ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ АВТОНОМНОЕ
ОБРАЗОВАТЕЛЬНОЕ УЧРЕЖДЕНИЕ
ВЫСШЕГО ОБРАЗОВАНИЯ
«НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ
«ВЫСШАЯ ШКОЛА ЭКОНОМИКИ»
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НЕОПРЕДЕЛЕННОСТЬ СПРОСА И ФИРМЫ С НУЛЕВЫМ ЗАЕМНЫМ КАПИТАЛОМ (DEMAND UNCERTAINTY AND ZERO-LEVERAGE FIRMS)

Выпускная квалификационная работа - БАКАЛАВРСКАЯ РАБОТА
по направлению подготовки 38.03.01 «Экономика»
образовательная программа «**Программа двух дипломов по экономике НИУ ВШЭ и Лондонского университета**»

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Москва 2018

Contents

Аннотация

Данное исследование рассматривает, как неопределенность спроса в индустриях влияет на то, что фирма может полностью отказаться от долга или иметь незначительную часть долга в структуре капитала, в различных индустриях США. Данные были взяты из терминала Thomson Reuters Datastream за период с 1990 по 2017 годов и включают в себя классификацию компаний по 87 индустриям. Были получены следующие результаты. Во-первых, эмпирические наблюдения подтверждают, что неопределенность спроса в индустрии оказывает сильное влияние на вероятность того, что фирма будет поддерживать уровень долга на крайне низком уровне. Во-вторых, приведен список индустрий и рассчитанное для каждой индустрии среднее значение неопределенности спроса, наряду со средним соотношением фирм с нулевым и очень низким заемным капиталом. Также неопределенность спроса оказывает высокое положительное влияние на соотношение таких фирм в индустрии. В-третьих, взаимодействия неопределенности спроса с соотношением текущей рыночной цены акции к балансовой стоимости акции и рентабельности были рассмотрены. Взаимодействие низкой определенности спроса в индустрии с соотношением текущей рыночной цены к балансовой стоимости влияет на вероятность того, что фирма полностью откажется от долга, и взаимодействие высокой неопределенности спроса с рентабельностью оказывает влияние на то, что фирма будет иметь нулевой заемный капитал. В-третьих, эндогенность неопределенности спроса была рассмотрена. Данная работа добавляет к текущей литературе новые наблюдения, что неопределенность спроса влияет на то, что фирма будет поддерживать крайне низкий уровень долга, и дает рекомендации для дальнейшего изучения этого феномена.

Abstract (Research question)

This study explores how demand uncertainty influences a firm to become zero-leverage or almost zero-leverage in main industries of the USA. The data is taken from Thomson Reuters Datastream over the period of 1990-2017 and includes internal classification by 87 industries. First of all, empirical findings prove that demand uncertainty of industry has a high impact on probability of a firm to maintain extremely low levels of debt. Secondly, the list of industries with calculated demand uncertainty and average proportions of these firms is provided. Demand uncertainty has a high positive impact on proportion of zero-leverage and almost zero-leverage firms. Thirdly, interaction of demand uncertainty with market-to-book ratio and profitability is considered. Interaction of low uncertainty of industry demand with market-to-book ratio influences probability of a firm to completely retain from debt and interaction of high demand uncertainty with profitability ratio has a significant impact on probability of a firm to become zero-leverage. Finally, endogeneity of demand uncertainty is considered. The current paper would extend the existing research by investigating that demand uncertainty influences a firm to maintain debt at extremely low levels and provides recommendations for further research.

1. Introduction

One of the most continuous debates in Corporate Finance is related to capital structure decision. Each firm has a choice between using different sources of funds – debt or equity. Debt is related to issuing bonds or taking a loan while equity is considered as issuing common or preferred securities and using retained earnings. However, we do not know what is an optimal capital structure that can be generalized to everyone is the economy. As S. Myers (1984) properly questioned in his famous paper "The Capital Structure Puzzle": "How do firms choose their capital structures?" The answer is "We don't know". So, after more than thirty years this question still remains unanswered, many researchers doubt whether the answer will ever be found applicable for any firm.

There are two main theories that attempt to explain capital structure choice – the Trade-off Theory and the Pecking Order Theory of Finance. The first theory states that there is a trade-off between costs of financial distress and tax savings. Firms with higher tax shield should have higher leverage due to greater debt. So, optimal leverage can be reached at the point where the curve that includes both tax and bankruptcy in (leverage - value of a firm) space stops increasing and starts decreasing. The pecking order theory of finance was created as an alternative to the tradeoff theory. It states that if a firm requires funding, it should finance its projects internally using retained earnings. It can be considered as a good signal to the market that a firm is strong. If internal funding is unavailable, then a firm should issue debt. As a last resort, if issuing debt is also unavailable, a firm may issue new equity. However, it is a negative signal to the market since a stock, in the firm's view, is overvalued, and so money should be raised as soon as possible before the price of this stock will decrease.

Also, these two theories attempt to provide an explanation for capital structure choice, but they are still not perfect. In the last decades there is an increasing of firms that deliberately refrain from borrowing and finance their projects with means other than debt. Strebulaev and Yang (2013) noticed that there are 30% of firms who refrain from using debt for at least five consecutive years. This is a great challenge to the existing theories that attempt to explain capital structure decision. It became known as the Zero-leverage puzzle. Mostly it refers to low-leverage puzzle which states that on average one receives a lower leverage levels than predicted by different capital structure models.

When the trade-off theory meets zero-leverage firms, it fails to explain their existence. It predicts that a profitable firm should have higher debt and leverage ratios since it has larger opportunities for scope for tax shields. However, zero-leverage firms still prefer not to borrow any debt which undermines this theory. When the pecking order theory meets Zero-leverage firms, it also fails to explain this phenomenon. Evidence that these firms prefer to use equity issuance rather than borrowing debt (even if the capacity of a firm is not exhausted) is inconsistent with the pecking order theory.

As a result, the phenomenon of a zero-leverage firm is not properly explained by two major theories that exist in Corporate Finance. The main purpose of this research is to study this anomaly and suggest that existence of zero-leverage firms may be due to uncertainty of demand in industry. The idea is to investigate in detail how demand uncertainty affects decision of a firm to refrain from any debt. The main hypothesis is that in industries with higher demand uncertainty a firm will be afraid of becoming bankrupt and so may decide not to borrow at all. Thus, firms in such industries will want to alleviate debt, and the portion of these firms will be high. In industries with a more certain demand a firm may predict its costs and sales and so determine how much it should pay on interest payments. Thus, in such industries the proportion of zero-leverage firms should be lower. This is relevant to existing empirical evidence of zero-leverage puzzle since nobody considered impact of industry demand uncertainty before.

So, the subject of this study are all American companies (except for Utilities and Financial sector) from 1990 to 2017. The object of the research are zero-leverage firms in industries with a different level of demand uncertainty. As a method of study, I would use panel logit regressions and linear regressions with fixed year and industry effects.

This work will be structured in the following way. The Section 2 contains description of related literature that is essential to study Zero-leverage phenomenon. In Section 3 development of three hypotheses will be provided. In Section 4 the data that is used in the work will be discussed and explanation for using the chosen variables will be given. In Section 5 summary statistics on all variables is to be considered. Moving on, in Section 6 main results of empirical findings will be discussed. In Section 7 the research considers endogeneity of demand uncertainty and Instrumental Variable regressions. In the final Section 8 main conclusions of the thesis will be stated and potential areas for future research will be outlined.

2. Related Literature

There is a number of articles that study zero-leverage puzzle. Devos et al. (2012) analyzed what are the main drivers for firms to alleviate debt in capital structure. They evaluate impact of financial constraints and managerial entrenchment on decision to become low leverage. The sample is taken from Compustat and CRSP and includes all US non-financial companies from 1990 to 2008. As a result, authors do not find any evidence in support to the hypothesis that in order to alleviate debt entrenched managers undertake zero-debt policies. In their logistic regression where dependent variable is zero-leverage dummy (1 for zero-leverage and 0 otherwise) almost all regressions showed that entrenchment is insignificant at 1% significance level. In contrast, findings support that financial constraints are a significant reason for firms not to take any debt. Authors conclude that these firms are smaller and younger and have more restrictions in their investment activities. These restrictions occur because of unwillingness of banks to lend at market rates to firms without reliable reputation. After these firms build reputation financial constraints are reduced and so firms take debt to run large profitable projects. Also, debt initiation does not change governance patterns.

Minton and Wruck (2001) study low leverage policy undertaken by firms. First, low leverage firms are consistent with the pecking order theory of finance. Conservative firms can finance their projects internally by using great flow of funds and significant cash balances. Secondly, in authors' view, low leverage policy of firms is transitionary. 70% of conservative firms move away from low leverage policy, 50% of which do so in a five years period. Thirdly, low leverage policy cannot be considered as an industry-based phenomenon. However, these firms work in industries that are quite responsive to changes in costs of financial distress and have high market-to-book ratio. Finally, firms with low leverage policy do not experience significant non-debt tax shields, low tax rates or suffer from asymmetry of information.

Strebulaev and Yang (2013) found that a large number of US non-financial firms prefer not to have any debt at all. They use sample taken from Compustat and CRSP and mostly the same criteria as Devos et al. (2012), but considering much wider period of time. They consider zero-leverage firms (ZL firms) that have zero book (market) leverage ratio, and in addition to it, almost zero-leverage firms (AZL firms) that have book (market) leverage ratio less than five percent. Authors evaluate relationship between zero-leverage firms and existence of policies to alleviate debt. They find that the zero-leverage tendency is not temporary, about 30% of zero-debt firms do not take any debt for at least five consecutive years. Also, authors distinguish between zero-

dividend and dividend payers among zero-leverage firms. The latter group is surprisingly large and, in contrast to their proxies (by industry and size), they are more profitable, pay higher taxes and higher dividends, which makes their total payout ratio independent of leverage. Zero-leverage behavior is significantly determined by the governance characteristics, large CEO ownerships and CEO-friendly boards. Like Devos et al. (2012) authors used multivariate logistic regressions with almost zero-leverage firm taken as a dummy. What is different to research of Devos et al. (2012) is that variables related to governance characteristics are almost all significant. Overall, the empirical study of the authors does not properly explain the existence of zero- and low-leverage puzzle.

In addition to Strebulaev and Yang (2013), Bessler et al. (2013) consider zero-leverage phenomenon all over the world. They attempt to explain the increasing percentage of zero-leverage firms and investigate both demand- and supply-side of zero-leverage firms. They construct sample from Compustat global database and Compustat North America from 1988 to 2011. Again, like Devos et al. (2012) and Strebulaev and Yang (2013), authors use the multivariate logistic regression where ZL dummy is a dependent variable. A large set of performance variables are taken as control, and almost all are shown to be significant. Authors state that the greatest percentage of zero-leverage firms are in those countries where exist protection of creditors, a common law system and dividends tax reliefs. Also, they show that there are several causes of growth in number of zero-leverage firms. First, IPO effect is when firms that became public recently have high percentage of growing trend of ZL firms. Second, industry effect - movement towards sectors where debt aversion is usually established. Third, general listing period effect - more newly listed firms prefer not to undertake any debt at all in later years of the sample due to demand-side effect. Finally, growing volatility of assets and decreasing corporate taxes are also causes of zero-leverage behavior. The authors also observed that only small firms prefer to be zero-leverage deliberately, and debt capacity is binding for ZL firms.

Lee & Moon (2011) analyzed long-run equity performance of zero-leverage firms. Authors obtained that zero-leverage firms perform better than their proxy firms (by firm size) based on regressions after one adjusts for Fama-French factors. As a result, absence of debt can be considered as an essential determinant of stock returns and is not fully captured by factors of Fama and French. I think that taking into consideration demand uncertainty as an exogenous variable in the regression may explain the firms' behavior more deeply.

Dang (2013) continues studying zero-leverage firms and focuses on two important issues. First, whether firms are debt-free because of strategic decision to be unlevered or financial constraints. Second, author investigates whether zero-leverage firms are affected by macroeconomic conditions. Dang (2013) analyzes new sample of UK from 1980-2007 and runs multivariate logistic regressions with ZL dummy as dependent variable. Also, he states that zero-leverage policy is not homogenous which means that there are different motives for firms to undertake this type of policy. Author divides firms into paying dividends and not paying. The first group prefer not have any debt to alleviate investment distortions (predicted by financial flexibility and underinvestment hypotheses) while the second group alleviate debt due to financial constraints. Moreover, zero-leverage decision (especially the first group) is highly influenced by macroeconomic conditions.

Banker et al. (2013) study the relationship between demand uncertainty and cost behavior. Authors state that when demand uncertainty increases, unconventional realizations of demand are more possible. In the paper they provide the proxy for demand uncertainty – standard deviation of natural logarithm of first difference in Sales. Banker et al. (2013) analyzed relationship between costs and demand uncertainty at firm level and at industry level and observed that for the latter demand uncertainty is three times lower than at firm level.

The capital structure puzzle was described by Myers (1984). He states that it is unknown how do firms actually choose capital structure ("debt, equity or hybrid equities they issue"), so he discusses two large theories: the pecking order theory and static trade-off theory. The trade-off theory can be modified by including adjustment costs and add elements that have essential empirical support. Myers also discusses the modified pecking order theory. It takes into account costs of financial distress and asymmetric information. However, there are some limitations with this. First, this theory depends on sticky dividends but provides no explanation why they are sticky. Secondly, it provides doubtful explanation on purposes of issuing common equity.

Barclay et al. (1995) analyzed determinants of corporate leverage and dividend policies. They ran several regressions on 6780 companies for the period 1963-1993 years: pooled OLS regression, a cross-sectional regression on averages and fixed effects (FE) regression with a dummy variable for one firm. For corporate leverage policy authors obtained that pooled OLS and cross-sectional regression equally better explain deviations in explanatory variables than in FE regression. For dividend policy the R-squared is the highest cross-sectional regression which explains variation in corporate debt decisions, but not the changes in returns in time-series. In

general, only 30% of variations is explained by these regressions in leverage and corporate policies. The most essential determinant of these two policies that the authors highlight is investment opportunities. Companies with high level of growth experience problem of underinvestment if both costs of large dividends and debt make policies costly. For older firms the problem of Free cash flows (when firms have large free cash flows, but do not know where to invest) is alleviated by benefits from high leverage and dividends.

Moving on, Fama and French (2002) test trade-off and pecking order theories predictions about dividends and debt. Even though nature of these theories is different, both of them agree on predictions about leverage and dividends. Higher dividend payouts belong to firms with lower amounts of investment and higher profitability. Moreover, lower market leverage experiences firms with larger investments. These firms have lower payout ratio, because short-term variation in investment is not affected by dividends. This variation is largely affected by debt which is predicted by the pecking order model. Also, firms that have higher profitability are less levered. This confirms the pecking order model and contradicts to the trade-off model. As a result, authors find negative relationship between leverage and profitability and that low-leverage firms experience equity issues.

Agrawal and Nagarajan (1990) compare all-equity firms with levered proxies (by size in the corresponding industry) by managerial, financial and ownership characteristics. They state that unlevered firms experience higher managerial stockholdings and liquidity compared to levered proxies. Moreover, extensive family relationships are more common for all-equity firms, and those firms with family involvement have higher corporate rights than firms without this type of involvement. As a result, the evidence obtained by the authors correspond to the idea that family relations in the top management and control of voting rights by managers are essential factors to run all-equity firms.

Kurshev and Strebulaev (2006) prove theoretical explanation whether the cross-sectional size-leverage relationship can be explained by dynamic capital structure. The authors explore dynamic financing model with fixed costs of external financing and infrequent adjustment. After applying it to the trade-off between capital structure and firm size there can be highlighted two effects. First of all, small firms prefer higher levels of debt to offset rebalancings that are less frequent. However, when waiting time between restructuring increases, this lead to lower debt on average. In one refinancing cycle there is a negative relationship between firm size and leverage. As a conclusion, in cross-section this relationship is positive and these fixed costs do not contradict to

stylized facts of relationship between size and leverage. However, if we control for the firms that do not have any debt, the relationship becomes negative.

According to the trade-off theory, there is a target debt level that a firm tends to maintain. Hovakimian et al. (2001) state that there can be barriers for firms to tend to its target ratio, and this ratio may change over time. Moreover, the authors state that the difference between target and actual debt ratio is more important in the repurchase decision rather than in the issuance decision.

Also, there are essential papers to this research that consider debt policies. First, it starts from tax benefits of debt. If one takes into account tax perspective, it is cheaper for firms to borrow debt than issue additional equity. Graham (2000) determines tax function and measures the tax advantage. Then he investigates how aggressively a firm can use its debt by considering its tax function. Finally, Graham finds out by how much firms can increase their value by borrowing more debt. In his view, large profitable liquid firms with low costs of distress and growth firms that produce unique goods use the highest tax advantage and have conservative debt policy. Moreover, the author states that this debt policy is persistent through the time. Graham states that on average firms could add up to 15,7 % to their value by taking more debt. This is done by moving towards the kink of tax benefit function without highly increasing risk. Many firms can double their debt without any unfavorable effects. Graham also indicates that there is a scope for future research why some firms are underlevered. In other words, zero-leverage and almost zero-leverage firms challenges the Graham's statements.

Moving on, Graham and Tucker (2006) consider 44 tax shelter cases from 1975 to 2000 to study attitude of tax shelter activities and whether participation in a tax shelter is related to debt policy. On average, there is a 9 % decrease in value of a firm which is produced by tax shelters. These reductions are three times as large as interest deductions for proxy firms. When a firm starts using tax sheltering, it borrows less. This decreases its debt ratio by 8 % on average, compared with similar pre-shelter debt ratios of proxy firms. As a result, if shelters are not considered, the tax shield firms drawn from the sample tend to be underlevered, but once they consider these shelters, firms do not continue to appear to be underlevered.

Lemmon and Zender (2010) investigate influence of debt capacity in tests of different capital structure theories. First of all, they state that all firms prefer to finance using internally generated funds. Secondly, debt is preferred to equity if there is a need in external funds, but with the assumption that there are debt capacity constraints. Presence of these concerns explains why firms

finance their activities using new external equity financing. Moreover, authors state that low leverage firms with low transaction costs of issuing additional equity stockpile debt capacity. This is consistent with the pecking order theory, but not with tradeoff theory. So, authors conclude that the pecking order theory of finance describes well financial behavior of firms over a long-time period.

Finally, there are several papers that investigate optimal capital structure of firms. DeAngelo and Masulis (1980) define a model of corporate leverage choice. They add ignored variables such as investment tax credits, depreciation and depletion allowances which can be considered as tax shields substitutes for debt. As a result, every firm has an optimal interior leverage level based on interaction of tax treatments of debt and equity.

Bradley et al. (1984) investigate the existence of optimal capital structure. The authors develop a model that includes personal taxes on stocks and bonds, agency costs, bankruptcy costs (costs of financial distress) and tax shields. As a result, leverage level of a firm negatively depends on expected costs of financial distress and on non-debt tax shields. If the former is significant, then leverage level is also negatively related to variability of firm's earnings. A puzzling evidence was documented about direct relationship between leverage and non-debt tax shields. A possible explanation can be that the former variable is an instrumental variable for securability of assets of a firm (increase in securability of assets lead to increase in leverage).

3. Hypotheses development

H1: Does demand uncertainty of industry affect probability of a firm to become almost zero-leverage?

This is a central hypothesis to the research. I suppose that industries with higher demand uncertainty affect firms in such a way that they prefer to eschew any debt or maintain a very low level of debt. So, it is a strategic decision of a firm to become almost zero-levered when industry experiences high uncertainty of demand.

The mechanism is as follows: when there is a high demand uncertainty, firms choose their projects and prefer to finance them internally rather than externally, because firms may face with a problem that they will be unable to pay out debt (the firm do not generate enough income to cover debt) and become bankrupt. However, when uncertainty of industry demand is low, then a firm may predict its sales and costs, and so may have a clear view of what profit it will receive in future. Knowing that, a firm understands whether it can pay its loan obligations or not, so it may prefer to finance its projects externally rather than internally.

Thus, probability of almost zero-leverage firm is positively related to demand uncertainty of industry in which a firm operates. Moreover, one would also divide the whole sample in Dividend paying and Zero-dividend almost zero-leverage firms to investigate whether demand uncertainty affects probability of a firm to become one of each of these two groups.

H2: If the first hypothesis is true, does portion of ZL and AZL firms are affected by uncertainty of industry demand?

After one observes that demand uncertainty of industry actually affects probability of a firm to become almost zero-leverage, this research will reconsider the question from a different angle. In the second hypothesis one would start from discussion of what portion of zero-leverage and almost zero-leverage firms exist in industries with the highest and the lowest uncertainty of demand. Then this research would attempt to find the relationship between portion of zero-leverage and almost zero-leverage firms and uncertainty of industry demand to prove the main hypothesis using the other way.

H3: How does market-to-book ratio and profitability interact with industry demand uncertainty to affect firm's leverage decision?

Finally, the last hypothesis states that interaction of market-to-book ratio or profitability with industry demand uncertainty may have an impact on the firm's decision to become zero-levered. Market-to-book ratio is a financial ratio used to compare a firm's market value with its book value. The market value represents the market capitalization of a firm and the book value of equity is the value of a firm if it sells all assets and repay all liabilities. A low market-to-book ratio (less than 1) may indicate the stock is undervalued and high ratio may be a sign that the stock of a firm is overvalued. So, it is appropriate to consider how these ratios may interact with demand uncertainty and together impact the probability of a firm to become ZL or AZL.

4. Data description and methodology

4.1 Sample construction

To construct the sample this research uses Thomson Reuters Datastream over the period 1990-2017. Here considered only publicly traded US firms and excluded two types of Industries: Financial and Utilities. The first group is excluded, because they have different structure of financial statements. Moreover, high leverage, which is appropriate for financial companies, is treated differently by non-financial companies (probably high leverage signals for distress). The second group is excluded, because it mostly regulated by the government and may undermine my results. Moreover, using Consumer Price Index from the US Bureau of Labor Statistics, this study adjusts all nominal variables to 2000-year dollar values. Also, out of scope are firm-year observations that contained total book value of assets less than 10 million dollars. This is done in order to eliminate noise that exists in financial data of these firms according to Strebulaev & Yang (2013). The research considers internal industry classification suggested by Thomson Reuters Datastream. There are 87 unique industries where sample companies operate and in Appendix 3 the full list of industries and calculated demand uncertainty is provided.

In the paper "date t" corresponds to a calendar year t and "observation i" refers to a firm i. As a result, the sample contains 8203 companies over the period 1990-2017 and some part of it are zero-leverage and almost zero-leverage firms. One defines them using two ratios: book leverage and market leverage ratios. The book leverage ratio is defined as follows:

$$Book\ leverage_{it} = \frac{Short-term\ debt_{it} + Long-term\ debt_{it}}{Total\ assets_{it}}$$

where short-term debt represents debt of a particular firm within one year and long-term debt exceeds maturity for more than one year. Total assets represent the sum of current and non-current assets of a firm.

Market leverage can be represented by the following formula:

$$Market\ leverage_{it} = \frac{Short-term\ debt_{it} + Long-term\ debt_{it}}{Short-term\ debt_{it} + Long-term\ debt_{it} + Market\ Price_{it} * \#\ Shares_{it}}$$

where nominator is similar to book leverage ratio, price represents the price of common share at the end of a fiscal year and number of shares is the number of common shares outstanding at the end of a fiscal year.

The choice between ratios is essential to my research. So, when running regressions, zero-leverage and almost zero-leverage firms are constructed on the basis of either market or book leverage ratios. When summary statistics are provided, book leverage ratio is used.

4.2 Definition of Zero-leverage and Almost Zero-leverage firms

Generally, a firm i is zero-leverage if the sum of long-term and short-term debt (total debt) is equal to zero. Both market leverage and book leverage can show that firm is zero-levered since they have similar nominators and it must equal to 0. In the sample for the period 1990-2017 there are 16840 (13.55%) firm-year observations out of 121704 that have zero-leverage (measured by book leverage). Strebulaev & Yang (2013) also suggest to extend this to almost zero-leverage (AZL) firms that have less than 5% book (market) leverage ratio. There are 38926 (31.98%) observations that are considered as almost zero-leverage. If one raises book leverage up to 7% or 10%, then there are 44009 (36.16%) or 51386 (42.2%) observations that refer to almost zero-leverage, correspondingly. The main logic to include almost zero-leverage firms in the discussion is ambiguity of different accounting conventions. As a result, some firms that in fact are zero-levered are excluded from the sample.

4.3 Definition of dependent and independent variables

In the regressions dummy zero-leverage or almost zero-leverage firms are created, and the cut-off is one of the two leverage ratios discussed above. Each dummy will be used in one of the three types of regressions.

$$ZL\ firm\ dummy = \begin{cases} 1, & if\ ratio = 0 \\ 0, & if\ otherwise \end{cases}$$

$$AZL\ firm\ dummy = \begin{cases} 1, & if\ ratio \leq 5\% \\ 0, & if\ otherwise \end{cases}$$

All variables are described in detail in Appendix 1, but here the most important control variables that used in the research will be outlined. As a proxy of firm's size, one uses natural logarithm of book value of assets adjusted to 2000-year dollars (suggested by Strebulaev & Yang). Market-to-book ratio represents ratio of market assets to book assets. The same researchers report that zero-leverage firms have higher market-to-book ratio compared to their proxies.

One of the variables is profitability ratio which is the ratio of Earnings before interest, taxes, depreciation and amortization to book value of assets. The majority of appropriate variables will be divided by total assets in order to consider firms with relative measures. In absolute terms these values do not provide a reliable measure to compare with each other.

Cash is divided by total assets to obtain a relative measure. It is hypothesized that many zero- or almost zero-leveraged firms have higher cash balances to alleviate a lack of debt capacity in accordance to financial constraints hypothesis.

Dividend is scaled to the firm's size in the models. The rationale is that firms may pay out dividends to signal to the market that they are of a good quality. So, firms that perform well can pay out higher dividends.

Tangibility is a ratio of fixed assets to book value of assets. Dang (2013) states that when there is a straight relationship between tangibility and leverage. According to Jensen and Meckling's (1976) asset substitution effect, when firms have small number of fixed assets, they will also experience low leverage.

An important argument why firms should take debt is the debt tax shield since it may increase value of a levered firm. However, if a firm can get benefits of favorable tax rates through, for example, non-debt tax shield, this advantage disappears. Non-debt tax shield represents depreciation, depletion and amortization scaled to the firm's size. It will be considered as it may provide an explanation why ZL or AZL firms maintain zero or low levels of leverage. Tax ratio is calculated as Income tax divided to total assets of a firm to become a relative measure. Thus, considering both tax ratio and non-debt tax shield is appropriate for this research.

Also, one of the most essential variables that will be considered in my research is demand uncertainty of industry. Proxy for this variable is the standard deviation of change in natural logarithm of Sales ($\sigma(\log(Sales_t) - \log(Sales_{t-1}))$) for all valid observations of industry in a year as suggested by Banker et al. (2013).

In the next chapter summary statistics on all variables that used in this research will be considered. Once again, all formulas and definitions are given in the Appendix 1.

5. Summary Statistics

Previous researchers (Strebulaev & Yang (2013), Dang (2013)) observed that zero-leverage firms have higher cash balances, pay higher dividends and are more profitable than their levered proxies measured by size. Main results of summary statistics are in line with these observations.

Table 1 demonstrates descriptive statistics of zero-leverage, almost zero-leverage and levered firms. The following results were obtained. For zero-leverage firms book leverage and market leverage ratios are equal 0. For almost zero-leverage firms market leverage and book leverage are equal to each other. For the levered firms the market leverage is insignificantly higher than book leverage, but they are almost equal. The same can be said about their standard deviations.

One of the main variables – demand uncertainty of industry – is higher for zero-leverage and almost zero-leverage firms and the lowest for levered firms. This finding means that ZL and AZL firms operate in more uncertain industry than levered firms, which prefer to take debt in industry where they can predict sales and costs.

As in line with Strebulaev & Yang (2013) cash balances are much higher for ZL and AZL firms. Their means are almost three times higher than for levered firms. Capital expenditures are lower for ZL and AZL firms compared to levered firms. What is also in line with the researchers mentioned above, common dividends ratio is higher for ZL and AZL firms, which means that on average these firms pay higher dividends than levered firms. However, standard deviation of ZL and AZL firms is twice than that of levered firms. Logarithm of book value of assets, which represents the size of a firm, is higher for levered firms compared to ZL and AZL firms, for which mean of ZL firm is the lowest. It may be in line with the financial constraints hypothesis that smaller firms prefer not to take any debt at all. Then as they become larger, AZL firms take small portion of debt in their capital structure and when they become big enough, levered firms prefer to take debt.

Surprisingly, profitability measured as the ratio of Earnings before interest, tax, depreciation and amortization to total assets is twice higher for levered firms than for almost zero-leverage firms and the lowest for zero-leverage where its average is only 0.3%.

Table 1. Descriptive statistics of zero-leverage, almost zero-leverage and levered firms

Panel A demonstrates the standard deviations and means of all variables used in this research. ZL firm dummy is equal 1 book leverage ratio equals 0, AZL firm dummy equals 1 if book leverage ratio is less or equal than 5% and Levered firm dummy equals 1 if book leverage ratio is greater than 5%. All means and standard deviations of variables are calculated for dummies based on book leverage except for alternative book leverage and market leverage ratios. For these variables classification of dummies is similar to the above discussion, but instead of book leverage, market leverage and alternative book leverage ratios are used.

Variable	ZL firms		AZL firms		Levered firms	
	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
Book leverage	0	0	0.01	0.014	0.309	0.228
Cash	0.397	0.272	0.329	0.255	0.125	0.149
Capital expenditures	0.059	0.085	0.0588	0.077	0.061	0.070
Demand uncertainty	0.718	0.381	0.642	0.369	0.494	0.316
Common Dividends	0.018	0.042	0.019	0.039	0.014	0.0255
Log(Size)	11.393	1.485	11.992	1.771	13.578	2.085
Market-to-book ratio	2.939	2.353	3.176	2.424	1.568	1.545
Market leverage	0	0	0.01	0.014	0.311	0.233
Net debt issuance	-0.0002	0.0009	-0.0001	0.008	-0.00008	0.00059
Non-debt tax shield	0.0317	0.0448	0.037	0.043	0.046	0.0541
Profitability	0.003	0.389	0.045	0.346	0.082	0.218
Tangibility	0.236	0.276	0.236	0.243	0.335	0.249
Tax	0.020	0.068	0.024	0.057	0.016	0.0402
Number of observations	16840		32824			88880

Moving on, market-to-book ratio is greater for ZL and AZL firms compared to levered firms. It means that zero-leverage and almost zero-leverage firms are growing firms and have large growing opportunities. Net debt issuance is greater for ZL and AZL firms compared to levered firms. It can be explained by the fact that levered firms prefer to decrease their total debt in a current year much less often than ZL and AZL firms. Non-debt tax shield, which is depreciation and amortization scaled to total assets, has a lower mean for zero-leverage and almost zero-leverage firms. Tangibility – ratio of fixed assets (for example, equipment, property and plant) to book value of

assets – shows that levered firms have higher average than zero-leverage and almost zero-leverage firms. This is in line with previous findings of this research.

Also, AZL firms pay higher taxes than levered and ZL firms. It is explained by the fact that levered firms use advantages of a debt tax shield, which decreases the amount of taxes to pay.

Overall, the most findings of this research on variables are in line with previous researches. However, there are some differences between this research and previous ones. The main one is that profitability is larger for levered firms rather than for ZL and AZL firms. Also, net debt issuance is very close to 0, but still negative for levered firms.

6. Empirical findings

6.1 Empirical findings on Hypothesis 1

The first hypothesis questions whether the demand uncertainty of industry affects probability of a firm to become almost zero-levered. The research extends this to observe whether demand uncertainty also impacts a dividend paying or zero-dividend firm to become almost zero-levered. So, one uses panel logit regression taking dependent variable as almost zero-leverage dummy (1 if book or market leverage ratio is less than 0.05 and 0 if otherwise). The control variables are demand uncertainty of industry for each year, market-to-book ratio, profitability ratio, common dividends ratio, logarithm of size, cash ratio, tangibility and taxes. All previous researchers (Strebulaev & Yang (2013), Dang (2013), etc.) suggest to run a model with fixed effects. So, fixed year and industry effects are included in the model. Moreover, all standard errors are adjusted for heteroscedasticity and clustering at firm level.

Before one begins the research, it is appropriate to choose a panel logit model with fixed or random effects. In order to do so, one runs the Hausman test to determine whether fixed or random effects model is better. Both of the models are constructed and then for the test one saves their coefficients with standard deviations to compare. So, the hypotheses are stated in the following way:

H_0: $difference\ in\ coefficients\ are\ not\ systematic$ $(choose\ RE\ model)$
H_1: $difference\ in\ coefficients\ is\ systematic$ $(choose\ FE\ model)$

The Hausman test produces Chi-squared statistic equal to 569.24. P-value is equal to 0, which means that since it is less than 1% significance level, the null hypothesis is rejected. Thus, further one will consider only panel logit regression with fixed effects.

Table 2 reports the main results of panel logit regression for the period 1990-2017 for the whole sample, then for zero-dividend firms and dividend paying firms. Since one uses different definitions of AZL firms (by market leverage and book leverage ratios), there are six regressions. For the whole sample demand uncertainty is significant, which indicates that it actually influences the probability of firm to become almost zero-levered. The market leverage and book leverage AZL dummy taken as dependent variable produce quite similar results, for which coefficients are significant or insignificant at the same significance levels, for the whole sample, dividend paying and zero-dividend firms. Demand uncertainty is also significant at 5% significance level for the dividend paying firms. However, one observes that for the sample of zero-dividend firms,

uncertainty of industry demand is insignificant, which means that demand uncertainty does not affect probability of a firm to become almost zero-levered for the following sample. Potential explanation can be that firms save dividends that would have been paid out otherwise and finance their projects with them. So, it does not matter in which industry a firm operates, as it will have money to finance projects anyway. In contrast, for dividend paying firms uncertainty of industry demand is essential as firms should consider it to decide about capital structure and pay out dividends.

Market-to-book ratio, common dividends ratio, logarithm of size, cash ratio and tax ratio are significant for all three groups of samples. All of them are significant at 1% significance level. For the sample of dividend paying firms tangibility ratio is insignificant.

Moreover, it is appropriate to consider whether time effects are the same. Under null hypothesis all time dummies are equal to 0 while under alternative hypothesis there exists at least one time dummy coefficient that is not equal 0.

$H_0: \beta_{1992} = \beta_{1993} = \cdots = \beta_{2017} = 0$
$H_1: \exists\ \beta_i \neq 0$

The Chi-squared statistic and p-value for these 6 regressions are reported in the Table 2. As one can see, p-value for all 6 regressions is equal to 0, which means that it is less than 1% significance level. Thus, one rejects null hypothesis, so time effects are not the same.

6.2 Empirical findings on Hypothesis 2

After one finds that demand uncertainty of industry influences probability of a firm to become zero- or almost zero-levered, the second hypothesis should also be discussed. It is stated in the following way: *"H2: If the first hypothesis is true, does portion of ZL and AZL firms are affected by uncertainty of industry demand?"* As the first hypothesis is proved for the whole sample, one would also want to reconsider it by running a linear regression on the proportion of zero-leverage and almost zero-leverage in the industry for each year. But before, it is essential to study distribution of these firms by various industries.

Table 2 reports the distribution of zero-leverage and almost zero-leverage firms in industries and its connection to the uncertainty of industry demand. As in line with Strebulaev & Yang (2013),

one calculates average uncertainty of demand and proportion of two types of firms for the period 1990-2017, assigning equal weight for every year. Also, average number of firms that operate in the industry is shown in the last column. Once again, classification of industries was suggested by Thomson Reuters Datastream (Worldscope – INDM5). As one can see, there is a high variation of firms that follow zero-leverage policy across industries. The highest demand uncertainty is in Biotechnology, General Mining, Alternative Fuels, Gold Mining and Diamonds & Gemstones industries. Biotechnology contains the highest average proportion of almost zero-leverage firms – 67% for the period 1990-2017. One of the highest number of zero-leverage firms relative to all firms is concentrated in General Mining and Diamonds & Gemstones – on average, there are 37%. The highest proportion of ZL firms is in Platinum & Precious Metals industry – 38%. In the same industry the third highest proportion of AZL firms (61%) is concentrated. The industries discussed above are traditionally considered as demand uncertain, because of firms' activities there. It is hard to predict sales, for example, Biotechnology or Diamonds & Gemstones, because the demand varies across the years.

The least uncertain industries are Trucking, Nondurable Household Production, Furnishings, Home Improvement Retail and Railroads industries. The highest proportion of AZL firms is in Home Improvement Retail – 35% of all firms in the industry. The lowest proportion of both ZL and AZL firms is in Railroads industry. There are no ZL firms in this industry and only 2% of AZL firms. This may be due to the fact that Railroads industry is highly certain industry. So, firms that operate there may easily predict demand to transport goods from one point to the other. Thus, there is no need to alleviate debt. Other industries that do not have zero-leverage firms at all are Electric Office Equipment and Integrated Oil & Gas. The latter may not contain any ZL firms because of complexity and high costs of projects, so these firms should take some portion of debt in their capital structure.

Many firms prefer to alleviate debt and finance their projects internally. Thus, they start to run zero-leverage or almost zero-leverage policies. However, ZL and AZL firms do not concentrate only in the high demand uncertain industries, they are widely distributed in all industries. For example, there are 63% of AZL firms in Software industry or 46% of AZL firms in Bus, Train and Employment industry. Thus, the zero-leverage phenomenon is not specialized, but rather widespread among industries.

Table 3 reports the main results of linear regression absorbing one categorical factor – Industry – for the period 1990-2017. The dependent variables are both proportion of zero-leverage and almost

zero-leverage to total number of firms for each year. In all linear regressions year fixed effects are included and standard errors are adjusted for heteroscedasticity. Control variables are demand uncertainty, market-to-book ratio, profitability, common dividends ratio, logarithm of size, cash ratio, tangibility and tax ratio. Each of dependent variables are calculated using either market leverage or book leverage definition. As the result, one observes that in all regressions demand uncertainty is highly significant. This means that demand uncertainty of industry has high impact on proportion of firms to become zero- or almost zero-leverage. All other control variables are all statistically significant at 5% significance level. Also, the adjusted R-squared is 83% for ZL firms and 85% for AZL firms. It means that only 83 % (85%) of variations in ZL dummy (AZL dummy) is explained by the model, which is high enough.

Analogously to the first hypothesis, one would also want to test whether time effects are the same for four regressions. In the Table 3 test-statistics are reported. As one can see, p-value equals 0 for both proportions of zero-leverage firms and almost zero-leverage firms to total firms in each year (ZL and AZL firms are measured using two definitions – by book leverage and by market leverage). So, since p-value is less than 1% significance level, one would reject the null hypothesis that coefficients of time dummies are equal 0. Thus, time effects are not the same in all of the four regressions.

6.3 Empirical findings on Hypothesis 3

Finally, as one proves that demand uncertainty influences probability of a firm to become almost zero-leverage (or proportion of zero-leverage and almost zero-leverage firms), the third hypothesis should be considered. It is stated in the following way "*H3: How does market-to-book ratio and profitability interact with industry demand uncertainty to affect firm's leverage decision?"* Now it is appropriate to consider how does interaction of either market-to-book ratio or profitability ratio with the uncertainty of demand influences probability of a firm to become zero-leverage.

Table 5 reports the results of panel logit regression, in which one includes the interaction variables of market-to-book ratio or profitability with demand uncertainty. Specifically, one includes the demand uncertainty dummy, where high (low) demand uncertainty of industry is defined as the demand uncertainty of a particular industry is higher (lower) than median (50^{th} percentile) for each year with profitability and market-to-book ratios. Both industry and year fixed effects are included in the models. Moreover, all standard errors are adjusted for heteroscedasticity and clustering at firm level. The results for zero-leverage firms suppose that the effect of Market-to-Book ratio is

mostly driven by observations, which exist in a lower demand uncertainty of industry. However, in contrast to that, the effect of profitability ratio is mostly driven by observations, which operate in a higher demand uncertainty of industry.

When one considers interaction of demand uncertainty with market-to-book ratio, it is observed that high demand uncertainty is statistically insignificant for the model. However, when one moves to the interaction of demand uncertainty with profitability, high demand uncertainty becomes significant, implying that it increases probability of a firm to become zero-leverage.

These models use the following control variables: profitability (where interaction of demand uncertainty and market-to-book ratio is considered), market-to-book ratio (where interaction of demand uncertainty and profitability ratio is considered), common dividends ratio, natural logarithm of size, cash, tax and non-debt tax shield ratios. All independent variables are statistically significant. The reason to include non-debt tax shield ratio in these models is that it is correlated with both variables of interaction, and when one adds it to the models, both interaction variables (high demand uncertainty with market-to-book ratio or profitability and low demand uncertainty with market-to-book ratio or profitability) are improved in terms of significance.

Next Section will describe the problem of endogeneity that may exist for these models and provide Instrumental Variable regressions with various tests.

7. Endogeneity and Instrumental Variable Regression

7.1 Potential endogeneity of demand uncertainty

In this research one considered influence of uncertainty of industry demand on probability of a firm to become zero-leverage or almost zero-leverage or on proportion these firms. However, what if both demand uncertainty and ZL or AZL firms are in fact affected by some unobserved factor that affects both of these variables? It can be the potential cause of omitted variable bias. Also, the other problem can be the reverse causality. What if not demand uncertainty influences probability of a firm to become zero-leverage (almost zero-leverage), but presence of these types of firm create uncertainty of demand in industries? The potential presence of problems like the reverse causality or omitted variable bias may signal that demand uncertainty is endogenous variable. Endogeneity implies that demand uncertainty may correlate with the error term, which may capture the variation of potential omitted variable discussed above. This causes violation of Gauss-Markov assumption in linear regressions that states that control variables do not correlate with the error. So, linear regressions in the second hypothesis can be inconsistent.

As a result, coefficients of control variables are higher than they actually are and t-statistics are incorrect. One should use the Instrumental Variable regression to eliminate the bias caused by endogenous demand uncertainty with the error term.

7.2 Instrumental Variable Regression

In econometrics exist different types of Instrumental Variables (IV) estimators to test a regression. This research uses Two-Stage Least Squares model (2TSLS). In this model there two stages of estimation. At the first stage the regression for endogenous variable is constructed and ran on various instruments. So, here one will use lag of demand uncertainty and recession variable as potential instruments for the demand uncertainty. Recession dummy equals 1 if in the year experienced a recession and 0 if otherwise. The data on recession is used from the US Federal Reserve Economic Data (FRED). At the second stage the Instrumental Variable (IV) regression is used and demand uncertainty is included in the linear regression model, where proportion of zero-leverage and almost zero-leverage firms is taken as a dependent variable. Intuitively, Two-Stage Least Squares model eliminates the bias of correlated error terms by keeping only error terms that were produced at the first stage.

7.3 Instrumental Variable Regression results

Finally, the Durbin-Wu-Hausman (DWH) test (the Augmented test for endogeneity) should also be conducted. First, one regresses demand uncertainty on its instruments – recession and lag of demand uncertainty and predicts the residuals. Then it is necessary to include it in regressions where dependent variable is a proportion of zero-leverage or almost zero-leverage firms as a control variable. After that one conducts DWH test on the significance of this error term with the following hypotheses:

$$H_0: \varepsilon_{it} = 0 \ (OLS \ is \ consistent)$$
$$H_1: \varepsilon_{it} \neq 0 \ (OLS \ is \ inconsistent)$$

Table 6 reports the F-statistics and p-value of the Durbin-Wu-Hausman test. As one can see, for all regressions p-value is equal to 0, which means that one should reject the null hypothesis of OLS consistency. Thus, OLS is inconsistent and other models should be considered.

Table 7 reports the main conclusions of IV regressions on zero-leverage and almost zero-leverage firm taken as dependent variables by two definitions – market leverage and book leverage ratios. All regressions include one endogenous variable – demand uncertainty of industry – and control variables: profitability, market-to-book ratio, common dividends ratio, natural logarithm of size, cash, tangibility and tax ratios. As one can see, the demand uncertainty of industry is significant in all regressions. For regressions where proportion of almost zero-leverage firms is taken as a dependent variable all coefficients are significant. For proportion of zero-leverage firms all variables are significant, except for tax ratio.

If one compares the results of the second hypothesis (Table 4) with the current, it can be noticed that for AZL firms profitability is insignificant in H2 while in IV regression it becomes significant at 1% significance level. For zero-leverage firms the coefficient of tax ratio was significant in H2, but in IV regression it becomes insignificant.

Also, it is appropriate to consider validity of instruments used for endogenous variable demand uncertainty. Sargan - Hansen test is necessary to consider here. It has the following null and alternative hypotheses:

$$H_0: all \ instruments \ are \ valid$$
$$H_1: some \ instruments \ are \ invalid$$

The Sargan – Hansen Chi-squared statistic is reported in the Table 6. As one can see, for proportion of zero-leverage firms p-value is almost equal to 0, which means that one will reject the null hypothesis of validity of all instruments. Thus, instruments (recession and lag of demand uncertainty) are not valid for regressions where proportion of zero-leverage firms is considered as a dependent variable. For AZL regressions both p-values are greater than 0, which implies that one should not reject the null hypothesis of validity of instruments. Thus, these instruments are valid for proportion of almost zero-leverage firms.

The results of Instrumental Variable (Two-Stage Least Squares) regression are very controversy to what has been previously established. If one looks at magnitude and direction of demand uncertainty of industry and other control variables, then he or she can find that IV regressions altered some of the outcomes. For proportion of zero-leverage firms instruments are invalid while for almost zero-leverage firms the same instruments are valid, which is a questionable evidence. Moreover, R-squared obtained from IV regressions is almost three times lower than those from Table 4 (Second hypothesis). There are two alternative explanations for this: either there exists a problem that models poorly fits the estimation or instruments that the research uses are invalid or irrelevant for demand uncertainty. Probably, the second problem is more likely to occur. The irrelevant instrument is that which have low correlation with endogenous variable. While lag of demand uncertainty has 70% correlation with demand uncertainty, the recession has only 4% correlation, so it can be considered as the weak instrument. This means that demand uncertainty may be actually not affected by the recession in the US. So, potentially this instrument may correlate with unobservable variable captured by the error term. Thus, the problem of endogeneity is not solved by the provided instruments, and this leads to the poor estimates. More will be discussed in the conclusion when recommendations for further research will be outlined.

8. Conclusions and Recommendations for Further Research

This thesis provides a research on how demand uncertainty of industry affects leverage decision of a firm to become zero-leverage or almost zero-leverage. The study considers two alternative definitions of ZL and AZL firms – by market leverage and by book leverage ratios. ZL firm is a firm that have one of these ratios equal to 0 and AZL firm is a firm that have leverage ratio less than 5%. The study was inspired by Strebulaev and Yang's (2013) study of zero-leverage puzzle that observed that around 30% of the US firms are zero- or almost zero-leverage. So, this research aims to find what can be significant explanatory variable that affect probability of a firm to become ZL or AZL. To explore it, we use the data from Thomson Reuters Datastream on all US non-publicly traded companies that have book value of assets greater than 10 million dollars and then state three hypotheses and main results will be provided on each of them.

8.1 Conclusions on Hypothesis 1

This hypothesis aims to prove that demand uncertainty of industry affects probability of a firm to become ZL or AZL. One considers three samples here: all firms, only dividend paying firms and zero-dividend firms. In these panel logit regressions for the period 1990-2017 fixed year and industry effects are included. All standard errors are adjusted to heteroscedasticity and clustering at firm level. As the result, one observes that for the whole sample of firms and only for dividend paying firms demand uncertainty of industry affects probability of a firm to become almost zero-leverage. However, for zero-dividend firms impact of demand uncertainty is insignificant on the probability of a firm to become AZL. Some explanation was given in this thesis, but, however, it requires further consideration. Additional tests showed that one panel logit model with fixed effects is more preferable than model with random effects. Moreover, test on whether time effects are the same reported that time effects for each year are different.

8.2 Conclusions on Hypothesis 2

The second hypothesis considers impact of demand uncertainty of industry on the proportions of zero-leverage and almost zero-leverage firms to total number of firms in a sector for each year. Appendix 3 provides full list of industries that was suggested by the internal classification of Thomson Reuters Datastream (Worldscope – INDM5). It was observed that one of the highest demand uncertain industries are Biotechnology, General Mining and Alternative Fuels while the least uncertain are Trucking, Nondurable Household Production and Furnishings. Then the linear regressions were run on the 1990-2017 period absorbing one categorical factor – Industry. The same as in the first hypothesis, year fixed effects are included, standard errors are adjusted for

heteroscedasticity and clustering at firm level. The dependent variables are ratio of ZL (AZL) firms to total number of firms measured either by book or market leverage ratios. For all regressions demand uncertainty of industry is significant and have high influence on proportions of ZL and AZL firms. Moreover, additional test on whether time effects are the same shows that there are different for each year.

8.3 Conclusions on Hypothesis 3

The third hypothesis considers whether interaction of demand uncertainty with market-to-book ratio or with profitability impacts probability of a firm to become zero-leverage. The study offers four regressions, where a zero-leverage firm is measured by either market or book leverage ratio. Once again, fixed year and industry effects are included, all standard errors are adjusted for heteroscedasticity and clustering at firm level. In addition to all previous control variables we add non-debt tax shield ratio that increases significance of interaction terms. High (low) demand uncertainty dummy is defined in the following way: it equal 1 if higher (lower) than median (50^{th} percentile) and 0 if otherwise. As the result, interaction of low demand uncertainty with market-to-book ratio influences the probability of a firm to become zero-leverage and interaction of high uncertainty of demand with profitability ratio also has a high impact on probability of a firm to become zero-leverage. High demand uncertainty by itself is significant only when the interaction of high demand uncertainty with profitability ratio is considered.

8.4 Limitations of the models and recommendations for further research

Finally, there are some limitations that were essential to all hypotheses. As it was mentioned before, there are two main problems: the reverse causality problem and omitted variable bias. Even though, probability of zero-leverage and almost zero-leverage firms was regressed on demand uncertainty of industry and other control variables, the reverse also holds, when demand uncertainty is influenced by the presence of ZL and AZL firms. The other problem is that there still can be some variables that were omitted in the model. All of those problems may give a rise to endogeneity which also should be considered.

The potential further research is to study demand uncertainty as endogenous variable and explore what instruments can predict this variable. Moreover, this research considers the benefits of debt tax shield ratio only using as a proxy tax ratio. It would be appropriate to consider what other tax benefits may weak the value of the debt tax shield and look at how they interact with demand uncertainty.

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Appendix 1. Definitions of used variables

Variable	Description	Formula
Alternative Book leverage		Provided on p.15
Book leverage		Provided on p.14
Cash	Ratio of cash holdings and short-term investments to Total Assets	$Cash = \frac{Cash\ \&\ ST\ Investments}{Total\ Assets}$
Capital Expenditures	Ratio of Capital Expenditures to Total Assets	$CapEx = \frac{Capital\ expenditures}{Total\ Assets}$
Consumer price index (CPI)	The consumer price index is calculated by the US Bureau of Labor Statistics	$CPI = \frac{Current\ year\ price}{Base\ year\ price} * 100\%$
Demand uncertainty	Standard deviation of first difference in natural logarithm of Sales of industry i	$Uncertainty = \sigma(\log(Sales_t) - \log(Sales_{t-1}))$
Dividend	Ratio of common dividends to Total Assets	$Dividend = \frac{Common\ dividends}{Total\ Assets}$
Log(Size)	Natural logarithm of Total assets adjusted for the year 2000	$\log(\frac{Total\ assets * CPI_{2000}}{CPI_t})$
Market-to-book ratio	Ratio of market value of Equity to book value of Equity	$MB\ ratio = \frac{Market\ price * \#Shares\ outstanding}{Total\ Assets - Total\ Liabilites}$
Market leverage		Provided on p.14
Net debt issuance	Ratio of the change in sum of ST and LT debt by Total Assets	$Net\ debt\ issuance = \frac{(ST\ Debt + LT\ Debt)_t - (ST\ Debt + LT\ Debt)_{t-}}{Total\ Assets}$
Non-debt tax shield	Ratio of depreciation and amortization to Total Assets	$NDTS = \frac{Depreciation\ \&Amortization}{Total\ Assets}$
Profitability	Ratio of Earnings before interest, tax, depreciation and amortization and Total Assets	$Profitability = \frac{EBITDA}{TA}$
Tangibility	Ratio of Fixed assets to Total Assets	$Tangibility = \frac{Fixed\ Assets}{Total\ Assets}$
Tax	Ratio of tax expenses to Total Assets	$Tax = \frac{Income\ tax}{Total\ Assets}$

Appendix 2

Table 2: Determinants of Almost Zero-leverage Policy

The table reports main results of panel logit regression for the period 1990-2017. The dependent variable is almost zero-leverage dummy, taking the value of 1 if book leverage (market leverage) is less or equal than 5 per cent and 0 if otherwise. In columns (1), (3) and (5) AZL dummy is measured using the definition of book leverage and in columns (2), (4) and (6) AZL is defined by market leverage ratio. Columns 1-2 show the results of panel logit regression for the whole sample. Columns 3-4 report the results only for almost zero-levered firms that do not pay dividends. Columns 5-6 represent the results for almost zero-levered firms that pay out dividends. All control variables are defined in the Appendix A. Coefficients and robust standard errors (in parentheses) are reported. In all logit panel regressions fixed year effects and industry fixed effects are included. All standard errors are adjusted to alleviate heteroscedasticity and clustering at firm level. Coefficients that have ***, **, * are significant at 1%, 5% and 10% significance level, correspondingly.

Independent Variables	**(1) ALL** (by book leverage)	**(2) ALL** (by market leverage)	**(3) ZD** (by book leverage)	**(4) ZD** (by market leverage)	**(5) DP** (by book leverage)	**(6) DP** (by market leverage)
Demand uncertainty	0.102**	0.104**	0.031	0.031	0.165**	0.163**
	(0.044)	(0.044)	(0.061)	(0.062)	(0.066)	(0.065)
Market-to-book ratio	0.285***	0.322***	0.291***	0.326***	0.288***	0.330***
	(0.773)	(0.009)	(0.009)	(0.0098)	(0.017)	(0.018)
Profitability	0.773***	0.721***	0.692***	0.647***	-0.191	-0.244
	(0.084)	(0.084)	(0.068)	(0.068)	(0.309)	(0.333)
Common Dividends	5.634***	5.741***	-	-	4.297***	4.393***
	(0.578)	(0.579)			(0.745)	(0.744)
Log(Size)	-0.342***	-0.341***	-0.304***	-0.303***	-0.399***	-0.397***
	(0.011)	(0.011)	(0.014)	(0.014)	(0.018)	(0.018)
Cash	4.740***	4.743***	4.134***	4.135***	6.114***	6.096***
	(0.122)	(0.124)	(0.122)	(0.123)	(0.239)	(0.239)
Tangibility	-0.427***	-0.416***	-0.641***	-0.626***	-0.195	-0.190
	(0.102)	(0.102)	(0.11)	(0.11)	(0.191)	(0.190)
Tax	5.533***	5.670***	2.431***	2.542***	15.054***	15.185***
	(0.528)	(0.530)	(0.418)	(0.424)	(1.258)	(1.277)

Constant	0.718** (0.281)	0.691** (0.282)	0.319 (0.358)	0.293 (0.358)	1.211*** (0.419)	1.171*** (0.417)
Observations	110444	110444	51434	51434	59010	59010
Year fixed effects	YES	YES	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES	YES	YES
Test: whether time effects are the same: Chi2-stat (p-value)	244.34 (0.000)	250.95 (0.000)	197.15 (0.000)	199.27 (0.000)	114.92 (0.000)	115.36 (0.000)
Pseudo R-squared	0.3264	0.3341	0.3124	0.3218	0.3353	0.3407

Appendix 3

Table 3: Demand uncertainty by industries and zero-leverage and almost zero-leverage firms

Demand uncertainty is the standard deviation of first difference of natural logarithms of Sales of a firm i. Higher demand uncertainty variables means that the industry is more uncertain. This table represents demand uncertainty and distribution of zero-leverage and almost zero-leverage firms in 87 industries as defined by the Thomson Reuters Datastream internal classification (Worldscope – INDM5). Column 1 shows the list of industries provided by the following classification. Column 2 represents demand uncertainty of industry and sorted in the descending order. Column 3 and 4 report the average fractions of zero-leverage and almost zero-leverage firms in industries for the period 1990-2017, assigning equal weight for every year. Column 5 shows the average number of firms in industry in each year.

	Industry	Demand uncertainty	ZL	AZL	Total
1	Biotechnology	1.238742	33%	67%	254
2	General Mining	1.202013	37%	50%	204
3	Alternative Fuels	1.138579	19%	35%	19
4	Gold Mining	1.077495	32%	53%	143
5	Diamonds & Gemstones	1.020278	37%	53%	16
6	Nonferrous Metals	1.00299	26%	42%	75
7	Exploration & Prod.	0.9021544	24%	35%	300
8	Pharmaceuticals	0.8750123	17%	48%	165
9	Platinum & Precious Metal	0.8334868	38%	61%	30
10	Coal	0.8164083	10%	22%	33
11	Renewable Energy Eq.	0.7735834	12%	43%	38
12	Internet	0.7293576	27%	57%	48
13	Waste, Disposal Services	0.6714936	10%	28%	30
14	Telecom. Equipment	0.654039	22%	49%	109
15	Software	0.6445878	32%	63%	174
16	Medical Equipment	0.6127984	17%	47%	113
17	Media Agencies	0.5945068	14%	34%	44
18	Special Consumer Service	0.5925537	18%	40%	61
19	Gambling	0.5770885	10%	29%	62
20	Medical Supplies	0.5652667	17%	44%	50
21	Financial Admin.	0.5632572	11%	33%	32
22	Aluminum	0.560722	6%	14%	11
23	Iron & Steel	0.5600252	6%	18%	55

24	Toys	0.5533514	19%	40%	27
25	Computer Services	0.5360308	22%	46%	72
26	Business Support Services	0.5322614	8%	28%	136
27	Specialty Chemicals	0.5105741	7%	19%	111
28	Pipelines	0.5098813	7%	13%	44
29	Consumer Electronics	0.5029606	10%	26%	19
30	Broadcast & Entertain	0.4950088	4%	17%	79
31	Fixed Line Telecom.	0.4861415	3%	8%	51
32	Electronic Equipment	0.4802831	19%	44%	101
33	Transport Services	0.4675385	4%	19%	65
34	Recreational Products	0.4647467	14%	34%	29
35	Marine Transportation	0.457654	2%	6%	55
36	Oil Equip. & Services	0.4562708	7%	22%	130
37	Publishing	0.4502494	17%	34%	51
38	Drug Retailers	0.4467019	6%	29%	12
39	Healthcare Providers	0.4329132	9%	22%	72
40	Electrical Equipment	0.4228411	11%	28%	119
41	Food Products	0.4207965	6%	23%	135
42	Specialty Retailers	0.4178367	11%	30%	89
43	Bus, Train & Employment	0.4150342	19%	46%	30
44	Auto Parts	0.4121458	5%	14%	63
45	Aerospace	0.4115956	3%	12%	40
46	Defense	0.4085405	9%	23%	30
47	Recreational Services	0.3945548	8%	20%	33
48	Computer Hardware	0.3861933	16%	42%	59
49	Tobacco	0.3790425	1%	17%	16
50	Restaurants & Bars	0.3746417	7%	24%	69
51	Mobile Telecom.	0.3733465	4%	19%	45
52	Farm Fish Plantation	0.3703563	5%	19%	40
53	Semiconductors	0.3649374	26%	54%	99
54	Heavy Construction	0.3440776	3%	16%	79
55	Building Materials & Fixtures	0.3392695	4%	15%	117
56	Forestry	0.3373315	2%	9%	10
57	Durable Household Prod.	0.3326346	9%	22%	43
58	Travel & Tourism	0.3301668	6%	20%	37
59	Soft Drinks	0.3272895	6%	25%	26
60	Hotels	0.3252583	1%	5%	25
61	Automobiles	0.3240966	2%	14%	31

62	Elec. Office Equip.	0.3238858	0%	16%	9
63	Commercial Vehicles, Trucks	0.3234827	4%	15%	73
64	Industrial Machinery	0.3199596	5%	25%	150
65	Divers. Industrials	0.3187398	2%	8%	50
66	Home Construction	0.3183361	9%	20%	35
67	Clothing & Accessory	0.3157586	8%	33%	67
68	Distillers & Vintners	0.3120419	6%	17%	20
69	Footwear	0.3065127	15%	49%	22
70	Integrated Oil & Gas	0.3047264	0%	10%	27
71	Personal Products	0.2929325	5%	35%	34
72	Industrial Suppliers	0.2755643	6%	21%	32
73	Tires	0.2679704	1%	7%	13
74	Apparel Retailers	0.267207	24%	55%	63
75	Containers & Package	0.2655202	1%	10%	38
76	Broadline Retailers	0.2594931	6%	25%	45
77	Brewers	0.2516927	8%	16%	18
78	Paper	0.2509784	2%	4%	23
79	Food Retail, Wholesale	0.2507623	7%	22%	52
80	Airlines	0.1831694	2%	8%	38
81	Commodity Chemicals	0.1728261	2%	7%	36
82	Delivery Services	0.1726184	3%	32%	15
83	Railroads	0.1724867	0%	2%	10
84	Home Improvement Retail	0.1674296	8%	35%	15
85	Furnishings	0.1641012	10%	30%	27
86	Nondurable Household Prod	0.1545892	3%	19%	16
87	Trucking	0.1389245	12%	27%	21
	Total				5304

Appendix 4

Table 4: Proportion of Zero-leverage and Almost Zero-leverage firms and Demand Uncertainty of industry

This table reports the main results of linear regression absorbing one categorical factor – Industry for the period 1990-2017. In Columns (1) and (2) the dependent variable is the ratio of zero-leverage firms to total number of firms in the industry for each year, where the zero-leverage dummy is 1 if book or marker leverage ratio equals 0 and 0 if otherwise. In Columns (2) and (4) the dependent variable is the ratio of almost zero-leverage firms to total number of firms in the industry for each year, where the almost zero-leverage dummy is 1 if book or marker leverage ratio is less than or equal to 5% and 0 if otherwise. In Columns (1) and (3) number of ZL and AZL firms are calculated using book leverage ratio and in Columns (2) and (4) number of ZL and AZL firms are calculated using market leverage ratio. All control variables are defined in the Appendix A. Coefficients and robust standard errors (in parentheses) are reported. In all linear regressions year fixed effects are included. All standard errors are adjusted for heteroscedasticity. Coefficients that have ***, **, * are significant at 1%, 5% and 10% significance level, correspondingly.

Independent Variables	(1) ZL (by book leverage)	(2) ZL (by market leverage)	(3) AZL (by book leverage)	(4) AZL (by market leverage)
Demand uncertainty	0.020***	0.020***	0.034***	0.035***
	(0.001)	(0.001)	(0.001)	(0.001)
Market-to-book ratio	0.001***	0.001***	0.004***	0.004***
	(0.00008)	(0.00008)	(0.0001)	(0.0001)
Profitability	-0.003***	-0.002***	0.0008	0.0008
	(0.0007)	(0.0007)	(0.00097)	(0.001)
Common Dividends	-0.017***	-0.017***	-0.038***	-0.038***
	(0.005)	(0.005)	(0.007)	(0.007)
Log(Size)	-0.0008***	-0.0008***	-0.00096***	-0.00097***
	(0.00008)	(0.00008)	(0.0001)	(0.0001)
Cash	0.0129***	0.013***	0.024***	0.024***
	(0.0009)	(0.0009)	(0.001)	(0.001)
Tangibility	-0.002**	-0.002**	-0.003**	-0.003***
	(0.0009)	(0.0009)	(0.001)	(0.001)
Tax	-0.0068**	-0.007**	0.0086*	0.0089**
	(0.003)	(0.003)	(0.004)	(0.004)
Constant	0.078***	0.078***	0.202***	0.204***
	(0.002)	(0.002)	(0.004)	(0.004)
Observations	110444	110444	110444	110444
Absorb by industry	YES	YES	YES	YES

Year fixed effects	YES	YES	YES	YES
Test: whether time effects are the same: Chi2-stat (p-value)	306.32 (0.000)	306.32 (0.000)	888.73 (0.000)	933.77 (0.000)
Adjusted R-squared	0.8371	0.8371	0.8520	0.8509

Appendix 5

Table 5: Interaction of Demand uncertainty with Market-to-Book ratio for Zero-leverage and Almost Zero-leverage firms

This table reports the main results of panel logit regression for the period 1990-2017 and shows the interaction of demand uncertainty and market-to-book ratio. The dependent variable is zero-leverage dummy. In Columns (1) and (3) ZL dummy is calculated using the book leverage ratio and in Columns (2) and (4) ZL dummy is calculated using the market leverage ratio. High (low) demand uncertainty dummy is 1 if demand uncertainty of industry is above (below) the sample median and 0 if otherwise. All control variables are defined in the Appendix A. Coefficients and robust standard errors (in parentheses) are reported. In all logit panel regressions fixed year effects and industry fixed effects are included. All standard errors are adjusted to alleviate heteroscedasticity and clustering at firm level. Coefficients that have ***, **, * are significant at 1%, 5% and 10% significance level, correspondingly.

Independent Variables	(1) ZL (by book leverage)	(2) ZL (by market leverage)	(3) ZL (by book leverage)	(4) ZL (by market leverage)
High Demand uncertainty x	0.012	0.012		
Market-to-Book ratio	(0.0098)	(0.0098)		
Low Demand uncertainty x	0.03**	0.03**		
Market-to-Book ratio	(0.015)	(0.015)		
High Demand uncertainty x			-0.469***	-0.469***
Profitability ratio			(0.906)	(0.906)
Low Demand uncertainty x			0.132	0.132
Profitability ratio			(0.099)	(0.099)
High Demand uncertainty	0.030	0.030	0.090**	0.090**
dummy	(0.049)	(0.049)	(0.038)	(0.038)
Profitability	0.490***	0.490***		
	(0.075)	(0.075)		
Market-to-Book ratio			0.022**	0.022**
			(0.009)	(0.009)
Common Dividends	5.586***	5.586***	6.303***	6.303***
	(0.675)	(0.675)	(0.666)	(0.666)
Log(Size)	-0.442***	-0.442***	-0.433***	-0.433***
	(0.016)	(0.016)	(0.016)	(0.016)
Cash	4.130***	4.130***	4.094***	4.094***
	(0.116)	(0.116)	(0.117)	(0.117)

Tax	2.985***	2.985***	3.987***	3.987***
	(0.482)	(0.482)	(0.519)	(0.519)
Non-debt tax shield ratio	-5.509***	-5.510***	-5.194***	-5.194***
	(0.756)	(0.756)	(0.758)	(0.758)
Constant	0.517	0.517	0.438	0.438
	(0.382)	(0.382)	(0.378)	(0.379)
Observations	111397	111397	111871	111871
Year fixed effects	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES
Pseudo R-squared	0.3165	0.3165	0.3123	0.3158

Appendix 6

Table 6: Durbin Wu Hausman test statistics

Durbin Wu Hausman Test	(1) ZL (by book leverage)	(2) ZL (by market leverage)	(3) AZL (by book leverage)	(4) AZL (by market leverage)
F-statistics	8166.43	8166.43	4918.21	4979.83
p-value	(0.000)	(0.000)	(0.000)	(0.000)

Table 7: Two-Stage Least Squares model, where demand uncertainty of industry is endogenous

This table reports the main results of Instrumental Variable regression for the period 1990-2017. In Column (1) and (2) are outlined regressions that take proportion of zero-leverage firms to all firms for each year in a particular industry as a dependent variable. In columns (3) and (4) are outlined regressions that take proportion of almost zero-leverage firms to all firms for each year in a particular industry as a dependent variable. In Columns (1) and (3) zero-leverage and almost zero-leverage firms are measured using the book leverage ratio while Columns (2) and (4) outline firms that were defined using the market leverage ratio. Demand uncertainty is an endogenous variable which uses recession dummy (1 if the year experienced recession and 0 if otherwise) and lag of demand uncertainty as instruments. In the last row Sargan-Hansen Chi-squared test statistic is reported. Coefficients that have ***, **, * are significant at 1%, 5% and 10% significance level, correspondingly.

Independent Variables	(1) ZL (by book leverage)	(2) ZL (by market leverage)	(3) AZL (by book leverage)	(4) AZL (by market leverage)
Demand uncertainty	0.266***	0.266***	0.347***	0.348***
	(0.001)	(0.001)	(0.002)	(0.002)
Profitability	0.012***	0.012***	0.023***	0.023***
	(0.001)	(0.001)	(0.002)	(0.002)
Market-to-book ratio	0.003***	0.003***	0.012***	0.012***
	(0.0002)	(0.0002)	(0.0003)	(0.0002)

Common Dividends	-0.065*** (0.010)	-0.065*** (0.010)	-0.128*** (0.016)	-0.125*** (0.016)
Log(Size)	-0.006*** (0.0002)	-0.006*** (0.0002)	-0.011*** (0.0002)	-0.011*** (0.0002)
Cash	0.046*** (0.002)	0.046*** (0.002)	0.104*** (0.003)	0.107*** (0.003)
Tangibility	-0.035*** (0.001)	-0.035*** (0.001)	-0.155*** (0.002)	-0.158*** (0.002)
Tax	-0.0003 (0.007)	-0.0003 (0.007)	0.073*** (0.0104)	0.072*** (0.0105)
Constant	0.069*** (0.002)	0.069*** (0.002)	0.278*** (0.003)	0.280*** (0.004)
R-squared	0.3452	0.3452	0.3606	0.3632
Observations	103086	103086	103086	103086
Sargan-Hansen test statistic (p-value)	15.856*** (0.0001)	15.856*** (0.0001)	0.112 (0.7383)	1.253 (0.2630)