The External Financing of Investment

Bruce D. Grundy and Patrick Verwijmeren*

14 March 2018

Abstract

Rather than examining firm-level data on capital structure and asset structure, we connect the financing choice to the characteristics of specific investments. We hand-collect and classify those characteristics. Controlling for a firm's existing assets, capital structure and valuation, we document a strong link between an investment's characteristics and the type of security issued if the investment is externally financed. Investments with more volatile and distant payoffs tend to be equity-financed. Investments in assets that are both tangible and non-unique tend to be debt-financed. The likelihood of debt financing increases with the need for monitoring and convertibles are relatively more common when payoffs are volatile and investment life is uncertain. Factor analysis indicates that the principal dimension determining the form of financing is the R&D-like nature of an investment.

JEL classification: E22, G32

Keywords: Investment characteristics, financing, debt-equity choice, convertible securities

* Bruce Grundy (bruceg@unimelb.edu.au) is from the University of Melbourne, and Patrick Verwijmeren (verwijmeren@ese.eur.nl) is from Erasmus School of Economics and the University of Melbourne. We would like to thank Mats van Marle and Hugo Wolters for excellent research assistance. We thank Gil Aharoni, Ali Akyol, James Brugler, Tze Chuan Ang, Sjoerd van Bekkum, Tobias Berg, Les Coleman, Neal Galpin, Ning Gong, Georges Hübner, Joachim Inkmann, Patrick Kelly, Marie Lambert, Ed Lin, Lyndon Moore, Wei Opie, Zacharias Sautner, Harminder Singh, Günter Strobl, Sheridan Titman, David Yermack, Jing Zeng and seminar participants at Deakin University, Frankfurt School of Finance and Management, the University of Melbourne, the University of Western Australia, and the University of Liège for helpful comments. Part of this work was completed while Grundy was visiting the McCombs School of Business and the Erasmus School of Economics.

1. Introduction

This paper investigates the impact of investment characteristics on the debt-equity choice. Trade-off theory recognizes that the optimal balance between debt's financial distress costs and tax advantages depends on an investment's risk characteristics and the time until taxable income is produced. The superior information enjoyed by management in the pecking order theory (Myers, 1984) and market timing theory (Baker and Wurgler, 2002) can also be impacted by the characteristics of a firm's investments. Further, agency costs can be impacted by investment characteristics (Jensen and Meckling, 1976). We rationalize and document a strong empirical link between the characteristics of investments and firms' choices between issuing debt or equity to raise the necessary finance.

Rather than examining firm-level data on capital structure and asset structure, we connect the financing choice to the characteristics of specific investments. We hand-collect and classify those characteristics.[1] Since recapitalizing a firm is costly, past performance can mean capital structure will deviate from the optimum and the observed cross-sectional relation between asset characteristics and leverage will then be a noisy variant of the optimal relation (Strebulaev, 2007). Our examination of the financing of new investments focuses on the situation when the relevant transaction cost of issuing securities is only the marginal cost of issuing debt versus equity; i.e., on the situation when managers can largely focus on future restructuring costs, agency costs, taxes, information asymmetries, and security mispricing issues. We examine all instances of seasoned equity, straight debt and convertible issues by U.S. firms between 1995 and 2014 where the stated *use of proceeds* is capital expenditure and we can determine the characteristics of the investment.

The set of investment characteristics that we investigate are as follows: whether the investment is both tangible and non-unique; whether the investment is part of an R&D program; the investment's expected life; the uncertainty surrounding that life; the time until the investment will begin to generate positive payoffs; the volatility of the payoffs; and the need for monitoring. Controlling for a firm's existing assets, capital structure, and valuation, we document that five of these seven characteristics are statistically significant determinants of the financing choice. Investments with more volatile payoffs and investments in R&D-like

[1] Other studies that focus on the financing of new investments do not examine their characteristics. Dudley (2012) examines Compustat firm-years in which investments exceed 1.5 times the median industry rate while Elsas, Flannery and Garfinkel (2015) examines Compustat firm-years in which investments exceed 30% of assets. These papers link the debt-equity choice to the difference between firms' existing and target capital structures, a measure that we incorporate as a control.

programs are more likely to be financed by issuing equity. In contrast, investments in tangible non-unique assets, or in assets with more uncertain lives, or in assets that require a high level of monitoring are more likely to be financed by issuing debt. Consistent with a benefit from a future ability to force conversion during a staged investment program, we find that callable convertibles tend to be used to finance high volatility investments with uncertain lives.

The seven investment characteristics are correlated and their separate effects are not immediately clear—consider investment life versus the time until positive payoffs. We therefore use factor analysis to investigate a smaller set of common factors underlying the characteristics. Investment characteristics vary primarily along a dimension that is consistent with the R&D-like nature of the investment, while the second (third) most important factor relates to the tangible and non-unique nature of an investment coupled with long life (the tangible and non-unique nature of an investment coupled with low payoff volatility). A regression of the debt-equity choice on these three factors indicates that the R&D-like nature of an investment is positively related to the probability of an equity issue, while investments that load heavily on the tangible, non-unique characteristics coupled with either long-term payoffs or non-volatile payoffs are more likely to be debt-financed.

Our analysis is innovative by connecting specific financing choices to specific investment characteristics and our main contribution is to improve our understanding of how investment characteristics impact financing decisions. Our study also contributes to the literature on collateral value as a determinant of the financing choice. Titman and Wessels (1988) observes that tangibility is only a partial measure of whether an asset has collateral value. An investment has collateral value only to the extent it is both tangible and redeployable. Tangible assets can be offered for sale. But only if the asset is non-unique and therefore redeployable will there be any demand from buyers. Determining the uniqueness of the set of assets owned by a firm using Compustat firm-level data requires using crude proxies for uniqueness such as expenditures on research and development, marketing expenses, and the rate at which employees voluntarily leave their jobs. In contrast, we estimate the uniqueness of specific investments be examining the breadth of the resale market for the particular investment. We show that it is the non-unique character of a tangible asset that is an important driver of the debt-equity financing choice and not its tangibility per se.

Our study has potential limitations. Naturally, a sample of externally-financed investments necessarily conditions on the fact that the firm was either unwilling or unable to finance via

retained earnings.[2] Also, our determination of the characteristics of investments involves some subjectivity. Another limitation is that our sample investigates only those investments for which we can obtain information on the characteristics of the investments. Still, we succeed in examining every public seasoned-equity, convertible, and straight debt issue used by non-utility and non-financial U.S. firms between 1995 and 2014 where the stated use of proceeds is capital expenditures and where either issuer announcements or press stories contain sufficient information to determine the investments' characteristics. A further potential limitation is that issuer announcements and press stories may be more likely to contain information sufficient to determine the investment's characteristics when the investment is equity-financed. We use a sample selection model to control for this last possibility.

The paper is organized as follows. Section 2 discusses the theoretical link between investment characteristics and the debt-equity choice. Section 2 also develops predictions on the signs of the coefficients of a logistic regression of the financing choice on both the set of investment characteristics and a set of controls suggested by the extant capital structure literature. Section 3 describes the classification of investment characteristics. Section 4 reports the initial logistic regression results of the relation between financing and characteristics. Section 5 shows that the results are similar when a Heckman two-stage sample selection procedure is employed. Section 6 investigates the common factors underlying investment characteristics and the link between these factors and the debt-equity choice. Section 7 focuses on convertible bond financing and the characteristics of investments financed by issuing a convertible rather than either equity or straight debt. Section 8 concludes.

2. Investment characteristics and the financing choice

Trade-off theory predicts that when a firm's existing capital structure deviates from its optimum, that deviation will impact the financing of a new investment. And since the pecking order and market timing explanations of the financing choice will also play a role in how a new investment is financed, our empirical analysis controls for determinants of the financing choice beyond the investment's characteristics.

2.1 Investment characteristics: Theory

[2] Ajello (2016) estimates that, consistent with a pecking order based preference for internal financing, only 27 percent of capital expenditures by U.S. non-financial firms during the 1989 through 2008 period were funded by new issues of debt or equity.

Investment characteristics that potentially affect the financing choice are the investment's collateral value; whether the investment is part of a sequential program; the expectation of the investment's life; the uncertainty surrounding that life; the volatility of the investment's payoffs; the time until the investment begins to produce income; and the degree of monitoring required.

2.1.1. Collateral value

While traditional trade-off theory predicts a positive link between collateral value and debt financing, Haugen and Senbet (1978) observes that if costs similar to those associated with bankruptcy (e.g., liquidation costs) would have been incurred by an all-equity financed firm that experienced similarly poor operating performance, then the marginal bankruptcy cost associated with debt financing would be zero and collateral value will be unrelated to the choice between debt and equity. The event of bankruptcy and the decision to bear the costs of liquidation would be correlated, but debt-financing would not be the cause of the incurrence of liquidation costs. Thus the trade-off theory notion of a trade-off between financial distress costs associated with debt financing and tax benefits of debt financing must implicitly assume that stockholder-bondholder coordination costs mean that levered and unlevered firms differ in their restructuring decisions (Titman, 1984). White (1989) shows that coordination costs in conjunction with the U.S. bankruptcy code can lead levered firms to continue loss-making operations when an otherwise equivalent all-equity financed firm would liquidate or otherwise restructure.[3] When assets have high collateral value more secured debt can be issued without risking bankruptcy and the need for coordination. Stockholder-bondholder coordination problems are thereby reduced and higher levels of tax-deductible debt will be optimal.

There are also information asymmetry-based reasons why assets with high collateral value are more likely to be financed with debt. White (1989) observes that secured loans have the advantage that secured lenders need only monitor the assets subject to the lien and not the firm's overall financial condition. Myers and Majluf (1984) establishes that in the presence of an information asymmetry it can be optimal to finance high collateral value investments with

[3] Jiang, Li and Shao (2010), Bodnaruk and Rossi (2016), and Chava, Wang and Zou (2017) document a reduction in stockholder-bondholder conflict when a single entity owns a position in both the debt and the equity of a firm. Although none of the externally financed investments in our data involve a simultaneous debt issue and equity issue, new debt (equity) may have been sold to a buyer who already held equity (debt). Further, dual ownership of securities could be established after the issue. Our Prediction 1 assumes that dual ownership is limited in our sample.

debt. A high collateral value means a high lower bound on the investment's future value and in turn a high minimum value for debt claims on the investment.[4]

In summary, both trade-off theory and information asymmetries support our first prediction:

Prediction 1. *High collateral value investments are less likely to be equity-financed.*

2.1.2. Sequential investment programs

Trade-off theory and agency theory both predict that sequential investments like R&D programs will more likely to be equity-financed.[5] One reason is that R&D has little collateral value and hence the likelihood of a suboptimal restructuring decision will be higher if the project is debt-financed. Further, Myers (1977) and Barclay, Smith and Morellec (2006) observe that debt overhang problems can mean forgoing valuable growth opportunities in a sequential investment program. If, rather than financing with straight debt, a sequential program is financed with a callable convertible, then in the state of the world where the firm will want to make a second-stage investment a call can force conversion and eliminate the overhang (Mayers, 1998). Li and Mauer (2016) examines the interaction between investment and financing decisions in a dynamic model and predicts that firms will finance the acquisition and exercise of growth options with equity since financing with equity precludes a future debt overhang. Thus we have our second prediction.

Prediction 2. *R&D programs are more likely to be financed with equity or convertible debt than with straight debt.*

2.1.3. Investment life

All else equal, if long-lived assets have high collateral value, then long-lived assets will be more likely to be debt-financed. The "all else equal" condition is quite important here. Rampini (2017) argues that the claim in Hart and Moore (1994) that durable assets can serve as collateral and thereby facilitate debt financing is flawed since durability affects the purchase

[4] Hart and Moore (1994) also considers the effect of collateral value on financing, but does so in a model of inalienable human capital in which entrepreneurs choose between abandoning or undertaking projects, and if a project is undertaken financing comes from public debt and injections of their own funds. The model's prediction that high collateral value investments are more likely to be undertaken by a financially constrained entrepreneur is not relevant to our study of public company choice between issuing debt and equity.

[5] See Cortazar, Schwartz and Casassus (2001) and Hsu and Schwartz (2008) for analyses of the sequential investments inherent in R&D.

price of an asset (and hence the overall financing need) by more than it affects the asset's collateral value. More durable assets may then be less likely to be debt-financed.

As argued in Baker (2009), capital supplier preferences can underlie a quite separate link between debt issuance and asset life. In particular, Badoer and James (2016) present evidence that insurance firms have a specific demand for long-term debt. If maturity matching means that long-term cash flows make it easier to issue long-term debt, then insurer preferences will be satisfied when long-term debt is issued against long-lived assets. The supply-driven tie between asset characteristics and financing relates to debt maturity. We have no clear prediction on the relation between investment life and the debt-equity choice.

Prediction 3. *Asset life needs to be controlled for in an analysis of the link between asset characteristics and the financing choice. We make no prediction concerning whether long-lived investments are more or less likely to be equity-financed.*

2.1.4. Uncertainty concerning an investment's life

If an investment is to be debt-financed, then maturity matching will reduce both refinancing costs and agency-related debt overhang problems (Myers, 1977; Barclay and Smith, 1995; Stohs and Mauer, 1996). The fact that matching is more difficult when the investment's life is uncertain, underlies our next prediction:

Prediction 4. *Investments with highly uncertain lives are more likely to be equity-financed.*

2.1.5. Payoff volatility

Trade-off theory predicts that investments with highly volatile payoffs are more likely to be financed with equity. This is because high volatility will mean a higher chance of a future stockholder-bondholder coordination problem and a suboptimal restructuring.

Prediction 5. *High volatility investments are more likely to be equity-financed.*

2.1.6. The time until an investment begins to produce payoffs

A firm that borrows must either hold low return liquid assets or incur transactions costs of additional borrowing to cover any interest payments that fall due before the investment begins to produce positive payoffs. Further, the corporate tax saving associated with interest deductions cannot be enjoyed until the investment produces taxable income (Berens and Cuny, 1995). Both observations underlie Prediction 6.

Prediction 6. *The longer the time until an investment produces payoffs, the more likely the investment will be equity-financed.*

2.1.7. The need for monitoring

Monitoring can potentially be undertaken by an incentivized manager irrespective of how an investment is financed (Dybvig and Zender, 1991). But the financing choice will act in conjunction with management incentives when outsiders are skilled at monitoring management's operation of an investment. For example, financing via a series of short-term debt issues can enhance monitoring by forcing the periodic reevaluation of a project. Further, financing an investment that has collateral value by issuing long-term secured debt will link the effective maturity and priority of the loan to how informed the lender chooses to be (Rajan and Winton, 1995). Monitoring can also be facilitated by placing equity with a blockholder (Burkart, Gromb and Panunzi, 1997; Edmans, 2014), but since over 99 percent of the equity issues in our sample are public issues, we have Prediction 7.

Prediction 7. *The greater the need for monitoring, the less likely an investment will be equity-financed.*

2.2 Logistic Regression

We investigate Predictions 1 through 7 using a logistic regression of the relative likelihood that an investment will be financed by equity rather than straight debt with the independent variables being measures of investment characteristics and a set of controls.

$$\begin{aligned}\text{log odds} = {} & \beta_0 + \beta_1 I\left(\textit{Tangible and non-unique}\right) + \beta_2 I\left(\textit{R\&D}\right) + \beta_3 \times \textit{Investment life} \\ & + \beta_4 I\left(\textit{Investment life uncertainty}\right) + \beta_5 I\left(\textit{Volatility}\right) + \beta_6 I\left(\textit{Time until cash flow}\right) \\ & + \beta_7 I\left(\textit{Need for monitoring}\right) + \sum_j \beta_j \times \textit{control}_j + \varepsilon.\end{aligned}$$

$I\left(\textit{Tangible and Non-unique}\right)$ is a zero-one dummy equal to one if the investment is both tangible and non-unique; $I\left(\textit{R\&D}\right)$ is a zero-one dummy equal to one if the investment is R&D-like; *Investment life* is a continuous variable equal to an estimate of the investment's life; $I\left(\textit{Investment life uncertainty}\right)$ is an indicator of uncertainty surrounding the investment's life; $I\left(\textit{Volatility}\right)$ is a zero-one dummy of volatility equal to one if the investment's volatility is classified as high; $I\left(\textit{Time until cash flow}\right)$ is a tri-valued indicator of whether the asset will first begin to produce positive payoffs within one year of the investment, after one year but

within five years, or after more than five years; and $I(\textit{Need for monitoring})$ is a tri-valued indicator of a low, medium or high potential for suboptimal operation of the investment.

Our seven predictions correspond to hypotheses about the signs of the seven coefficients, β_1 to β_7. In each case the alternate hypothesis is that the coefficient is zero. Prediction 1 implies that β_1 is negative. Prediction 2 implies that β_2 is positive. Prediction 3 makes no prediction about the sign of the β_3 coefficient on the asset life measure. Predictions 4, 5 and 6 imply that β_4, β_5 and β_6 are positive. Since the equity issues that we examine are public issues, Prediction 7 implies that β_7 will be negative.

2.3. Logistic regression controls

2.3.1. Controls related to trade-off theory

A firm's existing capital structure and the characteristics of its existing assets will influence how a new investment is financed. As an example, consider a firm that has performed well since its capital structure was last re-optimized. The firm may have become under-levered and regardless of a new investment's characteristics the firm will have an incentive to finance with debt. As a control for the incentives created by the firm's existing assets and capital structure, we include as a control a variable suggested by Hovakimian, Opler and Titman (2001). Hovakimian, Opler and Titman investigate the determinants of the decision to issue debt versus equity and use as an explanatory variable the difference between the absolute value of the deviation from target leverage if the firm issues debt and the absolute value of the deviation from target leverage if the firm issues equity. They find that the larger the absolute deviation if the firm issued debt relative to the absolute deviation if the firm issues equity, the more likely that equity will be issued. We therefore expect a positive relation between this variable and the log odds ratio of issuing equity.

We consider two proxies for a firm's target leverage. One is the median leverage of the firm's industry-year with industries defined by the Fama-French 12 industry classification. The other is the predicted value of the firm's leverage ratio obtained from a regression of book leverage in year t+1 on firm size, profitability, tangibility, market-to-book ratio, depreciation, R&D expenses, a dummy equal to one when the firm reports R&D expenses, industry median book leverage, and expected inflation in year t. The regression is estimated for all industrial

Compustat firms during the 1995-2014 period.[6] None of our qualitative results or conclusions depends on which of the two proxies is used in our analyses.

Both proxies contain measurement error. For example, firms that have, say, shunned debt in the past relative to the industry median and relative to what might be predicted from a regression estimate of the firm's target are likely to continue to do so (Lemmon, Roberts and Zender, 2008). Our data set does not contain sufficient instances of different investments by the same firm to allow us to include firm fixed effects and therefore, we also include book leverage at the end of the financial year preceding the issue as a further control.

2.3.2. Controls related to pecking order theory

The Myers (1984) pecking order model posits that the transaction costs associated with new issues and the costs that arise because of management's superior information about the firm's prospects are so large that the decision to finance externally largely reflects a firm's net cash flows. When a firm does raise external finance, firms will prefer to issue debt since the value of debt will be less information sensitive. Firms will though issue equity when financial distress costs loom large or a debt issue would constrain the firm's future actions too tightly. Pecking order theory predicts that the larger the investment relative to the market value of the firm's equity, the more likely that investment will be financed with equity (de Jong, Verbeek and Verwijmeren, 2010).

2.3.3. Controls related to market timing

The market timing view of the debt-equity issuance decision is that if a manager believes her firm is overvalued, then she will prefer to issue equity rather than debt (Baker and Wurgler, 2002; Warusawitharana and Whited, 2016).[7] In fact, a new investment may be simply a convenient opportunity to issue what the manager sees as overpriced shares. We include two proxies for the degree of management-perceived overvaluation of the firm's shares: the market-to-book ratio of the firm, *MB*, and the cumulative stock return prior to the new issue, *Stock Performance*.

2.3.4 Additional controls

[6] This set of variables is based on Flannery and Rangan (2006) and Frank and Goyal (2009).

[7] Stambaugh, Yu and Yuan (2012) conclude that positive investor sentiment can lead to equity overvaluation.

Consider an investment undertaken by a firm for which future investment opportunities are important. Regardless of the characteristics of the new investment, this firm will be less willing to use debt to finance the investment in order to avoid a future debt overhang and we therefore include firm-level R&D relative to sales in the year prior to the offering in our set of controls. We predict that high R&D firms will be more likely to finance with equity. A second proxy for valuable growth options is the firm's market-to-book ratio. Thus firms with high market-to-book ratios may be more likely to issue equity both in order to avoid future debt overhang problems and, as argued in subsection *2.3.3*, because management believes they can time the market and issue overpriced equity when the firm's market-to-book ratio is high.

The logistic regression including all controls is as follows:

$$\begin{aligned}\log \text{odds} = {} & \beta_0 + \beta_1 I\left(\textit{Tangible and non-unique}\right) + \beta_2 I\left(\textit{R\&D}\right) + \beta_3 \times \textit{Investment life} \\ & + \beta_4 I\left(\textit{Investment life uncertainty}\right) + \beta_5 I\left(\textit{Volatility}\right) + \beta_6 I\left(\textit{Time until cash flow}\right) \\ & + \beta_7 I\left(\textit{Need for monitoring}\right) + \beta_8 \times \begin{pmatrix} \textit{Deviation from estimated optimum} \\ \textit{when issuing debt vs equity} \end{pmatrix} \\ & + \beta_9 \times \left(\textit{Book Leverage}\right) + \beta_{10} \times \textit{MB} + \beta_{11} \times \left(\textit{Stock Performance}\right) + \\ & + \beta_{12} \times \left(\textit{R\&D / Sales}\right) + \beta_{13} \times \left(\textit{Proceeds / MV equity}\right) + \varepsilon.\end{aligned}$$

The predicted signs of the coefficients on the control variables are as follows. Trade-off theory predicts that β_8 is positive and β_9 is negative. Market timing theory predicts positive signs for β_{10} and β_{11}. A desire to avoid debt overhang when a firm has valuable growth options also leads to the prediction that β_{10} will be positive, and to the prediction that β_{12} will be positive. Pecking order theory predicts a positive value for β_{13}.

3. Data

We obtain security issuance data from Thomson One Banker's SDC for seasoned equity issues, convertible debt issues, and straight debt issues by U.S. firms between 1995 and 2014.[8] We require that the reported *use of proceeds*[9] of the issue in capital expenditure and we exclude

[8] Our study focuses on the financing of new investments. We begin in 1995 because before that date offering documents rarely listed capital expenditure as the purpose of a security issue.

[9] Schedule A of the Securities Act of 1933 requires public issuers to disclose the specific purposes for which funds are being raised "so far as determinable." Regulation S-K lays out reporting requirements for various SEC filings and requires public issuers to state the principal purposes for which the proceeds of an issue are intended to be used (or state that there is no current specific plan). Where the principal

IPOs, units, shelf filings, asset-backed securities, and issues by utilities (SIC codes 4900 to 4999) and financial firms (SIC codes 6000 to 6999). Examples of capital expenditure are construction, industrial development and the acquisition of ships, aircraft, real estate, and buildings. Acquisitions of other companies are not classified as capital expenditures. This results in 2,217 observations.[10]

For these 2,217 observations, we look for details of the investment in the issue prospectus and associated reports (SEC files S-3, 424B, and 8-K) from SEC Edgar and in news releases at the time of the issue announcement. The news releases are found in Factiva and via an internet search. We are able to find details on 371 investments by 269 different firms. The investments can be broadly divided into aircraft purchases (6%), development (20%), drilling/mining (10%), business expansion (40%), asset improvements (9%), innovation/exploration (8%), and equipment purchases (7%). Our goal is to classify the investments by their individual characteristics.

Prediction 1 relates to an investment's collateral value. Tangibility and the non-uniqueness of the final product produced by an investment are proxies for whether an asset has collateral value (Shleifer and Vishny, 1992; Benmelech, 2009). Tangibility alone can be a poor proxy for collateral value (Campello and Giambona, 2013). The empirical analyses of Campello and Giambona (2013) and Nyatee (2017) highlight the importance of asset redeployability as a determinant of leverage. Redeployability is simply an alternate term for the concept of non-uniqueness introduced in Titman (1984) and Titman and Wessels (1988). An example of a tangible but unique investment with little collateral value in our data set is the tangible equipment that produces Baxano Surgical's Avance pedicle screw system. This equipment has almost no alternate use and hence has little collateral value. Similarly, despite their tangibility, oil rigs have no alternate use beyond scrap and therefore little collateral value. Tangible non-unique assets have many alternate uses and are easy to sell. An example in our data set is the investment in trucks by Rollins Truck Leasing Corp. We create a dummy variable equal to one when an asset is both tangible and non-unique, and zero otherwise.

purpose is the acquisition of assets, other than in the ordinary course of business, the assets must be briefly described.

[10] Our approach does not require that the financing of an investment occurs in the same year as the new investment is made. The investment will appear in our dataset if the firm reports that it intends to use the capital raised to finance the particular investment. This is an advantage compared to an analysis that relates the characteristics of an investment to the change in the firm's capital structure in the year of the investment.

Prediction 2 relates to R&D-like investments. The R&D variable is equal to one when the investment is described as such in the issue prospectus, associated reports, or news releases by the use of terms like "R&D", "innovation", and "exploration", and is zero otherwise. Prediction 3 relates to investment life. We estimate the expected lifetimes of the 371 investments. Table 3 of Fraumeni (1997) reports information on the typical life spans of various asset types. For example, life spans are typically below ten years for computing equipment (7 years) and farm tractors (9 years), but above fifteen years for aircraft (20 years), steam engines (32 years), and buildings (36 years). We check these estimates against information on expected service lives found through an internet search. For example, a KPMG report gives the useful life of the aircraft of major airlines as 20 to 25 years.[11] We choose an estimated average useful life for aircraft of 22.5 years, which is close to the 20 year service life reported in Fraumeni (1997). Our sample contains aircraft purchases by Atlas Air, Allegiant Travel Co., JetBlue Airways, AMR Corporation, Frontier Airlines, and Alaska Air Group. As another example, the average useful life of drilling platforms is estimated via information in the Feb 2009 10-K filing of a large drilling rig contractor, Transocean Ltd.[12] The 10-K states a lifetime of 26.5 years for drilling platforms and in our sample drilling platforms are acquired by Parker Drilling Co., Pioneer Drilling Co., Maverick Oil & Gas, and Matador Resources Co. Investments in product launches have much shorter life spans. The investment to launch a new head lice product by TyraTech Inc. was assigned a three year life.[13] The average maturity of the investments in our sample is 11.52 years, with a median of 10 years.

Prediction 4 relates to uncertainty about an investment's life. We create a zero-one variable that is equal to one when the investment's life is relatively uncertain. As examples, the life of the project is relatively certain for Hornbeck Offshore Services' construction of ocean-going tugs, while Brainstorm Cell Therapeutics' research and development investments and clinical trials have a relatively uncertain lifespan.

The 0-1 dummy variable Volatility is a measure of the risk of the investment. As examples, the payoffs are classified as volatile for Pixelworks' development of solutions for the

[11] https://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublications/Documents/components-of-aircraft-acquisition.pdf

[12] http://www.sec.gov/Archives/edgar/data/1083269/000108326909000003/0001083269-09-000003.txt

[13] http://www.proactiveinvestors.co.uk/companies/news/55311/tyratech-raises-19mln-for-vamousse-head-lice-launch-65416.html

multimedia projector, high-end television, and mobile device markets while the payoffs from Javo Beverage's purchase of dispensing equipment are classified as not volatile.

The time until positive payoffs indicator is a tri-valued (zero, one or two) indicator that distinguishes between investments whose positive payoffs will begin within one year of the investment, after one year but within five years, or after more than five years. The time until positive payoffs is high (assigned an indicator value of two) for Vion Pharmaceuticals' funding of its preclinical trials and for Aquabounty Technologies' development of new products. An indicator value of one is assigned for Sotheby's expansion of its New York headquarters. Vision Sciences' upgrade of the efficiency of its manufacturing equipment is classified as likely having a short time until positive payoffs begin and the indicator is assigned a value of zero for this investment.[14]

The need for monitoring is a tri-valued indicator based on an assessment of the potential for suboptimal decision-making and continuous overinvestment. The indicator takes on the values zero, one and two. A high need for monitoring (a two) is assigned to Oasis Petroleum's funding of its acquisition program, and to T-Mobile's "opportunistically acquiring of additional spectrum in private party transactions".[15] In contrast, a purchase of machinery to service demand is assigned the low score of zero. An example of an investment receiving a score of one is Target Corporation's construction of a new store.

4. Data Analysis

We examine the investment characteristics and financing of the 371 investments in our sample. In total, 57 investments are financed by a debt issue, 279 by an equity issue, and 35 by a convertible issue. The relatively large proportion of equity issues might be due to greater press interest in equity issues, thereby making it more likely that we can find information of the specific investment. We examine this sample selection issue in Section 5.

We first analyze the debt-equity choice for the 336 investments financed by either straight debt or common stock. Panel A of Table I presents descriptive statistics on the characteristics of these investments. Panel B reports a univariate analysis of the link between the financing choice and the investments' characteristics. Investments that are financed by debt issues have on average a longer estimated asset life. Assets that are tangible and non-unique are

[14] Vision Sciences is a developer of endoscopic products utilizing disposable sheaths to obtain contaminant-free products.

[15] See http://investor.t-mobile.com/File/Index?KeyFile=20888515

substantially more likely to be financed by a debt issue. Consistent with our discussion of Prediction 1, this difference is driven more by uniqueness than by tangibility. In fact, in the univariate analysis, the difference in tangibility between debt-financed and equity-financed investments is non-significant.

While 67% of our sample of externally-financed investments involves tangible assets and 28% involves non-unique assets, 27% of assets are both tangible and non-unique. If these two characteristics were independent, then we would expect that 67% of investments in non-unique assets would have been tangible. The two characteristics are not independent. Fully 91 of the 94 investments in non-unique assets are tangible.

Of debt-financed investments, only two percent can be classified as R&D projects, whereas nine percent of the equity-financed investments can be so classified. While 18 percent for debt-financed investments have an uncertain life and 26 percent of equity-financed projects have an uncertain life; this univariate difference is not statistically significant. Equity-financed investments do have significantly more volatile payoffs, a significantly lower need for monitoring, and a significantly higher time until positive payoffs are first expected.

Panel B also reports univariate analyses of the link between the financing choice and the set of control variables. In every case, the control variables are significantly related to the debt-equity choice in the manner predicted in Section 2.3.

Because Panel C reports that many of the characteristics are correlated, our main results follow from a multivariate logistic regression analysis.[16] There are a number of correlations in excess of 0.3 in absolute value. The time until an investment first generates positive payoffs and the uncertainty about an investment's life are positively correlated. The indicator for an investment's R&D-like nature is positively correlated with both uncertainty about the investment's life and the time until positive payoffs. The tangible and non-unique investment indicator is negatively associated with uncertainty about the investment's life and with both the time until positive payoffs and the volatility of the payoffs.

Table II uses a logistic regression to investigate the relation between the debt-equity choice and investment characteristics. The results of Model 1, a model without controls other than industry fixed effects (industries are defined by the Fama-French 12 industry classification), are reported in column (1). To the extent that investments by firms in a given industry have similar characteristics, our use of industry controls will bias against finding that investment

[16] In computing the correlations we use the natural logarithm of the life of the investment. This is the form in which the variable is employed in the regression analysis.

characteristics are significantly related to the debt-equity choice. Standard errors are clustered at the issuer level. Observations on control variables that are in the 2.5% tails are set equal to the value at the 2.5 or 97.5 percentile.

Non-unique tangible (i.e., high collateral value) investments are significantly less likely to be financed by equity, in line with Prediction 1. As explained in Section 2.1.1, a positive link between collateral value and debt financing is in line with both the predictions of static trade-off theory and predictions based on informational asymmetries. The estimated relation is statistically significant at the 1% level.

Because debt can create an overhang problem, firm value could be diminished if a multistage R&D project were financed by debt. In line with Prediction 2, R&D-like investments are significantly more likely to be financed by equity. This relation is also statistically significant at the 1% level.

Prediction 3 was only that investment life needed to be controlled for but its affect could not be signed theoretically. In this multivariate setting, we do not find a statistically significant effect of an investment's expected life on the choice between debt and equity financing, whereas we did observe the conditionally predicted positive effect on the likelihood of financing with debt in the univariate analysis in Table 1B. The difference between the multivariate and univariate results is likely due to the fact that long-lived assets are more likely to be both tangible and non-unique (the correlation coefficient of 0.24) and hence there is a univariate force toward debt financing.

Prediction 4 is that the likelihood of equity financing is increasing with uncertainty about an investment's life. We do not find a statistically significant positive effect of investment life uncertainty on the likelihood of issuing equity in Model 1. In fact, the sign of the coefficient is negative, even though our univariate analysis indicated that 26 percent of investments financed by equity have uncertain lives versus 18 percent of investments financed by debt. An explanation for our finding is likely to be the exceptionally strong correlations between this variable and variables such as R&D (correlation coefficient of 0.49) and time until positive payoffs (correlation coefficient of 0.54). These strong correlations increase the relevance of the factor analysis conducted in Section 6.

Consistent with Prediction 5, the likelihood of equity financing is positively related to the investment's predicted payoff volatility. The relation is statistically significant at the 1% level. High volatility means a higher chance of bankruptcy if the investment is debt-financed and thus

a higher chance of a stockholder-bondholder coordination problem when it comes to restructuring the firm.[17]

Consistent with Prediction 6, there is a positive effect of the time until positive payoffs on the probability of equity financing. The relation is, however, only marginally statistically significant. Finally, consistent with debtholders being able to monitor more easily than outside shareholders and/or being able to incorporate restrictions into the debt's covenants, the analysis indicates that an increased need for monitoring decreases the likelihood of equity financing. The observed negative relation is statistically significant at the 1% level.

Models 2 and 3 of Table II include the full set of controls discussed in Section 2.3. Models 2 and 3 differ in the proxy employed for target leverage. Information from Compustat and CRSP is required to calculate the controls and their inclusion reduces our sample size from 336 to 289 observations. All the control variables enter with their expected signs. Equity issues are significantly more likely when they would move the firm closer to the industry median leverage than a debt issue would. The negative coefficient on book leverage at the end of the prior financial year indicates that firms that have shunned debt in the past continue to do so, in line with the persistence of capital structure choices documented in Lemmon, Roberts and Zender (2008). Consistent with market timing theory, equity issues are more likely after the firm's stock price has increased. A firm's R&D expenses are positively related to the choice for equity financing, in line with a desire to avoid a future debt overhang. In line with pecking order theory, a debt issue becomes less likely as the amount of capital raised becomes large relative to the firm's equity value.

Importantly, the effects of the investment characteristics on the debt-equity choice are robust to the inclusion of control variables. Only the time until positive payoffs variable loses the marginal statistical significance it had in Model 1 when we consider Model 2 but that marginal significance is regained in Model 3. The estimated negative effect of asset life uncertainty becomes (marginally) significant in Models 2 and 3. Importantly, with the sole exception of the predicted effect of investment life uncertainty, five of our six predications concerning the relation between investment characteristics and the debt-equity choice are borne out in the data and in four of the five cases the relation is highly significant.

[17] Guedes and Opler (1996) predic that when an investment's payoffs are volatile but a firm does choose to finance with debt, that debt issue is more likely to have a medium term rather than a short or long term. Guedes and Opler (1996) interpret issues with times to maturity between 5 and 29 years as medium-term. We find that 78% of debt issues corresponding to investments with volatile payoffs are medium-term while 57% of debt issues corresponding to investments with non-volatile payoffs are medium-term. The two-proportion z-test has a p-value of 0.10.

The pseudo R-squareds of Models 2 and 3 are 0.58 and 0.59, respectively. If we drop the investment characteristics from the regression specifications, the pseudo R-squared in both models decreases to 0.37. This substantial reduction in the fit of the model is significant at the 1% and shows the importance of considering investment characteristics when examining a firm's external debt-equity choice.

To consider whether the use of book leverage at the end of the prior financial year as a linear control appropriately captures the possibility that some firms are committed to very high or very low leverage, the analysis of Table II was repeated on the subset of observations where the prior year's leverage was between 0.1 and 0.9. All conclusions remain unchanged.

We now turn to the economic significance of the results of Table II and focus on Model 2 in doing so. Consider first the marginal effect of a dummy independent variable being one rather than zero when all the other explanatory variables are equal to their mean values. An equity issue is 13.9% less likely when the investment is both tangible and non-unique; 15.2% more likely when the investment is R&D-like; 9.9% less likely when the investment's life is more uncertain; and 21.3% more likely when the investment's payoffs are more volatile.

A one standard deviation increase in the log(investment life) from its mean value, holding constant all other variables at their respective means, reduces the likelihood of an equity issue by approximately 4.3%. The need for monitoring and the time until positive payoffs are tri-valued variables. We calculate their marginal effects as the average of the marginal effects of changing the variable from zero to one and from one to two, again holding all the other independent variables equal to their respective means. A one unit increase in the need for monitoring variable reduces the likelihood of an equity issue by 18.7%. A one unit increase in the time until positive payoffs variable increases the likelihood of an equity issue by approximately 8.3%.

5. Heckman two-stage sample selection model

For the 2217 issues undertaken to finance capital expenditures, we were only able to find details on the investments' characteristics in 371 cases. Thus sample selection bias could be problematic for the interpretation of our results if the firm's debt-equity choice and the likelihood of either the firm or the financial press reporting details on the use of the new issue's proceeds are determined by a common set of unobservable determinants (Heckman, 1979; Dutordoir et al., 2017). A bias will arise if the unobservable determinants are also correlated with investment characteristics. To examine the effects of a potential sample selection bias, we

use the two-stage Heckman regression technique, adjusted for a binary dependent variable. In the first stage, we estimate a probit model of the probability that a firm or the press reports details on an investment, and in the second stage we estimate a probit model of the debt-equity choice to finance the investment. The estimation of the first stage of the model results in an inverse Mill's ratio, which serves as control for sample selection bias in the second stage.

Our first-stage specification includes as explanatory variables the set of firm characteristics that are also used in the second stage plus two instruments for the probability of reporting.[18] The instruments are the reputation of the investment bank and the industry-year norm of providing information. Neither of these variables is likely to have a strong direct link to the debt-equity choice, while both variables are likely to be related to information provision. More specifically, higher reputation underwriters are expected to be associated with better information provision and we use the list of the 15 most reputable investment banks from Fang (2005). Use of the industry-year norm of providing information as an instrument follows Anderson, Duru and Reeb (2012).[19] We calculate the industry-year norm of providing information as the log of one plus the percentage of equity issuers in a Fama-French 12 industry-year that report a specific principal use of the issue proceeds in SDC (i.e., a use of proceeds such as "capital expenditures", "refinancing", or "future acquisitions", rather than simply "general corporate purposes"). We expect that a high industry norm of being more specific is associated with a higher likelihood of providing details on an investment's characteristics.

The results of the Heckman procedure are contained in Table III. It can be seen from the first stage probit that high reputation underwriters and a high industry norm are both associated with a higher likelihood of providing details on an investment's characteristics. Firms relying on R&D are less likely to disclose details, whereas high stock returns increase the probability of providing information. Importantly, the conclusions on the effects of the investment characteristics in the second-stage regression are similar to those drawn from Table II. The strongest effects are that R&D-like investments and investments with volatile payoffs are more likely to be financed by equity, whereas tangible and non-unique assets are more likely to be financed by debt. These findings suggest that our results are robust to the sample selection bias

[18] The results reported in Table III use industry median leverage deviation as one of the variables. The results are effectively unchanged if instead the leverage deviation is measured relative to the firm's target leverage ratio.

[19] Anderson, Duru and Reeb (2012) use the Heckman sample selection procedure for their analysis on R&D expenses, which are often not reported by firms. Appendix A of their paper provides a detailed explanation of the procedure. See also Guedes and Opler (1996).

resulting from heterogeneous information provision across firms and are not driven by an overrepresentation of equity issues in our sample.

6. Factor analysis

Investment characteristics are difficult to define precisely. For example, the collateral value of an investment is linked to its tangibility and non-uniqueness since both of these will determine the ease with which it can be traded without significant price impact. Hence we use the product of the tangibility and non-uniqueness dummies as our proxy for investments with high collateral values. Further, the ability to resell an asset will also depend on the uncertainty surrounding its life and the volatility of its payoffs; i.e., on other elements of our set of investment characteristics. Both the high correlations between the investment characteristics (Panel C of Table I) and the tractability of considering a smaller number of variables make a factor analysis potentially interesting. Table IV reports the results of a factor analysis of the seven investment characteristics using the principal factor method. The analysis identifies three principal dimensions along which investments differ.

The eigenvalue of a factor is a measure of the variation in all the characteristics accounted for by that factor. By construction, the first factor has the highest eigenvalue and contributes most to the explanation of variation in the characteristics. In our analysis, the first factor explains 71% of the total variation explained by the first three factors. The first factor loads positively on R&D, investment life uncertainty, payoff volatility, the need for monitoring, and the time until positive payoffs. The first factor also loads negatively on the tangible, non-unique investment characteristic. As such, the first factor seems to represent R&D-like investments. The second factor explains 17% of the variation associated with the first three factors loads positively on the tangible, non-unique characteristic and on the investment's life. The third factor, which explains only 12% of that variation, is also related to the tangible, non-unique nature of an investment, but differs from the second factor in that it loads negatively on payoff volatility rather than positively on investment life.

In Table V, we use the three identified factors as the explanatory variables for the debt-equity choice and employ the same set of control variables as in Table II. Whether or not the controls are included in the analysis, the results are consistent with (i) R&D-like investments (factor 1) being more likely to be equity-financed and (ii) long-term tangible, non-unique

investments (factor 2) and low-volatility tangible, non-unique investments (factor 3) being more likely to be debt-financed.[20]

7. Convertible issues

In this section we investigate the characteristics of the 35 investments in our sample that are financed by a convertible issue. There is no debt overhang when a sequential program is equity-financed. But financing with equity is not necessarily optimal since equity can fail to discipline managerial opportunism. And although there is no debt overhang if an investment program is financed by a series of short-term debt issues, each rollover involves additional issuance costs. Mayers (1998) argues that financing via a convertible reduces these issuance costs because callability allows the firm to force conversion and proceed with its desired financing plan only at the time a prior stage is successful. Convertibles are especially useful when the life of the first stage is uncertain. Since the call can be synchronized with the resolution of the uncertainty surrounding the first stage, Mayers concludes that issuing a convertible can be the optimal way to finance sequential investment programs.

Panel A of Table VI reports the mean value of the characteristics of the investments financed by issuing a convertible as well as information on the distribution of the estimated lives of these investments and on the issuing firm control variables. Panel B of Table VI reports the results of a multinomial logit analysis of the financing choice taking the issuance of a convertible as the reference category. Column (1) of Panel B reports the likelihood that an investment is financed by straight debt rather than issuing a convertible and Column (2) reports the likelihood of financing an investment with equity rather than with a convertible.

The relative likelihood of financing a new investment by issuing straight debt rather than a convertible is higher when the investment's characteristics are such that it can be classified as tangible and non-unique with a high need for monitoring. The likelihood of a convertible issue rather than a straight debt issue is increased when investments have volatile payoffs. The important control variable determining the likelihood of issuing a convertible rather than straight debt is the firm's existing expenditures on R&D relative to sales. A firm that undertakes a high level of R&D activity will want to preserve its ability to finance future growth

[20] Just as recent studies by Kaplan, Klebanov and Sorenson (2012), Custodio, Ferreira and Matos (2013) and Adams, Akyol and Verwijmeren (2017) have used factor analysis to identify relevant CEO and board "types", our study suggests that there are different investment "types".

opportunities and avoid a debt overhang. This increases the relative likelihood of financing by issuing a convertible rather than straight debt.

The relative likelihood of financing a new investment by issuing a convertible rather than equity increases when the investment's characteristics are such that its life is uncertain and its payoffs are more volatile. These findings are in line with the predictions of Mayers (1998). The control variables that are significant determinants of the likelihood of issuing a convertible rather than equity relate in part to an avoidance of the debt inherent in a convertible issue. Relative to financing with a convertible, equity financing becomes more likely when the issuing firm's existing leverage is consistent with a preference for low leverage and when financing with debt rather than equity would lead to a greater deviation from the industry median leverage.[21] Other important controls are the issuing firm's market-to-book ratio and its expenditures on R&D measured relative to its sales. An increase in either variable increases the likelihood of observing a convertible issue rather than an equity issue. This is consistent with the advantage convertible financing has for firms with high growth opportunities. Finally, and consistent with our earlier results on the choice between debt and equity financing, the larger the size of the investment relative to the market value of the issuer's equity, the more likely that any debt issue, convertible or otherwise, will push against the firm's debt capacity. The likelihood of an equity issue rather than a convertible bond issue is then higher.

In summary, our results on convertible financing and investment characteristics are in line with Mayers (1998): Highly volatile investment payoffs increase the likelihood of financing via a convertible rather than either debt or equity, and a highly uncertain investment life increases the likelihood of financing via a convertible rather than by issuing equity.

8. Conclusion

We examine the link between the characteristics of new investments and the choice between debt and equity when the investment is externally financed. We do so by investigating a hand-collected data set. Our analysis controls for potential selection biases in the type of new issues that are associated with sufficient information to determine the new investment's characteristics. Our analysis also controls for the firm's existing assets and capital structure and for both pecking order and market timing determinants of the financing choice. By investigating investment characteristics we are able to conclude that each of the trade-off,

[21] The results in Panel B are effectively unchanged if instead the deviation from the firm's target leverage rather than the deviation from its industry's median leverage is used as the control.

market timing, and pecking order theories helps explain the choice between debt and equity financing.

Investment characteristics are shown to reflect three factors. The first factor loads positively on R&D, investment life uncertainty, payoff volatility, the need for monitoring, and the time until positive payoffs, while loading negatively on the tangible, non-unique nature of an investment. As such, the first factor seems to represent R&D-like investments. Consistent with trade-off theory, investments associated with this factor are relatively more likely to be equity-financed. The second factor loads positively on tangible, non-unique, long-term investments and, also consistent with trade-off theory, these investments are relatively more likely to be debt-financed. The third factor seems to represent tangible, non-unique investments with low payoff volatility and such investments are also relatively more likely to be debt-financed. We separately examine the relation between investment characteristics and financing via a convertible bond issue. Convertibles are more likely to be issued when the investment's characteristics are consistent with it being part of a sequential investment program.

Our findings will be of interest to those investigating project financing. Project finance is used to finance economically separable, long-term infrastructure and industrial projects, with the funds raised by a legally independent project company on a limited or non-recourse basis (Esty, 2004; Leland, 2007; Finnerty, 2013). A different avenue for future research is the extent to which the characteristics of investments undertaken with the proceeds of new issues are important in understanding the differential announcement effects of debt versus equity issues.

References

Adams, Renee, Ali Akyol, and Patrick Verwijmeren, 2017, Director skill sets, *Journal of Financial Economics*, forthcoming.

Ajello, Andrea, 2016, Financial intermediation, investment dynamics, and business cycle fluctuations, *American Economic Review* 106(8), 2256-2303

Anderson, Ronald, Augustine Duru, and David Reeb, 2012, Investment policy in family controlled firms, *Journal of Banking & Finance* 36, 1744-1758

Badoer, Dominique C., and Christopher M. James, 2016, The determinants of long-term corporate debt issuances, *Journal of Finance* 71(1), 457-492.

Baker, Malcolm, 2009, Capital market driven corporate finance, *Annual Review of Financial Economics* 1, 1-41.

Baker, Malcolm, and Jeffrey Wurgler, 2002, Market timing and capital structure, *Journal of Finance* 57(1), 1-32.

Barclay, Michael J., and Clifford W. Smith, 1995, The maturity structure of corporate debt, *Journal of Finance* 50(2), 609-631.

Barclay, Michael J., Clifford W. Smith, Jr. and Erwan Morellec, 2006, On the debt capacity of growth options, *Journal of Business* 79(1), 37-60.

Benmelech, Efraim, 2009, Asset salability and debt maturity: Evidence from nineteenth-century American railroads, *Review of Financial Studies* 22(4), 1545-1584.

Berens, James L., and Charles J. Cuny, 1995, The capital structure puzzle revisited, *Review of Financial Studies* 8(4), 1185-1208.

Bodnaruk, Andriy and Marco Rossi, 2016, Dual ownership, returns, and voting in mergers, *Journal of Financial Economics* 120(1), 58–80

Burkart, Mike, Denis Gromb, and Fausto Panunzi, 1997, Large shareholders, monitoring, and the value of the firm, *Quarterly Journal of Economics* 112(3), 693-728.

Campello, Murillo, and Erasmo Giambona, 2013, Real assets and capital structure, *Journal of Financial and Quantitative Analysis* 48(5), 1333-1370.

Chava, Sudheer, Rui Wang and Hong Zou, 2017, Covenants, creditors' simultaneous equity holdings, and firm investment policies, *Journal of Financial and Quantitative Analysis*, forthcoming.

Cortazar, Gonzalo, Eduardo S. Schwartz, and Jaime Casassus, 2001, Optimal exploration investments under price and geological uncertainty: A real options model, *R&D Management Journal* 31(2), 181-189.

Custodio, Claudia, Miguel A. Ferreira, and Pedro Matos, 2013, Generalists versus specialists: Lifetime work experience and chief executive officer pay, *Journal of Financial Economics* 108(2), 471-492.

de Jong, Abe, Marno Verbeek, and Patrick Verwijmeren, 2010, The impact of financing surpluses and large financing deficits on tests of the pecking order theory, *Financial Management* 39(2), 733-756.

Dudley, Evan, 2012, Capital structure and large investment projects, *Journal of Corporate Finance* 18(5), 1168-1192.

Dutordoir, Marie, Joao Q.F. Neto, Norman Strong, and Ping Sun, 2017, Do stated use of proceeds affect stock price reactions to security offerings? Working paper.

Dybvig, Philip H., and Jaime F. Zender, 1991, Capital structure and dividend irrelevance with asymmetric information, *Review of Financial Studies* 4**(**1**)**, 201-219,

Edmans, Alex, 2014, Blockholders and corporate governance, *Annual Review of Financial Economics* 6, 23–50

Elsas, Ralf, Mark J. Flannery, and Jon A. Garfinkel, 2014, Financing major investments: Information about capital structure decisions, *Review of Finance* 18(4), 1341-1386.

Esty, Benjamin C., 2004, Why study large projects? An introduction to research on project finance, *European Financial Management* 10(2), 213-224.

Fang, Lily H., 2005, Investment bank reputation and the price and quality of underwriting services, *Journal of Finance* 60(6), 2729-2761.

Finnerty, John D., 2013, *Project Financing: Asset-Based Financial Engineering*, Wiley, NY.

Flannery, Mark J, and Kasturi P. Rangan, 2006, Partial adjustment toward target capital structures, *Journal of Financial Economics* 79(3), 469-506.

Frank, Murray Z. and Vidhan Goyal, 2009, Capital structure decisions: Which factors are reliably important? *Financial Management*, 38(1), 1-37.

Fraumeni, Barbera M., 1997, The measurement of depreciation in the U.S. National Income and Product Accounts, *Survey of Current Business* July, 7-23.

Guedes, Jose and Tim Opler, 1996, The determinants of the maturity of corporate debt issues, *Journal of Finance* 51(5), 1809-1833.

Hart, Oliver and John Moore, 1994, A theory of debt based on the inalienability of human capital, *Quarterly Journal of Economics* 109(4), 841-879.

Haugen, Robert A., and Lemma W. Senbet, 1978, The insignificance of bankruptcy costs to the theory of optimal capital structure, *Journal of Finance* 33(2), 383-393.

Heckman, James J., 1979, Sample selection bias as a specification error, *Econometrica* 47(1), 153-161.

Hovakimian, Armen, Tim Opler, and Sheridan Titman, 2001, The debt-equity choice, *Journal of Financial and Quantitative Analysis* 36(1), 1-24.

Hsu, Jason C., and Eduardo S. Schwartz, 2008, A model of R&D valuation and the design of research incentives, *Insurance: Mathematics and Economics* 43(3), 350-367.

Jensen, Michael C. and William H. Meckling, 1976, Theory of the firm: Managerial behavior, agency costs and ownership structure, *Journal of Financial Economics* 3(4), 305-360

Jiang, Wei, Kai Li and Pei Shao, 2010, When shareholders are creditors: Effects of the simultaneous holding of equity and debt by non-commercial banking institutions, Review of Financial Studies 23(10), 3595–3637.

Kaplan, Stephen N., Mark M. Klebanov, and Morten Sorensen, 2012, Which CEO characteristics and abilities matter? *Journal of Finance* 67(3), 973-1007.

Leland, Hayne E., 2007, Financial synergies and the optimal scope of the firm: Implications for mergers, spinoffs, and structured finance, *Journal of Finance* 62(2) 765-807.

Lemmon, Michael L., Michael R. Roberts, and Jaime F. Zender, 2008, Back to the beginning: persistence and the cross-section of corporate capital structure, *Journal of Finance* 63(4), 1575-1608.

Li, Jay Y. and David C. Mauer, 2016, Financing uncertain growth, *Journal of Corporate Finance* 41, 241-261.

Mayers, David, 1998, Why firms issue convertible bonds: The matching of financial and real investment options, *Journal of Financial Economics* 47(1), 83-102.

Myers, Stewart C., 1977, Determinants of corporate borrowing, *Journal of Financial Economics* 5(2), 147–175.

Myers, Stewart C., 1984, The capital structure puzzle, *Journal of Finance* 39(3), 575-592.

Myers, Stewart C., and Nicholas S. Majluf, 1984, Corporate financing and investment decisions when firms have information that investors do not have, *Journal of Financial Economics* 13(2), 187-221.

Nyatee, Anisha, 2017, Asset redeployability and capital structure choice: The role of competition, Simon Business School working paper.

Rajan, Raghuram, and Andrew Winton, 1995, Covenants and collateral as incentives to monitor, *Journal of Finance* 50(4), 1113-1146

Rampini, Adriano A., 2017, Financing durable assets, Fuqua Business School working paper.

Shleifer, Andrei, and Robert W. Vishny, 1992, Liquidation values and debt capacity: A market equilibrium approach, *Journal of Finance* 47(4), 143-166.

Stambaugh, Robert, Jianfeng Yu, and Yu Yuan, 2012, The short of it: Investor sentiment and anomalies, *Journal of Financial Economics* 104(2), 288-302.

Stohs, Mark Hoven, and David C. Mauer, 1996, The determinants of corporate debt maturity structure, *Journal of Business* 69(3), 279-312.

Strebulaev, Ilya A., 2007, Do tests of capital structure theory mean what they say?, *Journal of Finance* 62(4), 1747-1787.

Titman, Sheridan, 1984, The effect of capital structure on a firm's liquidation decision, *Journal of Financial Economics* 13(1), 137-151.

Titman, Sheridan, and Roberto Wessels, 1988, The determinants of capital structure choice, *Journal of Finance* 43(1), 1-19.

Warusawitharana, Missaka, and Toni Whited, 2016, Equity market misvaluation, financing, and investment, *Review of Financial Studies* 29(3), 603-654.

White, Michelle J., 1989, The corporate bankruptcy decision, *Journal of Economic Perspectives* 3(2), 129-151.

Table I. Descriptive statistics

Descriptive statistics for the 336 investments financed by either straight debt or by equity. Panel A reports means, medians and standard deviations. Estimated life is in years. The variables Tangible and non-unique (T & n-u), Tangible, Unique, R&D, Uncertain life, and Payoff volatility are zero-one dummies. The Time until positive payoffs and Need for monitoring variables are tri-valued indicators ranging from zero to two. Deviation from industry leverage when issuing debt vs equity is the projected difference between the absolute deviation from industry median leverage if the firm issues debt and the absolute deviation from industry median leverage if the firm issues equity. Industries are based on the Fama-French 12 industry classification. A positive value of this variable indicates that a firm would end up closer to its industry median leverage ratio if it issues equity rather than debt. Deviation from target leverage when issuing debt vs equity is the projected difference between the absolute deviation from target leverage if the firm issues debt and the absolute deviation from target leverage if the firm issues equity. Target leverage is the predicted value after estimating a regression of book leverage in year t+1 on firm size, profitability, tangibility, market-to-book ratio, depreciation, R&D expenses, a dummy indicating whether the firm reports R&D expenses, industry median book leverage, and expected inflation in year t for all industrial Compustat firms in the 1995-2014 period. Stock performance is the stock return over trading days −252 to −2 relative to the issue date. Book leverage, the market-to-book ratio, R&D expenses over sales, and the market value of equity are measured at the end of the financial year preceding the issue. Firm variables are winsorized at the 2.5% level at both tails. Panel B presents a univariate analysis of the distinction between investments financed by debt and investments financed by equity. For dummy variables we calculate whether the difference between two proportions is significant using a two-proportion z-test. For the other variables we calculate difference of means t-statistics with a t-test that does not assume equal variances. Panel C presents pairwise correlation coefficients. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Panel A	N	Mean	Median	Standard deviation
Tangible	336	0.67		
Unique	336	0.72		
Tangible & non-unique	336	0.27		
R&D	336	0.08		
Estimated life	336	11.52	10.00	5.89
Uncertain life	336	0.24		
Volatile payoffs	336	0.84		
Time until positive payoffs	336	1.07		
Need for monitoring	336	0.90		
Deviation from industry leverage when issuing debt vs equity	289	0.15	0.11	0.18
Deviation from target leverage when issuing debt vs equity	289	0.11	0.07	0.19
Book leverage	289	0.26	0.21	0.25
Market-to-book ratio	289	3.14	1.99	3.28
Stock performance	289	0.46	0.31	0.65
Firm R&D / sales	289	0.16	0	0.32
Proceeds / MV equity	289	0.27	0.17	0.36

Panel B	Debt issues	Equity issues	Difference of means statistic
Tangible	0.75	0.65	1.49
Unique	0.33	0.80	–7.14***
Tangible & non-unique	0.63	0.20	6.73***
R&D	0.02	0.09	–1.91*
Estimated life	13.97	11.01	3.21***
Uncertain life	0.18	0.26	–1.32
Volatile payoffs	0.63	0.88	–4.69***
Time until positive payoffs	0.82	1.13	–3.48***
Need for monitoring	1.09	0.87	4.84***
Deviation from industry leverage when issuing debt vs equity	0.05	0.17	–8.68***
Deviation from target leverage when issuing debt vs equity	0.03	0.13	–6.53***
Book leverage	0.41	0.23	5.40***
Market-to-book ratio	1.80	3.40	–6.13***
Stock Performance	0.15	0.53	–7.14***
Firm R&D / sales	0.03	0.18	–4.73***
Proceeds / MV equity	0.12	0.30	–5.41***

Panel C	T & n-u	R&D	Log (life)	Uncertain life	Volatile payoffs	Time until +ive payoffs	Need for monitoring
T & n-u	1.00						
R&D	–0.18	1.00					
Log(life)	0.24	0.01	1.00				
Uncertain life	–0.32	0.49	–0.04	1.00			
Volatile payoffs	–0.32	0.13	0.22	0.23	1.00		
Time until +ive payoffs	–0.44	0.47	–0.07	0.54	0.22	1.00	
Need for monitoring	–0.05	0.23	0.06	0.27	0.14	0.29	1.00

Table II. Logit analysis of the debt-equity issue determinants

Logit analysis of the debt-equity choice. The dependent variable is a dummy equal to one for equity issues and zero for straight debt issues. See Table I for a description of the explanatory variables. Industry dummies are based on the Fama-French 12 industry classification. Heteroskedasticity-consistent standard errors clustered at the issuer level are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Characteristics	Prediction	(1)	(2)	(3)
Tangible & non-unique	–	–1.45***	–2.02***	–2.18***
		(0.48)	(0.78)	(0.81)
R&D	+	3.32***	4.10**	4.09**
		(1.21)	(1.63)	(1.83)
Log estimated life	?	–0.77	–0.74	–0.79
		(0.54)	(0.62)	(0.62)
Uncertain life	+	–0.85	–1.63*	–1.82**
		(0.78)	(0.91)	(0.85)
Volatile payoffs	+	1.45***	2.87***	3.08***
		(0.54)	(0.90)	(0.96)
Time until positive payoffs	+	1.08*	1.37	1.52*
		(0.64)	(0.87)	(0.92)
Need for monitoring	–	–3.86***	–3.24***	–3.48***
		(0.61)	(1.13)	(1.14)
Control variables				
Deviation from industry leverage when issuing debt vs equity	+		6.96**	
			(3.43)	
Deviation from target leverage when issuing debt vs equity	+			8.41**
				(4.07)
Book leverage	–		–3.47**	–4.61***
			(1.44)	(1.60)
Market-to-book ratio	+		0.06	0.01
			(0.17)	(0.16)
Stock performance	+		1.99***	2.04***
			(0.63)	(0.66)
Firm R&D / sales	+		5.07**	5.75***
			(2.02)	(2.12)
Proceeds / MV equity	+		2.60**	2.53*
			(1.32)	(1.37)
Industry dummies		Yes	Yes	Yes
N		336	289	289
Pseudo *R*-squared		0.34	0.58	0.59

Table III. Controlling for a potential selection bias

The relation between investment characteristics and the debt-equity choice using a Heckman two-stage model to control for sample selection bias. The first stage model is a probit with the dummy dependent variable equal to one when there is information about the investment's characteristics. The second stage is a probit model and its dummy dependent variable equals one for equity issues and zero for debt issues. Reputable investment bank is a dummy for whether the underwriter is included in the top 15 in terms of market share (Fang, 2005). Industry-year norm is the log of one plus the % of equity issuers in a Fama-French 12 industry-year reporting a specific principal use of proceeds in SDC. See Table I for a description of the explanatory variables. Industry dummies based on the Fama-French 12 industry classification are included and standard errors are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Characteristics	First stage	Second stage
Tangible & non-unique		–0.37**
		(0.15)
R&D		0.96***
		(0.30)
Log estimated life		–0.22
		(0.16)
Uncertain life		–0.35*
		(0.19)
Volatile payoffs		0.53***
		(0.19)
Time until positive payoffs		0.10
		(0.14)
Need for monitoring		–0.49*
		(0.29)
Control variables		
Deviation from industry leverage when issuing debt vs equity	0.39	1.74**
	(0.28)	(0.79)
Book leverage	0.10	–0.32
	(0.17)	(0.33)
Market-to-book ratio	0.01	–0.01
	(0.01)	(0.02)
Stock performance	0.08	0.50***
	(0.04)	(0.14)
Firm R&D / sales	–0.25***	0.95
	(0.06)	(0.62)
Proceeds / MV equity	0.15	0.32
	(0.12)	(0.27)
Reputable investment bank	0.14**	
	(0.07)	
Industry-year norm	1.13*	
	(0.76)	
Inverse Mill's ratio		–5.17*
		(2.80)
N	1,918	
Censored observations		289

Table IV. Factor Analysis

This table reports the results of factor analysis based on the investment characteristics. We present unrotated factor loadings on the first three factors using the principal factor method. Factor loadings less than ｜0.25｜ are set to blank.

	Principal factors		
Investment characteristics	**Factor 1**	**Factor 2**	**Factor 3**
Eigenvalue	1.87	0.44	0.31
Percentage explained	0.71	0.17	0.12
Tangible & non-unique	–0.51	0.31	0.29
R&D	0.58		
Log estimated life		0.50	
Uncertain life	0.69		
Volatile payoffs	0.36		–0.37
Need for monitoring	0.35		
Time until positive payoffs	0.74		

Table V. Using factors in the logit analysis of the debt-equity choice

This table reports a logit analysis of the debt-equity choice. The three factors are those identified in Table IV. The dependent variable is a dummy equal to one for common equity issues and zero for straight debt issues. See Table I for a description of the explanatory variables. Industry dummies are based on the Fama-French 12 industry classification. Heteroskedasticity-consistent standard errors clustered at the issuer level are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	Debt-equity choice		
	(1)	(2)	(2)
Factors			
Factor 1	0.59*	1.35***	1.29***
	(0.30)	(0.50)	(0.50)
Factor 2	–1.21***	–0.75*	–0.79*
	(0.39)	(0.45)	(0.47)
Factor 3	–1.17***	–1.75**	–1.87***
	(0.41)	(0.51)	(0.53)
Control variables			
Deviation from industry leverage when issuing debt vs equity		7.67**	
		(3.10)	
Deviation from target leverage when issuing debt vs equity			7.39**
			(3.36)
Book leverage		–3.30***	–4.13***
		(1.26)	(1.45)
Market-to-book ratio		0.21	0.19
		(0.21)	(0.21)
Stock performance		1.54***	1.50***
		(0.46)	(0.46)
Firm R&D / sales		4.38***	4.83***
		(1.63)	(1.78)
Proceeds / MV equity		2.18*	2.31*
		(1.21)	(1.19)
Industry dummies	Yes	Yes	Yes
N	336	289	289
Pseudo R-squared	0.23	0.51	0.51

Table VI. Convertible issue determinants

Panel A reports the descriptive statistics for investments financed by convertible issues. Panel B reports a multinomial logit analysis. The dependent variable has a separate value for convertible issues, common equity issues, and straight debt issues. We use a convertible issue as the base outcome of our estimation. See Table I for a description of the explanatory variables. Industry dummies are based on the Fama-French 12 industry classification. Heteroskedasticity-consistent standard errors clustered at the issuer level are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Panel A	N	Mean	Median	Standard deviation
Tangible	35	0.69		
Unique	35	0.80		
Tangible & non-unique	35	0.20		
R&D	35	0.09		
Estimated life	35	11.87	10.00	5.85
Uncertain life	35	0.40		
Volatile payoffs	35	0.97		
Time until positive payoffs	35	1.09		
Need for monitoring	35	0.89		
Deviation from industry leverage when issuing debt vs equity	32	0.12	0.09	0.16
Deviation from target leverage when issuing debt vs equity	32	0.14	0.06	0.23
Book leverage	32	0.27	0.24	0.25
Market-to-book ratio	32	4.84	2.19	5.38
Stock performance	32	0.49	0.31	0.82
Firm R&D / sales	32	0.33	0.05	0.44
Proceeds / MV equity	32	0.14	0.11	0.11

Panel B

	Straight debt versus a convertible issue	Equity versus a convertible issue
Characteristics		
Tangible & non-unique	2.18**	0.26
	(0.93)	(0.65)
R&D	–2.07	0.41
	(1.69)	(0.75)
Log estimated life	–0.09	–0.32
	(0.69)	(0.42)
Uncertain life	0.13	–1.47**
	(0.99)	(0.59)
Volatile payoffs	–4.40***	–1.79**
	(1.02)	(0.79)
Time until positive payoffs	–0.60	0.71
	(0.87)	(0.51)
Need for monitoring	2.37*	0.34
	(1.31)	(0.67)
Control variables		
Deviation from industry leverage when issuing debt vs equity	–3.65	2.72**
	(3.45)	(1.38)
Book leverage	2.18	–1.74**
	(1.65)	(0.84)
Market-to-book ratio	–0.21	–0.12**
	(0.17)	(0.06)
Stock performance	–1.13*	0.16
	(0.63)	(0.34)
Firm R&D / sales	–6.39***	–1.80***
	(1.86)	(0.67)
Proceeds / MV equity	0.55	3.05**
	(1.98)	(1.47)
Industry dummies	Yes	
N	321	
Pseudo R-squared	0.38	