Rollover Risk and Tax Avoidance

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Abstract

This study examines the association between rollover risk and tax avoidance. Rollover risk, also referred to as refinancing risk, is the risk that firms are not able to obtain new debt to refinance their existing debt. On the one hand, firms may avoid taxes to generate cash internally. On the other hand, tax avoidance can increase the cost of debt. Our findings suggest that, in general, a positive relationship exists between rollover risk and tax avoidance. In cross-sectional analyses, we find that the positive association between rollover risk and tax avoidance is more pronounced for firms with financial constraints and weaker for firms that issue enough new long-term debt to replace maturing long-term debt. Moreover, this positive association is attenuated when the market interest rates are higher. Furthermore, financially constrained firms operating in a higher market interest rates environment exhibit a further reduction in the positive association between rollover risk and tax avoidance. Finally, we find that firms engage in tax avoidance in anticipation of debt maturing in the following year. The findings are informative to debt holders, shareholders, and policy makers who have an interest in shaping firms' tax avoidance activities. Overall, our findings suggest that firms trade off tax savings against increment cost of new borrowings when refinancing.

1 Introduction

Rollover risk, also referred to as refinancing risk, is the risk that firms are not able to acquire new debt to refinance their maturing debt. Diamond (1991) and Titman (1992) show that in the presence of credit market frictions, firms may face difficulties in rolling over their maturing debt. These challenges include the likelihood that the firms are not able to refinance their maturing debt or, if they are able to refinance it, the new debt must be obtained at unfavorable interest rates. Recent literature has documented various adverse effects arising from rollover risk. He and Xiong (2012a) analyze a theoretical model where a borrower encounters refinancing risk, and the creditor may choose not to roll over the borrower's debt in a dynamic setting, in which other creditors may choose to run on the borrower. Additionally, Harford, Klasa, and Maxwell (2014) find that firms accumulate more cash and save more cash from cash flows when faced with rollover risk. Thus, managers have an incentive to generate internal funds to facilitate the refinancing process.

Prior literature has documented the use of cash tax savings as an internal source of cash. Dyreng, Hanlon, and Maydew (2008) find that tax avoidance can result in substantial cash tax savings, which increases expected future cash flows. In addition, when firms are faced with financial constraints, they implement tax avoidance strategies to generate greater cash savings (e.g., Edwards, Schwab, and Shevlin 2016; Law and Mills 2015). However, tax avoidance can increase the variance and covariances of a firm's cash flows (Goh, Lee, Lim, and Shevlin 2016), thereby increasing the cost of debt and equity capital. For instance, tax avoidance is associated with larger loan spreads (Hasan, Hoi, Wu, and Zhang 2014; Isin 2018). Additionally, Shevlin, Urcan, and Vasvari (2013) find that tax avoidance increases public bond yield spreads, suggesting that debt holders are exposed to the risks of tax avoidance, but do not share the rewards from tax savings.

Therefore, it is an empirical question as to whether rollover risk is associated with higher or lower levels of tax avoidance. On the one hand, faced with rollover risk, firms may use cash tax savings generated through tax planning to pay down some of their maturing debt or present a stronger financial position to their existing and potential debt holders. For example, Harford, Klasa, and Maxwell (2014) find that firms increase cash holdings in the presence of rollover risk. Therefore, cash savings from tax avoidance can help the firms to meet their cash reserve requirements. On the other hand, tax avoidance can be costly to a firm because the interest rates of refinanced debt may rise due to tax avoidance activities (Hasan et al. 2014; Shevlin et al. 2013). A positive (negative) association between rollover risk and tax avoidance will be observed if the former cash flow effect (latter interest rate effect) of tax avoidance dominates. If the two effects offset each other, then we will not find a significant relationship between rollover risk and tax avoidance.

Based on the countervailing consequences of tax avoidance, we form our null hypothesis that rollover risk is not associated with tax avoidance. We test our hypothesis in the following steps. First, following prior literature (Almeida, Campello, Laranjeira, and Weisbenner 2011; Gopalan, Song, and Yerramilli 2014; Wang, Chiu, and Peña 2016), we measure rollover risk using the *ex-ante* variation in the current due portion of long-term debt. The long-term debt coming due results from past financing choices such that refinancing the maturing portion of the long-term debt is exogenous to current operating decisions. Accordingly, we construct our rollover risk measure LT_DUE1_{t-1} as the current portion of long-term debt, which is the ratio of long-term debt at the end of year $t-1$ that will mature in year t to total assets at the end of year $t-1$.

We then incorporate this measure in the tax avoidance model. We use cash effective tax rate (hereafter, *CETR*) as our measure of tax avoidance. We choose *CETR* because the underlying

assumption in our study is that cash tax savings can be used to facilitate the debt refinancing process. Using a sample with requisite data spanning from 1987 to 2016, we find that a larger amount of maturing debt relative to total assets, i.e., higher rollover risk, is associated with a lower *CETR* after controlling for well-known factors associated with cash effective tax rate as well as industry and year fixed effects. This finding rejects our null hypothesis, suggesting that firms engage in higher levels of tax avoidance when they face a higher rollover risk. Our finding sheds light on the interplay between a firm's financial policy, particularly the maturing structure of long-term debt, and its tax planning strategy.

We perform several cross-sectional analyses to corroborate our main finding. First, a recent stream of literature investigates the influence of financial constraints on tax avoidance (e.g., Edwards et al. 2016; Law and Mills 2015; Dyreng and Markle 2016). On the one hand, Edwards et al. (2016) and Law and Mills (2015) find a positive relationship between financial constraints and tax avoidance. On the other hand, Dyreng and Markle (2016) find that financially constrained firms shift less income from the U.S. to foreign countries than their unconstrained counterparts, suggesting that there is a negative relationship between financial constraints and aggressive tax planning. In our setting, financial constraints may limit the firms' ability to pay down some of their maturing debt or acquire new debt during refinancing, which may prompt the firms to rely more heavily on cash savings from tax avoidance to mitigate rollover risk. Alternatively, since financially constrained firms likely bear higher interest rates on their debt due to lack of financial resources, they may be more sensitive to the incremental cost of interest on the new debt stemming from tax avoidance activities. We measure financial constraints by the availability of credit rating, Z-score, firm size, and cash holdings. The findings show that financial constraints, on average, strengthen the positive relationship between rollover risk and tax avoidance.

Next, we expect that if a firm is able to refinance maturing debt, it should rely less on tax savings to reduce the negative effect of tax avoidance on refinanced debt (i.e., higher cost of interest). We test this expectation using issuance of debt in the year of debt refinancing as a moderating effect. We find that the positive relationship between rollover risk and tax avoidance is weaker for firms whose issuances of new long-term debt are greater than or equal to maturing debt. Our findings support the notion that firms conduct less tax avoidance if they are able to roll over maturing debt.

Third, we conduct further analyses to provide evidence as to whether the marginal cost of tax avoidance may exceed the marginal benefit of it under certain circumstances. As discussed above, the cost of tax avoidance may exceed the benefit of it because debt holders consider tax avoidance as a risk factor (Hasan et al. 2014; Shevlin et al. 2013), thereby increasing the interest cost of refinanced debt or exacerbating the risk that the firm will not be able to roll over its maturing debt. We explore the effect of market interest rates on the relationship between rollover risk and tax avoidance. Because a higher market interest rate already makes refinancing costlier, the incremental cost of debt due to tax avoidance will be more likely to exceed the incremental benefit of tax avoidance under this circumstance. Thus, in the presence of higher market interest rates, firms may choose to avoid taxes to a lesser degree. Therefore, we expect that the positive association between rollover risk and tax avoidance to be less pronounced when the market interest rates are higher. We obtain the market interest rates data, i.e., the commercial and industrial loan rates spreads over the intended federal funds rate, from the Federal Reserve's website.[1] Interacting market interest rate with rollover risk, we find that the positive association between rollover risk

[1] https://www.federalreserve.gov/releases/e2/e2chart.htm.

and tax avoidance is indeed less pronounced, suggesting that the marginal cost of tax avoidance exceeds the marginal benefit of it during refinancing if the market interest rates are higher.

Fourth, we examine the interactive effect of financial constraints and market interest rates on the relationship between rollover risk and tax avoidance. Because financial constraints (market interest rates) magnify (reduce) the positive association between rollover risk and tax avoidance, the net interactive effect of financial constraints and market interest rates depends on the relative importance of these two effects. Thus, compared with the rest of the firms, the subset of financially distressed firms in a high market-interest-rate environment may exhibit higher (lower) levels of tax avoidance when faced with rollover risk if a net positive cash flow effect (negative interest rate effect) of tax avoidance exists. To examine this question, we interact the rollover risk measure LT_DUE1_{t-1} with proxies of financial constraints and market interest rates. We find that the positive association between rollover risk and tax avoidance is further reduced for financially constrained firms in a high market-interest-rate environment relative to firms without financial distress when the market interest rates are high. These results are consistent with the notion that when the market interest rates are higher, firms with financial constraints face greater incremental refinancing costs than direct cash tax savings arising from tax avoidance.

In an additional analysis, we explore whether firms avoid taxes when they have long-term debt maturing beyond one year. Firms may begin to conduct tax avoidance activities prior to the year of debt maturity because lenders are likely to assess firm performance and financial position for a period of more than one year. Specifically, we include in the regression LT_DUE2_{t-1}, which is the amount of long-term debt maturing in year $t+1$ as of the end of year $t-1$ scaled by total assets. Our results show that both LT_DUE1_{t-1} and LT_DUE2_{t-1} are positively associated with tax

avoidance in year *t*, suggesting that firms engage in tax avoidance in year *t* to mitigate rollover risk in both years *t* and *t*+1.

We perform several robustness tests to corroborate our findings. First, we repeat our main analysis by controlling for firm and year fixed effects rather than industry and year fixed effects in the regression. Our results are not sensitive to this specification. Second, we relax the assumption of a linear relation between rollover risk and tax avoidance by defining a dummy variable which equals one if the rollover risk measure LT_DUE1_{t-1} is greater than 0.049 (which is the sample mean plus one standard deviation), and zero otherwise. We conduct this analysis because rollover risk may only be an issue when the amount of maturing long-term debt is large enough (Gopalan et al. 2014). We continue to find a positive relationship between rollover risk measured by this dummy variable and tax avoidance.

Finally, although endogeneity is not a major concern in the construction of our rollover risk measure because the maturing debt as of the end of year *t*−1 was originated several years ago, one may still argue that smart CEOs may be able to foresee in year *t*−1 the firms' tax avoidance activities and consequently the amount of cash generated through tax avoidance in year *t*. For instance, in year *t*−1, smart managers may predict a low level of cash generated from tax avoidance in year *t* and thus refinance in year *t*−1 some of the debt maturing in year *t*, thereby affecting the rollover risk measure LT_DUE1_{t-1} because it is measured at the end of year *t*−1. To mitigate this concern, we replace LT_DUE1_{t-1} with LT_DUE2_{t-2}, which is measured as the amount of debt maturing in two years (i.e., year *t*) as of the end of year *t*−2. Then, we regress tax avoidance in year *t* on LT_DUE2_{t-2}. Consistent with our main finding, we continue to find a positive relationship between this alternative measure of rollover risk and tax avoidance.

This paper contributes to the literature on rollover risk and tax avoidance. First, our findings expand the understanding of researchers on factors associated with firms' tax avoidance decisions. Our paper answers the call for research to examine the consequences of "real" corporate decisions on firms' tax reporting practices (Hanlon and Heitzman 2010). While the tax research in accounting and finance has focused on determinants of tax avoidance in terms of firm characteristics, managerial effects, ownership, governance, and incentives, an examination of the effect of firms' financial policy on tax avoidance is missing. Specifically, our paper documents an association between a firm's financial structure, namely debt maturing schedule, and its cash tax avoidance. This paper provides new evidence to the tax avoidance literature in that rollover risk arising from maturing long-term debt is positively associated with tax avoidance.

Our study also extends the literature on the association between tax avoidance and cost of debt (Hasan et al. 2014; Shevlin et al. 2013) by showing that firms avoid taxes to a less degree due to incremental cost of debt under certain circumstances. This finding differentiates the current study from Edwards et al. (2016) and Law and Mills (2015) that document a positive relationship between financial constraints and tax avoidance. Although firms with either rollover risk or financial constraints can benefit from cash tax savings, financially constrained firms do not necessarily encounter rollover risk. Nor do firms faced with rollover risk necessarily have financial constraints. Thus, investigating the effect of rollover risk on tax avoidance, as well as the interactive effect of rollover risk and financial constraints on tax avoidance, provides us with a setting in which we can separate the positive cash flow consequence and the negative interest cost of debt consequence associated with tax avoidance. This unique setting helps researchers to better understand the countervailing consequences of tax planning strategies and, therefore, the desired level of tax avoidance given specific firm- and market-level circumstances.

Furthermore, our findings enrich the literature on rollover risk. Harford et al. (2014) document that firms increase their cash holdings and save more cash from cash flows in order to mitigate the refinancing risk associated with shorter maturity debt. Because cash tax savings are an internal source of cash, the need for cash due to rollover risk can be partially fulfilled by cash tax savings. Our results extend this line of research by providing evidence that rollover risk can be mitigated by greater cash savings through tax avoidance. In regards to the cash flow generated internally through tax avoidance, our study also differs from Edwards et al. (2016) and Law and Mills (2015). While financially constrained firms may avoid taxes to satisfy their cash needs in general, firms faced with rollover risk engage in tax avoidance to meet their *immediate* cash needs.

Finally, our study integrates topics of a firm's financial policy and tax avoidance activities. Brunnermeier and Yogo (2009) analyze a model in which firms can manage rollover risk through an optimal dynamic choice of debt maturity structure. Norden, Roosenboom, and Wang (2016) document that bond granularity (i.e., a dispersed bond maturity structure) benefits firms in terms of financing availability, cost of financing, and stock return volatility. Our findings have practical implications for a firm's choice of its debt maturity structure because credit frictions stemming from it have an effect on corporate tax avoidance activities. To the extent that debt holders, shareholders, and policy makers have an interest in firms' tax policies, understanding the relationship between rollover risk and tax avoidance is salient. Since shorter debt maturity leads to more frequent refinancing needs and rollover risk is positively associated with tax avoidance, firms should consider structuring long-term debt maturity in a way that reduces credit frictions and rollover risk during debt refinancing if the goal is to reduce tax avoidance.

The remainder of this paper proceeds as follows. Section 2 reviews the literature and develops our hypotheses. Section 3 discusses our research methodology and descriptive statistics. Section 4 presents the results and section 5 concludes.

2 Literature Review and Hypothesis Development

2.1 Literature on tax avoidance

Extant studies have examined the effects of firm-level characteristics on tax avoidance. For example, Gupta and Newberry (1997) document that effective tax rates are associated with a firm's capital structure, asset mix, and performance. Subsequently, some papers incorporate agency considerations in the tax avoidance research. For instance, Phillips (2003) find that after-tax performance-based incentives increase tax avoidance, whereas Desai and Dharmapala (2006) document that executive equity-based compensation deters tax avoidance among firms with weaker shareholder rights and lower institutional ownership. Furthermore, Desai and Dharmapala (2008) and Chen, Chen, Cheng, and Shevlin (2010) document that firms with concentrated ownership, such as family firms, avoid fewer taxes because controlling shareholders have a longer horizon and are more sensitive to the costs of tax avoidance arising from loss of reputation and suspicion of rent extraction from minority shareholders.

The benefits and costs of tax avoidance are examined in various papers. On the one hand, tax avoidance provides benefits to shareholders and debt holders. Specifically, tax avoidance increases cash tax savings, which increase expected future cash flows (Dyreng et al. 2008; Hanlon and Heitzman 2010; Cook, Moser, and Omer 2017). Goh et al. (2016) document that tax avoidance is associated with a decrease in the cost of equity. Furthermore, this relationship is evidenced by the fact that firms provide incentives to executives to reduce tax burdens (Robinson, Sikes, and

Weaver 2010; Armstrong, Blouin, and Larcker 2012). On the other hand, tax avoidance can impose costs to shareholders and debt holders. Tax avoidance can result in higher fees paid to tax consultants, greater penalties and interest paid to tax authorities, loss of reputation, reduced transparency, greater information asymmetry, and increased uncertainty about the firm's future cash flows (Scholes, Wolfson, Erickson, Maydew, and Shevlin 2009; Graham, Hanlon, Shevlin, and Shroff 2014; Desai and Dharmapala 2009; Balakrishnan, Blouin, and Guay 2017; Dhaliwal, Lee, Pincus, and Steele 2015).

Finally, another line of literature examines the effect of tax avoidance on firms' cost of debt. For example, Hasan et al. (2014) and Isin (2018) find that tax avoidance is associated with greater loan spreads. Similarly, Shevlin, Urcan, and Vasvari (2013) show that tax avoidance increases public bond yield spread. The findings in these studies suggest that debt holders are exposed to the risks arising from tax avoidance, but do not share the rewards from tax savings as much as shareholders do. Together, the literature provides evidence in support of both the benefits and costs of tax avoidance.

2.2 Theory and literature on rollover risk

Prior literature establishes theory of rollover risk by recognizing the risk as an important determinant that influences debt maturity choice (e.g., Diamond 1991; Flannery 1986). Diamond (1991) and Titman (1992) show firms may be confronted with challenges in rolling over their maturing debt in the presence of credit market frictions. Recent works extend this stream of research by documenting that rollover risk increases a firm's default risk (e.g., He and Xiong 2012a, 2012b). Specifically, He and Xiong (2012a) analyze a model where creditors choose to run from renewing a firm's maturing debt. In this scenario, the existing creditor of the maturing debt is not only concerned about his or her own decision on whether to run on the firm, but also takes into

consideration whether or not creditors of future maturing debt are likely to run. Thus, the current creditor of the maturing debt can be shielded from the firm's future rollover risk caused by other creditors. In equilibrium, each creditor will impose a higher threshold on the firm's fundamentals when renewing debt in the presence of the problem of coordinating debt renewal with other creditors. When a firm suffers losses in rolling over its maturing debt, equity holders bear the losses while maturing debt holders receive full payments of the firm's borrowings (He and Xiong 2012b). This conflict between equity holders and debt holders prompts the firm to default at a higher than normal fundamental threshold.

A number of empirical studies corroborate theory of rollover risk by documenting the effects of rollover risk on default risk (e.g., Wang et al. 2016), long-term bond spreads (Gopalan et al. 2014; Valenzuela 2016), and credit quality (Gopalan et al. 2014). Specifically, Wang et al. (2016) find that rollover risk is positively correlated with default risk for firms that rely heavily on bank financing. Valenzuela (2016) documents that rollover risk exacerbates the effect of debt market illiquidity on corporate bond spreads based on a data set of corporate bonds in the international markets. Gopalan et al. (2014) provide evidence that firms faced with higher rollover risk experience credit rating downgrades and bear higher yield spreads on the long-term bonds that they issue. Overall, both theoretical and empirical research has provided ample evidence on the ramifications of rollover risk on firms' debt financing.

2.3 Hypothesis development

As discussed above, the possible outcomes associated with rollover risk can be very costly to the firms. Due to these detrimental effects of rollover risk, Harford et al. (2014) find that firms will increase their cash holdings and save more cash from their cash flows in order to mitigate rollover risk stemming from the firms' maturing debt. Their finding suggests that firms desire

sufficient financial resources during debt refinancing. Following this rationale, firms may increase cash holdings by engaging in tax avoidance activities that generate cash savings by paying fewer cash taxes. The additional cash holdings through cash tax savings will not only help a firm pay down some of its maturing debt if needed, but also enable the firm to present a stronger financial outlook to its existing and potential creditors.

However, the interest rates of debt may arise due to the firms' engaging in tax avoidance (Hasan et al. 2014; Shevlin et al. 2013). This consequence may exacerbate the risk that the firms end up with a higher interest rate on the refinanced debt or are unable to roll over their maturing debt. Therefore, it is an empirical question as to whether the benefits of cash tax savings the firms receive (i.e., additional cash holdings) are greater or less than the costs the firms bear due to tax avoidance activities (i.e., higher interest costs of debt) in the presence of rollover risk. If the benefits exceed the costs (the costs exceed the benefits), then the firms will avoid more (fewer) taxes and we should observe a positive (negative) association between rollover risk and tax avoidance. We state Hypothesis 1 in the null form as follows:

Hypothesis 1: Rollover risk, measured as the ratio of long-term debt maturing within one year to total assets, is not associated with tax avoidance.

3 Research Methodology and Descriptive Statistics

In this section, we first define the measures of rollover risk and tax avoidance. Then, we discuss the research methodology, sample selection, and summary statistics.

3.1 Empirical measure of rollover risk

Following prior studies (Almeida et al. 2011; Gopalan et al. 2014; Wang et al. 2016), we measure rollover risk as the portion of long-term debt maturing within one year and exclude short-

term debt to mitigate endogeneity in our analysis. Short-term debt is not included because a firm's decision to issue or repay short-term debt is likely to be correlated with the firm's current operating, investing, and financing activities as well as its tax avoidance activities. The long-term debt payable within a year, however, is a consequence of past debt financing choices made by the firm years ago. Therefore, the long-term debt maturing within a year is less likely to be endogenous with the firm's current operating, investing, and financing activities or its contemporaneous tax choices. Under this design, we can explore whether *ex-ante* variation in maturing long-term debt is associated with current tax avoidance. Following prior studies (e.g., Gopalan et al. 2014), we construct our rollover risk measure LT_DUE1_{t-1} as the ratio of long-term debt maturing within a year (COMPUSTAT data item *DD1*) at the end of year $t-1$ to total assets (COMPUSTAT data item *AT*) at the end of year $t-1$.

3.2 Measurement of tax avoidance

Our study focuses on cash tax savings as an internal source of financing. As such, we define tax avoidance as "all actions taken by managers to reduce cash income tax liabilities of their firms" (Edwards et al. 2016, p. 862). The tax avoidance literature differentiates itself from tax evasion, which is an aggressive form of tax strategies oftentimes characterized as illegal. Specifically, we measure tax avoidance by cash effective tax rate (*CETR*) because the underlying assumption in this study is that cash tax savings help firms to resolve their cash needs problem during debt refinancing. Additionally, prior studies indicate that *CETR* captures all tax activities that reduce cash tax paid (e.g., Dyreng et al. 2008; Higgins, Omer, and Phillips 2015). Finally, Hanlon and Heitzman (2010) suggest that researchers choose the most appropriate measure of tax avoidance for their setting. Thus, we compute *CETR* as:

$$CETR = TXPD / (PI - SPI) \quad (1)$$

where *TXPD* is cash income tax paid, *PI* is pretax income, and *SPI* is special items. All three variables are COMPUSTAT data items. Following prior studies, we eliminate observations with negative book income and truncate the values of *CETR* at 0 and 1. Based on this construct, a smaller (larger) value of *CETR* indicates higher (lower) tax avoidance.

3.3 Empirical model

To examine the association between rollover risk and tax avoidance, we estimate the following model:

$$CETR_{i,t} = \beta_0 + \beta_1 LT\_DUE1_{i,t-1} + \beta_2 NEG\_ZSCORE_{i,t-1} + \beta_3 SIZE_{i,t} + \beta_4 CASH_{i,t} + \beta_5 NOL_{i,t} + \beta_6 D\_NOL_{i,t} + \beta_7 PRETAXINC + \beta_8 EQINC_{i,t} + \beta_9 FORINC_{i,t} + \beta_{10} MB_{i,t} + \beta_{11} LEV_{i,t} + \beta_{12} PPE_{i,t} + \beta_{13} RD_{i,t} + \beta_{14} INTANGIBLE_{i,t} + \varepsilon_{i,t} \quad (2)$$

The definitions of variables are presented in the Appendix. We include industry and year fixed effects in the model to control for common effects among all firms in each industry and each year, respectively. $\varepsilon_{i,t}$ is the error term, which has a zero mean for any values of the explanatory variables. We cluster standard errors by firm because the error term for each firm may be serially correlated.

The main coefficient of interest is β_1, which captures the relation between $LT\_DUE1_{i,t-1}$ and $CETR_{i,t}$. Hypothesis 1 is rejected if an association exists between rollover risk and tax avoidance, i.e., if β_1 is significantly different from zero. We include several control variables in our regression model from prior literature to control for other well-known effects on tax avoidance (e.g., Mills, Erickson, and Maydew 1998; Hope, Ma, and Thomas 2013). Specifically, we follow prior literature and include $NEG\_ZSCORE_{i,t-1}$ to control for the effects of financial distress on tax avoidance. $NEG\_ZSCORE_{i,t-1}$ is the negative Altman's Z-score at the beginning of the period. We multiply the original Altman's Z-score by −1 so that a larger value of $NEG\_ZSCORE_{i,t-1}$ indicates greater financial distress. We also include $SIZE_{i,t}$ and $MB_{i,t}$, which capture firms' growth

opportunities and economies of scale. Next, we include prior operating loss carryforwards, $NOL_{i,t}$, because utilization of prior loss carryforwards should reduce current period tax burdens. $NOL_{i,t}$ is measured as a dummy variable equal to 1 if there is a net loss carry-forward, and 0 otherwise. Also included in the model is $D\_NOL_{i,t}$, an indicator variable equal to 1 if tax loss carryforward in year t is greater than tax loss carryforward in year $t-1$, and 0 otherwise. $PRETAXINC_{i,t}$, $EQINC_{i,t}$, and $FORINC_{i,t}$ control for firms' profitability and complexity of firms' operating environments. $LEV_{i,t}$ is included as a control variable to proxy for the effect of debt on firms' incentives to avoid taxes. $PPE_{i,t}$, $RD_{i,t}$, and $INTANGIBLE_{i,t}$ are used to control for the differences in the book and tax reporting regimes.

3.4 Sample selection and descriptive statistics

We start with a large sample of 233,525 U.S. firm-year observations spanning 1987-2016 by obtaining financial data from COMPUSTAT to compute various variables. This original sample excludes firms with the SIC codes between 4900 and 4999 or between 6000 and 6999. We present our sample selection criteria in Table 1, Panel A. We first eliminate 35,307 observations with missing data required to calculate $LT\_DUE1_{i,t-1}$. Then, we delete 110,770 observations with missing data required to compute cash effective tax rate or where pretax income is negative. Next, we discard 5,372 firm-years where $CETR_{i,t}$ is either smaller than zero or greater than one. Finally, we remove 40,157 observations with missing data required to calculate control variables. Following this procedure, we construct our main sample consisting of 41,919 firm-year observations with requisite variables for the main regression.

[Insert Table 1 about here]

Table 1, Panel B reports the descriptive statistics for the primary sample. The mean (median) value of $CETR_{i,t}$ is 0.256 (0.253), consistent with that reported in previous studies. The

mean value of $LT\_DUE1_{i,t-1}$ is 0.018, suggesting that for the average firm in our sample the amount of long-term debt maturing within a year is 1.8% of the firm's total assets. The median value of $LT\_DUE1_{i,t-1}$ is 0.005, smaller than the mean, suggesting that the distribution of $LT\_DUE1_{i,t-1}$ in our sample is upwardly skewed. The summary statistics of control variables are in line with those reported in extant studies.

4 Empirical results

4.1 Simple correlations between rollover risk and tax avoidance

We first examine the univariate relationship between rollover risk and tax avoidance by analyzing Pearson correlations. Table 2 provides the results of this analysis. $LT\_DUE1_{i,t-1}$ is negatively correlated with $CETR_{i,t}$, suggesting that firms with higher rollover risk have lower cash effective tax rates. In other words, rollover risk is positively associated with tax avoidance. This evidence rejects Hypothesis 1 that rollover risk is not associated with tax avoidance. In addition, the cash effective tax rate is positively (negatively) associated with a firm's profitability (financing difficulty). For example, $CETR_{i,t}$ is positively correlated with firm size ($SIZE_{i,t}$) and pretax income ($PRETAXINC_{i,t}$) and negatively correlated with financial distress ($NEG\_ZSCORE_{i,t-1}$) and loss carry forwards ($NOL_{i,t}$, $D\_NOL_{i,t}$). Finally, firms with more complex operating environments ($EQINC_{i,t}$, $FORINC_{i,t}$) and growth firms ($MB_{i,t}$, $RD_{i,t}$, $INTANGIBLE_{i,t}$) have lower cash effective tax rate ($CETR_{i,t}$).

[Insert Table 2 about here]

4.2 Multivariate analysis

Table 3 reports the empirical results for Equation (2) which examines the association between the long-term debt maturing within one year and tax avoidance. The coefficient on

$LT\_DUE1_{i,t-1}$ is negative and significant (Coefficient = −0.216; standard error = 0.033), suggesting that firms with higher debt rollover risk have lower cash effective tax rate. A one-standard-deviation (0.031) increase in $LT\_DUE1_{i,t-1}$ is associated with a decrease of 0.0067 in $CETR_{i,t}$, which represents a 2.62% decrease relative to the sample mean of $CETR_{i,t}$ (0.256). The 0.0067 decrease in cash effective tax rate arising from a one-standard-deviation increase in $LT\_DUE1_{i,t-1}$ represents U.S. $2.10 million of cash tax savings (0.0067×sample mean of pre-tax income less special items, i.e., U.S. $314.43 million).

Since firms that face higher financial constraints also have incentives to increase the cash level by avoiding taxes, we calculate the effect of the financial constraint measure, $NEG\_ZSCORE_{i,t-1}$, on $CETR_{i,t}$ and use it as a benchmark to gauge the economic significance of the effect of $LT\_DUE1_{i,t-1}$ on $CETR_{i,t}$. In comparison, a one-standard-deviation (5.237) increase in $NEG\_ZSCORE_{i,t-1}$ is associated with a decrease of 0.0052 in $CETR_{i,t}$, which represents a 2.04% decrease relative to the sample mean of $CETR_{i,t}$ (0.256). These results suggest that the effect of rollover risk on cash effective tax rate is economically significant because the magnitude of this effect is comparable to that of financial constraints on cash effective tax rate. In sum, the effect of $LT\_DUE1_{i,t-1}$ on $CETR_{i,t}$ is statistically and economically significant.

The results from this multivariate analysis suggest that firms use cash savings from tax avoidance to reduce the rollover risk faced by them. Specifically, firms with greater refinancing risk exhibit a lower cash effective tax rate, which indicates a positive association between rollover risk and tax avoidance, consistent with the notion that firms engage in tax avoidance to provide cash to facilitate debt refinancing. The results also suggest that when firms are faced with rollover risk, the benefit of cash tax savings, on average, exceed the cost of tax avoidance.

[Insert Table 3 about here]

4.3 Cross-sectional analyses

4.3.1 Effect of financial constraints on the relation between rollover risk and tax avoidance

A recent stream of literature on tax avoidance investigates the correlation between financial constraints and tax avoidance (Edwards et al. 2016; Law and Mills 2015). Specifically, Edwards et al. (2016) document that firms facing increases in financial constraints exhibit increases in cash tax planning. Law and Mills (2015) use a financial constraints measure based on firms' qualitative disclosures, i.e., negative words in their annual reports, and find that financial constraints are associated with more aggressive tax planning strategies. Meanwhile, firms faced with rollover risk strive to increase cash holdings (Harford et al. 204), which can be partially accomplished through cash tax savings. Accordingly, we predict that firms with financial constraints must rely more heavily on cash savings generated by tax avoidance activities during the debt refinancing process. Therefore, the effect of rollover risk on tax avoidance for these financially constrained firms may be larger. Alternatively, because financially constrained firms likely bear higher interest rates on their debt due to lack of financial resources, they may be more sensitive to the incremental cost of interest if they engage in tax avoidance activities. Thus, when faced with rollover risk, these firms may choose to avoid taxes to a less degree in the presence of financial constraints.

To test this empirical question, we add an interaction term between each of our financial constraint proxies and $LT\_DUE1_{i,t-1}$ in order to investigate whether financial constraints faced by the firm increase the relation between rollover risk and tax avoidance. In separate analyses, we adopt four different measures of financial constraints used in prior studies, including the availability of credit rating ($NORATING_{i,t-1}$), negative Z-score ($NEG\_ZSCORE_{i,t-1}$), firm size ($SIZE_{i,t-1}$), and cash holdings ($CASH_{i,t-1}$). $NORATING_{i,t-1}$ is equal to one if there is no credit rating in year $t-1$, and zero, otherwise. $NEG\_ZSCORE_{i,t-1}$ is the negative Altman's Z-score at the

beginning of the period. We multiply the original Altman's Z-score by −1 so that a larger value of $NEG\_ZSCORE_{i,t-1}$ indicates greater financial distress. $SIZE_{i,t-1}$ is the natural log of the market value of equity in year $t-1$. $CASH_{i,t-1}$ is cash at the beginning of the period divided by lagged assets.[2] Firms with no credit rating and higher $NEG\_ZSCORE_{i,t-1}$ face greater financial constraints, whereas firms that are larger in size or have greater cash holdings encounter less financial constraints. Therefore, according to our prediction, when we use $NORATING_{i,t-1}$ or $NEG\_ZSCORE_{i,t-1}$ ($SIZE_{i,t-1}$ or $CASH_{i,t-1}$) as the proxy for financial constraints, the coefficient on the interaction between $LT\_DUE1_{i,t-1}$ and $NORATING_{i,t-1}$ or $NEG\_ZSCORE_{i,t-1}$ ($SIZE_{i,t-1}$ or $CASH_{i,t-1}$) is expected to be negative (positive), suggesting that all four financial constraint measures intensify the negative relation between $LT\_DUE1_{i,t-1}$ and $CETR_{i,t}$. In other words, the positive relationship between rollover risk and tax avoidance is more pronounced when a firm has greater financial constraints.

Table 4 presents the results for the effect of financial constraints on the relation between rollover risk and tax avoidance. Columns (1) and (2) of Table 4 show that the coefficients on $LT\_DUE1_{i,t-1} \times NORATING_{i,t-1}$ and $LT\_DUE1_{i,t-1} \times NEG\_ZSCORE_{i,t-1}$ are negative and significant. In addition, the coefficient on $LT\_DUE1_{i,t-1}$ in Column (1) becomes insignificant, suggesting that firms with credit ratings do not avoid taxes when faced with rollover risk, possibly because firms with credit ratings can generate the cash needed for refinancing through new debt issuance. Columns (3) and (4) of Table 4 show that the coefficients on $LT\_DUE1_{i,t-1} \times SIZE_{i,t-1}$ and $LT\_DUE1_{i,t-1} \times CASH_{,t-1}$ are positive and significant. These results suggest that financial constraints intensify the positive relation between rollover risk and tax avoidance. Because

[2] We also include the stand-alone variables of financial constraint measures. However, since we include the concurrent *SIZE* and *CASH* as control variables in all of the regressions in this study, to the extent these two variables are serially correlated, we omit lagged *SIZE* and *CASH* as main effects in the regressions where we use *SIZE* and *CASH* as the proxies for financial constraints.

financially constrained firms have fewer financial resources at their disposal during refinancing, they are more likely to choose cash tax savings to increase cash holdings. In other words, when firms face rollover risk, tax avoidance provides even greater benefits than costs for firms with greater financial constraints compared with firms with fewer financial constraints. On the other hand, less financially constrained firms recognize the higher interest cost on refinanced debt and, therefore, engage in less tax avoidance.

[Insert Table 4 about here]

4.3.2 Effect of new debt financing on the relation between rollover risk and tax avoidance

If the managers expect to fulfill the firms' cash needs through debt refinancing, then they should rely less on tax avoidance to generate cash savings. More importantly, if they know that the new debt issuances can satisfy the firms' cash needs during refinancing, then they will likely not engage in tax avoidance because doing so will make the new debt issuance more costly due to higher interest rates. In contrast, if the managers expect not to be able to obtain enough new debt to refinance the maturing debt, then the benefit of cash savings from tax avoidance is more pronounced. Therefore, we predict that firms' access to cash through debt financing can moderate the positive relation between refinancing risk and tax avoidance. To test this prediction, we use debt issuance in year *t* as a proxy for a firm's ability to refinance maturing debt. Specifically, we estimate the following equation:

$$CETR_{i,t} = \beta_0 + \beta_1 LT\_DUE1_{i,t-1} + \beta_2 DEBTISSUE_{i,t} + \beta_3 LT\_DUE1_{i,t-1} \times DEBTISSUE_{i,t} + \beta_4 NEG\_ZSCORE_{i,t-1} + \beta_5 SIZE_{i,t} + \beta_6 CASH_{i,t} + \beta_7 NOL_{i,t} + \beta_8 D\_NOL_{i,t} + \beta_9 PRETAXINC_{i,t} + \beta_{10} EQINC_{i,t} + \beta_{11} FORINC_{i,t} + \beta_{12} MB_{i,t} + \beta_{13} LEV_{i,t} + \beta_{14} PPE_{i,t} + \beta_{15} RD_{i,t} + \beta_{16} INTANGIBLE_{i,t} + \varepsilon_{i,t} \quad (3)$$

In Equation (3), $DEBTISSUE_{i,t}$ is equal to one if long-term debt issuance in year *t* is greater than or equal to the long-term debt due in year *t* (COMPUSTAT item *DLTIS* in year *t*>=*DD1* in year *t*−1). Other variables are as defined in the Appendix. If debt issuance reduces firms' tendency to reserve cash through tax savings when they face rollover risk, then we expect β_3 to be positive.

Table 5 presents the results for the effect of firms' ability to refinance maturing debt on the relationship between rollover risk and tax avoidance. We find that the coefficient on $LT\_DUE1_{i,t-1}$×$DEBTISSUE_{i,t}$ is positive and significant (Coefficient = 0.244; Standard error = 0.062). The results suggest that when firms with rollover risk expect that they are able to obtain cash from debt refinancing, they have fewer needs of using cash tax savings to increase cash holdings in order to reduce refinancing risk. In addition, the sum of β_1 and β_3 equals −0.077, which indicates the effect of rollover risk on cash effective tax rate for firms that are able to refinance maturing debt with new debt issuance. A test of $\beta_1 + \beta_3 = 0$ generates a *p*-value of 0.127, which fails to reject the null. This result suggests that firms that are able to issue enough debt to replace their maturing debt exhibit no association between rollover risk and tax avoidance.

[Insert Table 5 about here]

4.3.3 Effect of market interest rates on the relation between rollover risk and tax avoidance

Prior research documents that corporate tax avoidance increases the cost of public debt and bank loans (Shevlin et al. 2013; Hasan et al. 2014). Because the interest rate of refinanced debt partly depends on the current market interest rate, during the period when the market interest rate is high, further conducting tax avoidance will make the interest rate of new borrowing to be higher for firms with rollover risk. This may cause the marginal cost of tax avoidance to exceed the marginal benefit of it for firms facing refinancing risk. Therefore, we predict that the magnitude

of the market interest rate will mitigate the positive relationship between rollover risk and tax avoidance. To test this prediction, we estimate the following model:

$$CETR_{i,t} = \beta_0 + \beta_1 LT\_DUE1_{i,t-1} + \beta_2 MKTRATE_{i,t} + \beta_3 LT\_DUE1_{i,t-1} \times MKTRATE_{i,t} + \beta_4 NEG\_ZSCORE_{i,t-1} + \beta_5 SIZE_{i,t} + \beta_6 CASH_{i,t} + \beta_7 NOL_{i,t} + \beta_8 D\_NOL_{i,t} + \beta_9 PRETAXINC_{i,t} + \beta_{10} EQINC_{i,t} + \beta_{11} FORINC_{i,t} + \beta_{12} MB_{i,t} + \beta_{13} LEV_{i,t} + \beta_{14} PPE_{i,t} + \beta_{15} RD_{i,t} + \beta_{16} INTANGIBLE_{i,t} + \varepsilon_{i,t} \quad (4)$$

where $MKTRATE_{i,t}$ is the commercial and industrial loan rates spreads over the intended federal funds rate. Following Officer (2007), we calculate a moving average using the four quarterly data ended in the fiscal year end for each firm-year. The higher this spread, the greater the cost of obtaining financing. If the magnitude of market interest rate attenuates the negative relation between rollover risk and cash effective tax rate, we predict β_3 to be positive.

Panel A of Table 6 presents the results for the effect of market interest rate on the relationship between rollover risk and cash effective tax rate. We omit control variables for brevity. The coefficient on $LT\_DUE1_{i,t-1} \times MKTRATE_{i,t}$ is positive and significant at the five percent level (Coefficient = 0.141; Standard error = 0.059), suggesting that a higher market interest rate makes firms with rollover risk to avoid taxes to a lesser degree. This finding supports the notion that when the marginal cost of tax avoidance exceeds the marginal benefit of it, the degree of tax avoidance in firms with refinancing risk is less pronounced.

[Insert Table 6 about here]

4.3.4 Interactive effect of financial constraints and market interest rates on the relation between rollover risk and tax avoidance

In section 4.3.3, we find that the magnitude of market interest rate attenuates the positive relation between rollover risk and tax avoidance. On the other hand, in section 4.3.1, we show that

financial constraints magnify the positive relation between refinancing risk and tax avoidance. During the periods of higher market interest rates, the cost of further borrowing for financially constrained firms would be even higher relative to less financially constrained firms. Financially constrained firms would be less tax aggressive to mitigate the incremental increase in interest costs of additional refinancing above and beyond high market interest rates. In this section, we use three-way interaction models to examine this prediction and show the interactive effect of market interest rate and financial constraints on the relationship between rollover risk and tax avoidance. Specifically, we add to Equation (4) the main effects of financial constraints, the two-way interaction between $LT\_DUE1_{i,t-1}$ and financial constraints, and the three-way interaction among $LT\_DUE1_{i,t-1}$, $MKTRATE_{i,t}$, and financial constraints. Similar to section 4.3.1, in separate models, we use four different measures to proxy for financial constraints, including the availability of credit rating ($NORATING_{i,t-1}$), negative Z-score ($NEG\_ZSCORE_{i,t-1}$), firm size ($SIZE_{i,t-1}$), and cash holdings ($CASH_{i,t-1}$).[3]

When the market interest rate is higher, if tax aggressiveness is too costly for financially constrained firms faced with rollover risk, tax avoidance would be less pronounced for these firms. Therefore, we predict that the coefficients on the three-way interaction among $LT\_DUE1_{i,t-1}$, $MKTRATE_{i,t}$, and the financial constraint measures to be positive when we use $NORATING_{i,t-1}$ and $NEG\_ZSCORE_{i,t-1}$ as the proxies for financial constraints. On the other hand, the coefficients on the three-way interaction among $LT\_DUE1_{i,t-1}$, $MKTRATE_{i,t}$, and the financial constraint measures are expected to be negative when we use $SIZE_{i,t-1}$ and $CASH_{i,t-1}$ as the proxies for financial constraints.

[3] Similar to the earlier analysis with the financial constraint measures in Section 4.3.1, we include the concurrent *SIZE* and *CASH* as control variables in all of the regressions in this study. To the extent these financial constraint measures are serially correlated, we omit lagged *SIZE* and *CASH* as main effects in the regressions where we use *SIZE* and *CASH* as the proxies for financial constraints.

Panel B of Table 6 shows the results for the interactive effect of financial constraints and market interest rates on the relation between rollover risk and tax avoidance. For parsimony, we do not report the coefficient estimates on control variables. Similar to the results in Table 4, Columns (1) and (2) in Panel B of Table 6 show that the coefficients on $LT\_DUE1_{i,t-1}\times NORATING_{i,t-1}$ and $LT\_DUE1_{i,t-1}\times NEG\_ZSCORE_{i,t-1}$ are still negative and significant. Columns (3) and (4) in Panel B of Table 6 show that the coefficients on $LT\_DUE1_{i,t-1}\times SIZE_{i,t-1}$ and $LT\_DUE1_{i,t-1}\times CASH_{i,t-1}$ are still positive and significant. These results suggest that, *ceteris paribus,* tax avoidance is still more pronounced for financially constrained firms given rollover risk. More interestingly, Columns (1) and (2) in Panel B of Table 6 show that, consistent with our prediction, the coefficients on $LT\_DUE1_{i,t-1}\times MKTRATE_{i,t}\times NORATING_{i,t-1}$ as well as $LT\_DUE1_{i,t-1}\times MKTRATE_{i,t}\times NEG\_ZSCORE_{i,t-1}$ are positive and significant. Columns (3) and (4) present the evidence that the coefficients on $LT\_DUE1_{i,t-1}\times MKTRATE_{i,t}\times SIZE_{i,t-1}$ and $LT\_DUE1_{i,t-1}\times MKTRATE_{i,t}\times CASH_{i,t-1}$ are negative and significant. These results suggest, when market interest rates are higher, financially constrained firms would be less tax aggressive when they face rollover risk. These results are consistent with the notion that when the market interest rates are higher, firms with financial constraints face greater incremental refinancing costs than direct cash tax savings arising from tax avoidance.

4.4 Additional analysis

When a firm issues debt, lenders may evaluate the firm's performance and financial position over a period of more than one year. Thus, the firm may begin to reserve cash through tax savings in year t in anticipation of debt maturing in year t+1 to reduce rollover risk. Specifically, in addition to the portion of long-term debt maturing in year t at the end of year $t-1$, i.e., $LT\_DUE1_{i,t-1}$, we include the portion of long-term debt maturing in year t+1 at the end of year

$t-1$, i.e., $LT\_DUE2_{i,t-1}$, in Equation (2). $LT\_DUE2_{i,t-1}$ is computed as COMPUSTAT data item *DD2* in year $t-1$ divided by total assets in year $t-1$.

Table 7 presents the results when we consider that firms may preempt tax avoidance activities in consideration of debt maturing in two years. Similar to the coefficient on $LT\_DUE1_{i,t-1}$, we find that the coefficient on $LT\_DUE2_{i,t-1}$ is also negative and significant (Coefficient = −0.061; standard error = 0.023). Although the magnitude of the coefficient for $LT\_DUE2_{i,t-1}$ is smaller than that for $LT\_DUE1_{i,t-1}$, the effect is still statistically significant. The results, in general, support the notion that firms use cash tax savings to reduce rollover risk arising from debt maturing in both one year and two years.

[Insert Table 7 about here]

4.5 Robustness tests

We conduct several tests to provide robustness to our results. First, although we follow prior tax avoidance literature to include industry and year fixed effects and other firm-level factors as control variables in the main regressions, we might still omit some firm characteristics that might affect both cash effect tax rate and long-term debt maturing in one year. To reduce the possibility of omitted correlated variable problem, we replace industry and year fixed effects with firm and year fixed effects and reports the results in the Column (1) of Table 8. The coefficient on $LT\_DUE1_{i,t-1}$ is still negative and significant (Coefficient = −0.158; standard error = 0.038), suggesting that our results are not affected by omitted firm-specific factors.

Second, as noted in Almeida et al. (2012) and Gopalan et al. (2014), in practice, firms' long-term debt maturities tend to concentrate in a few periods, which is consistent with our results in descriptive statistics that our rollover risk measure, $LT\_DUE1_{i,t-1}$, is right-skewed. Therefore, rollover risk may only be an issue when the amount of maturing long-term debt is large enough.

To examine this possibility, we relax the assumption of a linear relation between rollover risk and tax avoidance. Specifically, we define a dummy variable, $HIGH\_LT\_DUE1_{i,t-1}$, which equals one if the rollover risk measure $LT\_DUE1_{i,t-1}$ is greater than 0.049 (which is equal to its sample mean of 0.018 plus one standard deviation of 0.031), and zero otherwise. We replace $LT\_DUE1_{i,t-1}$ with this $HIGH\_LT\_DUE1_{i,t-1}$ dummy in Equation (2). As shown in Column (2) of Table 8, we find a negative relationship between rollover risk measured by this dummy variable and cash effective tax rate (Coefficient = −0.019; standard error = 0.003). The results suggest that compared with firms with a lower level of $LT\_DUE1_{i,t-1}$, firms with a large amount of long-term debt due in one year (greater than 4.9 percent of total assets) exhibit a greater level of tax avoidance.[4] This finding is consistent with our main finding of a positive relationship between rollover risk and tax avoidance based on the continuous rollover risk measure.

Finally, our rollover risk measure, i.e., $LT\_DUE1_{i,t-1}$, results from past financing choices and should be exogenous to current tax avoidance activities. Nevertheless, one may still argue that smart CEOs may be able to forecast in year $t-1$ the firms' tax avoidance activities and consequently the amount of cash savings from tax avoidance in year t. Thus, these managers may refinance in year $t-1$ some of the debt maturing in year t, which would affect $LT\_DUE1_{i,t-1}$ measured at the end of year $t-1$. To mitigate this concern, we replace debt maturing in one year at the end of year $t-1$ ($LT\_DUE1_{i,t-1}$) with debt maturing in two years at the end of year $t-2$ ($LT\_DUE2_{i,t-2}$) and repeat the regression of Equation (2). Given that $LT\_DUE2_{i,t-2}$ is based on the available information in year $t-2$, it is even less likely to be influenced by managerial anticipation of the firm's tax avoidance activity in year t. The results are presented in Column (3) of Table 8. We

[4] In addition to the cutoff of 0.049 based on the sample mean plus one standard deviation, we use alternative cutoffs at the 75th percentile or 80th percentile to define the $HIGH\_LT\_DUE1_{i,t-1}$ dummy variable, respectively, the results are qualitatively similar.

continue to find a significantly negative relation between $LT\_DUE2_{i,t-2}$ and $CETR_{i,t}$ (Coefficient = −0.083; standard error = 0.023). Compared to the coefficient on $LT\_DUE1_{i,t-1}$ (−0.216) in Table 3, the coefficient on $LT\_DUE2_{i,t-2}$ reported here is smaller in magnitude, possibly because $LT\_DUE2_{i,t-2}$ contains more noise as a measure of rollover risk in regard to tax avoidance activities in year *t* due to a considerable lapse of time.

[Insert Table 8 about here]

5 Conclusion

In this study, we examine whether rollover risk is associated with tax avoidance. Due to the detrimental consequences of rollover risk, firms may desire to use cash tax savings generated through tax avoidance to pay down some of their maturing debt or present a stronger financial position to their existing and potential deb holder. However, firms may also be concerned about the increase in the interest cost on their debt if they choose to avoid taxes. Thus, it is an empirical question as to whether the incremental benefits from cash savings as a result of tax avoidance are greater or less than the incremental costs of tax avoidance in terms of higher interests on refinanced debt. We test our hypothesis using a large panel data set spanning from 1987 to 2016 and find evidence of a positive association between rollover risk and tax avoidance, suggesting that, on average, the incremental benefit that firms receive from cash tax savings is greater than the incremental cost of interest that these firms bear.

We corroborate our main finding by showing that the positive association is stronger for firms with financial constraints and weaker for firms whose issuances of new long-term debt are greater than or equal to the amount of maturing long-term debt. Moreover, we document that the positive relationship between rollover risk and tax avoidance is less pronounced when the market

interest rates are higher, suggesting that the marginal cost of tax avoidance exceeds the marginal benefit of it during debt refinancing if the market interest rates are higher. Furthermore, we find evidence that the positive association between rollover risk and tax avoidance is further reduced for financially constrained firms in a high market-interest-rate environment. These results are consistent with the notion that when the market interest rates are higher, firms with financial constraints face greater incremental refinancing costs than direct cash tax savings arising from tax avoidance. Finally, we document that firms preempt their tax avoidance activities in anticipation of long-term debt maturing in two years.

Our study contributes to the literature on tax avoidance and rollover risk in several aspects. First, our findings enrich the understanding of researchers on factors associated with firms' tax avoidance activities. We document that a "real" corporate decision, i.e., maturing schedule of the long-term debt, is associated with tax avoidance. Additionally, our study extends the literature on the association between tax avoidance and cost of debt by documenting that firms engage in less tax avoidance due to concerns about incremental cost of debt under certain circumstances. Furthermore, our results extend the literature on rollover risk by providing evidence that firms mitigate rollover risk by generating cash savings from tax avoidance. Finally, our findings have practical implications for a firm's choice of its debt maturity structure because credit frictions arising from it have an effect on tax avoidance activities. To the extent that debt holders, shareholders, and policy makers have an interest in the firms' tax policies, a better understanding of the relationship between rollover risk and tax avoidance is important. Since shorter debt maturity leads to more frequent refinancing needs and rollover risk is positively associated with tax avoidance, firms should consider structuring the maturing schedules of their long-term debt in

a manner that reduces credit frictions and consequently rollover risk if the goal is to reduce tax avoidance activities.

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Appendix: Variable Definition

(In alphabetical order)

Variables	Definition
$CASH_{i,t}$	Cash (COMPUSTAT data item *CHE*) at the end of the period divided by lagged assets (COMPUSTAT data item *AT*).
$CETR_{i,t}$	Income tax paid (COMPUSTAT data item *TXPD*) divided by pre-tax income (COMPUSTAT data item *PI*) less special items (COMPUSTAT data item *SPI*). We truncate the values at zero and one.
$D\_NOL_{i,t}$	An indicator variable equal to 1 if tax loss carryforward (COMPUSTAT data item *TLCF*) in year *t* is greater than tax loss carryforward in year $t-1$.
$EQINC_{i,t}$	Equity income in earnings (COMPUSTAT data item *ESUB*) for firm *i*, year *t*, scaled by lagged assets (COMPUSTAT data item *AT*). We set equity income in earnings to zero if it is missing.
$FORINC_{i,t}$	Foreign income (COMPUSTAT data item *PIFO*) for firm *i*, year *t*, scaled by lagged assets (COMPUSTAT data item *AT*). We set foreign income to zero if it is missing.
$INTANGIBLE_{i,t}$	Intangible asset (COMPUSTAT data item *INTAN*) for firm *i*, year *t*, scaled by lagged assets (COMPUSTAT data item *AT*).
$LT\_DUE1_{i,t-1}$	Long-term debt due in one year (COMPUSTAT data item *DD1*) at the beginning of the period, scaled by lagged assets (COMPUSTAT data item *AT*).
$LT\_DUE2_{i,t-1}$	Long-term debt due in two years (COMPUSTAT data item *DD2*) at the beginning of the period, scaled by lagged assets (COMPUSTAT data item *AT*).
$LT\_DUE2_{i,t-2}$	Long-term debt due in two years (COMPUSTAT data item *DD2*) at the beginning of the previous period, scaled by lagged assets (COMPUSTAT data item *AT*).
$LEV_{i,t}$	Leverage for firm *i*, year *t*, measured as debt in current liabilities (COMPUSTAT data item *DLC*) plus long-term debt (COMPUSTAT data item *DLTT*) scaled by lagged assets (COMPUSTAT data item *AT*).
$MB_{i,t}$	Market-to-book ratio for firm *i*, at the beginning of year *t*, measured as market value of equity (COMPUSTAT data item *PRCC_F*CSHO*), scaled by book value of equity (COMPUSTAT data item *CEQ*).
$NOL_{i,t}$	Indicator variable coded as one if loss carry forward (COMPUSTAT data item *TLCF*) is positive as of the beginning of year *t*, and zero otherwise.
$PPE_{i,t}$	Property, plant, and equipment for firm *i* (COMPUSTAT data item *PPENT*), year *t*, scaled by lagged assets (COMPUSTAT data item *AT*).
$PRETAXINC_{i,t}$	Pre-tax income (COMPUSTAT data item *PI*) minus extraordinary items (COMPUSTAT data item *XI*) scaled by lagged assets (COMPUSTAT data item *AT*).
$RD_{i,t}$	R&D expense (COMPUSTAT data item *XRD*) scaled by lagged assets (COMPUSTAT data item *AT*). We set R&D expense to zero if it is missing.
$SIZE_{i,t}$	The natural log of the market value of equity (COMPUSTAT data item *PRCC_F*CSHO*) for firm *i*, at the end of year *t*.
$NEG\_ZSCORE_{i,t-1}$	Negative Altman's Z-score at the beginning of the period calculated as $-1\times$[1.2 (*Net working capital* / *Total assets*) +1.4 (*Retained earnings* / *Total assets*) +3.3 (*Earnings before interest and taxes* / *Total Assets*) +0.6 (*Market value of equity* / *Book value of liabilities*) +1.0 (*Sales* / *Total assets*)]. We multiply the original Altman's Z-score by -1 so that a higher *NEG_ZSCORE* indicates higher financial distress.

Table 1 Sample Selections and Descriptive Statistics

Panel A: Sample Selections

Unique COMPUSTAT observations from 1987 to 2016 excluding firms in SIC codes between 4900 and 4999 or between 6000 and 6999	233,525
Delete:	
Observations with missing data required to calculate $LT\_DUE1_{i,t-1}$	(35,307)
Observations with missing data required to calculate *CETR*s or with negative pretax income	(110,770)
Observations with *CETR*s that are smaller than 0 or greater than 1	(5,372)
Observations with missing data required to calculate control variables	(40,157)
Final Sample	41,919

Panel B: Descriptive Statistics

Variable	Mean	Lower Quartile	Median	Upper Quartile	Std Dev
$CETR_{i,t}$	0.256	0.118	0.253	0.359	0.177
$LT\_DUE1_{i,t-1}$	0.018	0.000	0.005	0.022	0.031
$NEG\_ZSCORE_{i,t-1}$	-5.138	-5.948	-3.825	-2.499	5.237
$SIZE_{i,t}$	5.938	4.282	5.960	7.544	2.293
$CASH_{i,t}$	0.174	0.027	0.090	0.237	0.215
$NOL_{i,t}$	0.479	0.000	0.000	1.000	0.500
$D\_NOL_{i,t}$	0.218	0.000	0.000	0.000	0.413
$PRETAXINC_{i,t}$	0.131	0.058	0.104	0.171	0.109
$EQINC_{i,t}$	0.001	0.000	0.000	0.000	0.004
$FORINC_{i,t}$	0.015	0.000	0.000	0.012	0.034
$MB_{i,t}$	2.690	1.267	2.025	3.285	3.136
$LEV_{i,t}$	0.246	0.047	0.203	0.360	0.242
$PPE_{i,t}$	0.333	0.123	0.256	0.462	0.278
$RD_{i,t}$	0.027	0.000	0.000	0.029	0.053
$INTANGIBLE_{i,t}$	0.168	0.000	0.071	0.252	0.228

Notes: Variables are as defined in Appendix.

Table 2 Pearson Correlations

	CETR	*LT_DUE1*	*NOL*	*D_NOL*	*PRETAXINC*	*EQINC*	*FORINC*	*MB*	*SIZE*	*LEV*	*CASH*	*PPE*	*RD*	*INTANGIBLE*
LT_DUE1	-0.083													
	(0.000)													
NOL	-0.302	0.098												
	(0.000)	(0.000)												
D_NOL	-0.089	0.019	0.436											
	(0.000)	(0.000)	(0.000)											
PRETAXINC	0.014	-0.068	-0.180	-0.125										
	(0.005)	(0.000)	(0.000)	(0.000)										
EQINC	-0.021	-0.001	0.007	0.015	0.016									
	(0.000)	(0.804)	(0.131)	(0.002)	(0.001)									
FORINC	-0.046	-0.042	0.173	0.132	0.121	0.021								
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)								
MB	-0.047	-0.011	0.031	0.013	0.299	0.015	0.140							
	(0.000)	(0.028)	(0.000)	(0.006)	(0.000)	(0.003)	(0.000)							
SIZE	0.009	-0.111	0.132	0.173	0.063	0.108	0.287	0.260						
	(0.060)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)						
LEV	-0.065	0.238	0.076	0.090	-0.144	0.023	-0.031	-0.028	0.048					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
CASH	-0.095	-0.131	0.053	0.004	0.369	-0.054	0.091	0.165	-0.048	-0.290				
	(0.000)	(0.000)	(0.000)	(0.359)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)				
PPE	-0.083	0.046	-0.137	-0.023	0.010	0.019	-0.099	-0.049	0.081	0.274	-0.245			
	(0.000)	(0.000)	(0.000)	(0.000)	(0.043)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)			
RD	-0.114	-0.058	0.122	0.042	0.145	-0.051	0.165	0.162	0.003	-0.185	0.386	-0.253		
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.580)	(0.000)	(0.000)	(0.000)		
INTANGIBLE	-0.041	0.019	0.200	0.163	-0.061	-0.012	0.065	0.053	0.238	0.310	-0.114	-0.256	-0.033	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.018)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
*NEG_*	-0.065	0.229	0.183	0.089	-0.425	0.016	-0.033	-0.224	-0.025	0.327	-0.421	0.122	-0.181	0.078
ZSCORE	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: p-values are in parentheses. Variables are as defined in Appendix.

Table 3 The Regression of Cash Effective Tax Rate and Refinancing Risk

VARIABLES	Dependent Var = $CETR_{i,t}$
$LT\_DUE1_{i,t-1}$	-0.216***
	(0.033)
$NEG\_ZSCORE_{i,t-1}$	-0.001***
	(0.000)
$SIZE_{i,t}$	0.008***
	(0.001)
$CASH_{i,t}$	-0.073***
	(0.006)
$NOL_{i,t}$	-0.096***
	(0.003)
$D\_NOL_{i,t}$	0.027***
	(0.002)
$PRETAXINC_{i,t}$	-0.006
	(0.012)
$EQINC_{i,t}$	-1.190***
	(0.256)
$FORINC_{i,t}$	-0.033
	(0.039)
$MB_{i,t}$	-0.003***
	(0.000)
$LEV_{i,t}$	-0.020***
	(0.006)
$PPE_{i,t}$	-0.090***
	(0.006)
$RD_{i,t}$	-0.318***
	(0.026)
$INTANGIBLE_{i,t}$	-0.028***
	(0.006)
CONSTANT	0.363***
	(0.012)
INDUSTRY DUMMY	Yes
YEAR DUMMY	Yes
Observations	41,919
Adjusted *R*-squared	0.168

Notes: Please see the Appendix for variable measurements. For each variable, the standard error is reported in parentheses. The standard errors are clustered by firm. Year and industry dummies are included in each specification, and for brevity, the results for these variables are not reported.

Table 4 Financial Constraint and the Relation between Refinancing Risk and Cash Effective Tax Rate

	Dependent Var = $CETR_{i,t}$			
	(1)	(2)	(3)	(4)
VARIABLES	$NORATING_{i,t-1}$	$NEG\_ZSCORE_{i,t-1}$	$SIZE_{i,t-1}$	$CASH_{i,t-1}$
$LT\_DUE1_{i,t-1}$	0.065	-0.351***	-0.688***	-0.259***
	(0.066)	(0.037)	(0.065)	(0.038)
$LT\_DUE1_{i,t-1} \times NORATING_{i,t-1}$	-0.358***			
	(0.075)			
$LT\_DUE1_{i,t-1} \times NEG\_ZSCORE_{i,t-1}$		-0.060***		
		(0.009)		
$LT\_DUE1_{i,t-1} \times SIZE_{i,t-1}$			0.095***	
			(0.011)	
$LT\_DUE1_{i,t-1} \times CASH_{,t-1}$				0.270**
				(0.116)
$NORATING_{i,t-1}$	0.012***			
	(0.004)			
$NEG\_ZSCORE_{i,t-1}$	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
$SIZE_{i,t}$	0.009***	0.008***	0.006***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)
$CASH_{i,t}$	-0.075***	-0.071***	-0.074***	-0.076***
	(0.006)	(0.006)	(0.006)	(0.006)
$NOL_{i,t}$	-0.095***	-0.096***	-0.095***	-0.097***
	(0.003)	(0.003)	(0.003)	(0.003)
$D\_NOL_{i,t}$	0.027***	0.027***	0.027***	0.027***
	(0.002)	(0.002)	(0.002)	(0.002)
$PRETAXINC_{i,t}$	-0.007	-0.006	-0.001	-0.005
	(0.012)	(0.012)	(0.012)	(0.012)
$EQINC_{i,t}$	-1.182***	-1.190***	-1.200***	-1.177***
	(0.257)	(0.256)	(0.257)	(0.258)
$FORINC_{i,t}$	-0.030	-0.035	-0.024	-0.033
	(0.039)	(0.039)	(0.039)	(0.040)
$MB_{i,t}$	-0.003***	-0.003***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
$LEV_{i,t}$	-0.018***	-0.018***	-0.020***	-0.020***
	(0.006)	(0.006)	(0.006)	(0.006)
$PPE_{i,t}$	-0.090***	-0.091***	-0.088***	-0.090***
	(0.006)	(0.006)	(0.006)	(0.006)
$RD_{i,t}$	-0.321***	-0.313***	-0.315***	-0.323***
	(0.026)	(0.026)	(0.025)	(0.026)
$INTANGIBLE_{i,t}$	-0.028***	-0.030***	-0.027***	-0.029***
	(0.006)	(0.006)	(0.006)	(0.007)
CONSTANT	0.351***	0.363***	0.373***	0.365***

	(0.013)	(0.012)	(0.012)	(0.012)
INDUSTRY DUMMY	Yes	Yes	Yes	Yes
YEAR DUMMY	Yes	Yes	Yes	Yes
Observations	41,919	41,919	41,919	41,445
Adjusted *R*-squared	0.169	0.170	0.170	0.168

Notes: We adopt four different measures of financial constraints used in prior studies, including the availability of credit rating ($NORATING_{i,t-1}$), negative Z-score ($NEG\_ZSCORE_{i,t-1}$), firm size ($SIZE_{i,t-1}$), and cash holdings ($CASH_{i,t-1}$). $NORATING_{i,t-1}$ is equal to one if there is no credit rating in year $t-1$, and zero, otherwise. $NEG\_ZSCORE_{i,t-1}$ is the negative Altman's *Z-score* at the beginning of the period. $SIZE_{i,t-1}$ is the natural log of the market value of equity (COMPUSTAT data item *PRCC_F*CSHO*) for firm *i* at the beginning of year *t*. $CASH_{i,t-1}$ is cash holding at the beginning of the period divided by lagged assets. We follow prior literature and use lagged *SIZE* and *CASH* as financial constraints measures. However, since we include the concurrent *SIZE* and *CASH* as control variables in Equation (2), to the extent these two variables are serially correlated, we omit lagged *SIZE* and *CASH* as main effects in the regressions where we use *SIZE* and *CASH* as the proxies for financial constraints. Please see the Appendix for the definitions of other variables. For each variable, the standard error is reported in parentheses. The standard errors are clustered by firm. Control variables as well as year and industry dummies are included in each specification, and for brevity, the results for these variables are not reported.

Table 5 New Debt Issuance and the Relation between Refinancing Risk and Cash Effective Tax Rate

VARIABLES	(1) $CETR_{i,t}$
$LT\_DUE1_{i,t-1}$	-0.321***
	(0.042)
$DEBTISSUE_{i,t}$	-0.005**
	(0.002)
$LT\_DUE1_{i,t-1} \times DEBTISSUE_{i,t}$	0.244***
	(0.062)
$NEG\_ZSCORE_{i,t-1}$	-0.001***
	(0.000)
$SIZE_{i,t}$	0.009***
	(0.001)
$CASH_{i,t}$	-0.073***
	(0.006)
$NOL_{i,t}$	-0.097***
	(0.003)
$D\_NOL_{i,t}$	0.027***
	(0.003)
$PRETAXINC_{i,t}$	-0.005
	(0.012)
$EQINC_{i,t}$	-1.206***
	(0.260)
$FORINC_{i,t}$	-0.037
	(0.039)
$MB_{i,t}$	-0.003***
	(0.000)
$LEV_{i,t}$	-0.023***
	(0.006)
$PPE_{i,t}$	-0.091***
	(0.006)
$RD_{i,t}$	-0.324***
	(0.026)
$INTANGIBLE_{i,t}$	-0.027***
	(0.006)
CONSTANT	0.366***
	(0.013)
INDUSTRY DUMMY	Yes
YEAR DUMMY	Yes
Observations	40,445
Adjusted *R*-squared	0.170

Notes: $DEBTISSUE_{i,t}$ is equal to one if long-term debt issuance in year *t* is greater than or equal to the long-term debt due in one year at the beginning of year *t* (COMPUSTAT item *DLTIS>=DD1*). Please see the Appendix for the definitions of other variables. For each variable, the standard error is reported in parentheses. The standard errors are clustered by firm. Control variables as well as year and industry dummies are included in each specification, and for brevity, the results for these variables are not reported.

Table 6

Panel A: Market Interest Rate and the Relation between Refinancing Risk and Cash Effective Tax Rate

VARIABLES	$CETR_{i,t}$
$LT\_DUE1_{i,t-1}$	-0.496***
	(0.125)
$MKTRATE_{i,t}$	0.009
	(0.012)
$LT\_DUE1_{i,t-1} \times MKTRATE_{i,t}$	0.141**
	(0.059)
CONTROL VARIABLES	Yes
INDUSTRY DUMMY	Yes
YEAR DUMMY	Yes
Observations	41,919
Adjusted *R*-squared	0.168

Notes: $MKTRATE_{i,t}$ is the commercial and industrial loan rates spreads over the intended federal funds rate. For each firm-year, we calculate a moving average using the four quarterly data ended in the fiscal year end of each firm. Please see the Appendix for the definitions of other variables. For each variable, the standard error is reported in parentheses. The standard errors are clustered by firm. Control variables as well as year and industry dummies are included in each specification, and for brevity, the results for these variables are not reported.

Panel B: Market Interest Rate and the Relation between Refinancing Risk and Cash Effective Tax Rate-The Moderating Effect of Debt Financing Difficulty

Market Interest Rate and No Rating		Market Interest Rate and Z-score		Market Interest Rate and Size		Market Interest Rate and Cash	
	(1)		(2)		(3)		(4)
VARIABLES	$CETR_{i,t}$	VARIABLES	$CETR_{i,t}$	VARIABLES	$CETR_{i,t}$	VARIABLES	$CETR_{i,t}$
$LT\_DUE1_{i,t-1}$	0.409	$LT\_DUE1_{i,t-1}$	-0.926***	$LT\_DUE1_{i,t-1}$	-1.281***	$LT\_DUE1_{i,t-1}$	-0.645***
	(0.279)		(0.140)		(0.233)		(0.150)
$MKTRATE_{i,t}$	0.010	$MKTRATE_{i,t}$	0.009	$MKTRATE_{i,t}$	0.013	$MKTRATE_{i,t}$	0.008
	(0.012)		(0.012)		(0.012)		(0.012)
$NORATING_{i,t-1}$	0.013***	$NEG\_ZSCORE_{i,t-1}$	-0.001***	$SIZE_{i,t}$	0.006***	$CASH_{i,t}$	-0.076***
	(0.004)		(0.000)		(0.001)		(0.006)
$LT\_DUE1_{i,t-1}$ $\times MKTRATE_{i,t}$	-0.162	$LT\_DUE1_{i,t-1}$ $\times MKTRATE_{i,t}$	0.274***	$LT\_DUE1_{i,t-1}$ $\times MKTRATE_{i,t}$	0.299***	$LT\_DUE1_{i,t-1}$ $\times MKTRATE_{i,t}$	0.199***
	(0.122)		(0.063)		(0.111)		(0.072)
$LT\_DUE1_{i,t-1} \times$ $NORATING_{i,t-1}$	-1.036***	$LT\_DUE1_{i,t-1} \times$ $NEG\_ZSCORE_{i,t-1}$	-0.153***	$LT\_DUE1_{i,t-1} \times$ $SIZE_{i,t-1}$	0.216***	$LT\_DUE1_{i,t-1} \times$ $CASH_{i,t-1}$	1.252**
	(0.298)		(0.034)		(0.044)		(0.544)
$LT\_DUE1_{i,t-1}$ $\times MKTRATE_{i,t}$ $\times NORATING_{i,t-1}$	0.333**	$LT\_DUE1_{i,t-1}$ $\times MKTRATE_{i,t}$ $\times NEG\_ZSCORE_{i,t-1}$	0.042***	$LT\_DUE1_{i,t-1}$ $\times MKTRATE_{i,t}$ $\times SIZE_{i,t-1}$	-0.059***	$LT\_DUE1_{i,t-1}$ $\times MKTRATE_{i,t}$ $\times CASH_{i,t-1}$	-0.504*
	(0.132)		(0.016)		(0.020)		(0.263)
CONTROL VARIABLES	Yes	CONTROL VARIABLES	Yes	CONTROL VARIABLES	Yes	CONTROL VARIABLES	Yes
INDUSTRY DUMMY	Yes	INDUSTRY DUMMY	Yes	INDUSTRY DUMMY	Yes	INDUSTRY DUMMY	Yes
YEAR DUMMY	Yes	YEAR DUMMY	Yes	YEAR DUMMY	Yes	YEAR DUMMY	Yes
Observations	41,919	Observations	41,919	Observations	41,919	Observations	41,445
Adjusted *R*-squared	0.169	Adjusted *R*-squared	0.170	Adjusted *R*-squared	0.170	Adjusted *R*-squared	0.168

Notes: $MKTRATE_{i,t}$ is the commercial and industrial loan rates spreads over the intended federal funds rate. For each firm-year, we calculate a moving average using the four quarterly data ended in the fiscal year end of each firm. We adopt four different measures of financial constraints used in prior studies,

including the availability of credit rating ($NORATING_{i,t-1}$), negative Z-score ($NEG\_ZSCORE_{i,t-1}$), firm size ($SIZE_{i,t-1}$), and cash holdings ($CASH_{i,t-1}$). $NORATING_{i,t-1}$ is equal to one if there is no credit rating in year $t-1$, and zero, otherwise. $NEG\_ZSCORE_{i,t-1}$ is the negative Altman's *Z-score* at the beginning of the period. $SIZE_{i,t-1}$ is the natural log of the market value of equity (COMPUSTAT data item *PRCC_F*CSHO*) for firm *i* at the beginning of year *t*. $CASH_{i,t-1}$ is cash holding at the beginning of the period divided by lagged assets. We follow prior literature and use lagged *SIZE* and *CASH* as financial constraints measures. However, since we include the concurrent *SIZE* and *CASH* as control variables in Equation (2), to the extent these two variables are serially correlated, we omit lagged *SIZE* and *CASH* as main effects in the regressions where we use *SIZE* and *CASH* as the proxies for financial constraints. Please see the Appendix for the definitions of other variables. For each variable, the standard error is reported in parentheses. The standard errors are clustered by firm. Control variables as well as year and industry dummies are included in each specification, and for brevity, the results for these variables are not reported.

Table 7 Effect of Debt Maturing in Both Year *T* and *T*+1
on Cash Effective Tax Rate

VARIABLES	$CETR_{i,t}$
$LT\_DUE1_{i,t-1}$	-0.209***
	(0.036)
$LT\_DUE2_{i,t-1}$	-0.061***
	(0.023)
CONTROL VARIABLES	Yes
INDUSTRY DUMMY	Yes
YEAR DUMMY	Yes
Observations	36,833
Adjusted *R*-squared	0.173

Notes: $LT\_DUE2_{i,t-1}$ is debt Maturing in two years at the end of year $t-1$, which is equal to COMPUSTAT data item *DD2* in year $t-1$ divided by total assets in year $t-1$. Please see the Appendix for the definitions of other variables. For each variable, the standard error is reported in parentheses. The standard errors are clustered by firm. Control variables as well as year and industry dummies are included in each specification, and for brevity, the results for these variables are not reported.

Table 8 Robustness Tests

Firm and Year Fixed Effects		$HIGH\_LT\_DUE1_{t-1}$=1 if LT_DUE1_{t-1}> 0.049		Debt maturing in two years at the end of year $t-2$ ($LT\_DUE2_{i,t-2}$)	
	(1)		(2)		(3)
VARIABLES	$CETR_{i,t}$	VARIABLES	$CETR_{i,t}$	VARIABLES	$CETR_{i,t}$
$LT\_DUE1_{i,t-1}$	-0.158***	$HIGH\_LT\_DUE1_{i,t-1}$	-0.019***	$LT\_DUE2_{i,t-2}$	-0.083***
	(0.038)		(0.003)		(0.023)
CONTROL VARIABLES	Yes	CONTROL VARIABLES	Yes	CONTROL VARIABLES	Yes
FIRM DUMMY	Yes	INDUSTRY DUMMY	Yes	INDUSTRY DUMMY	Yes
YEAR DUMMY	Yes	YEAR DUMMY	Yes	YEAR DUMMY	Yes
Observations	41,919	Observations	41,919	Observations	36,409
Adjusted *R*-squared	0.375	Adjusted *R*-squared	0.168	Adjusted *R*-squared	0.169

Notes: Column (1) shows the results when we replace industry and year fixed effects with firm and year fixed effects. In Column (2), $HIGH\_LT\_DUE1_{i,t-1}$ is a dummy variable equal to one if $LT\_DUE1_{i,t-1}$ is greater than 0.049 (which is equal to its sample mean plus 1 standard deviation), and zero otherwise. In Column (3), $LT\_DUE2_{i,t-2}$ is debt maturing in two years at the end of year $t-2$, which is equal to COMPUSTAT data item *DD2* in year $t-2$ divided by total assets in year $t-1$. Please see the Appendix for the definitions of other variables. For each variable, the standard error is reported in parentheses. The standard errors are clustered by firm.