater exposure to rollover risk suffer lower credit quality,measured by credit ratings. The RREalso is stronger among firms with speculative grade ratings and declining profitability, as well as during economic recessions.According to Chen et al. (2012), a bigger drop in the maturity of debt led to larger increases in credit spreads during the 2007–2009 crisis. This maturity effect on credit spreads ismore pronounced for firms with high leverage or high systematic risk. Valenzuela (2011) also finds an interaction between liquidity and default premiums, whereby debt market illiquidity increases firms' corporate bond spreads through rollover risk.

Our first hypothesis follows directly from these theoretical predictions and empirical evidence:

Hypothesis 1: *Firms with high exposure to rollover risk have higherdefault risk than firms without such exposure.*

Extant empirical studies that use particular proxies for default risk, usually study a restricted sample that does not cover all firms. For example, as proxies for default risk, they use credit ratings, corporate bond spreads, or credit default swap spreads, with samples that are limited to large or lessrisky firms. We argue though that it is important to study all firms, especially those that have not been widely considered thus far. For example, unrated firms represent almost 60% of total firms in the United States. Due to these considerations, we employ a general default risk measure (EDF) and study a comprehensive sample, which should lead to conclusions that are more reliable than those from other published studies.

B. Impacts of Financing Sources on the RRE

The RRE is notable with regard to the potential role of alternative financing sources. To address this insufficiently explored issue, we study the impact of alternative debt sources on the effect of rollover risk on default risk. We consider two main debt sources: bank loans and publicly traded debt (e.g., corporate bonds). Depending on its degree of reliance on each debt source, we classify each firm as dependent on bank financing or dependent on publicly traded debt. We classify firms according to these two types, because they probably differ in specific ways. In particular, we expect bank-dependent (BD) firms to experience stronger rollover risk effect than do publicly traded, debt-dependent (PDD) firms.

Carey et al. (1993) show that BD firms are more likely have trouble finding long-term debt financing, because bank debts have shorter average maturities than publicly traded debt.Lemmonand Zender (2010) also note that unrated firms tend toexhibit a lower debt capacity,because they have more volatile cash flows, possess a lower collateral value of assets, andare more informationally opaque. Unrated firmsalso tend to suffer higher costs due to financial distress. These factorssuggest unrated firms potentially are more exposed to rollover risk.[6]

[6]Unrated firms tend to borrow from banks, and are BD, whereas firms that have credit ratingsusually have access to public debt markets and are likely PDD. Prior literature similarly uses rating information

Furthermore, Diamond (1991) argues that low credit quality firms that face greater liquidity risk may demand longer-term debt to reduce this risk but cannot find lenders willing to supply it at reasonable cost.[7]Mian and Santos (2011)show that only creditworthy firms can choose to refinance at a lower rate if their cost of capital rises; lower credit qualityfirms instead have minimal access to new capital at a reasonable cost, such that they incur substantial rollover losses.In summary, rollover risk is higher for BD firms, because they likely suffer from lower credit qualitycompared with PDD firms. In turn, we expect BD firms to experience a greater RRE on default risk, because on average, they suffer stronger rollover risk.

Finally, Barclay and Smith (1995) find that a firm's debt maturity correlates negatively with credit risk for unrated firms (i.e., BD) but positively for rated firms (i.e., PDD). Higher short-term debt (i.e., higher rollover risk) thus might lead to a higher credit risk only for BD firms. Because BD firms tend to be the ones with more short-term debts, we expect that BD firms experience stronger RREon default risk,compared with PDD firms.Thus our second hypothesis is:

Hypothesis 2:*The RRE is stronger for bank-dependent firms than for firms that depend on publicly traded debts.*

III. Variables and Data

A. Variables

In addition to detailing the measures we used to proxy for default risk, in this section we explain the construction of rollover risk as our explanatory variable and the characteristics of the control variables we employ in the corresponding regression.

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to discriminate between BD andPDD firms (e.g., Chava and Purnanandam (2011)).

[7]In contrast, higher credit quality firms likely face lower liquidity risk and can borrow over the longer term if liquidity risk concerns arise.

1. Dependent Variable: Default Risk

To examine RREfor all levered firms (including rated and unrated firms), and obtain as large a sample as possible, we are restricted from using some commonly employed proxies for default risk.[8]That is, we need default risk measures that are flexible enough to quantify default risk for firms across the entire market.We compute the expected default frequency (EDF) on the basis of the Merton (1974) model, as the baseline measure of default risk; it has been used widely to indicate default risk for non-financial corporations (see Bharath and Shumway (2008); Chavaand Purnanandam (2010); Hovakimian et al. (2012)). We also use the distance-to-default (DD) as an alternative proxy for default risk.[9]

For both the EDF and DD measures, we adopted Moody's well-known KMV approach:

$$DD = \frac{\log(V/B) + (\mu - \sigma_V^2/2)T}{\sigma_V \sqrt{T}} ,(1)$$

where$V$ is a firm's total asset value, Brepresents the firm's face value of debt, σ_V is the volatility of the firm's asset return, μoffers an estimate of the expected long-run return of a firm's asset return, and Tindicates the maturity of a firm's debt. Thecorresponding implied probability of default, under the natural probability measure, or the EDF, thus can be defined as:

$$EDF = N\left(-\left(\frac{\log(V/B) + (\mu - \sigma_V^2/2)T}{\sigma_V \sqrt{T}}\right)\right) = N(-DD),(2)$$

where*N(.)* is the cumulative distribution function for a standard normal distribution.The EDF measures are statistical predictions of default over some

[8]For example, we cannot use credit ratings, corporate bond spreads, and credit default swap spreads, because they are only available for firms that have ratings, outstanding issuance of corporate bonds, or issuance of credit default swaps.

[9] The DD analysis is in Section IV.D.

specified time horizon; we calculate the one-year default probability. In addition, we implement an estimate based on a one-year rolling window, updated monthly, to obtain time-series EDF and DD data. We explain the details of the estimation procedure in Appendix A.

As a measure of default risk, EDF has several advantages. Unlike credit ratings, which measure the *relative* probability of default at a fixednumber of discrete levels, EDF is a continuous, *absolute* measure that changes over the course of the credit cycle. Therefore, changes in EDF imply changes in the level of default risk (seeHovakimian et al. (2012)).[10]When theaim is to capture changes in default risk, EDF is a more appropriate measure of default riskthan creditratings.[11] In addition, computing EDFonly requires stock price and accounting information, bothof which are publicly available, so we can measure default risks for many, rather than a restricted group of firms. Finally, using EDFhelps us avoidsample selection issues.

2. Explanatory Variables: Rollover Risk Variable

To define the rollover risk variable, we follow Gopalan et al. (2013) to exploit the exante heterogeneity in firms' long-term debt maturity. Thus, we look at the proportion of long-term debt that matures every year to gauge the impact of rollover risk, similar to Almeida et al.'s (2012) approach, because long-term debt payable during the year should depend on the firm's previous long-term debt maturity decisions but be less correlated with the firm's current risk characteristics or credit quality. In turn, this measure is largely free of the potential endogeneitythat affectsother measures of refinancing risk (e.g., refinancing interest rate charged by the

[10]Hovakimian et al. (2012) posit that ratings reflect relative rankings of credit risk at each point in time, without reference to an explicit time horizon; though credit ratings provide an ordinal ranking of default risk across firms, depending on the business cycle, mapping between ratings and short-run default probabilities may change.
[11]Gopalan et al. (2013) use credit ratings, and as far as our best understanding, we are the first study use EDF to examine the RRE.

bank, measures based on short-term debt). The rollover risk variable thus is defined as

$$\Delta(LT)_{-1_{i,t-1}} \equiv (LT)_{-1_{i,t-1}} - (LT)_{-1_{i,t-2}}, \quad (3)$$

where$(LT)_{-1,i,t-1}$ is the amount of firm$i$'s long-term debt outstanding at the end of year $t-1$ due for repayment in year t (i.e., COMPUSTAT item *dd1* in year $t-1$), scaled by the current book value of total assets.The $\Delta(LT)_{-1,i,t-1}$ is the year-to-year change in $(LT)_{-1,i,t-1}$.A positive value of $\Delta(LT)_{-1,i,t-1}$ implies that firm i's exposure to rollover risk increases in year t.

3. Explanatory Variables: Control Variables

We control forseveral relevant firm characteristics that may affect changes in a firm's default risk: (1) *Size*, measured using the log(total assets); (2) *Leverage*, or total debt/total assets; (3) *Interest coverage*; (4) *Profitability,*which is operating income/sales; (5) *Tax*, the ratio of tax expenditures to the book value of total assets;(6) *Market to book*, which represents growth opportunities; (7) *R&D* expense; (8) idiosyncratic volatility, denoted as *Idiovol*, which represents operating risk; (9) *Tangibility*; and (10) *Cash*. The changes in these variables serve as the regressors in our empirical model; their detailed definitions are in Appendix B.

Regarding their economic rationale, *Size* is relevant because larger firms are more diversified, which reduces operating risks, so they should face less default risk than smaller firms. Therefore, we expect a negative sign for this variable in the corresponding regression.We include *Leverage* because higher leverage implies a greater chance that the firm files for bankruptcy; we expect a positive sign associated with this variable in the corresponding regression. *Interest coverage* is a ratio used to assess how easily a firm can pay interest on its outstanding debt. When this ratio is lower, the firm is more burdened by debt expenses, so its chances of failure increase, suggesting an expected negative sign in the regression. For *Profitability*, we note that a profitable firm should be less likely to default; the expected sign is negative.*Tax*is negatively associatedwith default probability (Hovakimianet el. (2012)),because firms with higher tax rates tend to choose more conservative capital structures. Again, this expected sign is negative.*Market to book*reflects growth opportunities and should be negatively correlated with default probability, in that it represents additional value (over and above book value) that debt holders can access in the event of a default, such that we expect a negative sign. The *R&D* expenses proxy for the firm's brand equity and intellectual capital and are intangible. Intangible assets tend to lose more value than tangible assets in the event of default (Hale and Santos (2010)),so we expect a positive sign. The *Idiovol*(i.e., idiosyncratic volatility) variable implies the probability that a firm's asset value is below the default boundary; the higher volatility, the higher the uncertainty,and therefore the higherthe defaultprobability. The expected sign should be positive.*Tangibility*should have a negative effect on default probability, because tangible assets lose less of their value in default than do intangible assets. Finally, *Cash* reflects a firm's ability to pay its debt obligations, so we expect this variable to exhibit a negative sign in the corresponding regression.

B.Databases and Descriptive Statistics

We investigate industrial firms in the U.S. market over the period from 1986 to 2011.[12]Financial statement data come from COMPUSTAT, and the stock return data are from the Center for Research Security Prices (CRSP). We lag all accounting information by six months, to account for reporting delays.We exclude financial firms (standard industrial classification [SIC] codes 6000–6999), utilities (SIC codes 4900–4999), and quasi-public firms (SIC codes over 8999), whose capital structure

[12]We chose 1986 as the initial year, becauseCOMPUSTATstarted to cover credit ratings in that year.

decisions can be subject to regulation. In addition, we included only those firms whose total debt representsat least 5% of their assets (Chen et al. (2012)), to avoidinappropriately contrasting firms that can issue long-term debt with ones that cannot.To minimize the effects of outliers on the results, all variables arewinsorized at the 1st and 99th percentiles (e.g., values exceeding the 99th percentile are set equal to the 99th percentile). The final sample size featured is 45,565 firm-year observations, representing 7,272 firms.

To investigate whether bank-dependent firms experience more RREthanpublicly traded, debt-dependent firms, we first need to identify borrowers that depend on their lenders.We use the S&P long-term issuer level rating, extracted from COMPUSTAT,[13] to identify a firm as either BD (i.e., unrated firms) or PDD (i.e., rated firms). We thus identifyBD firms with 27,122 firm-year observations (approximately 60% of the full sample) andPDD firms with 18,443 firm-year observations (approximately 40% of the full sample).

In Table 1, we present the summary statistics for the variables, including $(LT)_{-1,t-1}$ (ratio of long-term debt maturing in one year), proxies for default risk, the EDF and DD, and relevant firm characteristics.The mean EDF value is about 0.1, and its median value is 0.001, indicating that its distribution is very rightskewed. Almost half of the firms areless likely to default,according to the very low median value.The mean (median) for $(LT)_{-1,t-1}$is 0.028 (0.011); an interquartile range of 0.026 implies wide variation in this debt maturity measure across firms.Similar to Gopalan et al. (2013), we focus on $\Delta(LT)_{-1,t-1}$ to take advantage of the variations in $(LT)_{-1,t-1}$ over time and across firms.We also present the firm characteristics in Table 1, which enables us to compare the characteristics of firms that have access to publicly traded debt with

[13]The COMPUSTAT data item for credit rating is SPLTICRM, defined as the S&P's current opinion of the issuer's overall creditworthiness, beyond its ability to repay individual obligations; this measure focuses on the obligor's capacity and willingness to meet its long-term financial commitments.

those that are not rated, through statistical tests of the differences in their characteristics.

Regarding our key variable$(LT)_{-1,i,t-1}$, we findaverage levelsof 0.035 for BD firms and0.018 for PDD firms. The median value shows a similar pattern, namely, 0.018 for BD firms and 0.007 for PDD firms, suggesting that BD firmsexperience more rollover risk. Furthermore, BD firms tend to besmaller andless profitable, and they havelower assettangibility, tax rates, leverage, andinterest coverage; in contrast, they show higher default risk, long-term debts that mature within one year,cash holdings, market-to-book ratios, idiosyncratic volatility, and R&D expenditures.These differences arestatistically significant at the 1% level and generally consistent with our expectations (see alsoChava and Purnanandam(2011); Hovakimian et al.(2012)).[14]The average one-year default probability is approximately 12% for BD firms and 8% for PDD firms.[15]

[Insert Table 1 Here]

C. Correlation Matrix

Table 2 contains the correlation matrix of the variables (Panel A). The correlation between $(LT)_{-1,t-1}$ and EDF (DD) is 0.19 (-0.15), at a1% significance level, consistent with our prediction that higher rollover risk would mean higher default risk. The correlation between EDF and DD is -0.61, which reflects both variables provide measures of default risk; that is, the higher the EDF, the higher the default risk, whereas the lower the DD, the higher the default risk. The two proxies of default riskare not perfectly correlated though, so each proxy has some specific information

[14]Chava and Purnanandam (2011) show that BD firms have lower leverage and profitability but higher default risk, market to book, and equity volatility. Hovakimian et al. (2012)find similar results and also show that BD firms have lower tangibility, size, and R&D expenses.

[15] Hovakimian et al. (2012) find that the average one-year default probability is about 5% for unrated firms and 1.6% for rated firms—lower than in our sample. A possible explanation of this difference is that our sample covers three years (2009, 2010, 2011) that do not appear in their sample and that areparticularly turbulent, which likely leadsto higher default probabilities.

not shared by the other measure, and it is important to use both variablesto achieve a more robust analysis.The signs of the correlations between EDF and the other factors are also as expected. That is,*Cash*, *Market to book*, *Tangibility*, *Size*, *Tax*, *Profitability*, and *Interest coverage*relate negativelyto EDF, whereas *Idiovol* and *Leverage*relatespositively to it.The signs of the correlations change from positive (negative) to negative (positive) for DD, as we expected, with the exception of R&D.

Because we use first differences in the regressions, we present these correlations in Panel B of Table 2. Specifically,$\Delta(LT)_{-1,t-1}$ is significantly and positively related to ΔEDF, consistent with our expectation. The correlations between ΔEDF and changes in the other factors also aregenerally consistent with the results in Panel A, except for *Tangibility*, *Size*, and *R&D*, for which the low correlations are barely significant.

[Insert Table 2 Here]

IV. Empirical Results

We present the results in five sections, to focus on (a) theresults of testing the effect of rollover risk on default risk, in the baseline case; (b) the test of the hypothesis about whether bank borrowing dependence drives the rollover risk effect; (c) checks of the extent to which rollover risk effect is conditional on credit quality, the firm's size, and the state of the economy; (d) the overall results, using DD to measure default risk; and (e) various robustness checks.

A. Baseline Results

We follow Gopalan et al. (2013) and use a regression with variables in first differences, to avoid the firm-specific fixed effects. That is,

$$\Delta Default\ Risk_{i,t} = \alpha + \beta \times \Delta(LT)_{-1_{i,t-1}} + \sum_{k=1}^{K} \gamma_k \times \Delta X_{i,t,k} + \text{Year FE} . \quad (4)$$

The dependent variable, $\Delta Default\ Risk_{i,t}$, represents the change in firm *i*'s default risk in year *t* against year *t – 1*. For this study, we proxy for default risk using EDF, and we control forchanges (during year *t*) in the tenrelevant firm characteristics $\left(\Delta X_{i,t,k} \equiv X_{i,t,k} - X_{i,t-1,k}\right)$ that may affect any change in the firm's default risk, as we detail in Section III.

We estimate Equation 4with a panel comprised of one observation for each firm-year combination, spanning the period from 1986 to 2011. In all the specifications, we also include year fixed effects to control for any macroeconomic variables that may affect changes in the default risk. The standard errors are robust to heteroscedasticityand autocorrelation, clustered at the industry level, where we define the industry according to the Fama-French 48 industry categories.

The baseline results are in Table 3. The variable of interest for our study is$\Delta(LT)\text{-}1_{,i,t-1}$, that is, the change in long-term debt that matures in a year. Column 1 reports the estimators without control variables and shows that the estimated coefficient of $\Delta(LT)\text{-}1_{,i,t-1}$ is positive and significantly different from zero atthe1% significance level, consistent with Hypothesis 1. The coefficient of 0.067 implies that a onestandarddeviation increase in $\Delta(LT)\text{-}1_{,i,t-1}$ leads to a 5.9% increase in default rates.[16] Thus, the effect of rollover risk on default risk is not only statistically but also economically significant.

After controlling for other default risk factors (Column 2), we find that the estimated coefficient of $\Delta(LT)\text{-}1_{,i,t-1}$ retain its statistical significance at the1% level.Regarding the influence of the control variables on EDF, the results are largely consistent with ourexpectations: *Cash*, *Market to book*, *Tax*, *Profitability*, and *Interest coverage*relate significantly negatively to EDF, whereas*Idiosyncratic risk* and

[16]In the full sample, the mean and standard deviation of $\Delta(LT)\text{-}1_{,i,t-1}$ are 0.002 and 0.09, respectively. We rely on this information to quantify the economic impact of the RRE. Adding the mean value of $\Delta(LT)\text{-}1_{,i,t-1}$ to the standard deviation of $\Delta(LT)\text{-}1_{,i,t-1}$ represents a onestandard deviation increase in $\Delta(LT)\text{-}1_{,i,t-1}$. Then, we compute the economic impact as follows: We multiply the former figure by the estimated coefficient of $\Delta(LT)\text{-}1_{,i,t-1}$, then divide it by the unconditional mean value of the dependent variable (EDF or DD). That is, 0.002+0.09= 0.092; 0.092×0.067= 0.006164; and 0.006164/0.105 = 0.0587.

*leverage*relate significantly positivelyto it.However, some variables do not relate significantly to EDF in thissample, namely, *Tangibility*, *Size*, and *R&D*.Regarding the economic impact of the control variables on changes in default risk, the most influential variable by faris the change in idiosyncratic volatility, followed leverage and market-to-book.

[Insert Table 3 Here]

B.RRE and Financing Sources

Firms that are bank dependent likely experience a larger effect of the rollover risk on the default risk (see Hypothesis 2). To test this idea, we employ a dummy variable*BD_dummy*that equals 1 if the firm is BD firm and 0 otherwise.We next create two separate interaction terms by multiplying therollover risk factor(i.e., $\Delta(LT)_{-1,i,t-1}$) by the *BD_dummy*variable and multiplying $\Delta(LT)_{-1,i,t-1}$) by (1 – *BD_dummy*).These two interactions make the effect of rollover risk on default risk conditional on the dependence of a firm’s financing source, enabling us to test whether bank borrowing dependence affects the RRE. The testing method is based on Equation 4, but we replace $\Delta(LT)_{-1,i,t-1}$ with the two interaction terms, as follows:

$$\begin{aligned} \Delta Default\ Risk_{i,t} = \alpha &+ \beta_1 \times \Delta(LT)_{-1_{i,t-1}} \times BD\_dummy \\ &+ \beta_2 \times \Delta(LT)_{-1_{i,t-1}} \times (1 - BD\_dummy) \quad (5) \\ &+ \sum_{k=1}^{K} \gamma_k \times \Delta X_{i,t,k} + \text{Year FE} \end{aligned}$$

If being bank dependentstrengthens the effect of rollover risk on default risk, the coefficient of the variable of $\Delta(LT)_{-1,i,t-1}\times$*BD_dummy*, or β_1,should be positive and statistically significant. If PDD firmsinstead experiencea lower effect of rollover risk on default risk, the interaction variable of $\Delta(LT)_{-1,i,t-1}\times$ *(1 – BD_dummy*),which we refer to as β_2, would benon-significant.

We notice that the distributions of $\Delta(LT)_{-1,i,t-1}$ are not alike for BD and PDD firms; for example, the mean of $\Delta(LT)_{-1,i,t-1}$ is 0.0026 for BD and0.0013 for PDD, and the standard deviations are0.112 for BD and 0.042 for PDD. Thus, rather than comparing the estimated coefficients directly, we compute their economic impactsusingtheir respective means and standard deviations, for BD and PDD firms.

Columns 3 and 4 in Table 3contain the results ofEquation 5.We find a significant estimated coefficient of $\Delta(LT)_{-1,i,t-1} \times BD\_dummy$, but not for $\Delta(LT)_{-1,i,t-1} \times (1 - BD\_dummy)$, though they both have positive signs.Therefore, firms that experience growth in their long-term debt maturing in the coming year suffer higher default rates, though this effect is only significant for BD firms, consistent with our Hypothesis 2. In particular, a onestandarddeviation increase in $\Delta(LT)_{-1,i,t-1}$ leads to a 0.0076 increase in EDF. Given the average value of 0.124 for EDF, this result indicates that a onestandard deviation increase in $(LT)_{-1,i,t-1}$ leads to a 6.1% increase in default rates. After controlling for other default risk factors, the RREstill holds for BD firmsand is significant at the 1% level.

Thus, our results suggest overall that rollover risk effect has material importance for BD firms, consistent with our Hypothesis 2, even after we account for relevant default risk factors. These resultsconstitute evidence about the lower limit of the effect of rollover risk on credit risk, because short-term debt (less than one year to maturity) tends to amplify this effect—especially in the case of BD firms,which use more short-term debt than do PDD firms.[17]

C. Rollover Risk Effect, Conditional on Credit Quality, Size, and Recession

Factors other than the amount of long-term debt also may affect the RRE; we considercredit quality, size, and the overall economic situation(recessionary or otherwise).[18]First, the RRE on credit risk should be stronger for poor credit quality

[17] The reason not to use short-term debt measures is the potential for endogeneity.The amount of short-term debt outstanding likely relates to the default risk (e.g., Almeida et al. (2012)).

[18] Recession identifiesyears classified by the NBER as recessionary: 1990, 1991, 2001, 2002, 2008, and 2009.

firms, because they should find it more difficult to extend the maturity of their debts. Diamond (1991) argues that low credit quality firms facing greater liquidity risk seek longer-term debt to reduce this risk but find no lenders willing to supply it at reasonable cost. According to Mian and Santos (2011), only creditworthy firms can choose to refinance at a lower rate when the cost of capital rises; credit-poor firms are less likelyto do so and thus incur substantial rollover losses.

Second, larger firms are more diversified, and their debt has longer maturity. Smaller firms have more cash reserves and lower debts, thus decreasing the rollover risk effect. However, larger firms also rely more on publicly traded debt financing, and smaller firms may face more problems in refinancing, especially if the debt market is in crisis. Thus, though the RRE may depend on firm size, we have no clear prediction about how size influences the RRE, so we consider it an empirical question.

Third, He and Xiong's (2012) theoretical model demonstrates that debt market frictions trigger the emergence of the RRE. During recessions, these frictions likely increase. Gopalan et al. (2013) also provide empirical evidence that the RRE exists during both recessionary and normal periods, but the effect is stronger in the former case. Thus, a rollover risk effect should exist all the time but be stronger during difficult economic times.

To test whether RRE is driven by credit quality, we split the sample, according to the sample median EDF value, such that the highEDF group representsbad credit quality, whereas the lowEDF group constitutesthe good credit quality group. We implement the baseline regression (Equation 4) on the two groups separately and obtained the results in Panel A of Table 4. Firms in the bad credit quality group experience higher RRE; the coefficient of $\Delta(LT)_{-1,i,t-1}$ is significantly positive at the 1% level but is not significant for the good credit quality group (Columns 1 and 2).

To test whether size drives the RRE, we split the sample on the basis of the sample median size value, into a largesize group and a smallsize group. All firms suffer RRE significantly, regardless of their size, in that the estimated coefficients of $\Delta(LT)_{-1,i,t-1}$ are positive and significant at the 1% level in all cases (Columns 3 and 4 of Panel A).

Finally, to test the influence of the overall economic situation, we implement a baseline regression for the subsamplecovering recessionary years and the other subsample that does not cover those years. The RRE exists, irrespective of the state of the economic situation, according to the positive and significant (1% level) of the estimated coefficients of $\Delta(LT)_{-1,i,t-1}$ in all these model specifications. Therefore, the basis for the rollover risk likely relates to the firm's fundamental factors, rather than transitory credit market conditions

[Insert Table 4 Here]

To examinefurther whether these results relate to financing sources, we reexamine Panel A of Table 4 with our alternativeregression specification (Equation5) and report the results in Panel B. Financing sources exertnotable impacts on the RRE in many cases. In the poor credit quality group (Column 2, Panel B), the estimated coefficient of $\Delta(LT)_{-1,i,t-1}$ is highly significant (at the 1% level) for BD firms but hardly significant for PDD firms. In the small size group, the estimated coefficient of $\Delta(LT)_{-1,i,t-1}$ is significant only for BD firms, not for PDD firms. Whether during a recession or not, the estimated coefficient of $\Delta(LT)_{-1,i,t-1}$ is significant at the 5% level (or better) only for BD firms, not for PDD firms.

Therefore, the RREdepends on financing sources, and it is relevant only for firms that depend on banks for their financing needs. The effect is especially amplified forBD firms when they have poor credit quality anda small size, but good and bad economic times do not induce different effects for them.

D.Alternative Default Risk Measure: Distance-to-Default

By construction, EDF is a non-linear function of DD (see Section II.A), so they are not perfectly correlated. As a robustness test, we use the measure of DD, following prior literature that uses it to assess default risk (e.g., Goyal and Wang (2013)).The DDreflects the number of standard deviations between a firm's asset valueand its default threshold at the forecasting horizon. Therefore, it relates inversely to the default risk and the EDF measure as well.

We replace EDF with DD and reexamine all the regression specifications in Table 3, with the results reported in Table 5. The negative estimated coefficient of $\Delta(LT)_{-1,i,t-1}$affirmsa rollover risk effect on default risk. Generally, these results are consistent with our findings using EDF as the proxy for default risk; they also supportedHypothesis 1. The estimated coefficient of $\Delta(LT)_{-1,i,t-1}$ is significantly negative at the 5% level (or better), whether we include the control variables or not (Columns1 and 2 of Table 5). The influences of the control variables for DD are similar to those for the EDF, such that *Cash*, *Market to book*, *Size*, *Tax*, *Profitability*, and *Interest coverage*relate significantly positively to DD, and *Idiosyncratic risk*, *R&D*, and *Leverage*relate significantly negatively to it. *Tangibility*is not significant.

[Insert Table 5 Here]

Columns 3 and 4 inTable 5provide the Equation5results, with DD as the dependent variable. In the regression without control variables(Column 3), the coefficient of $\Delta(LT)_{-1,i,t-1}$ is negative and significant at the 5% levelfor BD firms, but it is barely significantfor the PDD firms. After controlling for other default risk factors, this result holds(Column 4), such that the $\Delta(LT)_{-1,i,t-1}$ is significant at 1% for BD firms and 5% for PDD firms.This result is consistent with the results when we use EDF as proxy of default risk and again supportHypothesis 2.

We also reexamine whether the RRE is conditional on credit quality, size, or the market economic situation (see Section IV.C) with DD as the proxy for default risk. The outcomes in Table 6 are very similar to those we report previously: RRE depends on financing sources and is particularly significant for BD firmsin the smaller size group and during recessions.However, in the poor credit quality group, the RRE was indifferently significant between BD and PDD firms.

[Insert Table 6 Here]

E.Robustness Tests

Weconduct several robustness checks. First, we use credit ratings provided by rating agencies as a proxy for default risk. Second, we adopt an alternative model specificationto test the influences of credit quality, size, and recession. Third, we sort firms into terciles and quartiles, instead of median splits.

1. Credit Ratings

Following Gopalan et al. (2013), we use credit ratings as a proxy for default risk. We transform the alphabetical ratings intonumerical equivalents, using an ordinal scale that ranges from 1 for thehighest-rated firms (AAA) to 22 for the lowest-rated firms (D: Default).The EDF (or DD) measureof default probability is available for all sample observations (45,565 firm-year observations), whereas only11,110 observations pertain to firms with credit ratings.

The reestimated baseline regression (Equation 4)produces the results in Table 7.Hypothesis 1 still holds,consistent with Gopalan et al.'s (2013) results.

[Insert Table 7 Here]

2. Dummy Variables on Credit Quality, Size, and Recession

Another alternative model specificationteststhe influence of credit quality, size, and recession, such that we create dummy variablesfor these effects, as well as their interactions with the rollover risk variable, and include them in the baseline regression one at a time. Running the regression on the entire sample with the new model provideresults consistent with the main results, as we report in Table 8.

[Insert Table 8 Here]

3. Alternative Firm Identification

Rather than using the sample median value, we next sort firms into terciles, on the basis of their credit qualities and size. When using EDF (DD) as a proxy for default, the first tercile includesfirms with good (bad)credit quality and small size, and the third tercile featured those with bad (good) credit quality and large size. We then change the terciles into quartiles and perform all the model specifications in Tables 4 and 5 again. The results, reported in Tables 9–12, remain consistent with the baseline specification based on the median split.

[Insert Tables9–12 Here]

V. Conclusion

Understanding which economic factors explain a firm's credit quality is of paramount importance. The seminal work of Merton's(1974) model signaled the firm's debt structure and the value of its assets as two fundamental variables for explaining a firm's credit quality. We pay particular attention to one aspect of the debt structure, namely, refinancing or rollover risk, which theoryhas predicted should be an important variable, and we consider the extent to which this risk has material importance.

To this end, we examine the impact on default riskthat arises from rollover risk in the U.S. context, from 1986 to 2011.Our results support the notion that this risk is materially importance,though not for all firms. Only firms that depend on banks for their refinancing needs suffer increases in their rollover risks credit risk. This risk is even greater for small and low credit quality firms. However, firms with relatively poor credit quality or relatively small ones that do not depend on bank financing are not affected by the rollover risk, even during economic recessions.

Considering the evidence that suggests the bond market already is aware of the possible impact of refinancing risk on credit quality (Gopalan et al.(2013)), an obvious extension of our work would be to investigate the extent to which banks recognize the importance of the rollover risk effect, such that they adjust the terms and conditions of loans dedicated to refinancing existing debt.

Appendix A

Estimating Expected Default Frequency and Distance-to-Default

Moody's KMV model is closely related to the Black and Scholes (1973) model: The basic idea is that equity can be viewed as a call option, for which the underlying asset is a firm's asset value and the strike price is equal to the face value of a firm's debt. A firm's market value of assets is assumed to follow a geometric Brownian motion, of the form:

$$dV = \mu V dt + \sigma_V V dZ, \text{(A1)}$$

where V is the total value of a firm, μ indicates the expected continuouslycompounded return of V, σ_V represents the volatility of a firm's value, and dZ is a standard Brownian motion. With these assumptions and a Black and Scholes (1973) model, we can express a firm's market value of equity V_E as a function of its total value,

$$V_E = VN(d_1) - Be^{-rT}N(d_2), \text{(A2)}$$

where

$$d_1 = \frac{\ln(V/B) + (r + 0.5\sigma_V^2)T}{\sigma_V \sqrt{T}}, \quad d_2 = d_1 - \sigma_V \sqrt{T},$$

B is the face value of a firm's debt, r is the risk-free rate, T is the forecast horizon, and *N(.)* is the cumulative standard normal distribution.

In our exercise, we compute V_E as the productof a firm's outstanding shares and its current stock price, assume Tequals one year, andtreat B as the debt in current liabilities plus half of the long-term debt, consistent with prior applications.The two remaining variables in the Black-Scholes equation—the total asset value of thefirm V and the volatility of the firm value σ_V—are estimated with an iterativeprocedure, following the method proposed by Vassalou and Xing (2004). Initially, we estimate $\sigma_V$as the annualized standard deviation of a firm's assetreturns, using daily dataabout the summation of the market value of equity and the face value of debtover the past year. Thismethod provides an initialestimate ofσ_v, and together with the market value of equity and other inputs, Equation A2indicates the daily values of V.Using these estimated values of V, we generate new estimates of $\sigma_v$with the implied logreturns on assets. The new estimate of$\sigma_v$enters the next iteration, until the difference in values of$\sigma_v$across twoconsecutive iterations is less than 10^{-3}. Then we take the final estimated $\sigma_v$andits implied V. We compute the drift $\mu$by calculating the mean value of log-returns of V. With these estimated values, the DDcan be calculated according to Equation 1.

Appendix B

Variable Definitions

- *Cash*is the ratio of the book value of cash and marketable securities (COMPUSTAT item che) to the book value of total assets (COMPUSTAT item at).
- *Idiovol*is the standard deviation of daily excess returns relative to the CRSP value-weighted index for each firm's equity in a year.
- *Interest coverage*is the ratio of operating income after depreciation(COMPUSTAT items oiadp+ xint) to the total interest expenditure (COMPUSTAT item xint).
- *Leverage*is the ratio of total debt (COMPUSTAT items dlc + dltt) to total assets.
- *Market to book*is the ratio of the market value of total assets to the book value of total assets.We calculate the market value of total assets as the sum of the book value of total assets and themarket value of equity, less the book value of equity.
- *Profitability*is the ratio of operating income after depreciation (COMPUSTAT item oiadp) to total sales (COMPUSTAT item sale).
- *R&D*is the ratio of research and development expenditures (COMPUSTAT item

xrd) to the book value of total assets (COMPUSTAT item at). We replace missing values of xrdwith zeros.

- *Size* is the natural logarithm of the book value of total assets (COMPUSTAT item at).
- *Tangibility*is the ratio of book value of property, plants, and equipment (COMPUSTAT item ppent) to the book value of total assets (COMPUSTAT item at).
- *Tax*is the ratio of tax expenditure (COMPUSTAT item txt) to the book value of total assets (COMPUSTAT item at).

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Table 1.Summary statistics

The summary statistics refer to the sample of 45,565 firm-year observations from 1986 to 2011. Firms are identified as either bank dependent (BD) or publicly traded debt dependent (PDD), where BD firms are unrated and PDD firms are rated, with rating information extracted from COMPUSTAT item SPLTICRM. The subsample that only contains BD (PDD) firms has 27,122 (18,443) firm-year observations. Interquartile is the difference between first and third quartiles. EDF is the expected default probability, and DD is the distance-to-default; they are measured according to Merton's model. $(LT)\text{-}1_{,t-1}$is the amount of firm *i*'s long-term debt outstanding at the end of year $t-1$ that is due for repayment in year *t* (i.e., COMPUSTAT item *dd1* in year $t-1$), scaled by the current book value of total assets. We control for relevant default risk factors: *Cash*, *Market to book*, *Idiovol*, *Tangibility*, *Size*, *R&D*, *Tax*, *Profitability*, *Leverage*, and *Interest coverage* (see Appendix B).The statistically significantdifferences between the characteristics of rated and nonrated firms are at the 1% level, as indicated by ***.

	Full sample				Bank-dependent (BD) firms		Publicly traded debt–dependent (PDD) firms		
Variable	Mean	Median	S.D.	Interquartile range	Mean	Median	Mean	Median	Diff. of Mean of BD and PDD
EDF	0.105	0.001	0.216	0.079	0.124	0.003	0.076	0.000	0.048 ***
DD	4.821	4.251	3.956	5.029	4.119	3.540	5.854	5.358	-1.734 ***
$LT\text{-}1_{t-1}$	0.028	0.011	0.087	0.026	0.035	0.014	0.018	0.007	0.017 ***
Cash	0.088	0.045	0.115	0.100	0.096	0.046	0.077	0.044	0.019 ***
Market to book	1.301	0.961	1.178	0.827	1.329	0.937	1.261	0.996	0.069 ***
Idiovol	0.037	0.028	0.028	0.025	0.044	0.035	0.026	0.021	0.018 ***
Tangibility	0.354	0.305	0.234	0.348	0.341	0.290	0.374	0.331	-0.033 ***
Size	6.038	6.045	2.232	3.167	4.823	4.817	7.825	7.729	-3.002 ***
R&D	0.022	0.000	0.051	0.021	0.027	0.000	0.015	0.000	0.012 ***
Tax	0.019	0.015	0.028	0.034	0.017	0.012	0.021	0.019	-0.004 ***
Profitability	-0.015	0.066	0.661	0.098	-0.083	0.05	0.086	0.09	-0.169 ***
Leverage	0.330	0.298	0.191	0.237	0.312	0.278	0.357	0.322	-0.045 ***
Interest coverage	5.360	3.861	11.602	5.723	4.598	3.479	6.481	4.347	-1.883 ***

Table 2. Correlation matrix

The correlations are for the sample of 45,565 COMPUSTAT firm-year observations from 1986 to 2011.Panel A presents the correlation matrix for the variables, and Panel B reports the correlation matrix for the changes in variables. EDF is the expected default probability, and DD is the distance-to-default; they are measured according to Merton's model. $(LT)\text{-}1_{,t-1}$is the amount of firm *i*'s long-term debt outstanding at the end of year $t - 1$ that is due for repayment in year *t* (i.e., COMPUSTAT item *dd1* in year $t - 1$), scaled by the current book value of total assets. We control for relevant default risk factors: *Cash*, *Market to book*, *Idiovol*, *Tangibility*, *Size*, *R&D*, *Tax*, *Profitability*, *Leverage*, and *Interest coverage* (see Appendix B).* Correlation is significantly different from zero at the 0.05 level or higher.

Panel A: Correlation matrix forlevels of variables

	EDF	*DD*	$(LT)\text{-}1_{,t-1}$	*Cash*	*Market to book*	*Idiovol*	*Tangibility*	*Size*	*R&D*	*Tax*	*Profitability*	*Leverage*
DD	-0.61*											
$(LT)\text{-}1_{,t-1}$	0.19*	-0.15*										
Cash	-0.04*	0.05*	-0.01									
Market to book	-0.21*	0.33*	0.04*	0.23*								
Idiovol	0.68*	-0.62*	0.18*	0.02*	-0.05*							
Tangibility	-0.01*	0.00	0.00	-0.25*	-0.08*	-0.05*						
Size	-0.18*	0.36*	-0.13*	-0.07*	-0.12*	-0.54*	0.10*					
R&D	-0.01	-0.01*	0.02*	0.41*	0.31*	0.12*	-0.24*	-0.15*				
Tax	-0.27*	0.42*	-0.08*	0.01*	0.20*	-0.31*	-0.03*	0.17*	-0.06*			
Profitability	-0.13*	0.14*	-0.08*	-0.26*	-0.18*	-0.24*	0.05*	0.21*	-0.34*	0.17*		
Leverage	0.33*	-0.39*	0.16*	-0.14*	-0.01	0.23*	0.13*	-0.03*	-0.08*	-0.27*	-0.08*	
Interest coverage	-0.23*	0.39*	-0.09*	-0.03*	0.09*	-0.32*	-0.03*	0.25*	-0.18*	0.49*	0.37*	-0.27*

Panel B: Correlation matrix forchanges in variables

	Δ*EDF*	Δ*DD*	$\Delta(LT)\text{-}1_{,t-1}$	Δ*Cash*	Δ*Market to book*	Δ*Idiovol*	Δ*Tangibility*	Δ*Size*	Δ*R&D*	Δ*Tax*	Δ*Profitability*	Δ*Leverage*
Δ*DD*	-0.49*											
$\Delta(LT)\text{-}1_{,t-1}$	0.04*	-0.02*										
Δ*Cash*	-0.06*	0.08*	-0.01									
Δ*Market to book*	-0.12*	0.24*	0.02*	-0.02*								
Δ*Idiovol*	0.49*	-0.32*	-0.01*	-0.07*	-0.08*							
Δ*Tangibility*	0.05*	-0.04*	0.01*	-0.35*	0.06*	0.07*						
Δ*Size*	0.01*	-0.07*	-0.07*	-0.02*	-0.37*	-0.05*	-0.13*					
Δ*R&D*	0.03*	-0.02*	0.00	-0.09*	0.11*	0.04*	0.10*	-0.17*				
Δ*Tax*	-0.05*	0.05*	0.01*	0.06*	0.03*	-0.05*	-0.02*	-0.04*	-0.01*			
Δ*Profitability*	-0.04*	0.03*	0.01	-0.04*	-0.04*	-0.04*	0.01	0.08*	-0.10*	0.11*		
Δ*Leverage*	0.16*	-0.16*	0.00	-0.13*	0.08*	0.14*	0.11*	0.06*	0.07*	-0.16*	-0.08*	
Δ*Interest coverage*	-0.07*	0.07*	0.01	0.07*	0.01	-0.08*	-0.06*	0.06*	-0.12*	0.29*	0.24*	-0.13*

Table 3. Rollover risk effect on default risk

This table reports the results of regressions aimed at understanding the impact of the RRE on the default probability. The dependent variable is ΔEDF, the year-to-year change in expected default frequency, based on Merton's model. The main independent variable is $\Delta(LT)\text{-}1_{,t\text{-}1}$, the year-to-year change in long-term debt outstanding at the end of year $t - 1$ that is due for repayment in year t. Columns 3 and 4 present the results of the RRE on default risk, depending on financing sources (bank dependent or not). The *BD_dummy* equals 1 if the firm is identified as a BD firm and 0otherwise.We control for relevant default risk factors: *Cash*, *Market to book*, *Idiovol*, *Tangibility*, *Size*, *R&D*, *Tax*, *Profitability*, *Leverage*, and *Interest coverage* (see Appendix B).EI indicates economic impact, as we described in Footnote 17 in the main text. The standard errors (in parenthesis) are robust to heteroscedasticity and autocorrelation and are clustered at the industry level, definedaccording to the Fama-French 48 industry categories.

***Significant at 1%. **Significant at 5%. *Significant at 10%.

	(1)		(2)		(3)		(4)	
	Coef.	[EI(%)]	Coef.	[EI(%)]	Coef.	[EI(%)]	Coef.	[EI(%)]
$\Delta(LT)\text{-}1_{,t\text{-}1}$	0.067 ***	[5.90]	0.081 ***	[7.10]				
	(0.022)		(0.019)					
$\Delta(LT)\text{-}1_{,t\text{-}1}$ *x BD_dummy*					0.066 ***	[6.10]	0.078 ***	[7.20]
					(0.023)		(0.019)	
$\Delta(LT)\text{-}1_{,t\text{-}1}$ *x (1-BD_dummy)*					0.075		0.119 *	[6.70]
					(0.061)		(0.062)	
Δ*Cash*			-0.025 *	[-1.67]			-0.025 *	[-1.67]
			(0.013)				(0.013)	
Δ*Market to book*			-0.018 ***	[-15.14]			-0.018 ***	[-15.14]
			(0.001)				(0.001)	
Δ*Idiovol*			4.543 ***	[84.30]			4.543 ***	[84.30]
			(0.110)				(0.111)	
Δ*Tangibility*			0.015				0.014	
			(0.016)				(0.016)	
Δ*Size*			0.001				0.001	
			(0.004)				(0.004)	
Δ*R&D*			0.015				0.015	
			(0.039)				(0.039)	
Δ*Tax*			-0.080 *	[-1.97]			-0.081 *	[-1.99]
			(0.040)				(0.040)	
Δ*Profitability*			-0.005 **	[-2.20]			-0.005 **	[-2.20]
			(0.002)				(0.002)	
Δ*Leverage*			0.148 ***	[14.82]			0.148 ***	[14.82]
			(0.011)				(0.011)	
Δ*Interest coverage*			-0.0003 **	[-2.27]			-0.0003 ***	[-2.26]
			0.000				0.000	
Const.	0.023 ***		-0.013 *		0.023 ***		-0.013 *	
	(0.008)		(0.007)		(0.008)		(0.007)	
Obs.	45371		45371		45371		45371	
R2	0.077		0.295		0.077		0.295	
Year FE	Yes		Yes		Yes		Yes	

Table 4.Rollover risk effect on default risk conditional on credit quality, size, and the state of the economy

This table reports the results of regressions to test whether the rollover risk effect is conditional on credit quality, firm size, and the state of the economy. The dependent variable is ΔEDF, the year-to-year change in expected default frequency, measured with Merton's model. The main independent variable is $\Delta(LT)\text{-}1_{,t-1}$, the year-to-year change in long-term debt outstanding at the end of year t – 1 that is due for repayment in year t.The median splitsof the sample define the low-EDF (high-EDF) group with good (bad) credit quality (Columns 1 and 2) and the large-size and small-size groups(Columns3 and 4); the economic recessions are defined as years classified by the NBER as recessionary. Those years are 1990, 1991, 2001, 2002, 2008, and 2009(Columns 5 and 6).Panel B present the results of the rollover risk effect on the default risk, depending on financial sources (bank-dependent firms or not). The *BD_dummy* equals 1 if the firm is identified as a BD firm and 0 otherwise. We control for relevant default risk factors: *Cash*, *Market to book*, *Idiovol*, *Tangibility*, *Size*, *R&D*, *Tax*, *Profitability*, *Leverage*, and *Interest coverage* (see Appendix B).The standard errors (in parenthesis) are robust to heteroscedasticity and autocorrelation and are clustered at the industry level, definedaccording to the Fama-French 48 industry categories.

***Significant at 1%. **Significant at 5%. *Significant at 10%.

Panel A: Credit quality, size and economic recession						
	Credit quality		Size		Economic Recession	
	Good	Bad	Large	Small	Yes	No
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta(LT)\text{-}1_{,t-1}$	0.046	0.084 ***	0.190 ***	0.069 ***	0.079 ***	0.080 ***
	(0.035)	(0.019)	(0.046)	(0.018)	(0.023)	(0.024)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	22682	22689	22738	22633	10785	34586
R2	0.088	0.347	0.223	0.365	0.309	0.275
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Across BD and PDD firms						
	Credit quality		Size		Economic Recession	
	Good	Bad	Large	Small	Yes	No
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta(LT)\text{-}1_{,t-1}$ x *BD_dummy*	0.045	0.081 ***	0.206 ***	0.070 ***	0.074 ***	0.077 ***
	(0.045)	(0.019)	(0.072)	(0.018)	(0.020)	(0.025)
$\Delta(LT)\text{-}1_{,t-1}$ x (1-*BD_dummy*)	0.049	0.129 *	0.175 **	0.052	0.146	0.11 *
	(0.045)	(0.075)	(0.069)	(0.100)	(0.128)	(0.064)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	22682	22689	22738	22633	10785	34586
R2	0.088	0.347	0.223	0.365	0.309	0.275
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 5. Rollover risk effect on default risk measured by distance-to-default

This table reports the results of regressions to understand the rollover risk effect on default probability. The dependent variable is ΔDD, the year-to-year change in DD, measured with Merton's model. The main independent variable is $\Delta(LT)\text{-}1_{,t-1}$, the year-to-year change in long-term debt outstanding at the end of year $t - 1$ that is due for repayment in year t. Columns 3 and 4 present the results of the rollover risk effect on default risk, dependent on financial sources (bank-dependent firms or not). The *BD_dummy* equals 1 if the firm is identified as a BD firm and 0 otherwise. We control for relevant default risk factors: *Cash*, *Market to book*, *Idiovol*, *Tangibility*, *Size*, *R&D*, *Tax*, *Profitability*, *Leverage*, and *Interest coverage* (see Appendix B).The standard errors (in parenthesis) are robust to heteroscedasticity and autocorrelation and are clustered at the industry level, definedaccording to the Fama-French 48 industry categories.

***Significant at 1%. **Significant at 5%. *Significant at 10%.

	Effect of ΔLT-1t-1 on ΔDD			
	(1)	(2)	(3)	(4)
$\Delta(LT)\text{-}1_{,t-1}$	-0.453 **	-0.629 ***		
	(0.180)	(0.165)		
$\Delta(LT)\text{-}1_{,t-1}$x *BD_dummy*			-0.393 **	-0.551 ***
			(0.160)	(0.150)
$\Delta(LT)\text{-}1_{,t-1}$ x (1-*BD_dummy*)			-1.085 *	-1.466 **
			(0.548)	(0.580)
Δ*Cash*		1.269 ***		1.262 ***
		(0.195)		(0.195)
Δ*Market to book*		0.605 ***		0.605 ***
		(0.037)		(0.037)
Δ*Idiovol*		-26.404 ***		-26.418 ***
		(0.650)		(0.658)
Δ*Tangibility*		0.063		0.067
		(0.227)		(0.227)
Δ*Size*		0.112 *		0.111 *
		(0.059)		(0.059)
Δ*R&D*		-1.279 ***		-1.281 ***
		(0.353)		(0.353)
Δ*Tax*		0.959 **		0.972
		(0.686)		(0.686)
Δ*Profitability*		0.054		0.054 *
		(0.025)		(0.025)
Δ*Leverage*		-2.787 ***		-2.79 ***
		(0.167)		(0.167)
Δ*Interest coverage*		0.008 ***		0.008 ***
		(0.002)		(0.002)
Const.	-0.94 ***	-0.644 ***	-0.94 ***	-0.643 ***
	(0.154)	(0.150)	(0.154)	(0.150)
Obs.	45371	45371	45371	45371
R2	0.257	0.346	0.257	0.346
Year FE	Yes	Yes	Yes	Yes

Table 6.Rollover risk effect on DD, conditional on credit quality, size, and recession

This table reports the results of regressions to understand whether the rollover risk effect is condition on credit quality, size, and recession. The dependent variable is ΔDD, the year-to-year change in DD, measured with Merton's model. The main independent variable is $\Delta(LT)\text{-}1_{,t-1}$, the year-to-year change in long-term debt outstanding at the end of year $t - 1$ that is due for repayment in year t. The sample is split into halves, based on the median value of DD, where the high-DD (low-DD) group is the one with good (bad) credit quality (see Columns 1 and 2), and on the median size value, where the large-size group and small-size group are presented in Column 3 and 4 respectively, and on being in a recession or not (Column 5 and 6).Panel B presentsthe results of the rollover risk effect on default risk, dependent on financial sources (bank-dependent firms or not). The *BD_dummy* equals 1 if the firm is identified as a BD firm and 0 otherwise. We control for relevant default risk factors: *Cash*, *Market to book*, *Idiovol*, *Tangibility*, *Size*, *R&D*, *Tax*, *Profitability*, *Leverage*, and *Interest coverage* (see Appendix B).The standard errors (in parenthesis) are robust to heteroscedasticity and autocorrelation and are clustered at the industry level, definedaccording to the Fama-French 48 industry categories.
***Significant at 1%. **Significant at 5%. *Significant at 10%.

	Panel A: Rollover risk conditional on credit quality, size, and recession					
	Credit quality		Size		Recession	
	Good	Bad	Large	Small	Yes	No
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta(LT)\text{-}1_{,t-1}$	-0.713	-0.617 ***	-1.721 ***	-0.521 ***	-0.850 ***	-0.574 ***
	(0.775)	(0.128)	(0.611)	(1.143)	(0.167)	(0.208)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	22698	22673	22738	22633	10785	34586
R2	0.421	0.321	0.370	0.380	0.343	0.315
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

	Panel B: Across BD and PDD firms					
	Credit quality		Size		Recession	
	Good	Bad	Large	Small	Yes	No
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta(LT)\text{-}1_{,t-1}$ x *BD_dummy*	-0.745	-0.541 ***	-1.597 ***	-0.512 ***	-0.824 ***	-0.472 **
	(1.030)	(0.116)	(0.710)	(0.133)	(0.163)	(0.185)
$\Delta(LT)\text{-}1_{,t-1}$ x (1-*BD_dummy*)	-0.635	-1.633 ***	-1.846 **	-0.720	-1.197	-1.563 **
	(0.954)	(0.479)	(0.745)	(0.733)	(0.833)	(0.596)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	22698	22673	22738	22633	10785	34586
R2	0.421	0.321	0.370	0.380	0.343	0.315
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 7.Usingcredit ratings as proxies for default risk

This table reports the results of regressions to understand the rollover risk effect on default probability. The dependent variable is Δrating, the year-to-year change in credit ratingextracted from COMPUSTAT, with the item SPLTICRM.The letter ratings are transformed intonumerical equivalents, using an ordinal scale that ranges from 1 for thehighest-rated firms (AAA) to 22 for the lowest-rated firms (D: Default).The main independent variable is $\Delta(LT)\text{-}1_{,t-1}$, the year-to-year change in long-term debt outstanding at the end of year $t - 1$ that is due for repayment in year t. We control for relevant default risk factors: *Cash*, *Market to book*, *Idiovol*, *Tangibility*, *Size*, *R&D*, *Tax*, *Profitability*, *Leverage*, and *Interest coverage* (see Appendix B).The standard errors (in parenthesis) are robust to heteroscedasticity and autocorrelation and are clustered at the industry level, definedaccording to the Fama-French 48 industry categories.

***Significant at 1%. **Significant at 5%. *Significant at 10%.

	(1)	(2)
$\Delta(LT)\text{-}1_{,t-1}$	0.481 **	0.567 ***
	(0.195)	(0.185)
Intercept	Yes	Yes
Control Variables	No	Yes
Obs.	17540	17540
R2	0.0272	0.200
Year FE	Yes	Yes

Table 8. Rollover risk effect conditional on credit quality, size, and recession

	Effect of ΔLT-1t-1 on ΔEDF			Effect of ΔLT-1t-1 on ΔDD		
	(1)	(2)	(3)	(4)	(5)	(6)
Δ*(LT)-1*$_{,t-1}$ x credit_dummy	0.085 ***			-0.640 ***		
	(0.020)			(0.138)		
Δ*(LT)-1*$_{,t-1}$ x (1-credit_dummy)	0.044			-0.499		
	(0.039)			(0.796)		
Δ*(LT)-1*$_{,t-1}$ x Large		0.189 ***			-1.707 ***	
		(0.049)			(0.555)	
Δ*(LT)-1*$_{,t-1}$ x (1-Large)		0.070 ***			-0.514 ***	
		(0.019)			(0.151)	
Δ*(LT)-1*$_{,t-1}$ x Recession			0.083 ***			-0.738 ***
			(0.023)			(0.144)
Δ*(LT)-1*$_{,t-1}$ x (1-Recession)			0.081 ***			-0.583 ***
			(0.023)			(0.205)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	45371	45371	45371	45371	45371	45371
R2	0.2954	0.2957	0.295	0.346	0.3464	0.346
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 9. Rollover risk effect conditional on credit quality, size, and recession with tercile splits and EDF as proxy for default risk

The dependent variable is ΔEDF. We sort firms into terciles, on the basis of their EDF and size. Firms in the first tercile are those with good credit quality and small size; firms in the thirdtercileare those with bad credit quality and large size.

	Panel A: Rollover risk conditional on credit quality, size, and recession			
	Credit quality		Size	
	Good	Bad	Large	Small
	(1)	(2)	(3)	(4)
Δ*(LT)-1*$_{,t-1}$	0.111 *	0.080 ***	0.329 ***	0.054 ***
	(0.062)	(0.018)	(0.084)	(0.017)
Control variables	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes
Obs.	15120	15114	15164	15081
R2	0.038	0.372	0.185	0.377
Year FE	Yes	Yes	Yes	Yes

	Panel B: Across BD and PDD firms			
	Credit quality		Size	
	Good	Bad	Large	Small
	(1)	(2)	(3)	(4)
Δ*(LT)-1*$_{,t-1}$ x BD_dummy	0.132	0.079 ***	0.640 ***	0.054 ***
	(0.091)	(0.018)	(0.125)	(0.017)
Δ*(LT)-1*$_{,t-1}$ x (1-BD_dummy)	0.076	0.089	0.235 **	0.031
	(0.060)	0.085	(0.095)	(0.114)
Control variables	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes

Obs.	15120	15114	15164	15081
R2	0.039	0.372	0.186	0.377
Year FE	Yes	Yes	Yes	Yes

Table 10. Rollover risk effect conditional on credit quality, size, and recession with tercile splits and DD as a proxy for default risk

The dependent variable is ΔDD. We sort firms into terciles on the basis of their DD and size. Firms in the first tercile are those with poor credit quality and small size; firms in the thirdtercileare those with good credit quality and large size.

	Panel A: Rollover risk conditional on credit quality, size, and recession			
	Credit quality		Size	
	Good	Bad	Large	Small
	(1)	(2)	(3)	(4)
$\Delta(LT)\text{-}1_{,t-1}$	-1.942	-0.577 ***	-3.056 **	-0.390 ***
	(1.278)	(0.117)	(1.210)	(0.126)
Control variables	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes
Obs.	15131	15107	15164	15081
R2	0.447	0.295	0.363	0.379
Year FE	Yes	Yes	Yes	Yes
	Panel B: Across BD and PDD firms			
	Credit quality		Size	
	Good	Bad	Large	Small
	(1)	(2)	(3)	(4)
$\Delta(LT)\text{-}1_{,t-1}$ x BD_dummy	-1.990	-0.526 ***	-5.514 ***	-0.389 ***
	(1.917)	(0.114)	(1.905)	(0.118)
$\Delta(LT)\text{-}1_{,t-1}$ x (1-BD_dummy)	-1.868	-1.376 ***	-2.312 **	-0.477
	(1.183)	(0.439)	(1.097)	(1.114)
Control variables	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes
Obs.	15131	15107	15164	15081
R2	0.447	0.295	0.363	0.379
Year FE	Yes	Yes	Yes	Yes

Table 11. Rollover risk effect conditional on credit quality, size, and recession with quartile splits and EDF as proxy for default risk

The dependent variable is ΔEDF. We sort firms into quartiles on the basis of their EDF and size. Firms in the first quartile are those with good credit quality and small size; firms in the fourthquartile are those with poor credit quality and large size.

	Panel A: Rollover risk conditional on credit quality, size, and recession			
	Credit quality		Size	
	Good	Bad	Large	Small
	(1)	(2)	(3)	(4)
$\Delta(LT)\text{-}1_{,t-1}$	0.153	0.074 ***	0.345 ***	0.049 ***
	(0.096)	(0.019)	(0.081)	(0.017)
Control variables	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes

Obs.	11340	11338	11376	11301
R2	0.037	0.380	0.158	0.384
Year FE	Yes	Yes	Yes	Yes

	Panel B: Across BD and PDD firms			
	Credit quality		Size	
	Good	Bad	Large	Small
	(1)	(2)	(3)	(4)
$\Delta(LT)\text{-}1_{,t-1}$ x BD_dummy	0.203	0.073 ***	1.065 ***	0.049 ***
	(0.153)	(0.018)	(0.186)	(0.017)
$\Delta(LT)\text{-}1_{,t-1}$ x (1-BD_dummy)	0.091	0.088	0.175 **	0.090
	(0.076)	(0.096)	(0.082)	(0.100)
Control variables	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes
Obs.	11340	11338	11376	11301
R2	0.039	0.380	0.161	0.384
Year FE	Yes	Yes	Yes	Yes

Table 12. Rollover risk effect conditional on credit quality, size, and recession with quartile splits and DD as a proxy for default risk

The dependent variable is ΔDD. We sort firms into quartiles on the basis of their DD and size. Firms included in the first quartile are those with poor credit quality and small size; firms in the fourth quartile as those with good credit quality and large size.

	Panel A: Rollover risk conditional on credit quality, size, and recession			
	Credit quality		Size	
	Good	Bad	Large	Small
	(1)	(2)	(3)	(4)
$\Delta(LT)\text{-}1_{,t-1}$	-2.276	-0.566 ***	-4.406 ***	-0.354 ***
	(1.589)	(0.117)	(1.383)	(0.130)
Control variables	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes
Obs.	11349	11325	11376	11301
R2	0.463	0.275	0.355	0.379
Year FE	Yes	Yes	Yes	Yes

	Panel B: Across BD and PDD firms			
	Credit quality		Size	
	Good	Bad	Large	Small
	(1)	(2)	(3)	(4)
$\Delta(LT)\text{-}1_{,t-1}$ x BD_dummy	-2.245	-0.511 ***	-10.346 ***	-0.351 ***
	(2.493)	(0.111)	(3.029)	(0.122)
$\Delta(LT)\text{-}1_{,t-1}$ x (1-BD_dummy)	-2.317	-1.525 ***	-3.002 **	-0.692
	(1.458)	(0.528)	(1.382)	(1.686)
Control variables	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes
Obs.	11349	11325	11376	11301
R2	0.463	0.275	0.355	0.379
Year FE	Yes	Yes	Yes	Yes