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The mystery of zero-leverage firms ☆

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ABSTRACT

We present the puzzling evidence that, from 1962 to 2009, an average 10.2% of large public nonfinancial US firms have zero debt and almost 22% have less than 5% book leverage ratio. Zero-leverage behavior is a persistent phenomenon. Dividend-paying zero-leverage firms pay substantially higher dividends, are more profitable, pay higher taxes, issue less equity, and have higher cash balances than control firms chosen by industry and size. Firms with higher Chief Executive Officer (CEO) ownership and longer CEO tenure are more likely to have zero debt, especially if boards are smaller and less independent. Family firms are also more likely to be zero-levered.

1. Introduction

In the year 2000, 701 (or 14.0%) of large public nonfinancial US firms had zero outstanding debt, including both short- and long-term debt, in their capital structure. This is neither an outlier nor an aberration. Between 1962 and 2009, on average 10.2% of firms show no debt in their capital structure, and 32% have zero or negative net debt. This is also not a short-term fad, for 61% of firms that have no debt in their capital structure in any given year show no inclination to take on any debt in the next year. We call the tendency of so many firms to eschew any debt the zero-leverage puzzle. In this paper we explore the puzzle along various dimensions and test a number of economic mechanisms that can shed light on such an extreme corporate financial policy.

For a number of reasons, studying the zero-leverage (ZL) phenomenon is important for better understanding of capital structure decisions. It is closely related to the much studied low-leverage puzzle, which refers to the stylized fact that on average firms have low leverage

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ratios relative to what would be expected from various models of capital structure. The way theoretical work has typically addressed the low-leverage puzzle is by considering plausible economic forces that would drive the optimal average leverage ratio down (e.g., Goldstein, Ju, and Leland, 2001). However, this reconciles empirical facts with theory only insofar as average leverage ratios are equated. What we show is that to explain the low-leverage puzzle one needs to explain why some firms tend not to have debt at all instead of why firms on average have lower outstanding debt than expected, and most of extant models fail on this dimension. For example, excluding firms with lower than 5% of book (market) leverage (optimal leverage under a reasonable set of parameters is higher than 5% in most theoretical models) increases the average book (market) leverage ratio from 25% to 32% (28% to 37%). Thus, this result partially replaces the low-leverage puzzle with a zero-leverage puzzle.

From the empirical perspective, studying the determinants of zero-leverage behavior can shed light on the economic mechanisms that lead firms to become low-levered as such factors are likely to be dominating for zero-debt firms and are thus easier to identify. In addition, it is important to investigate whether zero-leverage firms leave a substantial fraction of their value on the table by not optimizing on tax benefits of debt, extending the line of research originated by Graham (2000).

In addition to showing the extent of the zero-leverage behavior, the paper presents evidence on another surprising (given our theories of capital structure and dividend policies) stylized fact that about a third of zero-leverage firms pay dividends. Moreover, and more intriguing, we find that, conditional on paying dividends, firms effectively replace interest expense with dividends and share repurchases, so that the total payout ratio is relatively flat across the whole spectrum of leverage.

To understand better the nature of zero-leverage behavior, we construct for each zero-leverage firm-year observation a reference set of proxy firms that serve as control observations. Each set has up to four firm-observations in the same year and industry that are closest in size and have the same dividend-paying (DP) status as the zero-leverage observation. Importantly, in constructing reference sets, we do not condition on debt policy. Our findings strongly indicate that substantial differences exist in fundamental characteristics between zero-leverage firms and their proxies. Proxy firms are highly levered (on average 20%), indicating that neither industry nor size can account for zero-debt policies.

Firms that follow zero-leverage policy have higher market-to-book ratios and higher cash balances, are more profitable, and pay more taxes and dividends. Perhaps surprisingly, zero-leverage firms are not younger than their control firms. Our analysis also indicates that debt substitutes such as leasing and pension liabilities cannot account for zero-leverage behavior. Taken together, these stylized facts provide a striking illustration of the assertion by Graham (2000) that many profitable firms seem to be underlevered.

Dividend-paying zero-leverage firms leave considerable amount of money on the table by not levering up. Were an average such firm to increase its leverage to the level of its dividend-paying proxies, potential tax benefits amount, under the conservative scenario, to more than 7% of the market value of equity. Were the same firm to refinance to the point where its marginal corporate tax rate is zero, gains would be much larger at about 15% of the equity value.

Zero-leverage behavior is a highly persistent phenomenon. For example, conditioning on survival for five years, 30% of zero-leverage firms do not raise any debt in the next four years. In the absence of persistence, simulations show that this fraction is only 0.3%. If the firm survives for 10 years, it does not have any debt over the 10-year period in 15% of cases.

A plausible explanation of the zero-leverage phenomenon is that the manager's personal preferences differ from those of shareholders. For example, if the manager is endowed with substantial stock ownership and is thus underdiversified, he would find debt more costly than shareholders. Furthermore, if the board is more manager-friendly, a manager finds it easier to implement a strategy of his personal choice. In our empirical analysis, we find strong evidence consistent with these mechanisms. For example, for the sample of 1,006 firm-year observations with Chief Executive Officer (CEO) ownership above 10%, 22% of observations have no debt, double the fraction for the total sample. Controlling for other factors, a 1 standard deviation increase in CEO ownership increases the likelihood that a firm adopts (almost) zero-leverage policy by an economically significant 3.3%. We also find that firms with longer-tenured CEOs and smaller and more independent boards are more likely to use debt conservatively. Moreover, CEO ownership and tenure are significantly related to zero-leverage policy only in firms with smaller and less independent boards. Interestingly, these findings are much stronger in the dividend-paying sample than in the zero-dividend (ZD) sample, indicating that economic forces related to managerial preferences have a potential to explain the most puzzling part of zero-leverage behavior.

Family-controlled firms can also be expected to follow conservative debt policies. Becker (1981) and Bertrand and Schoar (2006) argue that family members can be altruistic and derive utility from passing on the family legacy and safeguarding the well being of other family members. The desire for long-term survival increases the perceived risk of default-risky debt. Consistent with this intuition, we find that family firms are substantially more likely to be zero-levered.

Our paper belongs to the cohort of empirical studies that have recently investigated conservatism in corporate debt policy. Graham (2000) finds that firms are substantially underlevered from the viewpoint of debt tax benefits. Moreover, firms that follow conservative debt policy are more likely to be stable and profitable. Minton and Wruck (2011) analyze the behavior of low-leverage firms. Similar to our study, they form reference sets for low-leverage firms in their sample and analyze the persistence and implications of financial conservatism. Our empirical method and set of questions differ from theirs in a number of ways. Their low-leverage sample includes firms that had long-term leverage in the bottom 20% of all firms for five prespecified years, and the reference set includes all remaining firms. Thus, their proxy construction is conditioned on leverage, while our proxy construction specifically excludes capital structure. Recently, Dang (2011) also shows that extreme debt conservatism is a common empirical phenomenon in the UK. Our results also add to the existing body of literature exploring the relation between managerial features and corporate capital structure policies. One stream of literature (Agrawal and Nagarajan, 1990; Berger, Ofek, and Yermack, 1997; Lewellen, 2006; Coles, Daniel, and Naveen, 2006) has examined the influence of managerial ownership and compensation on leverage choices. Graham and Narasimhan (2004) and Malmendier, Tate, and Yan (2011) show that CEO characteristics such as overconfidence and Great Depression experience cause managers to reduce leverage. Our findings complement this literature by linking the puzzling extreme debt conservatism with several salient CEO and firm characteristics, such as CEO ownership and family status.

The rest of the paper is organized as follows. The following section presents the data, the methodology we use to estimate capital structure and construct proxies for zero-leverage firms, and our initial empirical analysis. Section 3 provides further empirical analysis on potential tax benefits, relation between zero-debt policy and industry and size, and the persistence of zero-debt behavior. Section 4 presents our analysis of the relation between zero-leverage policy and managerial and governance variables. Section 5 concludes.

2. Data description and initial empirical evidence

In this section we describe our data and present preliminary empirical evidence.

2.1. Data sources, sample selection, and leverage definitions

To construct our sample, we start with the merged annual Compustat and Center for Research in Security Prices (CRSP) data set over the period 1962–2009. We start in the year 1962 because the Compustat data before then are known to be biased towards large firms. We exclude financial companies [Standard Industrial Classification (SIC) codes 6000–6999], utilities (SIC 4900–4999), non-US companies [entries in Compustat with International Standards Organization country code of incorporation (FIC) not equal to USA], and nonpublicly traded firms and subsidiaries (entries in Compustat with stock ownership variable, *STKO*, equal to one or two). There are 259,579 firm-year observations that satisfy these criteria. We also exclude firm-years with total book value of assets (Compustat data item *AT*) of less than $10 million in inflation-adjusted year 2000 dollars.[1] All nominal values are converted into year-2000 dollar values using Consumer Price Index (CPI) from the US Bureau of Labor Statistics. In the paper, date *t* always refers to calendar year *t*, given by the Compustat data item *DATADATE*, which is the calendar date of the fiscal year-end. For consistency, we also use fiscal year-end stock prices (the variable *PRCC_F*). We require the observations to have valid market leverage and book leverage ratios as defined below. This leaves 157,536 firm-year observations with 14,327 unique firms, from a minimum of 471 observations in 1962 to a maximum of 5,358 in 1997.

We define the book leverage ratio of firm i in year t by

$$BL_{it} = \frac{DLTT_{it} + DLC_{it}}{AT_{it}}, \tag{1}$$

where *DLTT* is the amount of long-term debt exceeding maturity of one year and *DLC* is debt in current liabilities, including long-term debt due within one year. The book leverage ratio is defined similarly in most recent capital structure papers (e.g., Lemmon, Roberts, and Zender, 2008; Graham and Leary, 2011; Leary and Roberts, 2010; Lemmon and Zender, 2010).[2]

By the same token, we define the (quasi-)market leverage ratio of firm i in year t by

$$ML_{it} = \frac{DLTT_{it} + DLC_{it}}{DLTT_{it} + DLC_{it} + CSHO_{it} \times PRCC\_F_{it}}, \tag{2}$$

where *PRCC_F* is the fiscal year-end common share price and *CSHO* is the fiscal year-end number of shares outstanding. Because leverage measures are central to our study, we exclude all observations with missing data components (such as missing *DLTT* or *DLC*).

The choice of leverage definitions requires a special discussion in the context of our paper. As we are interested in interpreting empirical results, we would like to use the measures most often used in the empirical literature. From this perspective, Eqs. (1) and (2) are the most common definitions of total leverage. At the same time, no widespread consensus exists on what constitutes debt, and one alternative is to use total liabilities (e.g., Rajan and Zingales, 1995). However, we are interested in active capital structure choices of firms, and a nontrivial portion of nondebt liabilities (such as accounts payable) can reflect day-to-day business arrangements instead of financing considerations. The unreported analysis of other liabilities such as accounts payable confirms that these liabilities are typically substantially smaller for zero-leverage firms.

The choice of denominator is less important in the context of zero leverage. Also, because all US firms follow

[1] Another possibility is to exclude all firms with less than $10 million nominal value of book assets, which results in the omission of more observations. As the exclusion of small firms is due to the presence of noise in the accounting data, the rationale for either of the two procedures depends on the nature of noise, which can be either fixed across years or proportional to average input numbers. We have replicated all the empirical analysis in the paper on the resulting second data set without any of the qualitative results being affected.

[2] An alternative definition used in earlier papers is $BL_{it} = (DLTT_{it} + DLC_{it})/(DLTT_{it} + DLC_{it} + AT_{it} + TXDITC_{it} - PSTKL_{it} - LT_{it})$, where *LT* is the book value of total liabilities, *TXDITC* is deferred taxes, and *PSTKL* is preferred stock (see, e.g., Fama and French, 2002). Defining book equity this way, using accounting variables, can lead to low or negative values of book equity causing outliers in leverage ratios. Replicating all our results using this definition of book equity while controlling for outliers does not affect our results.

broadly the same accounting rules, there is no need to make any of the adjustments one has to make when comparing leverage internationally (e.g., Rajan and Zingales, 1995). Finally, using the interest-coverage ratio as our main definition does not materially change our results.

2.2. Zero and almost zero-leverage firms and their proxies

In this section we provide descriptive statistics on zero-leverage firms and their proxies.

2.2.1. Zero-leverage firms

We define firm *i* in year *t* as a zero-leverage firm if in that year the outstanding amounts of both short-term debt (*DLC*) and long-term debt (*DLTT*) equal zero.[3] Column 1 of Table 1 shows the fraction of ZL firms relative to the total size of the sample in each year between 1962 and 2009. On average, 10.2% of firm-years over the whole sample period exhibit zero leverage, from a minimum of 4.3% in 1980 to a maximum of 19.9% in 2005. The table shows a substantial variation in the fraction of unlevered firms across years. For comparison, we also calculate the fraction of firms with zero long-term debt. Column 2 reports that about 15% of the sample carry no long-term debt, implying that on average about 30% of firms with zero long-term debt carry liabilities classified by Compustat as short-term debt. Whether these firms refinance their short-term debt every year or the definition of short-term debt includes items that would not be classified as debt for financial, as opposed to accounting, purposes is unclear.

We also define the second category of firms, which we call almost zero-leverage (AZL) firms. AZL firms have a marginal debt presence in their capital structure, and we classify a firm as an AZL firm if its book leverage ratio is less than 5%. We consider these firms in addition to ZL firms for a number of reasons. From a theoretical standpoint, a number of models (e.g., Fischer, Heinkel, and Zechner, 1989; Leland, 1994, 1998; Leland and Toft, 1996; Goldstein, Ju, and Leland, 2001; Ju, Parrino, Poteshman, and Weisbach, 2005) produce leverage ratios that are well above zero. Cross-sectional dynamics modeled by Strebulaev (2007) can produce firms that are almost zero-leverage but in his benchmark case their fraction is very low. Practically, the finance nature of various liabilities assigned by accounting conventions to debt is ambiguous (for example, advances to finance construction or installment obligations). While our choice of the 5% cutoff is ad hoc, it is likely on the conservative side. Increasing the cutoff to 7% (10%) increases the average annual fraction of AZL firms by 3.1 (7.7) percentage points. As Columns 3 of Table 1 shows, an astonishing 22% of firms are almost zero-levered for the whole sample and almost 28% can be classified as AZL over the 1987–2009 period. Untabulated results for AZL firms defined by market leverage are qualitatively similar. To reflect on the models mentioned above, none of them, whether dynamic or static, can produce such low leverage for reasonable parameters (for example, in Strebulaev, 2007, less than 1% of firms have leverage of less than 5% in dynamics).

Table 1

Frequency of zero-leverage (ZL) firms.

ZL firms are firms that have zero book debt ($DLTT+DLC=0$, where *DLTT* and *DLC* are the Compustat long-term debt and debt in current liabilities, respectively). ZLTD firms are firms that have zero long-term debt ($DLTT=0$). Almost zero-leverage (AZL) firms are firms with book leverage not exceeding 5% in a given year. NPND firms are firms that have nonpositive net debt in a given year, i.e., $DLTT+DLC-CHE\leq 0$, where *CHE* is the Compustat cash holdings. Columns ZL, ZLTD, AZL, and NPND report corresponding fractions of firms relative to the total sample in each year. Column *N* gives the number of firms in the sample.

Year	ZL	ZLTD	AZL	NPND	N
1962	12.7	17.4	23.6	39.5	471
1963	12.9	17.5	25.7	42.4	498
1964	11.9	17.7	24.0	39.2	530
1965	10.5	16.9	21.2	34.3	638
1966	9.6	15.3	16.9	25.8	1,281
1967	7.9	12.2	14.8	22.2	1,398
1968	8.0	12.9	16.2	24.6	1,844
1969	6.4	10.5	13.9	22.1	2,101
1970	5.8	9.4	12.1	18.1	2,509
1971	6.2	9.6	13.3	20.3	2,771
1972	6.6	10.3	15.0	22.2	3,019
1973	6.1	10.2	12.8	19.9	3,085
1974	4.7	8.8	11.0	16.4	3,124
1975	5.4	8.6	13.2	20.2	3,055
1976	5.9	9.0	13.9	23.6	3,022
1977	5.6	8.5	13.6	21.7	2,932
1978	4.9	7.4	12.2	19.7	3,034
1979	4.3	7.0	11.2	18.1	3,153
1980	4.3	6.6	11.4	18.5	3,126
1981	5.0	7.8	13.0	24.0	3,400
1982	5.2	7.5	13.9	24.6	3,371
1983	5.8	8.7	17.7	31.3	3,505
1984	5.9	8.8	17.3	29.3	3,611
1985	5.9	8.9	16.4	28.7	3,507
1986	6.7	10.3	16.8	29.7	3,579
1987	6.7	10.6	16.7	28.6	3,740
1988	6.3	10.3	15.7	27.3	3,609
1989	7.1	11.5	16.8	27.4	3,445
1990	7.6	11.8	18.0	28.2	3,366
1991	9.4	13.5	21.1	32.2	3,427
1992	10.0	14.9	24.2	34.9	3,662
1993	11.3	16.8	25.6	36.7	4,063
1994	11.6	16.2	25.8	35.8	4,367
1995	11.3	16.3	26.2	35.8	4,703
1996	13.1	18.4	29.5	39.8	5,220
1997	13.2	18.5	29.6	39.6	5,358
1998	13.0	18.4	27.3	36.8	5,179
1999	13.1	19.2	28.7	38.0	5,107
2000	14.0	20.8	31.7	42.2	5,015
2001	14.8	21.5	31.2	42.7	4,485
2002	15.9	22.2	31.1	43.1	4,144
2003	18.0	24.3	33.0	45.9	3,900
2004	19.1	24.7	34.9	48.5	3,906
2005	19.9	25.5	35.6	49.0	3,841
2006	19.5	25.3	34.7	47.8	3,811
2007	19.8	26.2	35.5	48.3	3,786
2008	18.9	26.9	32.4	44.2	3,555
2009	19.5	26.9	34.2	48.3	3,283
Total	10.6	15.3	22.6	33.1	157,536
Mean (1987–2009)	13.6	19.2	27.8	39.2	4,129
Mean (1962–2009)	10.2	14.8	21.5	32.0	3,282

[3] As a robustness check, we exclude from the final sample all observations with zero debt for the first time. It does not change any qualitative results.

Finally, as cash could be viewed as negative debt in some contexts, we also investigate the fraction of firms that have nonpositive net debt (NPND), in which net debt is defined as the book value of debt minus cash (*CHE*).[4] We find that 33% (39%) of firms had nonpositive net debt over the 1962–2009 (1987–2009) period. Again, the means hide a substantial variation across years. A comparison of ZL and NPND firms suggests that for a substantial number of firms cash plays a more important role in their balance sheets than debt liabilities.

2.2.2. Proxies

The consistently large fractions of ZL and AZL firms are surprising and the next question to ask is whether comparable firms have different leverage ratios. To gauge this, we proceed by constructing for every ZL and AZL firm-year observation a reference set of proxy firm-years. Our benchmark construction procedure is by calendar year, industry, size, and dividend-paying status. It is important to stress that we do not condition on leverage-related measures. For example, proxies can be zero-levered as well. Specifically, we start by identifying for each ZL and AZL firm-year all firms in that year with the same three-digit SIC code. Compustat reports historical SIC codes (*SICH*) starting from 1987. For firm-years before 1987 we have to use the 1987 historical SIC codes or, if unavailable, the codes in Compustat primary SIC variable (*SIC*) reported in 2009. In unreported analysis, using the 1987–2009 sample does not change our results qualitatively. Thus, the potential misidentification of the industry code prior to 1987 does not seem to bias the results substantially.

As most industries include firms in different stages of their life, such as high-growth (by industry standards) and mature, we condition by choosing only those proxies that follow the same dividend policy: for zero-dividend (dividend-paying) ZL and AZL firms, proxies are chosen among zero-dividend (dividend-paying) firms. This conditioning has been used in other studies. For example, Fama and French (2002) justify the separation of ZD and DP firms by arguing that it tests better the implications of the pecking order idea (Myers, 1984), and Lemmon, Roberts, and Zender (2008) control for dividend payers in their empirical analysis of leverage ratios.

Of all the firms in the same three-digit SIC industry in the year of the observation and the same dividend-paying status, we choose up to four firms closest to the ZL and AZL observation in size, as measured by the natural logarithm of the book value of assets, as long as the value of book assets is between 0.5 and 2 times the corresponding value of the ZL and AZL observation. We call this a reference set of proxy firms. On average, for each ZL and AZL observation, this set contains 3.4 proxies. The set of proxy firms varies cross-sectionally for ZL and AZL firms within the same industry because of differences in size, and it varies temporally for the same ZL and AZL firm because of the evolution in the industry composition.[5]

Panel A of Table 2 reports the range of descriptive statistics for ZL and AZL firms and their proxies. Definitions of all the variables are given in Appendix A. To produce the statistics for proxies, we weigh all observations equally within each reference set. All statistics are then equally weighted for each year and then annual statistics are averaged. Averaging equally across observations does not change any of the results significantly. The table demonstrates that proxy firms do have substantially larger leverage. For the 1962–2009 period, the average book (market) leverage ratio of proxies is 19% (20%).[6] These statistics are also closer to the average leverage ratio in the aggregate Compustat sample [which is 25% (28%) for book (market) leverage] than to their ZL and AZL counterparts. This suggests that industry and size alone cannot account for the zero-leverage phenomenon. The unreported results for the 1987–2009 period are similar, suggesting that using constant SIC for the pre-1987 sample is unlikely to introduce a substantial bias.

ZL and AZL firms and their proxies are also different along a number of other dimensions. On average, they have higher market-to-book ratio, have less tangible assets, are more profitable, and pay higher dividends and higher income taxes. An important observation is that ZL and AZL firms have substantially higher cash balances, on average 75% more, than their proxies.[7] This suggests that zero-leverage firms could prefer having negative debt to the extent that increasing cash is a substitute for negative debt. If that is the case, it could have nontrivial implications for standard econometric analysis of leverage decisions for it implies that zero leverage is, in fact, a binding constraint and the results reported in the first three columns of Table 1 can underestimate the number of low-levered firms. ZL and AZL firms also invest less than their proxy firms as demonstrated by capital expenditure.

Do ZL firms have credit ratings? Using Standard & Poor's (S&P) long-term debt credit ratings, we construct two variables. First, Rating Dummy equals one if the firm has a credit rating and zero otherwise. Second, for the subsample of firms with a credit rating, Investment Grade equals one if the firm has an investment-grade rating (BBB− or higher). ZL firms are substantially less likely to have a credit rating than their proxies. Only 0.6% of ZL

[4] For the analysis of corporate cash policy and differences between cash and negative debt, see Acharya, Almeida, and Campello (2007), Gamba and Triantis (2008), and Acharya, Davydenko, and Strebulaev (forthcoming).

[5] To ensure the robustness of the matching procedure, we also construct a matched sample using a propensity score methodology similar to that of Lemmon and Roberts (2010). In particular, we use size, dividend-paying status, industry (three-digit SIC classification) dummies, and year dummies to predict AZL status in a logit regression and obtain propensity scores (the predicted probability of a firm being AZL). Overall, the results are consistent across the two samples. Further details are available upon request.

[6] Book leverage is slightly lower than market leverage because of the way we define book leverage. See footnote 2.

[7] One well-known explanation of higher cash balances is that large global companies are tax-disadvantaged when repatriating profits into the US and, thus, keep cash in their foreign subsidiaries (Foley, Hartzell, Titman, and Twite, 2007). See also Graham and Tucker (2006) for the analysis of tax shelters in general. If we exclude the largest zero-leverage firms, however, the result is virtually unchanged.

Table 2

Descriptive statistics for zero-leverage (ZL) and almost zero-leverage (AZL) firms.

This table reports the descriptive statistics for ZL and AZL firms and their proxy firms. ZL firms are firms that have zero book debt in a given year. AZL firms are firms with book leverage not exceeding 5% in a given year. The selection procedure of proxy firms is described in Section 2.2.2. All variables are defined in Appendix A. Panel A reports statistics for all ZL and AZL firms and their proxy firms. Panel B reports the same statistics for dividend-paying (DP) ZL and AZL firms; Panel C, for zero-dividend (ZD) ZL and AZL firms. The statistics of ZL and AZL firms are obtained by taking first means for firms in each year and then averaging over all years. To compute proxy statistics, proxy firms for each ZL and AZL observation are first equally weighted, then means are taken for each year, assigning equal weight to each set of proxy firms, and then means are averaged over all years. The *t*-statistic is obtained by applying the Fama and MacBeth procedure to the timeseries of annual averages. The absolute value of a positive (negative) *sig* is the number of years in which there is a significant positive (negative) difference (at 5% level) between ZL and AZL firms and proxy firms. The "All" column gives the means for the total sample [DP (ZD) firms in Panel B (C)].

	ZL and proxy firms				AZL and proxy firms				
Variable	ZL	Proxy	*t*-stat.	sig	AZL	Proxy	*t*-stat.	sig	All
Panel A: Comparison of ZL and AZL firms and their proxy firms									
Market Leverage	0.0	19.9	−20.39	−48	1.2	19.7	−20.19	−48	27.0
Book Leverage	0.0	19.1	−36.49	−48	2.7	19.6	−32.66	−48	24.8
Log(Size)	4.5	4.5	−0.23	0	4.7	4.8	−0.09	0	5.3
Market-to-Book	2.4	1.9	3.96	40	2.6	2.0	5.66	48	1.7
Cash	33.0	19.6	7.12	48	28.2	19.1	5.16	48	14.0
Profitability	12.4	9.2	1.62	23	13.0	9.5	1.80	32	11.0
Dividend	2.2	1.3	3.03	35	2.0	1.3	2.45	37	1.2
Share Repurchase	1.3	1.0	2.25	25	1.3	1.0	1.95	29	1.0
Tangibility	21.3	26.2	−3.81	−38	23.4	26.7	−2.53	−39	31.4
Tax	6.2	3.9	3.73	47	6.2	3.9	3.85	48	3.5
R&D	20.1	18.1	0.52	1	21.4	18.7	0.67	6	9.4
Age	6.7	7.1	−0.52	−3	6.9	7.5	−0.84	−23	9.1
Earnings Vol.	9.1	9.1	−0.06	2	8.9	8.9	0.01	3	7.0
Capital Expenditure	5.9	6.8	−2.97	−16	6.9	7.0	−0.27	−2	7.3
Asset Sale	3.0	2.2	1.55	25	2.4	2.2	0.57	23	1.9
Net Debt Issuance	−0.7	0.5	−1.12	22	−0.7	0.7	−2.89	−23	0.8
Net Equity Issuance	7.8	7.0	0.70	11	9.5	6.9	2.01	33	4.0
Init. ZL	58.0	16.6	19.59	48	31.7	15.9	14.56	48	12.2
Init. AZL	83.0	45.8	16.48	48	77.2	45.9	14.79	48	34.4
Kink	7.0	4.5	15.7	48	6.5	4.5	14.4	48	3.8
Operating Leases	8.6	9.3	−0.82	0	8.9	9.2	−0.26	0	8.7
Net Pension Liabilities	0.06	0.11	−2.05	23	0.08	0.12	−1.59	23	0.2
Rating Dummy	0.6	2.7	−5.02	−25	1.0	3.6	−4.64	−25	10.6
Investment Grade	33.1	21.0	2.56	26	58.7	19.6	14.05	40	41.1
Number of observations (per year)	313	1,081			769	2,641			3,282

Panel B: Comparison of dividend-paying ZL and AZL firms and their proxy firms									
Market Leverage	0.0	18.3	−20.11	−48	1.3	19.0	−20.04	−48	24.4
Book Leverage	0.0	16.8	−36.82	−48	1.2	17.4	−39.88	−48	22.4
Log(Size)	5.0	5.0	−0.50	0	5.3	5.3	−0.30	0	6.2
Market to Book	2.2	1.7	5.40	33	2.1	1.7	4.70	40	1.6
Cash	26.6	15.1	12.69	47	22.0	13.8	11.55	48	10.1
Profitability	21.1	17.1	6.41	36	20.6	16.9	6.87	40	16.3
Dividend	4.4	2.8	11.07	43	3.8	2.7	7.96	40	2.5
Share Repurchase	1.8	1.5	1.04	14	1.8	1.5	1.07	16	1.4
Tangibility	25.6	29.5	−4.62	−10	26.8	29.7	−3.75	−17	34.9
Tax	7.8	5.3	5.71	42	7.5	5.2	5.63	44	4.6
R&D	2.2	2.1	0.26	1	2.2	2.0	0.79	0	1.2
Age	11.2	11.1	0.07	1	12.0	11.8	0.14	1	13.7
Earnings Vol.	5.4	5.3	0.21	2	5.0	4.9	0.34	2	4.0
Capital Expenditure	5.9	6.8	−3.72	−8	6.2	6.7	−2.28	−11	7.2
Asset Sale	2.7	1.9	1.79	11	2.3	1.8	1.27	11	1.5
Kink	8.0	4.9	16.6	46	7.4	4.8	17.8	47	4.2
Operating Leases	7.0	7.4	−0.53	0	7.2	7.4	−0.35	0	6.7
Net Pension Liabilities	0.16	0.27	−1.82	24	0.22	0.30	−1.13	24	0.5
Number of observations (per year)	83	226			183	502			1,343
Panel C: Comparison of zero-dividend ZL and AZL firms and their proxy firms									
Market Leverage	0.0	23.3	−16.22	−44	1.3	23.0	−17.74	−46	31.1
Book Leverage	0.0	23.4	−25.53	−44	1.1	23.6	−27.15	−44	28.8
Log(Size)	3.9	3.9	−0.08	3	4.1	4.1	−0.08	1	4.6
Market to Book	2.7	2.0	4.09	30	2.6	2.0	3.99	38	1.8
Cash	35.6	20.3	7.29	46	31.3	19.5	5.85	43	15.2
Profitability	8.0	4.5	1.88	9	8.9	5.7	1.77	13	7.4
Dividend	0.0	0.0		47	0.0	0.0		48	0.0
Share Repurchase	1.3	0.9	2.94	25	1.2	0.9	2.55	24	0.8
Tangibility	17.3	24.0	−5.50	−33	19.2	25.2	−4.66	−37	29.1
Tax	4.9	2.4	4.78	40	4.9	2.6	4.69	41	2.4
R&D	25.6	22.3	0.73	4	24.8	20.9	0.89	5	12.6
Age	5.0	5.6	−1.07	−16	5.0	5.7	−1.16	−28	6.7
Earnings Vol.	11.6	11.4	0.15	4	11.0	10.8	0.21	6	8.9
Capital Expenditure	6.2	7.0	−1.75	−9	6.7	7.2	−0.99	−8	7.6
Asset Sale	3.4	2.6	1.42	22	2.7	2.4	0.53	22	2.2
Kink	6.6	4.3	14.0	47	6.1	4.3	12.3	48	3.5
Operating Leases	10.0	10.0	0.01	3	10.2	9.9	0.39	1	9.9
Net Pension Liabilities	0.05	0.08	−1.97	22	0.05	0.09	−1.75	23	0.2
Number of observations (per year)	230	855			483	1,777			1,939

firms have a credit rating, compared with 2.7% of proxies. However, conditional on having a credit rating, ZL firms are substantially more likely to have an investment grade rating than proxy firms. The effect is particularly pronounced for dividend payers, in which, conditional on having a credit rating, 92% of ZL firms have an investment-grade credit rating.

At the same time, ZL and AZL firms and their proxies are similar along other dimensions, such as age (defined as the number of years in Compustat), Research and development (R&D) expenditure, and earnings volatility. In particular, ZL and AZL firms are not statistically different from their proxies in terms of net equity issuance, suggesting that these firms do not use external equity financing to substitute debt financing. Instead, ZL firms seem to use overall less external financing.[8]

The table also reports the kink measure, introduced by John Graham (Graham, 2000; van Binsbergen, Graham, and Yang, 2010), for ZL and proxy firms. Kink is defined as the ratio of the amount of interest required to make the firm marginal tax rate slope downward to the actual interest expense of the firm.[9] ZL and AZL firms have much larger kinks than their proxy firms, indicating that ZL and AZL firms potentially have considerable room to increase their leverage and take advantage of the tax benefits of debt.

2.2.3. *Dividend-paying and zero-dividend samples*

While this descriptive analysis is suggestive, it overlooks the possibility that the differences are driven by ZL firms that are high-growth firms. That very high-growth firms could prefer having substantially less debt is not very surprising. At the same time, for the total sample, ZL and AZL firms pay higher dividends and have higher cash balances. As a standard approach to distinguish between high-growth firms and cash cows, we study dividend-paying and zero-dividend samples separately. From an economic viewpoint, it would be more surprising to observe ZL firms that also pay dividends, thus effectively replacing payout to debtholders with payout to equityholders.[10]

Table 3 summarizes our final classification of the sample, with the abbreviated names for the four classes of firms. For example, firms that pay a dividend and have the book leverage ratio of less than 5% are called AZL-DP firms. It might be of more economic importance to show and explain the puzzling prevalence of ZL-DP and AZL-DP firms, the issue on which we mostly concentrate in this paper.

Table 3
Classification of firms by zero-leverage and dividend-paying status.
This table explains the classification of firms by their zero-leverage and dividend-paying status and the associated abbreviated names. ZL firms are firms that have zero book debt in a given year. AZL firms are firms with book leverage not exceeding 5% in a given year. DP (ZD) firms are firms that pay (do not pay) dividends in a given year.

	Zero-leverage status	
Dividend-paying status	Zero leverage	Almost zero leverage
Dividend-paying firms	ZL-DP	AZL-DP
Zero-dividend firms	ZL-ZD	AZL-ZD

Panels B and C of Table 2 report descriptive statistics for DP and ZD firms and their proxies, respectively. An important result is that conditioning on dividend-paying policy does not resolve the zero-leverage puzzle. Firms in each of four classes have substantially lower leverage than their proxies. The characteristics of ZL-ZD and AZL-ZD firms support the contention that these firms are high-growth. Their size is smaller than that of DP firms, they are younger, their R&D expense is higher, and, importantly, they are on average substantially less profitable than DP firms.[11] Perhaps surprisingly, ZD and DP zero-leverage firms are similar along a number of other dimensions in that ZD firms also have higher cash balances and pay higher income taxes than their proxies.

ZL-DP (AZL-DP) firms have substantially higher dividend ratios than their proxies. They pay out on average 57% (41%) more than their proxies as measured relative to book assets. What is then the total payout of these firms? Fig. 1 shows the decomposition of the ratio of total payout to book assets as a function of leverage for the total sample period. It shows that, as expected, interest expense is a monotonically increasing function of leverage. It also shows that dividends and share repurchases are almost monotonically decreasing in leverage. A surprising observation is that the total payout ratio is relatively stable across the leverage spectrum, between about 5.1% and 6.1%. If anything, the payout ratio of zero-leverage firms is almost the largest of all firms at 6.0%. This supports the intuition that ZL-DP and AZL-DP firms do not choose to eschew debt because they think they have to retain a higher fraction of earnings, which is something one would expect from high-growth firms in the presence of financial constraints.[12] The upshot of this figure is that to explain the zero-leverage puzzle we need to identify economic mechanisms that make firms willing to replace payments to debtholders with payments to shareholders.

[8] In an unreported analysis, we follow Hovakimian, Opler, and Titman (2001) and study a logit model to predict firms' financial choices. We find that ZL and AZL firms are much less likely to issue equity compared with their proxies and overall prefer internal over external financing. Results are available upon request.

[9] We thank John Graham for generously sharing the data with us. The maximum of kink is set to 10 in van Binsbergen, Graham, and Yang (2010). Although ZL firms have zero debt level at the end of the fiscal year, they still could have made interest payments in that year and, thus, the kink variable can be less than the allowed maximum.

[10] We also explore several alternative classification schemes, for example, based on the expected tax benefits and on the total payout policy (the sum of interest and dividend payments) with qualitatively similar conclusions.

[11] Although many of these firms report negative Generally Accepted Accounting Principles (GAAP) profits, some still pay income taxes. We also do not take into account tax credits and the nonlinearities in income tax schedules.

[12] Unreported, when we produce the same figure for zero-dividend firms, the result is strikingly different: ZD firms have a payout that is monotonically increasing with leverage. These firms could need to save retained earnings for expansion and their access to credit could be more limited. Also unreported, the results of both of these figures, for DP and ZD firms, are consistent across years.

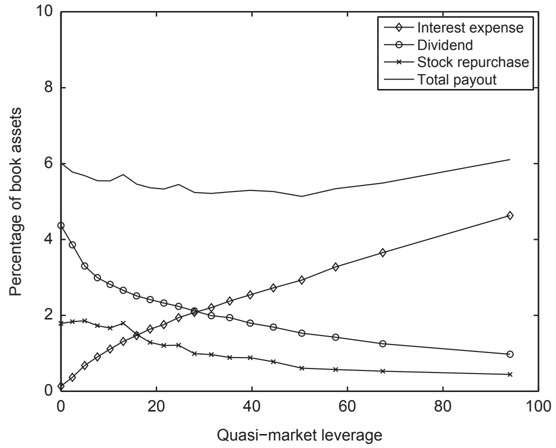

Fig. 1. Decomposition of payout for dividend-paying firms. The total payout ratio (in percent, measured relative to book assets) and its components are plotted against market leverage ratios for the 1962–2009 period. Total payout is defined as the sum of dividend payout (including preferred dividend), share repurchases, and interest payment.

2.2.4. Regression analysis

To explore further the properties of zero-leverage firms, Table 4 reports the results of multivariate logit regressions, in which the dependent variable takes the value of one if a firm-year observation is AZL, i.e., has a book leverage of 5% or less, for the total sample as well as for the DP and ZD subsamples. Unreported, when we conduct the analysis only for the sample of AZL firms and their proxies, or using the ZL dummy variable as the dependent variable, the results are very similar. Firms that follow zero-leverage policy are smaller, have higher market-to-book ratio, are more profitable, have less tangible assets, and pay higher dividends. Zero-leverage policy is also persistent. Firms that have zero leverage when they are reported in Compustat for the first time are more likely to have zero leverage in subsequent years. Firms are also more likely to have zero leverage when the fraction of ZL firms is high in their three-digit SIC industry. The table also shows the economic significance of these measures by providing the change in probability that the firm follows a ZL policy for 1 standard deviation change in the independent variable (or for the change from zero to one for a dummy variable). A 1 standard deviation increase in profitability is associated with an increase in propensity to become an AZL firm by between 1.9% and 3.5% and the same change in tangibility with a decrease in propensity by between 4.6% and 7.1%. Controlling for other variables, firms that have higher asset sales and capital expenditures are more likely to be AZL. This suggests that AZL firms could sell assets to finance capital expenditure or retire debt, or both, and is consistent with our (unreported) finding that AZL firms use less external financing than comparable firms (see also footnote 8).

A straightforward explanation of low leverage is that debt is squeezed out by various substitutes or nondebt tax shields (DeAngelo and Masulis, 1980; Graham, Lang, and Shackleford, 2004; Graham and Tucker, 2006; Shivdasani and Stefanescu, 2010). Data availability allows us to check two such economic mechanisms. First, although capital leases are included on the balance sheet as debt, operating leases are not. Recently, the topic of operating leases has received renewed attention in the capital structure literature. Rampini and Viswanathan (2010) and Rauh and Sufi (2012) propose including the capitalized value of operating leases in total debt valuation. However, operating leases can both complement traditional debt and play the role of its substitute (see, e.g., Ang and Peterson, 1984; Lewis and Schallheim, 1992; Graham, Lemmon, and Schallheim, 1998; Yan, 2006; Eisfeldt and Rampini, 2009). Following Graham, Lemmon, and Schallheim (1998), we define operating leases as the sum of current rental payment (*XRENT*) and the discounted present value of future rental commitments (*MRC*1,*MRC*2, … ,*MRC*5). The discount rate is set to be 10% for all firms as in Graham, Lemmon, and Schallheim (1998).[13] Results of univariate comparison in Table 2 and logit regressions Table 4 show that ZL and AZL firms' use of operating leases are not significantly different from other firms, for all the samples we consider. This finding suggests that operating leases are unlikely to play a major role in explaining zero-leverage policy.

Second, unfunded pension and health care liabilities constitute potentially an important debt substitute. These liabilities have recently played an important part in many high-profile bankruptcies, such as GM and United Airlines. Shivdasani and Stefanescu (2010) find that for firms with defined benefit pension plans, tax deductions of pension contributions equal about one-third of that of debt interest payments. Following Shivdasani and Stefanascu, we define pension obligations as the sum of Projected Pension Obligations (*PBPRO*) and Projected Pension Obligations (Underfunded) (*PBPRU*), and pension assets as the sum of Pension Plan Assets (*PPLAO*) and Pension Plan Assets (Underfunded) (*PPLAU*). We define Net Pension Liabilities as the difference between pension obligations and pension assets if pension obligations are greater than or equal to pension assets, and as zero otherwise. We use Net Pension Liabilities as a proxy for the extent of tax deductibility of pension plans.[14] In our sample, only about one-tenth (16,966) of the firm-year observations report positive Net Pension Liabilities. Interestingly, Tables 2 and 4 show that zero-leverage firms have significantly less (net) pension liabilities than other firms. This result is consistent with a stylized observation that firms with large unfunded pension plans are also typically highly levered. Overall, economic factors that lead to higher debt usage also likely contribute to larger pension liabilities and are unlikely to explain zero-leverage policy.

Firms can also follow zero-leverage policy in an attempt to retain financial flexibility in anticipation of future investment. To study the impact of future investment, we follow Titman, Wei, and Xie (2004) and define

[13] We also tried an alternative definition of operating leases using available short-term borrowing rate (*BASTR*). Adopting this alternative definition reduces the size of the sample by more than two-thirds, but does not change any results materially.

[14] Using pension contributions as an alternative proxy does not generate any differences between ZL/AZL firms and proxy firms.

Table 4

Determinants of almost zero-leverage (AZL) policy.

This table reports the results of logit regressions on the sample over 1962–2009. The dependent variable is the dummy that equals one if a firm-year is AZL, i.e., when it has book leverage less than 5%. Columns 1–2 present results for the entire sample. Columns 3–4 present results for the subsample of dividend-paying (DP) firms. Columns 5–6 present results for the subsample of zero-dividend (ZD) firms. Ind. Frac. AZL is the fraction of AZL firms (excluding the firm in question) in the same industry, defined by three-digit standard industrial classification, and the same year. All other variables are defined in Appendix A. All independent variables are lagged one year, except for the Abnormal Cap. Ex. variable, which is contemporaneous to capture anticipated investment. Coefficients, *t*-statistics (in parentheses), and economic significance are reported. Economic significance is the average change in probability for a one standard deviation change for a continuous independent variable or for the change from zero to one for a dummy variable. Year fixed effects for calendar years are included. All standard errors adjust for heteroskedasticity and clustering at the firm level. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

	All firms		DP firms		ZD firms	
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Log(Size)	−0.360***	−0.380***	−0.499***	−0.539***	−0.225***	−0.255***
	(−23.59)	(−23.33)	(−19.09)	(−18.58)	(−12.98)	(−13.71)
	−7.7%	−7.9%	−10.8%	−11.4%	−3.9%	−4.2%
Market to Book	0.213***	0.195***	0.150***	0.178***	0.213***	0.195***
	(17.70)	(14.91)	(4.67)	(5.27)	(17.28)	(14.31)
	3.3%	2.9%	1.8%	2.1%	3.5%	3.0%
Profitability	1.221***	1.838***	3.074***	3.417***	0.812***	1.292***
	(13.10)	(15.79)	(7.62)	(8.43)	(8.71)	(11.10)
	2.6%	3.4%	3.3%	3.5%	1.9%	2.6%
Tangibility	−2.352***	−2.566***	−2.320***	−1.867***	−2.380***	−2.852***
	(−18.56)	(−15.92)	(−9.63)	(−6.41)	(−17.80)	(−16.26)
	−6.2%	−6.6%	−5.8%	−4.6%	−6.1%	−7.1%
Dividend Payer	−0.067	−0.018	−0.389***	−0.409***	−0.202**	−0.134
	(−1.13)	(−0.30)	(−5.15)	(−5.29)	(−2.34)	(−1.48)
	−0.8%	−0.2%				
Dividend	22.013***	22.521***	22.037***	21.486***	8.959***	8.223***
	(15.19)	(15.23)	(13.05)	(12.30)	(4.16)	(3.53)
	4.6%	4.8%	5.5%	5.2%		
Earnings Volatility	−0.370***	−0.330**	2.516***	2.954***	−0.364***	−0.343**
	(−3.19)	(−2.20)	(2.67)	(3.13)	(−3.10)	(−2.30)
	−0.6%	−0.4%	1.2%	1.2%	−0.7%	−0.5%
Init. ZL	1.237***	1.161***	1.308***	1.291***	1.153***	1.036***
	(27.56)	(24.97)	(16.35)	(15.94)	(23.84)	(20.63)
	15.0%	13.9%	16.3%	16.0%	13.1%	11.5%
Ind. Frac. ZL	1.515***	1.376***	1.187***	1.089***	1.627***	1.523***
	(13.34)	(11.59)	(5.72)	(5.18)	(12.61)	(11.18)
	3.4%	3.0%	2.3%	2.0%	3.6%	3.3%
R&D		0.284***		0.268		0.212***
		(6.72)		(0.50)		(5.10)
		1.3%		0.1%		1.2%
Log(Age)		−0.041		0.186***		−0.090***
		(−1.50)		(3.27)		(−2.96)
		−0.4%		1.8%		−0.8%
Capital Expenditure		0.768**		−2.315***		1.895***
		(2.44)		(−3.56)		(5.61)
		0.6%		−1.7%		1.5%
Abnormal Cap. Ex.		−0.074***		−0.074***		−0.081***
		(−6.44)		(−3.59)		(−5.75)
		−0.7%		−0.6%		−0.8%
Asset Sale		1.291***		1.913***		1.070***
		(7.78)		(4.17)		(6.31)
		1.2%		1.3%		1.1%
Operating Leases		0.126		0.310		0.136
		(0.96)		(1.22)		(0.96)
		0.2%		0.5%		0.3%
Pension Liabilities		−6.705***		−14.252***		−0.382
		(−3.58)		(−4.78)		(−0.18)
		−0.9%		−2.2%		0.0%
Constant	−0.334**	−0.514***	0.704***	0.833***	−2.613***	−1.600***
	(−1.98)	(−2.80)	(2.96)	(3.37)	(−2.73)	(−2.64)
Number of observations	113,869	108,078	52,020	50,658	61,849	57,378
Pseudo *R*-squared	0.239	0.244	0.276	0.283	0.218	0.223

abnormal investment as

$$CI_t = \frac{CE_t}{(CE_{t-1}+CE_{t-2}+CE_{t-3})/3} - 1, \quad (3)$$

where CE_t is capital expenditure scaled by book assets. To capture the anticipation of future abnormal investment, we use contemporaneous values of the abnormal investment variables (we use lagged values of other independent variables). Table 4 shows that firms with lower abnormal investment levels in the future are more likely to become zero-levered. Panels B and C show that this relation is exhibited by both dividend payers and nonpayers. For robustness, we consider a variety of alternative definitions of abnormal investment. Specifically, we also define abnormal investment as $CE_t-(CE_{t-1}+CE_{t-2}+ CE_{t-3})/3$ and use sales instead of book assets as the denominator of capital expenditure. Alternatively, we define unexpected investment as the residual from regressions of current capital expenditure on three (or five) lagged values at the individual firm or at the industry level. The results are similar across all these specifications. Our results suggest that future financial flexibility is potentially an important factor in zero and low-leverage policy decisions.

The results of our regression analysis need to be taken with a large grain of salt as leverage decisions are endogenous to other financial and investment decisions. Nevertheless, the reported correlations are suggestive. Firms (and, more so, dividend-paying firms) that prefer to eschew debt are profitable, exhibit large tax payments, accumulate large cash balances, and pay out larger dividends; in fact, they replace interest payments with dividends and stock repurchases. If anything, these firms violate the standard trade-off proposition and take to the extreme the Graham (2000) assertion that firms that are “large, profitable, liquid, in stable industries, and face low ex ante costs of distress” (p. 1902) are underlevered.

Table 5
Entry and exit decisions of almost zero-leverage (AZL) policy.

This table reports the results of the logit analysis of entry and exit decisions of the AZL policy. An entry (exit) decision is defined as a firm being non-AZL (AZL) in the last year and AZL (non-AZL) in the current year and the change in book debt is at least 5% of lagged book assets. Columns 1–2 present results for the entry decisions; Columns 3–4, for the exit decisions. Ind. Frac. AZL is the fraction of AZL firms (excluding the firm in question) in the same industry, defined by three-digit standard industrial classification, and the same year. All other variables are defined in Appendix A. All independent variables are lagged one year, except for the Abnormal Cap. Ex. variable, which is contemporaneous to capture anticipated investment. *t*-Statistics is reported in parentheses. All standard errors adjust for heteroskedasticity and clustering at the firm level. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

	Entry Decision		Exit Decision	
Variable	(1)	(2)	(3)	(4)
Log(Size)	−0.301***	−0.301***	0.013	0.037*
	(−17.96)	(−16.92)	(0.76)	(1.95)
Market to Book	0.037**	0.033*	0.004	0.006
	(2.05)	(1.65)	(0.32)	(0.46)
Profitability	0.191	0.169	−0.293***	−0.691***
	(1.35)	(0.94)	(−2.64)	(−4.97)
Tangibility	−1.097***	−1.398***	0.797***	0.633***
	(−8.71)	(−8.37)	(6.16)	(3.68)
Dividend Payer	−0.352***	−0.297***	−0.124*	−0.069
	(−4.72)	(−3.87)	(−1.68)	(−0.90)
Dividend	10.163***	10.554***	−7.204***	−6.973***
	(5.69)	(5.82)	(−4.41)	(−4.16)
Earnings Vol.	0.162	0.324*	0.319**	0.167
	(1.10)	(1.80)	(2.16)	(0.97)
Init. AZL Dummy	0.607***	0.574***	−0.300***	−0.319***
	(11.65)	(10.62)	(−6.37)	(−6.35)
Ind. Frac. AZL	1.103***	1.041***	−0.826***	−0.748***
	(7.97)	(7.20)	(−6.07)	(−5.34)
R&D		−0.031		−0.160***
		(−0.51)		(−3.17)
Age		−0.088***		−0.052
		(−2.75)		(−1.48)
Capital Expenditure		1.233***		1.127**
		(2.74)		(2.36)
Abnormal Cap. Exp.		−0.067**		0.178***
		(−2.29)		(7.85)
Asset Sales		0.516**		−0.564**
		(2.06)		(−2.53)
Constant	−2.938***	−3.145***	−0.450	−1.470***
	(−4.97)	(−4.39)	(−1.58)	(−3.65)
Number of observations	81,118	77,367	20,796	19,604
Pseudo *R*-squared	0.0913	0.0938	0.0284	0.0331

2.2.5. Zero-leverage policy entry and exit

We now extend the regression analysis of Section 2.2.4 to study the determinants that make firms switch from being zero-levered to issuing debt and vice versa.[15] Table 5 reports the logit analysis of AZL policy initiations and exits. An entry (exit) event is defined as a firm following a non-AZL (AZL) policy in the last year and an AZL (non-AZL) policy in the current year. In addition, to study nontrivial changes in leverage, we exclude all observations, in which the change in book debt amounts is less than 5% of lagged book assets.

The table shows that smaller, less tangible firms are more likely, and dividend payers are less likely, to become zero-levered. However, conditional on paying dividends, paying out more in dividends increases the propensity to become zero-levered. Firms that have the AZL status when they are recorded in Compustat for the first time and have a larger number of peers that follow the AZL policy are substantially more likely to initiate the AZL policy. For exit decisions, almost all of the variables have the opposite sign compared with the entry decision (with the notable exception of firm size, which has no impact on exit). Thus, AZL firms are less likely to lever up when they have lower tangibility, pay out larger dividends, or have more peers that also follow the AZL policy. In addition, more profitable AZL firms are less likely to lever up. Future abnormal capital expenditures are negatively related to entries and positively related to exits, consistent with the intuition that future financial flexibility can be an important concern for adopting the AZL policy. Overall, the results of Table 5 confirm the panel results discussed in Section 2.2.4.

3. Understanding zero-leverage behavior

In this section we provide further empirical analysis of the zero-leverage phenomenon.

3.1. The value of potential tax benefits for zero-leverage firms

How much in tax benefits can ZL and AZL firms potentially get if they increase their leverage? In other words, how much money do they leave on the table by not levering up? This is a similar question to the one investigated by Graham (2000) for a cross-section of US firms. If the marginal tax rates for ZL firms are close to zero, then the potential tax benefits of borrowing are limited and the ZL phenomenon might not be puzzling after all. Some preliminary evidence, such as that on the extent of profitability of dividend-paying ZL and AZL firms, suggests that the marginal tax rates of ZL firms are in fact likely to be higher than those of comparable firms. Also, ZL firms are more likely to have an investment-;grade rating, conditional on having a credit rating at all. Most important, ZL and AZL firms have much larger kinks than their proxy firms. However, this evidence does not show the economic magnitude of the unutilized tax savings. In this section, we quantify the value of these tax shields to explore the issue in more detail.

Consider a scenario, in which a firm intends to raise its (market) leverage from its current ratio L_0 to a new leverage ratio L^* by undergoing recapitalization. For tractability, we assume that debt takes the form of perpetuity and is issued at par and that all parameters are constant. As long as finite maturity debt issues are expected to be routinely rolled over, this assumption is innocuous. Let firm's outstanding book debt be D_0 and the current value of its market equity be ME_0. After restructuring, book debt and market equity values are, respectively, $D^* = D_0 + \Delta D$ and ME^*. The potential tax benefits, denoted by $PTB(\Delta D)$, are given by

$$PTB(\Delta D) = \int_{D_0}^{D_0+\Delta D} \tau(x)\, dx, \tag{4}$$

where $\tau(x)$ is the marginal tax rate of the firm with debt level x. We assume that tax benefits accrue to equityholders and that any debt raised is used to pay dividends or repurchase shares. The new market equity value is given by

$$ME^* = ME_0 + PTB(\Delta D) - \Delta D, \tag{5}$$

and the new leverage ratio L^* is

$$L^* = \frac{D^*}{ME^* + D^*} = \frac{D_0 + \Delta D}{ME_0 + PTB(\Delta D) + D_0}. \tag{6}$$

To compute the potential tax benefits for each firm, we need marginal tax rates at all leverage levels. For the marginal tax rate $\tau(D_0)$ at the firm's current leverage, we use both the after-interest and before-interest marginal tax rates (Graham, Lemmon, and Schallheim, 1998; Graham, 2000).[16] We then assume that $\tau(x)$ is linearly declining from $x = D_0$ to $x = D^m$, where D^m is the debt level at which the marginal tax rate first becomes zero.[17] In other words,

$$\tau(x) = \begin{cases} \tau_0 \dfrac{D^m - x}{D^m - D_0}, & D_0 \le x < D^m, \\ 0, & x \ge D^m. \end{cases} \tag{7}$$

We estimate D^m for each firm-year as

$$D^m_{i,t} = \max\left(\frac{CF^m_{i,t}}{r_t}, D_0\right), \tag{8}$$

where $CF^m_{i,t}$ reflects the projected cash flow capability and r_t is the applicable interest rate. In essence, we assume that the firm can utilize tax benefits only to the extent it is

[15] We thank the anonymous referee for suggesting this line of analysis.

[16] Although after-interest marginal tax rates are commonly used to compute tax benefits of debt, Graham, Lemmon, and Schallheim (1998) propose using before-interest marginal tax rates under certain circumstances to avoid the endogenous influence of capital structure on marginal tax rates. We thank John Graham for making the data available to us. Because Graham's data start in 1980, we restrict our sample in this section to the 1980–2009 period. The resulting subsample consists of 72,597 (81,522) observations between 1980 and 2009 if we use the before-interest (after-interest) marginal tax rate.

[17] Unreported, the results are robust to using alternative specifications of the marginal tax rate, e.g., a monotonically decreasing marginal tax rate function as in Hennessy and Whited (2005).

Table 6
Potential tax benefits for zero-leverage (ZL) firms.

This table reports the value of potential tax benefits as a percentage of market asset values for ZL and almost zero-leverage (AZL) firms. Medians are reported in parentheses. The sample of DP/ZD-ZL/AZL firms are considered separately. Panels A and B present results computed using the before-interest and after-interest marginal tax rates, respectively. To calculate the potential tax benefits, the marginal tax rate $\tau(D)$ is assumed to decline linearly with book debt level D from the current debt level D_0 to D^m and is zero for higher debt levels. The optimal debt level $D^m = D^m_{i,t} = CF^m_{i,t}/r_t$, where $CF^m_{i,t}$ is the minimum cash flow (rescaled to current book assets) in the past N years (including the current year t) of firm i, and r is the average corporate bond yield. The benchmark assumptions are $N=5$ and $r_t = r_t^{AA}$, the AA-rated corporate bond yield. Column 1 considers the case of the new leverage $L^* = \min(L^{Pr},70\%)$, where L^{Pr} is the average market leverage ratio of the firm's proxies. In Column 2, the new leverage $L^* = \min(L^m,70\%)$, where L^m is the optimal leverage ratio. Columns 3–5 consider the case $L^* = \min(L^{Pr},70\%)$ with alternative assumptions. Column 3 changes the definition of CF^m to be the current cash flow. Column 4 changes CF^m to be the average (rescaled) cash flow of the past five years. Column 5 changes r_t to be r_t^{BBB}, the BBB-rated corporate bond yield. Columns 6–8 consider the case $L^* = \min(L^m,70\%)$ with parallel assumptions as in Columns 3–5. DP=dividend-paying; ZD=zero-dividend.

	Scenario							
Firm Class	1	2	3	4	5	6	7	8
Panel A: Results using before-interest marginal tax rates								
DP-ZL	7.58	15.63	8.45	8.82	7.39	19.12	20.11	14.68
	(7.97)	(17.14)	(8.91)	(9.12)	(7.70)	(20.66)	(21.29)	(15.83)
DP-AZL	7.71	16.27	8.53	8.81	7.53	19.71	20.52	15.32
	(8.22)	(17.97)	(9.01)	(9.16)	(8.02)	(21.09)	(21.46)	(16.78)
ZD-ZL	2.81	6.37	3.74	4.04	2.73	9.91	10.59	5.95
	(0.10)	(0.82)	(1.41)	(1.92)	(0.10)	(8.06)	(9.33)	(0.76)
ZD-AZL	3.10	6.95	4.07	4.36	3.01	10.58	11.22	6.51
	(0.42)	(2.40)	(1.97)	(2.52)	(0.40)	(9.56)	(10.60)	(2.20)
Panel B: Results using after-interest marginal tax rates								
DP-ZL	7.07	14.46	7.83	7.99	6.89	17.55	18.03	13.59
	(7.38)	(16.04)	(8.51)	(8.67)	(7.12)	(19.80)	(20.14)	(14.73)
DP-AZL	7.08	14.79	7.79	7.91	6.92	17.83	18.21	13.94
	(7.67)	(16.85)	(8.57)	(8.65)	(7.43)	(20.21)	(20.48)	(15.60)
ZD-ZL	2.00	4.68	2.57	2.62	1.94	7.04	7.06	4.37
	(0.00)	(0.00)	(0.12)	(0.16)	(0.00)	(0.58)	(0.70)	(0.00)
ZD-AZL	2.17	4.98	2.76	2.80	2.10	7.33	7.36	4.66
	(0.00)	(0.00)	(0.14)	(0.17)	(0.00)	(0.65)	(0.78)	(0.00)

profitable and we ignore the complications of tax carry provisions. As a conservative benchmark case, we assume that the marginal tax rate is zero at the minimum cash flow level that the firm had over the last N years:

$$CF^m_{i,t} = \min\left(\frac{EBIT_{i,t-s}}{AT_{i,t-s}} : s=0,\ldots,N-1\right) \cdot AT_{i,t}, \tag{9}$$

where earnings are rescaled by the firm's book assets in year t. This definition of D^m ensures that in each period the interest payment rD^* for debt level $D^* < D^m$ is smaller than any of the cash flows in the past N years, so that this firm, if it refinances to D^*, is unlikely to face a liquidity crisis in the future. Specifically, if in any year cash flow is negative, the marginal tax rate is assumed zero. As a proxy for r_t we use the average corporate bond interest rate in year t. In the benchmark case, we choose $N=5$ and $r_t = r_t^{AA}$, the AA-rated corporate bond yield, which we obtain from Moody's AA corporate bond yield time series from Global Financial Data.

Alternatively, we define $CF^m_{i,t}$ to be the average (rescaled) cash flow level in the past N years:

$$CF^m_{i,t} = \frac{1}{N}\left(\sum_{s=0}^{N-1} \frac{EBIT_{i,t-s}}{AT_{i,t-s}}\right) \cdot AT_{i,t}. \tag{10}$$

This formulation is less conservative in a sense that even in the case of tax losses, it assumes that the firm is able to utilize them later. We also consider the alternative choice for interest rate $r_t = r_t^{BBB}$, the BBB-rated corporate bond yield.

With Eqs. (7) and (4), the potential tax benefit function is

$$PTB(\Delta D) = \begin{cases} \tau_0 \Delta D\left(1 - \dfrac{\Delta D}{2(D^m - D_0)}\right), & 0 \le \Delta D < D^m - D_0, \\ \dfrac{1}{2}\tau_0 (D^m - D_0), & \Delta D \ge D^m - D_0. \end{cases} \tag{11}$$

Plugging Eq. (11) into Eq. (6), the new leverage ratio is

$$L^* = \begin{cases} \dfrac{D_0 + \Delta D}{ME_0 + \tau_0 \Delta D\left(1 - \dfrac{\Delta D}{2(D^m - D_0)}\right) + D_0}, & 0 \le \Delta D < D^m - D_0, \\ \dfrac{D_0 + \Delta D}{ME_0 + \frac{1}{2}\tau_0 (D^m - D_0) + D_0}, & \Delta D \ge D^m - D_0. \end{cases} \tag{12}$$

The solution of ΔD in terms of the new leverage, $\Delta D = \Delta D(L^*)$, is provided in Appendix B.[18]

[18] Unreported, if we extend the analysis to allow also for a decrease in leverage, the results are virtually unchanged.

Table 6 shows the potential tax benefits of ZL and AZL firms as a fraction of market asset values (in which the market value of equity is measured before relevering) for various new leverage ratios and alternative assumptions. We first investigate the scenario of the new leverage L^* being the average market leverage ratio of the reference set, which we denote by L^{Pr}. To control for implicit distress costs, we impose an additional upper bound of 70% (see, e.g., Asquith, Gertner, and Scharfstein, 1994 for evidence of distress at high leverage). Thus, $L^* = \min(L^{Pr}, 70\%)$.[19] For brevity, we discuss the results using the before-interest tax rates (Panel A) and note that the results in Panel B are quantitatively similar. Column 1 in Panel A of Table 6 shows that dividend-paying ZL firms leave on average 7.6% (8.0% at the median) of their market value on the table by not increasing leverage ratios to the level of their proxy firms. In this case, the use of average proxy leverage can also be thought of as accounting for unobserved industry factors. Our second choice of L^* is the optimal leverage ratio, L^m. Again, to be conservative, we use $L^* = \min(L^m, 70\%)$. Column 2 of Panel A shows that dividend-paying ZL firms give up on average a striking 15.6% (17.1% at the median) of their market value by not restructuring to optimal leverage ratios. Potential savings for dividend-paying AZL firms are of similar magnitude. The other columns of Table 6 also show that these numbers are robust to alternative assumptions about cash flows and corporate bond interest rates. The tax savings for zero-dividend ZL and AZL firms are much smaller at 2.8% (0.1%) for an average (median) ZD-ZL firm. The difference between means and medians indicates, however, that tax benefits are also substantial for a number of ZL and AZL firms that do not pay dividends, which include such high-profile firms as Microsoft (until recently) and Apple.

Our assumptions in deriving potential tax benefits are mostly on the conservative side: Tax savings from carry-forward and carry-back provisions are largely excluded; by using the minimum cash flow in the past five years as the liquidity threshold in the benchmark case, the chances that the firm goes into liquidity crisis and incurs significant costs of distress are much lower; and the assumption that the marginal tax rate function is linear decreases tax benefits relative to the case, in which it is concave (which is more likely to be the case in practice). Therefore, the fact that ZL-DP firms give up substantial amount of tax benefits reinforces the mystery about their extreme debt aversion. One reason for a potential overestimation of tax benefits is our lack of adjustment for personal taxes. As the level of marginal personal taxes on income and capital gains depends on the ownership structure of firms, and firm-specific marginal personal tax rates are not available, we leave it for further exploration.

3.2. Relation between zero-leverage and low-leverage puzzles

The low-leverage puzzle refers to the stylized fact that, on average, firms are lower levered than otherwise would be expected by standard trade-off models of capital structure. For example, over the period 1987–2003, the market leverage ratio of an average firm in the Compustat sample is about 26%. A benchmark static capital structure model of Leland (1994) produces a leverage ratio in the order of 70–90% under reasonable parameters. A number of studies have been trying to identify theoretically the reasons that firms are on average low levered. For example, Goldstein, Ju, and Leland (2001), Ju, Parrino, Poteshman, and Weisbach (2005) and Strebulaev (2007) explain the low-leverage puzzle by considering dynamic capital structure and non-linear tax benefits to debt. In addition, Strebulaev (2007) shows that in dynamic capital structure models typically lead to higher leverage in dynamics compared with refinancing points. Ju, Parrino, Poteshman, and Weisbach (2005) and Morellec (2004) consider managerial risk-aversion and managerial entrenchment. All these studies find that their calibrated models can produce, under reasonable parameters, *lower* leverage ratios, thus explaining the average corporate leverage ratio in the economy. For example, by considering the dynamic version of their static model, Goldstein, Ju, and Leland (2001) reduce the benchmark leverage ratio in their calibrations from 55% to a more reasonable 36% at refinancing.

Characteristically, however, all these models produce a relatively high lowest leverage ratio under the most cases they consider. The lowest leverage is 34.3% in Goldstein, Ju, and Leland (2001, Table 1, p. 498), 6% at the 1 percentile value in the dynamic version of Strebulaev (2007, Table 3, p. 40), 9.35% in Morellec (2004, Table 1, p. 274), and 8.03% in Ju, Parrino, Poteshman, and Weisbach (2005, Table 2, p. 270). The exceptions are models with endogenous investment (Hennessy and Whited, 2005; Hackbarth and Mauer, 2012) and models that introduce fixed costs in the dynamic capital structure model with sufficiently small firms optimally choosing zero leverage (Kurshev and Strebulaev, 2012). For example, Hackbarth and Mauer (2012) find optimal leverage ratios as low as 12% as a result of debt overhang and debt dilution in dynamics.

These models are a long way from being able to explain the presence of ZL and AZL firms in the economy. Broadly, our results demonstrate that these models are unlikely to explain the cross-sectional distribution of corporate leverage ratios. This is consistent with the observation of Graham (2003) that many low-debt firms are not firms that one would think of having high costs of debt.

The low-leverage and zero-leverage puzzles are closely connected. Table 7 shows that if one excludes ZL firms from the Compustat sample, then the average (market) leverage ratio over the 1987–2009 period increases from 24.7% to 28.6%. Moreover, if one also excludes AZL firms (as most of these models cannot produce almost zero leverage as well), the average leverage ratio increases further from 28.6% to 36%, which is roughly the level of debt produced by such models as Goldstein, Ju, and Leland (2001) and Strebulaev (2007). The fact that excluding ZL and AZL firms produces a moderately "high" leverage of about 36% suggests that the explanation of

[19] Unreported, our results are not sensitive to an increase in the upper bound.

Table 7
Low-leverage and zero-leverage puzzles.

This table reports means and medians of leverage ratios for the total sample, the sample excluding zero-leverage (ZL) firms, and the sample excluding almost zero-leverage (AZL) firms. Results for the 1962–2009 and 1987–2009 periods are given in Panel A and Panel B, respectively. Columns 1 and 2 report market leverage; Columns 3 and 4, book leverage. For consistency, in Columns 1 and 2, AZL firms are defined by market leverage not exceeding 5%, and in Columns 3 and 4 they are defined by book leverage not exceeding 5%.

	Market leverage		Book leverage	
Sample	Mean	Median	Mean	Median
Panel A: Period 1962–2009				
All firms	27.5	20.9	25.2	21.9
Excluding ZL firms	30.7	25.1	28.2	24.8
Excluding AZL firms	36.8	31.8	32.3	28.2
Panel B: Period 1987–2009				
All Firms	24.7	16.4	24.7	19.8
Excluding ZL firms	28.6	21.7	28.5	24.3
Excluding AZL firms	36.0	30.1	33.9	29.1

the low-leverage puzzle is likely to lie not in the behavior of the average firm, which is almost "normally" levered, but in the extremely low-levered firms. In other words, these results show that the low-leverage puzzle is actually an artifact of the zero-leverage puzzle and a new generation of theoretical models to explain it could be needed.

3.3. Persistence of zero-leverage behavior

Corporate leverage is a persistent phenomenon (e.g., Lemmon, Roberts, and Zender, 2008). In this subsection we, therefore, address an important question of whether zero-leverage policy is persistent. If zero-leverage is an artifact of imbalance between maturing debt contracts and new debt issuance, this would imply that the puzzling behavior is only of short duration.

To analyze the persistence with which firms follow ZL and AZL policies, for each firm j in our sample and for each k between 1 and 20, we estimate the probability that firm j follows the ZL (AZL) policy continuously for $k-1$ more years, conditional on adopting such a policy in any given year and surviving for at least $k-1$ years.[20] To give an example, assume the firm has 25 consecutive annual observations in Compustat and has zero leverage in the first 15 years and is highly levered in the remaining 10 years. There are 15 sequences of $k=10$ consecutive years for this firm beginning with a year in which the firm has zero debt. The firm follows the zero-debt policy for at least 10 years for six out of these 15 sequences. Thus, conditional on adopting a ZL policy, the firm continues to follow it for a further nine years with likelihood of 0.4. By averaging over all firms we get a measure of the k-year conditional persistence of a chosen debt policy in the sample. Averaging over firms avoids bias in favor of more mature firms.

Table 8 reports the results of this exercise. Firms have a 61% chance of continuing a ZL policy in the next year. About 30%, 15%, and 5% (35%, 20%, and 9%) of firms that survived for five, ten, and 20 years, respectively, continuously exhibit ZL (AZL) behavior. Although these numbers are suggestive, to compare them with similar statistics in the absence of intertemporal dependence, we construct the same persistence measure for random samples. To this end, for each year we randomly reshuffle leverage ratios across firms in the Compustat data set. In other words, for each firm in the Compustat sample, a corresponding firm in the random sample is assumed to exist for exactly the same number of years. However, in each year this corresponding firm in the random sample has the book leverage ratio of a random Compustat firm in that year, instead of that of the actual Compustat firm. The resulting random sample is, thus, identical to the empirical sample in terms of the number of firms each year as well as the distribution of cross-sectional leverage ratios each year. We then repeat this process to construct 500 random samples. Finally, we estimate the persistence measure for each random sample and report averages in the table. Constructed in this way, the random samples can be thought of as a benchmark economy with no persistence in debt policies, which at the same time produces cross-sectional descriptive statistics of leverage ratios identical to the economy observed in each year.

Panel A of Table 8 reports that in the random economy a ZL firm stays ZL in the next year with a 9.3% chance, compared with the empirically observed 61%. For longer periods the random economy generates persistence values close to zero. As confirmed by t-statistics, a statistically significant difference exists in persistence between the actual and random economies. Such differences effectively rule out the possibility that zero-leverage is not a persistent phenomenon. This result is consistent with findings that firms restructure their leverage infrequently (Leary and Roberts, 2005; Strebulaev, 2007).

DeAngelo and Roll (2012) find evidence that, although capital structure stability is an infrequent phenomenon, the stable leverage regimes are mostly concentrated in the low leverage spectrum. To relate our results to theirs, we replicate the procedure used in DeAngelo and Roll (2012, Table 10) on our sample.[21] Following their analysis, an X% stability regime is defined as the longest period in which the firm's book leverage continuously remains in a range of values that differ by no more than X%. Panel B of Table 8 shows that, for firms with stable leverage regimes for 10 years and longer, most of the 5% and 10% stable leverage firms are, in fact, zero- or almost zero-leverage firms. For example, in the 5% stability sample, 99% of firms are always AZL firms, and 94% of firms follow the AZL policy for at least one year. Even in wider leverage regimes, zero-leverage policy is prominent. For example,

[20] Alternatively, we study the occurrence and duration of ZL and AZL spells. Unreported, the majority of ZL and AZL firms experience at most two spells, with the average duration of each spell about 3.2 (3.6) years for ZL (AZL) firms. Overall, these results are complementary to those reported in this subsection.

[21] We would like to thank the anonymous referee for this suggestion.

Table 8
Persistence of zero leverage.
This table reports the persistence of zero-leverage (ZL) and almost zero-leverage (AZL) policies. Panel A reports the empirical persistence measures of ZL or AZL firms compared with those of firms in random economies in which leverage ratios each year are reshuffled to remove persistence across years. The persistence measure for ZL policy is defined as $PerZL_k=(1/|A_k|)\sum_{i\in A_k} s_{i,k}^{PerZL}/s_{i,k}^{ZL}$, where A_k is the set of firms with at least one k-year sequence of observations that begins with a ZL observation, $s_{i,k}^{ZL}$ is the number of k-year sequences for firm i that begin with a ZL observation, and $s_{i,k}^{PerZL}$ is the number of k-year sequences for firm i that are all ZL observations. The persistence of AZL policy is similarly defined. Column 1 gives the number of consecutive years k in consideration. Column 2 reports the persistence measure (in percentage points) of the ZL policy for the Compustat sample. Column 3 and 4 report the mean and standard deviation of the persistence measure over five hundred randomly generated economies, respectively. Columns 5–7 report the same measures for AZL firms. Panel B reports the relation between stable leverage regimes and zero-leverage behavior. An X% stability regime is defined as the longest period in which the firm's book leverage continuously remains in a range of values that differ by no more than X%. Panel B shows the fractions of firms with stable leverage regimes ten years and longer (or 20 years and longer) that have always pursued a ZL or AZL policy or have adopted a ZL or AZL policy at least once in their history. The last column gives the number of firms that have a X% stability regime for 10 years and longer (or 20 years and longer).

Panel A: Persistence of zero leverage in empirical and random economies

	ZL persistence			AZL persistence		
		Random			Random	
k	Empirical	Mean	Standard deviation	Empirical	Mean	Standard deviation
1	100.0	100.0		100.0	100.0	
2	60.9	9.3	0.22	63.9	20.3	0.24
3	45.0	1.5	0.10	49.1	5.9	0.16
4	35.8	0.5	0.08	40.4	2.3	0.13
5	30.0	0.3	0.08	34.5	1.4	0.12
6	24.7	0.3	0.08	29.3	1.0	0.11
7	21.4	0.2	0.08	25.9	0.8	0.10
8	18.1	0.2	0.08	23.0	0.7	0.11
9	16.7	0.2	0.08	21.5	0.7	0.11
10	14.8	0.3	0.10	19.6	0.9	0.14
15	8.2	0.3	0.12	12.5	0.8	0.17
20	5.2	0.1	0.12	8.5	0.4	0.17

Panel B: Stable leverage regimes and zero leverage behavior

	Always ZL	Always AZL	Once ZL	Once AZL	Number of firms
Stable leverage regimes of 10 years or longer					
5%stability regimes	26.6	98.8	95.0	99.2	241
10%stability regimes	14.9	55.5	85.8	94.4	429
15%stability regimes	8.9	33.2	69.5	81.9	717
20%stability regimes	5.6	20.7	55.4	70.0	1,149
Stable leverage regimes of 10 years or longer					
5%stability regimes	14.3	100.0	100.0	100.0	28
10%stability regimes	8.3	58.3	100.0	100.0	48
15%stability regimes	4.2	29.5	72.6	81.1	95
20%stability regimes	2.1	14.9	57.4	68.6	188

in the 20% stability regime, 70% of firms follow the AZL policy at least once and 20% of firms are always AZL.

These results show that the persistence of ZL and AZL behavior is likely responsible for most of the stable leverage behavior identified by DeAngelo and Roll (2012). In other words, taken together, these results suggest that ZL and AZL firms are more persistent than firms in all other leverage ranges.[22]

3.4. Industry and zero-leverage firms

Results in Table 4 strongly indicate that zero-leverage behavior is driven in part by industry-specific factors. To explore this further, Table 9 reports the distribution of ZL and AZL firms in major industries using either equal (Panel A) or value (Panel B) weights. There is indeed a substantial variation of the extent of zero-leverage

[22] In unreported analysis, we study to what extent unexpected leverage (Lemmon, Roberts, and Zender, 2008) influences our persistence results. We find that the persistence of ZL and AZL firms is to a large extent insensitive to unexpected leverage, except when

(*footnote continued*)
unexpected leverage is very low, consistent with dynamic rebalancing mechanism.

Table 9
Zero leverage and industries.

This table reports the distribution of zero-leverage (ZL) and almost zero-leverage (AZL) firms in major industries as defined by the Fama and French 12-industry classification scheme. Columns 1 and 2 report the average fractions (in percent) of zero-leverage and almost zero-leverage observations in a given sector over the 1962–2009 period. Annual fractions are first computed, with equal weight (Panel A) or value weights by market capitalization (Panel B) within each year. The means of annual averages are then reported, with equal weights assigned to each year. Column 3 gives the average number of firms in each year in a sector. Columns 4–6 report the same results for the 1987–2009 period.

	1962–2009			1987–2009		
Industry	ZL	AZL	*N*	ZL	AZL	*N*
Panel A: Equally weighted average fractions						
Consumer nondurables	8.7	18.3	308	9.1	19.1	298
Consumer durables	8.0	17.3	126	8.8	18.4	134
Manufacturing	6.8	15.6	585	7.4	17.6	578
Energy	6.7	13.3	172	8.1	15.2	200
Chemicals	7.2	17.9	106	5.2	14.8	117
Technology	15.0	32.0	599	23.9	46.6	917
Telecommunication	4.3	9.4	103	4.8	12.4	157
Shops	6.9	15.5	477	9.1	20.3	570
Health care	13.1	30.2	298	19.0	38.3	502
Other	9.6	19.4	509	11.7	23.2	657
All	10.2	21.5	3,282	13.6	27.8	4,129
Panel B: Value-weighted average fractions						
Consumer nondurables	4.3	14.0	308	2.2	5.8	298
Consumer durables	2.6	16.5	126	2.5	5.3	134
Manufacturing	4.3	14.1	585	1.5	6.5	578
Energy	0.8	6.6	172	0.6	11.4	200
Chemicals	3.7	9.8	106	0.4	3.3	117
Technology	10.6	29.5	599	20.7	42.0	917
Telecommunications	1.0	2.2	103	0.7	2.8	157
Shops	4.9	12.5	477	4.9	14.6	570
Health care	4.7	20.3	298	3.4	10.4	502
Other	4.4	11.4	509	4.5	11.7	657
All	5.2	15.6	3,282	6.5	15.8	4,129

behavior across industries—in Panel A from 4.3% (9.4%) of firms following a ZL (AZL) policy in the telecommunications sector to 15.0% (32.0%) of firms following ZL (AZL) policy in the technology sector over the 1962–2009 period. The extent of ZL (AZL) behavior in health care and technology industries could be consistent with the view that reputation, human capital, and asset illiquidity considerations are influential.

Given that ZL and AZL firms are smaller than their industry peers, it is not surprising that their fractions are lower when the value weighting is used. Nevertheless, as Panel B of the table shows, each industry still has a significant number of ZL and AZL firms, indicating that extreme debt-aversion is a widespread rather than a specialized phenomenon. The results over the two sample periods (1962–2009 and 1987–2009) also demonstrate that the distribution of ZL firms in each industry is relatively stable over time.

4. Zero-leverage behavior and corporate governance

A plausible explanation of the puzzling zero-leverage behavior is in the preferences of corporate decision makers, managers, and large shareholders. Firms could end up low-levered if managers have a personal preference to use debt conservatively. For example, CEOs with large stock ownership are likely to be less diversified than institutional investors, leading to personal costs of distress being substantially higher. Another argument that CEOs who are large shareholders could be unwilling to lever up is that their personal tax situation is different from that of a marginal shareholder. Grinblatt and Titman (2002, p. 552) give an example of Microsoft, suggesting that a potential reason of Microsoft's zero leverage is Bill Gates's personal tax situation. Furthermore, when CEOs are more entrenched and face friendlier boards, they are more likely to be successful in pursuing policies of their choice (Weisbach, 1988; Hermalin and Weisbach, 1998). In this section, we examine whether the relation between zero-leverage phenomena and CEO and governance variables is consistent with some of these economic forces.

A substantial empirical literature links managerial preferences and corporate actions. For example, Lewellen (2006) finds that the larger the stock ownership of CEOs and the smaller their option grants, the more likely their firms have lower leverage. Agrawal and Nagarajan (1990) find that firms that had no long-term debt between 1979 and 1983 have higher managerial stockholdings than their levered industry counterparts. Coles, Daniel, and Naveen (2006) find that managers with greater delta (sensitivity of compensation to stock prices) and smaller vega (sensitivity of compensation to stock volatility) use less debt.[23] In addition, Graham and Narasimhan (2004) show that CEOs with Great Depression experience tend to rely more on internal than external financing, and Malmendier, Tate, and Yan (2011) show that CEO overconfidence and Great Depression experience lead to more conservative leverage policy. In a theoretical model, Hackbarth (2008) studies the implications of managerial traits such as optimism and overconfidence on leverage decisions. Yang (2011) shows that the heterogenous beliefs between the manager and investors can lead to debt conservatism. Ryan and Wang (2011) find that CEOs who have worked for more employers increase firm's leverage. Our results complement these studies by providing links between the extreme debt conservatism of firms and salient CEO and firm characteristics.[24]

4.1. Data and variables

Adding CEO characteristics, as well as ownership and corporate governance measures, reduces our sample substantially. We first introduce the new variables and discuss the resulting sample. We use board and certain CEO characteristics from the RiskMetrics Directors database [formerly Investor Responsibility Research Center

[23] However, in an earlier work, Berger, Ofek, and Yermack (1997) find that both CEO stock ownership and option holdings are positively related to leverage.

[24] Zwiebel (1996) proposes an economic mechanism in which managers can optimally choose higher leverage when faced with a possibility of hostile takeovers. Using such measures as the G-index of Gompers, Ishii, and Metrick (2003), we do not find support for this argument. However, these measures are known to be endogenous and more robust empirical methods, such as structural modeling, are needed to shed further light on this issue. We leave it to future research.

(IRRC)]. The database covers the S&P 1500 firms over the period 1996–2009. The variables we use are *Board Size*, the number of directors in the board; *Frac. Indep. Directors*, the fraction of independent (noninsider and nonaffiliated) directors in the board; and *CEO Tenure*, the number of years that the current CEO has served as the firm's CEO.

We also use CEO ownership and compensation variables from the Compustat ExecComp database, which covers essentially the S&P 1500 firms over the period 1992–2009. The variables we use are *CEO Stock Ownership*, CEO holdings of the firm's stock as a fraction of total shares outstanding; *CEO Option Holdings*, CEO holdings of the firm's stock options as a fraction of stock shares outstanding; and *CEO Cash Comp.*, logarithm of the sum of CEO salary and bonus. We restrict analysis to firms in our entire sample for which the above CEO and board variables are defined. The restricted sample consists of 13,446 observations with 1,962 unique firms over the period 1996–2009.

4.2. Empirical analysis

We start by describing the relation between zero-leverage policies and CEO ownership in our sample. Table 10 ranks all sample firm-years (Panel A) and firms (Panel B) by CEO stock ownership and reports the fraction of ZL and AZL among these firms. The table clearly shows that two measures are highly correlated. For example, consider one hundred firms with the highest CEO ownership. For these firms, the average CEO ownership is 24% (versus 2.8% for the whole sample) and the fraction of these firms that pursue ZL (AZL) policy is 20.4% (40.5%) compared with just 14.1% (27.1%) for the whole sample. Overall, the table shows a nearly monotonic relation between the extent of the CEO stock ownership and the zero-leverage policies.

Table 10
Zero leverage and chief executive officer (CEO) stock ownership.
This table reports the relationship between zero-leverage (ZL) and almost zero-leverage (AZL) policy and CEO stock ownership. In Panel A (B), all firm-years (firms) are ranked by CEO stock ownership. Columns ZL and AZL show the fraction of firm-years (firms) with zero debt. In Panel B, for each firm, timeseries average of its CEO stock ownership is used.

Panel A: ZL and AZL policy and CEO stock ownership: firm-years

Number of firm-years with largest CEO stock ownership	CEO stock ownership (percent)	ZL (percent)	AZL (percent)
50	50.8	44.0	58.0
100	44.9	36.0	60.0
200	38.5	29.5	50.0
500	29.0	26.0	47.6
1000	21.2	21.9	43.4
2000	13.8	20.5	38.2
5000	6.4	14.9	29.3
All (13,446)	2.5	11.7	23.3

Panel B: ZL and AZL policy and CEO stock ownership: firms

Number of firms with largest CEO stock ownership	Average CEO stock ownership (percent)	ZL (percent)	AZL (percent)
10	43.5	33.3	60.7
20	38.8	28.9	52.7
30	35.0	26.0	48.9
40	32.5	24.1	44.2
50	30.5	22.5	42.7
100	24.0	20.4	40.5
200	17.2	21.2	40.6
500	9.4	20.0	36.6
1000	5.2	16.4	31.3
All (1,962)	2.8	14.1	27.1

Table 11 shows the results of the logit analysis of AZL policy. For all regressions, we control for the variables used in Table 4 (except Net Pension Liabilities and Operating Leases). All independent variables are lagged in the regressions. Unreported, the economic and statistical significance of these variables is consistent with the results in Table 4, suggesting that the determinants of ZL policy in the restricted sample have a similar impact.

Table 11 shows that firms with larger CEO stock ownership are substantially more likely to be zero-levered, consistent with managerial preference explanations. A 1 standard deviation increase in CEO stock ownership increases the likelihood of AZL policy by an economically and statistically significant 3.3 percentage points. In addition, firms in which CEOs have larger option-based compensation packages are likely to be more levered, although this relation is less robust. The results also indicate that poorer corporate governance is related to ZL policy: Firms with more independent directors, larger boards, and shorter CEO tenure are less likely to choose zero leverage. In addition, unreported results show that these results are substantially stronger for the sample of dividend-paying firms than for zero-dividend firms, suggesting that the managerial preference story is able to explain the most puzzling part of zero-leverage behavior. Existing empirical evidence on the relation between board size and firm performance is ambiguous (e.g., Yermack, 1996; Eisenberg, Sundgren, and Wells, 1998; Bhagat and Black, 2001; Coles, Daniel, and Naveen, 2008). Cheng (2008) finds that firms with a larger board adopt less extreme policies, suggesting that it is harder for a larger group to reach a consensus. This economic mechanism can explain why a smaller board is more associated with ZL policy. In an unreported analysis, we also find that lagged CEO and governance variables can predict firms' decisions to adopt and abandon ZL policy. For example, larger CEO ownership is associated with a significantly higher chance of adopting and lower chance of abandoning a zero-leverage status.

The governance story suggests that CEOs should find it easier to adopt a low-debt policy with a more favorable board. Therefore, the effects of the CEO ownership and tenure are likely to be stronger when the board is smaller and less independent. Table 12 reports the results of the logit analysis, in which we include the interaction terms of board and CEO characteristics. Specifically, we include the interactions of a board size dummy [where Small (Large) Board Dummy is defined as the board with

Table 11
Determinants of zero-leverage policy: chief executive officer (CEO) and governance variables.

This table reports the results of logit regressions of almost zero-leverage (AZL) policy. The dependent variable is the dummy that equals one if a firm-year has book leverage $\leq 5\%$. Coefficients and *t*-statistics (in parentheses) significance are reported. Control variables include Log(Size), Market to Book, Profitability, Tangibility, Dividend, Earnings Vol., R&D, Log(Age), Initial AZL dummy, Industry Fraction of AZL, Capital Expenditure, and Asset Sale. Industry Fraction of AZL is the fraction of AZL firms (excluding the firm in question) in the same industry defined by three-digit standard industrial classification and the same year. All other variables are defined in Appendix A. All independent variables are lagged by one year. Coefficients, *t*-statistics (in parentheses), and economic significance are reported. Economic significance is the average change in probability for one standard deviation change. Year fixed effects for calendar years are included in all regressions. All standard errors adjust for heteroskedasticity and clustering at the firm level. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CEO Stock Ownership	0.047***					0.037***	0.026***
	(5.64)					(4.64)	(3.00)
	3.3%					2.6%	1.8%
CEO Options Ownership		−0.056*				−0.035	−0.036
		(−1.78)				(−1.21)	(−1.28)
		−1.4%				−0.9%	−0.9%
CEO Cash Comp.						−0.080	−0.089
						(−1.46)	(−1.64)
						−0.9%	−1.0%
CEO Tenure			0.032***				0.019***
			(6.17)				(3.27)
			3.5%				2.1%
Log(Board Size)				−1.239***		−1.110***	−1.063***
				(−5.09)		(−4.72)	(−4.58)
				−3.8%		−3.4%	−3.2%
Frac. Ind. Directors					−1.196***	−0.728**	−0.571*
					(−3.74)	(−2.30)	(−1.81)
					−2.4%	−1.4%	−1.1%
Constant	2.513***	2.838***	2.583***	4.676***	3.608***	4.662***	4.909***
	(4.86)	(5.44)	(5.00)	(7.48)	(6.63)	(6.92)	(7.09)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	9,591	9,591	9,591	9,591	9,591	9,591	9,591
Pseudo *R*-squared	0.313	0.303	0.312	0.309	0.306	0.322	0.324

the size below (above) the sample median] and a board independence dummy [where Low (High) Board Independence is defined as the board with the fraction of independent directors below (above) the sample median] with CEO stock ownership and tenure. The results suggest that the effects of CEO stock ownership and tenure are mostly driven by observations, in which the boards are less independent and small.[25]

It is important to emphasize that, although the economic mechanisms underlying our intuition are plausible, we cannot rule out the potential explanation that firms for which zero-leverage policy is optimal (for as yet unknown to us reasons) choose CEOs and their compensation packages correspondingly. Our results clearly indicate the need for further study of these economic mechanisms when additional data are available.

4.3. Family firms and zero-leverage firms

The private benefits of control is another well-recognized dimension of agency costs. Large shareholders and founders could care more about the private benefits of control and their voting rights. With respect to family firms, Becker (1981) and Bertrand and Schoar (2006) argue that family members can be altruistic in the sense that they can derive utility from maintaining the family legacy or the well being of other family members. Taken together, CEOs of family firms could be particularly averse to risks posed by the presence of debt.

To shed light on this issue, we use a hand-collected data set that contains family firm status for large firms over the 1992–2009 period.[26] The definition of a family firm follows that of Anderson and Reeb (2003), Villalonga and Amit (2006), and Li, Ryan, and Wang (2011). Specifically, a family firm is one in which the founder or any family member of the founding family is a director, is an officer, or owns 5% or more of the outstanding equity. We also require the observations to have valid board size,

[25] Unreported, including CEO and governance variables in the analysis of entry and exit decisions shows that these factors are significant and have a similar economic effect. For example, larger board size and shorter CEO tenure increase (decrease) the likelihood of the firm switching to the AZL (non-AZL) policy.

[26] We construct our data set from several sources. Our first source is a data set on family firms for S&P 1500 firms over 2003–2006. We thank Harley R. Ryan for generously sharing the data with us. See Li, Ryan, and Wang (2011) for detailed descriptions of their data. Our second data source contains the family firm status for the two thousand largest firms in Compustat over the 2001–2009 period. We thank Ronald Anderson for generously sharing the data. See Anderson, Duru, and Reeb (2009) and Anderson, Reeb, and Zhao (2012) for detailed descriptions of their data. Finally, we hand-collected the family firm status for S&P 500 firms over the 1992–2000 period.

Table 12
Determinants of zero-leverage policy: interactions of chief executive officer (CEO) and governance variables.

This table reports the results of logit regressions of almost zero-leverage (AZL) policy. The dependent variable is the dummy that equals one if a firm-year has book leverage $\leq 5\%$. Small (Large) Board Dummy is one if the board size is below (above) the sample median and zero otherwise. Low (High) Board Independence dummy is one if the fraction of independent directors is below (above) the sample median and zero otherwise. Control variables include Log(Size), Market to Book, Profitability, Tangibility, Dividend, Earnings Vol., R&D, Log(Age), Initial AZL Dummy, Industry Fraction of AZL, Capital Expenditure, and Asset Sale. Industry Fraction of AZL is the fraction of AZL firms (excluding the firm in question) in the same industry defined by three-digit standard industrial classification and the same year. All other variables are defined in Appendix A. All independent variables are lagged by one year. Coefficients and *t*-statistics (in parentheses) are reported. Year fixed effects for calendar years are included in all regressions. All standard errors adjust for heteroskedasticity and clustering at the firm level. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

Variable	(1)	(2)	(3)	(4)	(5)	(6)
CEO Stock Ownership	0.036***		0.032***			
× Small Board Dummy	(3.85)		(3.33)			
CEO Stock Ownership	−0.007		0.008			
× Large Board Dummy	(−0.39)		(0.52)			
CEO Tenure		0.027***	0.026***			
× Small Board Dummy		(4.20)	(3.97)			
CEO Tenure		−0.008	−0.003			
× Large Board Dummy		(−0.77)	(−0.30)			
CEO Stock Ownership				0.034***		0.029***
× Low Board Independence				(3.66)		(3.08)
CEO Stock Ownership				0.015		0.027
× High Board Independence				(0.98)		(1.38)
CEO Tenure					0.027***	0.027***
× Low Board Independence					(4.37)	(4.31)
CEO Tenure					0.003	0.003
× High Board Independence					(0.30)	(0.33)
CEO Stock Ownership		0.029***			0.029***	
		(3.18)			(3.21)	
CEO Tenure	0.020***			0.019***		
	(3.40)			(3.42)		
Large Board Dummy	−0.240*	0.041	0.038	−0.351***	−0.362***	−0.362***
	(−1.80)	(0.24)	(0.22)	(−2.81)	(−2.87)	(−2.87)
High Board Independence	−0.154	−0.160	−0.160	−0.110	0.112	0.111
	(−1.53)	(−1.58)	(−1.58)	(−1.03)	(0.77)	(0.76)
Constant	2.216***	2.158***	2.168***	2.209***	2.113***	2.114***
	(4.29)	(4.14)	(4.18)	(4.26)	(4.08)	(4.07)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	9,591	9,591	9,591	9,591	9,591	9,591
Pseudo *R*-squared	0.320	0.321	0.321	0.319	0.321	0.321

board independence, and CEO tenure and compensation variables that we use in Section 4.2. Our resulting sample consists of 9,183 firm-year observations for 1,465 unique firms over 18 years.

As Table 13 reports, a family firm is significantly more likely to use debt conservatively. At the same time, most of related corporate governance variables remain significant (apart from the board independence). Even after controlling for other variables, family firms are 6% more likely to pursue zero-leverage policy than nonfamily firms. Consistent with the intuition that family members care about survival, ZL firms on average survive by about 13% (10 months) longer than their proxy firms. Many recent studies investigate various aspects of family firms, such as performance (Anderson and Reeb, 2003; Pérez-González, 2006; Bennedsen, Nielsen, Pérez-González, and Wolfenzon, 2007), corporate transparency (Anderson, Duru, and Reeb, 2009), investment (Fahlenbrach, 2009), management compensation (Gomez-Mejia, Larraza-Kintana, and Makri, 2003; Li, Ryan, and Wang, 2011), and short sales (Anderson, Reeb, and Zhao, 2012). Our study contributes to the literature by shedding light on the relation between family firms and the puzzling debt conservatism.

5. Concluding remarks

This paper presents the puzzling evidence that a substantial number of large public nonfinancial US firms follow a zero-debt or almost zero-debt policy. Using the Compustat data set, we find that, over the 1962–2006 period, on average 10.2% of such firms have zero leverage and almost 22% have a less than 5% book leverage ratio. Neither industry nor size can fully explain such puzzling behavior. Particularly surprising is the presence of a large number of zero-leverage firms that pay dividends. Zero-leverage dividend-paying firms are more profitable, pay higher taxes, and have higher cash balances than their proxies chosen by industry and size. These firms also pay substantially higher dividends than their proxies and thus the total payout ratio is relatively independent of leverage.

Were they to lever up to the level of their proxies, zero-leverage dividend-paying firms would save about 7% of the

Table 13
Zero-leverage policy and family firms.

This table reports the results of logit regressions of almost zero-leverage (AZL) policy. The sample includes all observations over the period 1992–2009 for which chief executive officer (CEO), governance, and family firm variables are available. The dependent variable is the dummy that equals one if book leverage in that firm-year is less than 5%. Control variables include Log(Size), Market to Book, Profitability, Tangibility, Dividend, Earnings Vol., R&D, Log(Age), Initial AZL Dummy, Industry Fraction of AZL, Capital Expenditure, and Asset Sale. Industry Fraction of AZL is the fraction of AZL firms (excluding the firm in question) in the same industry defined by three-digit standard industrial classification and the same year. All other variables are defined in Appendix A. All independent variables are lagged by one year. Coefficients, *t*-statistics (in parentheses), and economic significance are reported. Economic significance is the average change in probability for one standard deviation change for a continuous independent variable or for the change from zero to one for a dummy variable. Year fixed effects for calendar years are included in all regressions. All standard errors adjust for heteroskedasticity and clustering at the firm level. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

Variable	(1)	(2)	(3)	(4)	(5)
CEO Stock Ownership	0.029***				0.022**
	(2.98)				(2.43)
	2.0%				1.5%
CEO Options Ownership					−0.033
					(−0.96)
					−1.0%
CEO Cash Comp.					−0.037
					(−0.60)
					−0.4%
CEO Tenure		0.020***			
		(3.09)			
		2.1%			
Log(Board Size)			−1.505***		−1.423***
			(−5.32)		(−5.09)
			−4.2%		−4.0%
Frac. Ind. Directors				−0.876**	−0.607
				(−2.18)	(−1.51)
				−1.5%	−1.0%
Family Firm Dummy	0.549***	0.538***	0.717***	0.612***	0.532***
	(3.86)	(3.81)	(5.35)	(4.47)	(3.73)
	6.4%	6.3%	8.3%	7.2%	6.1%
Constant	2.031***	1.792***	4.065***	2.664***	4.438***
	(3.00)	(2.73)	(5.28)	(3.65)	(5.15)
Control variables	Yes	Yes	Yes	Yes	Yes
Number of observations	6,476	6,476	6,476	6,476	6,476
Pseudo *R*-squared	0.310	0.309	0.316	0.307	0.320

market equity value in a conservative scenario. Nevertheless, zero-leverage policy is found to be persistent over the long term. Firms with large CEO ownership and more CEO-friendly boards are more likely to end up being zero-levered. Family firms are also more likely to pursue zero-leverage policies. Overall, our results suggest that the CEO and governance characteristics of firms are likely important determinants of the zero-leverage and low-leverage phenomena.

Further studies of endogenous dynamic relation between financing and investment can shed more light on corporate financial policies. For example, unobserved heterogeneity in the structure of the investment process (e.g., front-loaded versus back-loaded) can influence the levels, timing, and persistence of corporate financial policy. More research that further explores these and other relations will be helpful for understanding of the zero-leverage puzzle and debt conservatism in general.

Appendix A. Definition of variables

The third column of the following table lists variable formulas, using the abbreviated names of Compustat primitive variables (in uppercase letters).

Variable	Description	Definition
Abnormal Cap. Ex.	Abnormal capital expenditure (Titman, Wei, and Xie, 2004)	$\frac{CE_t}{(CE_{t-1}+CE_{t-2}+CE_{t-3})/3}-1$
Age	Number of years since the firm's record first appears in Compustat (Age=0 for the first record)	
Asset Sale	Ratio of asset sales to book assets	$(SPPE+SIV)/AT$
Book Leverage	Book leverage	$(DLTT+DLC)/AT$
Capital Expenditure	Ratio of capital expenditure to book assets	$CAPX/AT$
Cash	Ratio of cash holdings to book assets	CHE/AT
CPI	Annual consumer price index from the US Bureau of Labor Statistics	
Dividend	Ratio of common dividends to book assets	DVC/AT
Earnings Vol.	Volatility of profitability calculated for the past 10 years (minimum three years of data required)	
Init. Book Lev.	Initial book leverage of the firm (first record in Compustat)	

Init. Market Lev.	Initial market leverage of the firm (first record in Compustat)	
Init. AZL	Dummy variable that equals one if initial book leverage is 5% or lower and zero otherwise	
Init. ZL	Dummy variable that equals one if initial book leverage is zero and zero otherwise	
Investment Grade	Equals one for having an investment-grade rating (BBB− or higher), zero for having a speculative grade rating (BB+ or lower), and missing otherwise	
Kink	Ratio of the amount of interest required to make the firm marginal tax rate slope downward to the actual interest expense (Graham, 2000; van Binsbergen, Graham, and Yang, 2010)	
Log(Size)	Natural logarithm of book assets adjusted to 2000 dollars	$\log(AT_t \times CPI_{2000}/CPI_t)$
Market Leverage	Market leverage	$(DLTT+DLC)/(DLTT+DLC+CSHO \times PRCC\_F)$
Market to Book	Ratio of market assets to book assets (Tobin's q)	$(LT+PSTKL-TXDITC+CSHO \times PRCC\_F)/AT$
Net Debt Issuance	Ratio of the change in current and long-term debt to book assets	$(DLC_t+DLTT_t-DLC_{t-1}-DLTT_{t-1})/AT_t$
Net Equity Issuance	Ratio of net equity issuance to book assets	$(SSTK-PRSTKC)/AT$
Net Pension Liabilities	Difference between pension obligations and pension assets (=0 if the result is negative)	$\max(PBPRO+PBPRU-PPLAO-PPLAU,0)$
Operating Leases	Sum of current rental payment and the discounted present value of future rental commitments (up to five years)	$XRENT+\sum_{s=1}^{5}\frac{1}{1.1^s}MRC_s$
Profitability	Ratio of earnings before interests, taxes, and depreciation to book assets	$OIBDP/AT$
Rating Dummy	Equals one if the firm has a credit rating and zero otherwise	
R&D	Ratio of research and development expenses to sales	$XRD/SALE$
Share Repurchases	Ratio of share repurchases to book assets	$PRSTKC/AT$
Tangibility	Ratio of fixed assets to book assets	$PPENT/AT$
Tax	Ratio of taxes paid to book assets	TXT/AT

Appendix B. Estimation of potential tax benefits

Eq. (12) can be solved algebraically to find ΔD. Define

$$A=\frac{L^{*}ME_0-(1-L^{*})D_0}{D^m-D_0}. \tag{13}$$

Because $L^{*}\geq L_0=D_0/(D_0+ME_0)$, it follows that $A\geq 0$. There are two cases,

(1) If $0\leq A<1$, then

$$\Delta D=(D^m-D_0)\frac{\sqrt{(1-\tau_0L^{*})^2+2\tau_0L^{*}A}-(1-\tau_0L^{*})}{\tau_0L^{*}} \tag{14}$$

(2) If $A>1$, then

$$\Delta D=(D^m-D_0)(A+\tfrac{1}{2}\tau_0L^{*}). \tag{15}$$

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