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Information Asymmetry Reduction in Opaque Contexts: Evidence from Debt and Outside Equity Financing in Early Stage Firms

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Abstract
This study analyzes the relationship between debt and outside equity investments in early stage firms. The existing evidence on this relationship is scarce and inconclusive, mostly due to the pervasive opaqueness of early stage firms. We argue that outside investors who face the severe information asymmetries that exist in entrepreneurial firms may use the level of debt as a signal. In addition, personal and business debt could signal different information to outside investors. We use the Kauffman Firm Survey and develop an empirical strategy based on a Heckman selection model and a propensity score matching analysis. Our results consistently show that debt, and particularly business debt, is positively related to outside equity investments, especially in times of economic distress. We posit that start-ups with higher levels of business debt can send more credible signals to capital markets, and identify cash holdings and the firm-bank relationship as possible information channels for outside investors.

JEL classification: G32, M13, M40

Keywords: financing; debt; equity; entrepreneurship; information asymmetry; capital structure

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1. Introduction

The increasing supply of private equity investments positively affects firm creation, employment, and aggregate income (Samila & Sorenson, 2011). The ability to attract private investors is especially critical for early stage firms.[1] More than 400,000 new businesses were created in 2014 in the US and, most probably, their financing decisions were subject to different constraints as compared to incumbent firms. Recurrent cash flows and retained earnings are usually not an option for new ventures. Instead, these generally cover their financing needs through owners, family and acquaintances' funds or some form of debt. Robb & Robinson (2014) show that debt is the most important financing source for new ventures, which can also attempt to attract equity injections from private investors. Outside equity injections have been documented to positively impact start-ups' growth and are becoming a popular funding source for early stage firms (Croce, Martí, & Murtinu, 2013; Puri & Zarutskie, 2012). Indicatively, outside investments amounted to $610 million in 1980 (Puri & Zarutskie, 2012), while $60.1 billion were injected in new businesses in 2015. Thus, entrepreneurs increasingly consider attracting outside equity investments and at the same time rely on debt financing. The use of equity and debt has important relevant implications for the business operations, the risk of failure, firm performance and growth (Cassar, 2004), as well as for the information conveyed to potential investors (Myers, 1984).

This study analyzes the relationship between debt and outside equity investments in early stage entrepreneurial firms. One of the most important determinants of financing decisions in start-ups is the pervasive information asymmetry that exists in young small firms (Berger & Udell, 1998; 2006; Cassar et al., 2015). Due to the stringent opaqueness of early stage firms, outside investors need to identify reliable information channels that could reveal

[1] Existing studies refer to early stage firms in various ways: start-ups, new ventures, entrepreneurial firms, entrepreneurial ventures, among others. We use these terms interchangeably.

firm characteristics. The existing literature can explain either a negative or a positive relationship between the two financing options. On the one hand, some studies highlight that information on debt levels can be used to predict financial distress and bankruptcy (Caskey, Hughes, & Liu, 2012; Jones & Hensher, 2004; Opler & Titman, 1994). Under this approach, prospective outside investors would prefer less indebted firms. On the other hand, the ability of the firm to send reliable signals to outside investors would support a positive relationship between debt and outside equity investments (see, e.g., Baldenius & Meng, 2010; Connelly, Certo, Ireland, & Reutzel, 2011; Davila et al., 2003; Spence, 2002). In this case, a debt contract that results from tougher screening processes and implies higher monitoring costs could be a positive signal that the entrepreneur can send to capital markets.

Most of the existing studies refer to large incumbent firms, while not much attention was directed to new ventures despite their unique characteristics (Cassar, 2004). This may well be so because of their opaqueness, as accounting data on start-ups (especially from the US) are rarely available. Therefore, we fill a gap in the literature by conceptually and empirically analyzing the relationship between debt and outside equity investments in early stage firms. We tackle this objective by disentangling how two main components of debt, personal and business debt, could be interpreted as valuable signals by potential outside equity investors. In this sense, outside investors could attempt to reduce the prevailing information asymmetries in entrepreneurial contexts by identifying signals within the initial capital structure of early stage firms.

We empirically address our objective by analyzing start-ups from the Kauffman Firm Survey (KFS), which provides information on 4,928 firms that were founded in 2004 as new independent businesses and are representative of the US population. Various existing studies scrutinize the financing of start-ups based on samples of firms of over ten years of age, or by analyzing the information that firms are required to disclose when entering IPOs. This entails

a high degree of sample selection or survival bias. Instead, we analyze start-ups that are going through their early development phases. To account for selection in the process of receiving outside investments, we first run a Heckman model to establish baseline relationships between the types of debt and the existence and magnitude of outside equity investments. Second, we use propensity score matching to compare similar firms in terms of observable characteristics that only differ in their level of debt at the moment of founding. Third, we take advantage of a specific KFS question that clearly separates firms that seek outside equity from those who do not during 2009-2011 and provide further support to our main findings. Finally, an instrumental variable approach strengthens our results.

We find consistent evidence of a positive relationship between debt and outside equity investments. This result is corroborated by the four different empirical approaches. Moreover, the propensity score matching analysis indicates that outside investors tend to invest more in high debt start-ups in periods of economic distress. We also show that the positive relationship between debt and outside equity is mainly driven by business debt. We argue that business debt, in contrast to personal debt, is more useful for reducing information asymmetries since it can be a more credible signal due to tougher screening processes and higher monitoring costs.

We explore several mechanisms that can explain the positive relationship between debt and outside equity. First, we find that cash holdings are also consistently positively related to outside equity investments. Importantly, we find that highly indebted start-ups hold higher levels of cash during the two years following the debt injection. This asset class has documented importance for equity transactions. Demers and Lev (2001) suggest that cash could be a proxy for firm sustainability and Hand (2005) argues that venture capitalists include cash in their assessment of start-ups survival and success potential. We conjecture that start-ups could partially use debt to increase their level of cash. This in turn serves as a

reliable signal for prospective investors, especially in turbulent economic times. Second, we interpret the bank-firm relationship as a complementary mechanism through which debt could be positively associated with outside investments. We believe that this relationship is signaled more credibly by more indebted start-ups, which exhibit stronger ties between the entrepreneurial team and the creditors. Investors could perceive this relationship as a proxy for cash buffers (e.g. credit lines renewals, longer grace periods) and thus invest in this type of firms.

While the previous ideas are in line with our primary findings, we further contribute to the literature in at least two additional ways. First, we show that debt levels can be path dependent in entrepreneurial firms. Start-ups that show lower debt levels in 2004 consistently keep lower average debt relative to more indebted start-ups. This result corroborates the argument that start-up capital structure is entrepreneur-dependent, meaning that personal attitudes toward risk and control are reflected in the composition of the firm capital structure (Cassar, 2004). Second, we also find a positive relationship between debt and firm growth, but no relationship between debt and profitability. This result supports the recurrent ideas that start-ups focus more on creating market momentum (e.g. revenues, users, traction) rather than on profitability (Puri & Zarutskie, 2012; Robb & Robinson, 2014).

Taken together, our results provide relevant insights into the financing sources of early-stage ventures, a topic of current interest given the increasingly important role of start-ups for economic growth. For example, the European Investment Fund (the SMEs financing branch of the European Investment Bank) recently set up the European Angels Fund to co-invest with business angels (BA) and other non-institutional investors in the firms' seed, early or growth stages.[2] This initiative is currently present in Austria, Germany, Ireland, the Netherlands and Spain. Importantly for our context, in a recent letter to the US Senate, the

[2] See http://www.eif.org/what_we_do/equity/eaf/index.htm. Accessed on May 1, 2016.

Kauffman Foundation emphasizes the crucial role of equity financing for young firms. Indicatively, the letter to the US Senate states:[3]

"Research shows that equity investments play a particularly useful role in growth firms. Businesses that receive venture capital investment, for example, tend to grow faster and are more likely to go public (IPO). This subset of new businesses, which grow quickly and create many jobs, is especially important to the economy."

Our study is closely related to the core content of this debate. In the discussion of the results we contribute to policy-making by critically assessing the mechanisms through which start-ups can raise funds and achieve higher growth. Understanding the underpinnings of the role of debt for outside equity investments and growth makes room for institutional implications that can range from economic programs promoting credit granting to young firms, to relaxing regulations for new sources and platforms of venture lending and investment.

The reminder of the paper is structured as follows. Section 2 presents the theoretical underpinnings and related literature on the relationship between debt and outside equity. Section 3 describes the sample and variables, which are analyzed following the empirical strategy in Section 4. The results are presented in Section 5 and discussed in detail in Section 6. Section 7 provides some brief concluding remarks.

2. Related literature and theoretical underpinnings

2.1. Information asymmetries and the relationship between debt and outside equity

The relationship between debt and outside equity injections in start-ups is especially difficult to predict. This is so mostly due to the pervasive information asymmetry that exists in young

[3] See http://www.kauffman.org/~/media/kauffman_org/resources/2016/kauffman_foundation_senate_finance_tax_reform_working_group_letter_4_15_15.pdf. Accessed on May 1, 2016.

small firms (Berger & Udell, 1998; 2006; Cassar et al., 2015). Outside investors face an increased information risk that influences their decisions. Given that they cannot rely on historical information on firm ability or market valuations as in the case of publicly listed firms, they must identify reliable information channels which can signal firm characteristics and thus mitigate the severe opaqueness prevalent in the start-ups' context. According to the signaled information, the relationship between debt and equity can be positive or negative.

On the one hand, a stream of literature based on large incumbent firms would point to a negative relationship. The seminal works of Beaver or Altman in the 1960s or the more statistically sophisticated studies of Ohlson (1980) or Jones and Hensher (2004) argue that high leverage could be informative of higher bankruptcy or financial distress rates. Opler and Titman (1994) find that in periods of economic distress highly indebted firms lose more market share in comparison to their less leveraged competitors. Caskey et al. (2012) conclude that an excess of leverage negatively affects future firm fundamentals such as profitability, asset growth and the probability of financial distress. In addition, Jones and Hensher (2004) show that Australian firms that filed for bankruptcy were more indebted relative to their potential to generate cash. Accordingly, if these results were to be valid for start-ups, one would expect that holding more debt would send a negative information signal to investors (i.e. negative relationship between debt and outside equity). These results are especially worrisome if they were to apply to start-ups, given that bank debt is the most important source of funding for entrepreneurial firms (Robb and Robinson, 2014). An open question therefore emerges on whether this evidence is valid for early stage firms, which are mostly financed through debt, have unique characteristics and are subject to more severe information asymmetries (Cassar, 2004; Cassar et al., 2015).

On the other hand, a positive relationship between debt and equity could be supported by taking a signaling theory approach (Connelly et al., 2011; Spence, 2002) to decreasing

information asymmetries in the particularly opaque context in which start-ups operate (Berger & Udell, 1998; 2006; Cassar, 2004; Cassar et al., 2015; Watson & Wilson, 2002). Some existing studies have used signaling theory to explain the entrepreneur-investor relationship. Baldenius and Meng (2010) examine how entrepreneurs can signal their firm's value to investors. They present a stylized model in which the entrepreneur needs to balance the signal sent to investors (e.g. by keeping a fraction of ownership) with the potential effort that investors may elicit once equity is contracted. The authors conclude that the signal may lead to different investor efforts depending on whether this effort is contractible (e.g. capital contributions) or noncontractible (e.g. ex-post networking). Other studies state that a venture capital (VC) funding event is a credible signal for future employees (or the labor market for that matter) to assess the quality of the firm (Davila et al., 2003). The signal is thus a way to alleviate information asymmetries between the firm and prospective employees. In a related study, Elitzur & Gavious (2003) theoretically argue how the negotiation between entrepreneurs and investors can be costly in itself and therefore a reliable signal of fewer potential moral hazard problems. Along these lines, we would expect investors to attempt to reduce information asymmetry by relying on signals such as debt acquisition, and thus invest in more indebted start-ups.

Overall, for a signal to be credible, it needs to be observable and costly (Connelly et al., 2011; Spence, 2002). We posit that a debt contract sufficiently meets these conditions and can be used as a credible, reliable signal that alleviates information asymmetries. First, it is observable in that it reveals information provided to investors at pre-investment stages. Second, it is costly to produce since it has to adhere to (bank) contracting conditions, including screening processes and the subsequent agreement on mandatory and default contracting clauses. In this sense, leverage, especially in the case of early stage firms, can be perceived as a positive signal by the market, and as a result firm value is expected to increase

(see Ross, 1977). Investors may interpret larger debt levels as a signal of higher quality, and could consider that managers of low quality firms do not have incentives to leverage their firms given higher marginal expected bankruptcy costs (Harris and Raviv, 1991). Therefore, more indebted start-ups are more likely to send stronger signals to prospective investors, which would imply a positive relationship between debt and outside equity.

Taking these arguments together, we are unable to clearly predict the sign and magnitude of the relationship between debt and outside equity investments in start-up firms. Due to the complexity of this relationship and the recurrent data availability issues, the link between debt and equity is many times left out from analyses of drivers of firm fundamentals. To better integrate our study in the existing literature, we also scrutinize the more traditional associations between debt and measures of growth and performance. First, debt is expected to have a positive relationship with growth. Robb and Robinson (2014) report a positive relationship between outside debt acquired in 2004 and revenues, number of employees and total assets observed in 2007. Cole & Sokolyk (2015) use the KFS survey and find a positive relationship between debt financing at inception, and survivorship and revenues after three years of firm activity. Second, the entrepreneurial finance literature is not conclusive on the relationship between debt and profitability. In particular, Robb and Robinson (2014) do not find any association between debt in 2004 and profits in 2007, suggesting that start-ups may prioritize growth measures over profitability in their initial stages.

2.2. Debt in start-up firms

Evidence on the financing of early stage firms is still scarce, mainly due to their opaqueness. While outside equity—particularly VC investments—has benefited from rather extensive academic and practitioner debates, the debt phenomenon remains unexplored to a large extent. The finance literature has only recently studied the debt structure in different types of firms.

For instance, Rauh and Sufi (2010) find that, for public rated firms, different debt instruments can lead to different firm outcomes (e.g. profitability). Similarly, Colla et al. (2013) explore debt heterogeneity in a sample of rated and unrated public firms. Although they find that 85% of firms borrow with only one type of debt, they argue that the capital structure of the firm is fundamentally affected by the debt structure, which may include debt types such as commercial paper, drawn credit lines, term loans, senior bonds and notes, subordinated bonds and notes, capital leases and other debt. None of these mainstream studies on debt structure include start-ups. In the context of small firms (not necessarily start-ups), it is common to split debt into short- and long-term (Cassar & Holmes, 2003; Hall et al., 2004; Watson & Wilson, 2002) by arguing that long-term debt requires tougher screening process, higher monitoring costs and greater contractual obligations (e.g. covenants, collaterals).

Robb and Robinson (2014) are likely to be the first to extensively describe the different typologies of debt for start-ups in the US (they document up to 22 different debt instruments). Bank lending is by and large the most important financing source for start-ups, as it accounts for about 40%-50% of an average start-up capital structure. In addition, Cole & Sokolyk (2015) indicate that 75% of firms use some type of credit instrument at inception and argue that personal debt is fundamentally different from business debt. Accordingly, the lender assesses personal debt by analyzing the creditworthiness of an individual and not necessarily the viability of the firm's prospects. In many cases lenders may not even know that the loan will be transferred to the funding of a start-up. In contrast, business debt is subject to a greater scrutiny ex ante contracting and greater ex post monitoring (Cole & Sokolyk, 2015). Taking these arguments together, we believe that outside investors would perceive business debt as a more reliable signal. The process of acquiring business debt is more costly, requires more firm-specific information, and can restrict ex post contracting firm behavior.

2.3. Outside equity in start-up firms

Start-ups can receive equity funds from the owner, insiders (e.g. family or acquaintances) and outsiders. We focus on outside equity, which is key for start-up survival (Puri & Zarutskie, 2012) and growth (Davila, Foster, & Gupta, 2003; Puri & Zarutskie, 2012). Outside investors can range from informal individuals that pledge part of their disposable income, the so-called business angels (BA), to very institutionalized VC firms. Other types of outsiders include companies (usually big companies taking positions in new investment projects or potential competitors) or government agencies, among others.

Outside investors are playing an increasingly important role in the financing of early stage firms, and BAs and VCs are becoming fundamental means for business creation (Chemmanur & Fulghieri, 2013). Puri and Zarutske (2012) report that in 1980, the US venture capital industry invested $610 million in business projects. In 2015, the same industry invested $60.1 billion, and had a peak of $105 billion in 2000 (dotcom bubble).[4] Importantly, 39.7% of VC-backed firms fail, 33.5% are acquired and 16.1% go public. For non-VC financed firms, 78.9% fail, 1.04% are acquired and 0.02% go public. Thus, in a context of limited financing options for start-ups (e.g. recurrent cash flows are typically scarce if not negative and public financing unattainable), it seems that outside investors are fundamental for survival and growth.

Despite the obvious importance of outside equity, little is known about how the investors select firms (Bernstein, Korteweg & Laws, 2015). This is mostly due to the opacity of both the entrepreneurial firms and the investors involved in the financing processes. Previous efforts to disentangle the characteristics of the equity investment process find that both financial and non-financial items are relevant attributes. First, with respect to non-

[4] According to MoneyTree™Report. Pricewaterhouse Coopers and National Venture Capital Association: https://www.pwcmoneytree.com/HistoricTrends/CustomQueryHistoricTrend. Accessed on October 18, 2016.

financial items, there is general consensus on the importance of intangible attributes such as the management team, the identity of current investors or expectations about the product (Bernstein et al. 2015; Sorensen, 2007). Among these, the founding team is systematically cited as an important criterion for BAs in their investment decisions (see Maxwell et al. (2011) for a literature review). More recently, Bernstein et al. (2015) present a randomized field experiment in which they demonstrate that the entrepreneurial team characteristics (e.g. education, past experience) causally affect investors' interest for a given project. We therefore control for several owner characteristics in our analysis. Second, financial information can play a substitution or complementary role in early stage private equity transactions (Armstrong, Davila, & Foster, 2006; Hand, 2005; Sievers, Mokwa, & Keienburg, 2013). For instance, Hand (2005) shows that financial statements elements such as R&D expenses or cash balances can be positively related to equity valuations. Armstrong et al. (2006) study how financial statement information can be used to explain pre-IPO differences in firms' equity valuations. Sievers et al. (2013) document that financial and non-financial information are complementary and jointly explain around 62% of the variation in pre-money valuations. Thus, we also include several financial control variables in our analysis. We conjecture that the relationship between debt and outside equity may be partly explained through balance sheet items. In this line, the assets' value (partly a function of debt use) is what investors may evaluate more, among other start-up characteristics, when making their investment decisions.

Whereas we illustrate the increasing importance of outside equity and some of the factors influencing the investors' decisions, our viewpoint on the equity investment process remains rather agnostic. There are unquestionable benefits of outside investors for the firm. However, one needs to carefully consider the implications of outside investor presence for management decision and control. In start-up firms there is no clear separation between ownership, management and control. Incoming outsiders who hold significant equity may

well redistribute the power within the firm and reshape the decision-making and control processes. For instance, VC presence is related to a variety of formal organizational measures such as new human resource policies, the adoption of stock option plans (Hellmann & Puri, 2000) as well as the implementation of systematic management control systems (Davila & Foster, 2007). This potential change in management practices could clash with the entrepreneurs' way of managing the business. All in all, the presence of outside equity in new ventures could represent a firm-specific trade-off, an issue which we further discuss when setting-up the empirical strategy.

3. Methods and data

3.1. Sample

We use the Kauffman Firm Survey (KFS) database that contains information on 4,928 US start-ups founded in 2004 as new independent businesses. The survey tracks firms during eight years and provides information on aspects such as industry, location, employment information, credit scores, financial information, as well as detailed demographics of the entrepreneurial team. All start-ups were sampled in their founding year (avoiding left-censoring problems) and are representative of the US population. The sampling process started from a Dun & Bradstreet database containing 250,000 businesses that had started operations in 2004 from which a random sample of 32,469 was drawn and contacted for eligibility.[5] Finally, 4,928 responses were recorded in the baseline survey. The survey follow-ups were based on this initial cohort, which means that each subsequent year some of the firms were lost. At the end of the process (year 2011), the KFS recorded complete information on 2,007 start-ups founded in 2004.

[5] Dun & Bradstreet is a US-based commercial information company. Today, its databases contain information on more than 225 million businesses worldwide. For the final sample, businesses were excluded if they had an EIN, had scheduled C income, or had paid taxes prior to 2004 (Robb and Robinson, 2014).

Due to the purpose of this study, not all start-ups are subject to analysis. The legal form of an organization is a key feature for future equity holders who evaluate their investments. According to the US Small Business Administration, one entrepreneur can choose between five legal statuses: sole proprietorship, limited liability company (LLC), cooperative, corporation and partnership.[6] The KFS includes all types except cooperatives. We discard sole proprietorships and partnerships because of various reasons. First, the sole proprietorship is not consistent with our research objective. Sole proprietorships are unincorporated businesses owned by an individual, which do not distinguish between the business and the owner personal income or wealth filings. By definition, outside investors cannot invest in sole proprietorships, and indeed the dataset reports no outside investments for this type of entities. Second, we also exclude partnerships, a very specific type of business in which a legal partnership agreement establishes key corporate decisions (e.g. how partners split profits, resolve disputes or change ownership). Especially in the case of new ventures, these particular conditions can potentially distort more traditional or arm's length private equity transactions that are the main focus of our study. It is worth mentioning that in the KFS dataset, only 42 firm-year observations are partnerships that receive outside investment.

Our final sample is composed of 3,038 LLC and corporations in year 2004. Corporations include two subcategories: C-corporations (the traditional business structure that is held legally liable for the actions and debts of the business) and the subchapter S-Corporation (a special type of corporation that, for instance, allows for profits and losses to be passed through shareholders' personal tax filing).

[6] See https://www.sba.gov/category/navigation-structure/starting-managing-business/starting-business/choose-your-business-stru. Accessed on May 27, 2016.

3.2. Main variables and descriptive statistics

The main variables of interest are outside equity (the dependent variable), total debt and its decomposition into personal and business debt (independent variables).[7] To illustrate the relative importance of each financing source at the initial stages of the firm, Table 1 presents descriptive statistics for the complete eight-years panel, while correlations are shown in Appendix B.

[Table 1 about here]

The initial financing structure of start-ups relies on three different pillars: the funds provided by the owners ($81,209 on average in 2004), outside investors ($78,094) and business debt ($70,812). The latter two are increasingly important in the following years, especially the business debt, which reaches an average value of $211,709 in 2006. It is noteworthy that outside equity shows a relatively high average absolute value in each year but few start-ups report it (at the 90th percentile, the value for this variable is 0), suggesting that only a small proportion of start-ups raise high amounts of outside equity. This is in line with other studies showing that VC-firms are an extremely small percentage (0.11%) of all newly created firms (Puri & Zarutskie, 2012). Table 2 describes the main variables of our analysis as well as additional control variables.[8]

[Table 2 about here]

Importantly, the personal and business debt variables show a different number of observations (14,714 and 13,703, respectively). This translates into an even lower number of observations for the total debt variable that, due to the survey's construction, requires non-missing values in both types of debt (12,884 observations). Several control variables are

[7] We avoid using ratio measures (e.g. debt over total assets) to prevent accounting mechanics to drive the relationship between debt and outside equity.

[8] We use the ln(variable+1) transformation since many start-ups show $0 values in certain financial variables. Note that ln(1)=0, which is the actual value of the considered variable. In the absence of this transformation, the analysis would lose a high proportion of the observations in the sample. In the empirical strategy (Section 4) we explain in detail how we treat these observations.

related to firm characteristics, the business form (LLC or corporation type) and owner characteristics. Average revenues are of $1,086,461 (median value of $85,000) for the entire panel during 2004-2011, and 4 to 5 employees. Their profitability is relatively low. While the average start-up is making profits of $29,214 (median of $1,200), return on assets (ROA, measured as profit divided by total assets) shows an average value of 1.06, which seems to be driven by highly profitable firms since the median value is 0.04. Main owner characteristics indicate that entrepreneurs are on average 47 years old, have been working in the industry for about 13 years and many have already set up a business (whereas the median entrepreneur did not). Most entrepreneurs are males (74%) and 89% are born in the US (96% are US citizens). Table 2 also reports statistics for categorical variables such as legal form, education and race. Appendix A further defines all variables.

4. Empirical strategy

4.1. Heckman two-stage model

The standard OLS regression specification is not an adequate empirical strategy in our setting. Table 1 shows that our main variable of interest (outside equity) has a $0 amount even at the 90th percentile despite the $78,094 average value in 2004 (and its consistency over time). Tobit or selection models would better fit the data. Tobit models are especially useful when the dependent variable is censored, as it is our case (outside equity is 0 or positive). However, Tobit regressions assume that the same probability mechanism generates both the zeros and the positive values (Cameron and Trivedi, 2009), which is not true in our context. The majority of start-ups do not raise outside equity either because they are not able to attract investors or because they are not interested in the funds and presence of external investors (see our firm governance rationale in Section 2.3). These are two different mechanisms that

generate zeros in the outside equity variable. Thus, Tobit models are not suitable for our analysis.

Selection models are especially useful in this context. We understand outside equity investment as a two-stage process in which first the start-up either receives or does not receive outside equity ("participation decision") and second, conditional upon receiving outside equity, the amount of money the firm raises ("amount decision"). This is similar to the case of two-part models that allow for the possibility that the zero ("participation decision") and positive ("amount decision") values are generated following different and independent mechanisms, thus assuming that, controlling for regressors, those with positive outside equity are randomly selected from the population (Cameron and Trivedi, 2009). In our case, the second "amount equation" is not strictly random or independent of the first "participation equation" since there could exist some selection (e.g. those with certain levels of revenues and traction may be more prone to raise private funds). To account for this selection process, we use the Heckman selection model, which allows for dependence between the two equations and corrects for it when computing the standard errors (Cameron and Trivedi, 2009). Our main model specifications for the selection (1) and outcome (2) equations are:

$$Out\_E\_Dum_{i,t} = \alpha + \beta_1 Ln(Debt)_{i,t} + \beta_2 Out\_E_{i,t-1} + \beta_3 X_{i,t} + \beta_4 Z_i + \delta_t + \gamma_i + \varepsilon_{i,t} \quad (1)$$

$$Ln(Out\_E)_{i,t} = \alpha + \beta_1 Ln(Debt)_{i,t} + \beta_2 X_{i,t} + \beta_3 Z_i + \delta_t + \gamma_i + \lambda_{it} + \varepsilon_{i,t} \quad (2)$$

where $Out\_E\_Dum_{i,t}$ is a binary variable that takes the value of one if firm i receives outside equity financing at time t, $Ln(Debt)_{i,t}$ and $Ln(Out\_E)_{i,t}$ are the natural logarithms of one plus the amount of debt and outside equity, respectively, that firm i acquires at time t. X_{it} is a vector of time-varying independent variables (e.g. number of employees or firm financial information), while Z_i includes time-invariant covariates (e.g. gender and nationality of the

main entrepreneur). In addition, we control for year (δ_t), industry (γ_i) and location (λ_{it}) effects. These variables are described in Appendix A. Finally, $Out\_E_{i,t-1}$ is a binary variable that takes the value of one if firm *i* received outside financing in *t-1*, and zero otherwise. This variable fulfills the exclusion restriction for robustness identification of the model, since it is included only in the selection equation and is not included in the outcome equation. We assume that the lagged value of $Out\_E_{i,t}$ is significant in the selection equation (the probability of being invested) but not in the outcome equation (the amount invested). More specifically, we assume that having received outside investments in the past positively affects the likelihood of receiving investment in the present (selection equation), but does not necessarily imply that new outside investors will invest a greater or a lower amount (outcome equation).

We use the Heckman model to determine the main relationships among the variables of interest. Several issues need to be addressed. First, the Heckman model is estimated by pooling all start-ups and years. Second, there are some endogeneity concerns. It can be that other potential factors make the relationship between debt and outside equity spurious. For instance, better-managed start-ups could obtain greater amounts of debt. This omitted variable problem occurs if the model does not systematically control for the management team characteristics that would then be captured by the error term, which would become correlated with debt and produce biased coefficients. For reducing the concerns related to these issues, we include several control variables, not only related to management skills (e.g. owner industry and start-up experience, education or week hours dedicated to the project), but also to firm characteristics (e.g. revenues, measures of profitability or accounting information) and owner demographics (e.g. gender, age or home country). Furthermore, the models include industry, location and year effects. Finally, debt and outside equity could be subject to simultaneous causality. It is true that an entrepreneur may be able to raise external funds because of the positive signals sent to capital markets, but the relationship could also be the

opposite. Start-ups might be able to increase their leverage because they are more capitalized (i.e. higher equity to total assets) and therefore, they can afford leveraging up the firm. Ideally, this concern could be addressed through a natural experiment in which different levels of debt are randomly assigned to similar start-ups seeking outside equity investments. Most times however, this setting is not available. To address these remaining concerns in the context of the KFS database, we design a propensity score matching empirical strategy.

4.2. Propensity Score Matching

We use propensity score matching (PSM) to match two groups of start-ups with similar observed characteristics at inception (year 2004) that differ in the level of debt. We obtain two groups: the treated (high debt) and the control (low debt) groups. This matching method comes at a cost. While regressions generally use full samples, PSM scores are available for sub-samples, penalizing sample size by leaving out unmatched observations. However, it is many times the case that estimates based on unmatched samples (e.g. regressions) are more biased and less robust to miss-specification than those based on matched samples (Rubin & Thomas, 2000). In addition, the PSM empirical identification is especially suitable in our case. The fact of having both the treatment and control group coming from the same data source helps to obtain better matches, since both groups have received the same survey and are agents in a similar economic environment (Jalan & Ravallion, 2003).

In practice, the PSM estimates a score based on observables that are used to match both groups. We follow the mainstream approach of estimating the propensity score by using the predicted values of a logit regression:

$$P(Debt\_Dum_i \mid X_i) = F(\alpha + \beta_1 Ln(Out\_E)_i + \beta_2 Controls_i) \quad (3)$$

where $Debt\_Dum_i$ is a binary variable that takes the value of one if the start-up is highly indebted in 2004 (i.e. top quartile of the debt variable distribution) and zero if the firm has little outside debt in 2004 (i.e. lower two quartiles). F(.) is the logistic function that includes all predictor variables: $Ln(Out\_E)_i$, the natural logarithm of outside equity plus one, which is included jointly with a series of owner characteristics and other firm controls. The results section provides details on the employed variables, the matching outcomes and the evolution of outside equity investments in each of the two groups.

4.3. Restricting the sample to start-ups that seek outside equity financing

Interestingly, for the period 2009-2011, the KFS survey includes a specific question that allows us to distinguish those start-ups that seek outside equity financing from those which do not. This is particularly important because it offers a clear rule for excluding the firms that report zero values in the outside equity variable due to not seeking outside equity. Given that the survey only allows identifying this subsample between 2009 and 2011, the sample size available for this robustness test is slightly larger than one hundred observations. Therefore, we use this analysis as an additional robustness test that allows us to isolate the debt to outside equity relationship for those firms that strategically decide to actively seek outside equity. For this subsample we can assume that the same probability mechanism generates both zeros (i.e. firms which fail to raise outside equity) and positive values (i.e. firms which succeed in raising outside equity), and therefore use a Tobit model for analyzing the relationship between debt and outside equity injections. We use the following specification:

$$Ln(Out\_E)_{i,t} = \alpha + \beta_1 Ln(Debt)_{i,t} + \beta_2 X_{i,t} + \beta_3 Z_i + \delta_t + \gamma_i + \varepsilon_{i,t} \quad (4)$$

where $Ln(Out\_E)_{i,t}$ and $Ln(Debt)_{i,t}$ are the natural logarithm of one plus the amount of outside equity and debt, respectively, that firm *i* acquires at time *t*. Different specifications decompose the main independent variable debt into personal and business debt. $X_{i,t}$ includes firm and owner time-variant characteristics while Z_i captures time-invariant controls. Year and industry dummies are also included. For robustness, we also estimate OLS regressions.

4.4. Instrumental variable approach

The empirical strategies discussed above address various concerns. We address selection issues by using a Heckman model and a reduced sample of start-ups that seek outside equity financing. We also control for an extensive set of entrepreneur and firm characteristics, time-constant firm heterogeneity (industry and location effects) and systematic shocks to all firms (year effects). Importantly, we reduce simultaneity concerns by developing an empirical strategy based on PSM. Although these are already restrictive specifications, endogeneity problems are extremely difficult to rule out. To further reduce endogeneity concerns, we re-estimate our baseline result using an instrumental variable approach.

We use the number of bank branches in each county at the start of our sample (year 2004) as an instrument for the level of debt held by firms. We believe that the bank presence in the county where the firm is located is informative on the firm's debt level for several reasons. First, in line with Degryse and Ongena (2005) and Hollander and Verriest (2016), we expect bank proximity to have a negative effect on information asymmetry. Accordingly, early stage firms in counties with more bank branches could benefit from a closer relationship with banks and could receive debt under looser conditions, as compared to start-ups in counties with less bank presence. Second, this may be especially relevant in the case of early stage firms for which the use of soft information is prevalent. Indeed, in informationally opaque contexts, such as the one of early stage firms, bank proximity has been shown to be

positively related to the use of private information at loan granting (see Agarwal and Hauswald 2010). In addition to our main arguments, a higher number of bank branches at county level can be a proxy for competition, which may also lead to more credit granting. Overall, we believe that the instrument is informative on the bank-firm relationship, which may well be established right from the firm's inception.

5. Results

5.1. Heckman selection model results

Table 3 presents the results of the Heckman model. Panel A reports seven different specifications for the first-stage regression (selection equation). The baseline models (specifications (1) and (2)) include the main variables (debt and its decomposition), the identifying variable and additional control variables (i.e. crisis, firm credit risk, revenues, number of employees and a high-tech sector dummy). Specifications (3) and (4) add financial information variables, the legal status and owner characteristics (not reported for brevity purposes, see variable details in Table 2 and Appendix A). Specifications (5) and (6) add year, industry and location dummies. Finally, specification (7) decomposes business debt into bank and non-bank business debt.

[Table 3 about here]

We consistently find that debt and its decomposition into personal and business debt are positively related to the likelihood of receiving outside equity investments (see Panel A in Table 3). Importantly, the identifying variable (outside equity dummy in period t-1) is also positive and significant, revealing that having been invested in the previous year has a positive effect on receiving funds in the current period. This is most times the case in BA and VC markets, in which one of the few ways to finance growth is by periodically issuing stock. Results are consistent across specifications. One salient finding is that cash is positively

related to the likelihood of receiving funds. This could be one of the information channels in early stage firms. Outside investors may see this balance sheet item as a buffer that firms use in times of distress (e.g. revenues slowdown or bad macroeconomic conditions). In this line, start-ups that hold higher amounts of cash can be seen as more sustainable or better-managed, especially in entrepreneurial contexts in which funding is scarce. We further develop this argument in the discussion section. Moreover, cash is positively associated to the amount invested by outsiders in the outcome equation.

Panel B in Table 3 reports the results of the second-stage regression (outcome equation). The number of observations is reduced since this analysis only includes start-ups that received outside equity at least once. Results indicate that the positive relationship between debt and outside equity is mostly driven by business debt (see positive coefficients in all model specifications). Consistent with our arguments in Section 2, business debt is subject to greater scrutiny by the lenders and therefore it may be perceived as a more valuable and credible signal by prospective outside investors. This is so not only due to the costlier ex ante screening process, but also to the more extensive ex post monitoring of firm activity. To provide more insights into this argument, we decompose business debt into bank and non-bank business debt (e.g. family, employee or government credit given to the business legal entity). Specification (7) shows that the positive significant relationship between business debt and outside equity is mainly driven by bank business debt. We build on this finding in the discussion section. Overall, the results of the Heckman model support our conjectures that outside investors could use certain types of debt as reliable signals for reducing information asymmetries.[9]

[9] All results are robust to winsorizing variables at 1%.

5.2. Propensity score matching results

To reach more meaningful interpretations, we implement a PSM analysis. Out of the 3,038 start-ups surveyed in 2004, 2,610 show non-missing values for the debt variable. We classify these observations as high debt (641 firms are in the top quartile of the debt variable distribution) and low debt start-ups (1,384 firms are in the lower two quartiles). We match these two groups on a series of covariates that are used as explanatory variables in the logit regression (equation (3)): (1) firm characteristics (revenues, profits, credit score, number of employees, total assets, cash level, ROA and a high tech dummy variable); (2) legal status (LLC, S-Corp and C-Corp), (3) owner characteristics (age of the respondent, years of tenure in industry, former start-ups experience, hours dedicated to the business, gender, educational level, race and whether the entrepreneur is a US citizen and US born); and (4) outside equity level. We match each high debt start-up with one control firm using closest neighbor matching without replacement and requiring exact matching by industry (NAICS 2-digit code). As a result, we obtain 187 matched-paired observations, which are summarized in Table 4.

[Table 4 about here]

Table 4 confirms that the matching process has been successful as there are no significant differences in any variable across groups, meaning that each paired observation is equal in all matched dimensions. The non-significant difference in the outside equity variable, with an average value of 1.10 for high debt start-ups and 1.00 for the low debt matched firms (p-value of 0.77) is of special interest.

Figure 1 and Table 5 (Panel A) illustrate the level of debt that each group holds over time. After matching in 2004, we first observe that start-ups follow a certain path dependency, since the group of low debt start-ups is systematically significantly below the high debt group, with the exception of year 2011 (in which the difference is not significant). Despite the

differences at inception (year 2004), there is a converging trend until 2006 when firms seem to stabilize their level of debt. Next, both groups follow a relatively parallel trend until year 2011. This result could suggest that the capital structure may not be defined clearly at inception, but instead it may be adjusted dynamically to a certain firm specific level. This is in line with well-established theories of capital structure, such as the static trade-off theory, in which firms pursue an optimal capital structure by taking into account certain benefits and costs of leverage (Myers, 1984).

[Figures 1 and 2 and Table 5 about here]

We are mainly interested in the amount of outside equity that both types of firms are able to attract. Figure 2 and Table 5 (Panel B) summarize the evolution of the outcome variable, illustrating a salient significant difference in financial distress times (year 2007 and 2008). Due to the matching process, the outside equity is not significantly different between the two groups at inception. In addition, no significant differences appear during good economic times (between 2004 and 2006). However, the start-ups in the high debt group seem to attract significantly more outside equity during the 2007-2008 crisis period. We argue that this result can be driven by two main factors. First, acquiring debt in 2004 may indicate that a bank-firm relationship is established right from the firm's inception, which could favor future credit availability. We thus suggest that, especially in times of crisis, outside investors may positively assess longer and possibly stronger bank-firm relationships. Second, the investments that start-ups make in 2005 and 2006, the years prior to the observed difference in outside equity, can be dissimilar across the high and low debt groups. Therefore, we analyze in detail the asset composition of the treatment and control groups for these years.

[Table 6 about here]

Table 6 reveals several interesting differences between groups. High debt start-ups show higher values for almost all asset items (except for accounts receivable in 2005),

irrespective of whether the difference between high and low debt firms is significant. Having debt at inception may increase firm size and, as such, the start-up becomes more visible in capital markets. Importantly, high debt start-ups consistently show higher cash and inventories in 2005 and 2006, and fixed assets in 2005. Firms that acquire more debt at inception hold more cash, have more inventories and fixed assets, suggesting that debt is not only contracted but also used. These findings provide support to the Heckman model results, which are indicative of the role of cash as an information channel to outside investors for firm (financial) sustainability. We explore this result further in the discussion section.

To check whether the results are driven by personal or business debt, we redo our PSM analysis for each debt category. Consistent with the Heckman model findings, business debt is the main driver of the positive relationship between debt and outside equity. Figure 3 shows that, when matching by business debt, there is a significant difference in 2008 and 2010, indicating that high business debt start-ups attract more outside equity. In contrast, matching by personal debt does not reveal any significant difference across groups during the analyzed period (see Table 5).

[Figure 3 about here]

Finally, we also track the evolution of traditional measures of growth (revenues) and profitability (ROA). Panel E in Table 5 shows that the high debt start-ups achieve greater growth relative to low debt firms in times of economic distress. This is in line with existing findings that firms which receive outside investments from VCs or BAs generally grow more (Davila et al., 2003; Puri & Zarutskie, 2012). The significant differences observed in revenues (for 2007 and 2008) can be partially explained by the impact that new investors have on the firm. However, growth does not seem to come along with profitability, as ROA is not statistically different across groups. It may be that during the early stages of the firm, profitability could be postponed in favor of growth.

5.3. Results from a subsample of start-ups that seek outside equity

Without specific data on the characteristics of companies that were turned down by investors, learning about investors' decision-making process remains a complicated endeavor (Bernstein et al., 2015). For 106 observations during 2009-2011, the KFS allows us to identify precisely the firms that specifically seek outside equity investments and were successful or failed in the process. For this subsample we run OLS and Tobit regressions, which are reported in Table 7.

[Table 7 about here]

We show that, although the total debt measure is positive but not significant, business debt is significant and positive. This provides further support to our findings.[10] In addition, we also corroborate that cash is positively and significantly related to outside equity investments, and may well be one of the information channels for outside investors,

5.4. Results from an instrumental variable approach

We replicate our results for the baseline relationship between debt and outside equity using an instrumental variable approach. The specifications presented in Table 8 use the number of bank branches in each county at the start of our sample (year 2004) as an instrument for the level of debt held by firms (see the rationale for this instrument in Section 4.4). For our data, the model is uniquely identified, which avoids problems related to overidentification. The F-statistics for first stage specifications are well above the usual threshold value of 10, indicating that the instrument is relevant and strong. The first stage results (columns 1 and 3 in Table 8) are in line with the arguments developed in the PSM analysis. Specifically, the positive and significant relationship between the instrument (bank branches in each county in 2004) and debt supports the idea that an early-stage bank-firm relationship could be favorable

[10] Results are robust to winsorizing variables at 1%.

for future firm credit availability (see Degryse and Ongena 2005). The results lend support to the existing evidence that bank proximity is positively related to decreasing information asymmetry through the use of private (soft) information (see Degryse and Ongena 2005; Agarwal and Hauswald 2010; Hollander and Verriest 2016). Given the stringent informational opacity of early-stage firms, banks may well use soft information, and, in turn, the bank-firm relationship can be a reliable signal to outside investors. The second stage results (columns 2 and 4 in Table 8) support this argument by showing that the instrumented level of debt is positively and significantly related to outside equity financing.

[Table 8 about here]

In addition, we also use an instrument created following the rationales in Laeven and Levine (2009) and Lin et al. (2011). Specifically, for each industry (2-digit NAICS codes) and year pair, we calculate the average level of debt excluding the contribution of the focal firm. As a result, the instrument varies across firms. The intuition is that the focal firm's debt level is likely to be influenced by the debt level of other firms in the same industry and economic conditions. As in the case of the bank branches in county instrument, the first stage results reveal a positive and significant relationship between the instrument (average level of debt in industry-year excluding the focal firm) and debt (first stage F-statistic 75.65). The second stage parameter estimate of the instrumented debt variable is 0.278 (p-value 0.059). Overall, the positive relationship between debt and outside equity is confirmed and actually strengthened by further addressing the potential endogeneity problems.

6. Discussion

We consistently find that debt, and in particular business debt, is positively related to raising outside equity funds, especially in times of financial distress. We mostly base our interpretations on how investors could interpret credible signals transmitted through the firm's

capital structure in order to reduce the severe information asymmetries present in the starts-ups' context. For a signal to be useful for reducing information asymmetries, it must be observable and costly to produce (see, e.g., Baldenius & Meng, 2010; Connelly et al., 2011; Davila et al., 2003; Spence, 2002). Accordingly, the relationship between debt and outside equity may be stronger for business debt because the signal is more easily observable (through financial statements) and costlier to produce (given the tougher screening process, higher monitoring costs and greater contractual obligations) than the one sent through personal debt. Therefore, business debt can serve as a reliable anchoring point to prospective investors and capital markets, an issue which is increasingly important in the start-up setting characterized by high opaqueness and asymmetric information (Berger & Udell, 1998; 2006; Cassar et al., 2015; Watson & Wilson, 2002).

In addition, we argue that information asymmetry reduction through valuable signals does not exclusively come from the mere existence of debt or business debt, but also from the potential use of debt. Important contributions by Hand (2005), Armstrong et al. (2006) and Sievers et al. (2013) document the significant role of financial statement information in early-stage equity markets. When we compare the investment strategy of high and low debt start-ups at the year of founding, we detect significant differences in the asset composition across time in the following two years. The high debt start-ups group shows consistently higher values for inventories and cash (see Table 6). Among balance sheet components, cash deserves special attention since it shows a significant positive relationship with outside equity in our main empirical approaches. This could be one of the information transmission channels from which outside investors could benefit when attempting to interpret signals on firm characteristics and the potential use of debt. In this line, Demers and Lev (2001) suggest that cash can be a proxy for liquidity reserves that can be dedicated to sustaining product developments much longer. Similarly, Hand (2005) finds a strong relationship between cash

and pre-money valuations, and argues that VCs include cash in their assessment of start-up survival and success potential. By holding higher levels of cash in the two years following the debt injection, the high debt start-ups' group could have enhanced the value of the informative signal sent to prospective investors.

A complementary information channel could be the relationship that the firm establishes with financial institutions. High debt start-ups are more likely to be strongly tied to banks, signaling not only network connections but also higher buffers (e.g. credit lines renewals, longer grace periods) in view of financial distress times that can be of firm-specific (e.g. revenues slowdown or product launch deferrals) or macroeconomic nature. Table 3 supports this argument by showing that bank business debt (and not other non-bank sources of business debt such as family, employees or government loans to the firm) mainly drives the positive relationship between business debt and the amount of outside equity injections (see Panel B in Table 3, specification (7)). This is consistent with banking studies that indicate that credit supply reductions are accentuated in firms that are small, younger and have weaker banking relationships (Iyer, Peydró, Da-Rocha-Lopes, & Schoar, 2014). In addition, our instrumental variable estimations support that the bank-firm relationship could favor credit availability. Given that lenders necessarily use of private (soft) information in early stage firms (see Degryse and Ongena 2005; Agarwal and Hauswald 2010; Hollander and Verriest 2016), outside investors can use the signals based on this relationship to reduce the stringent informational asymmetry and risk they constantly face. Taking these arguments together, we posit that both cash holdings and the bank-firm relationship are two important information channels that could explain the significant positive relationship between business debt and outside equity investments.

While these are our primary findings, we also contribute with specific empirical insights in a number of different ways. First, we conceptually argue that, following the literature on

large incumbent firms, there are two possible alternatives to approaching the relationship between debt and outside equity. On the one hand, the empirical accounting literature would suggest that start-ups which hold high levels of debt are more exposed to financial distress and bankruptcy and would therefore be less attractive to outside investors (Caskey et al., 2012; Jones & Hensher, 2004; Opler & Titman, 1994). On the other hand, various studies grounded in reducing information asymmetry through the use of reliable signals would support a positive relationship between debt and equity (see, e.g., Baldenius & Meng, 2010; Connelly et al., 2011; Davila et al., 2003; Spence, 2002). We contribute to the literature by documenting that, for early stage firms, findings based on incumbent firms may not always hold. Our results build on the findings from recent studies showing a positive relationship between debt and firm survival and growth (Cole & Sokolyk, 2015). We thus support taking a differentiated approach to analyzing the entrepreneurial context and corroborate that start-ups have unique characteristics (Cassar, 2004), which are developed in opaque environments (Berger & Udell, 1998; 2006; Cassar et al., 2015) that should be further explored.

Second, as shown in Figure 1, the debt measure exhibits a certain path dependency. Start-ups with lower debt levels in 2004 maintain lower levels in subsequent years (although some convergence appears until 2006). In an approach related to our study, Cassar (2004) suggests that the capital structure of start-ups is entrepreneur-dependent, meaning that the particular attitudes owners have towards risk, control and exposure to social networks can be reflected in the start-up's capital structure. Third, initial levels of debt seem to play an important role in future growth. High debt start-ups consistently show higher levels of revenues (see Panel E in Table 5). These differences are significant in 2007 and 2008, precisely when these firms receive significantly higher amounts of outside equity investments. This is in line with Puri and Zarutskie (2012) who use a matched sample to show that VC-backed firms grow more partly due to the presence of the outside investors.

Finally, we do not observe a clear relationship between debt and profitability measures such as ROA (see Panel F in Table 5). It may well be that start-ups mainly focus on growth as long as this is long-term value enhancing (Carpenter & Petersen, 2002) rather than on profitability. This is consistent with some prominent high tech start-ups that eventually go public (e.g. Facebook, Twitter or Linkedin) and with the recent entrepreneurial finance literature (Puri & Zarutskie, 2012; Robb & Robinson, 2014).

7. Concluding remarks

This study analyzes the relationship between debt and outside equity in the context of early stage firms. We believe that this is an important issue given the increasing importance of young firms for economic growth. We consistently show that debt, and in particular business debt, is positively related to outside equity investments, especially in times of economic distress. We thoroughly discuss this result and posit that start-ups with higher levels of business debt can send more credible signals that can alleviate information asymmetries in capital markets. This is a crucial matter in the start-ups' context in which firms tend to be more opaque and outside investors face more severe information asymmetries as compared to the case of large incumbent firms. The analyzed signals and their respective information channels are not only related to the screening and monitoring implications of the debt contract *per se*, but also to the use of debt by the firm. In particular, we examine how cash holdings and the firm-bank relationship are possible information channels on which outside equity investors can rely.

Future research could attempt to employ quasi-natural experiments to more clearly identify the underpinnings of the causal mechanisms between debt and outside equity. These, however, are not always available. A long-standing unresolved issue relates to the extent to which new firms can be leveraged. While we provide important insights into the underlying

relationship between debt and outside equity investments, we do not indicate an optimum amount of debt that a start-up should contract. To tackle this issue, formal models from the more traditional capital structure literature could be employed. Finally, there is an increasing trend to study debt concentration (Colla et al., 2013; Rauh and Sufi, 2010). Whereas debt concentration is a characteristic usually found in established firms, the potential implications for young firms remain underexplored. All in all, future research could use our study as a first step toward bridging the gap between the research on start-ups and incumbent firms.

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Table 1. Evolution of start-up financial injections (2004 – 2011)

	Obs.	Mean ($)	Std. dev.	p50	p90
Year: 2004. Baseline survey					
Owner equity	2,627	81,209	1,547,886	11,000	10,000
Inside equity	2,055	4,097	32,499	0	0
Outside equity	2,018	78,094	1,325,940	0	0
Personal debt	2,752	38,527	159,731	0	93,000
Business debt	2,812	70,812	1,103,361	0	50,000
Year: 2005. First follow-up					
Owner equity	2,422	26,917	254,580	0	50,000
Inside equity	1,579	5,558	94,994	0	0
Outside equity	1,566	70,093	752,997	0	0
Personal debt	2,349	32,083	192,640	0	70,000
Business debt	2,349	188,509	4,621,973	0	50,000
Year: 2006. Second follow-up					
Owner equity	2,146	16,361	80,353	0	40,000
Inside equity	1,462	1,520	20,439	0	0
Outside equity	1,443	44,713	5,910,885	0	0
Personal debt	2,081	37,642	847,055	0	70,000
Business debt	1,885	211,709	4,218,904	0	65,300
Year: 2007. Third follow-up					
Owner equity	1,868	15,597	76,223	0	30,000
Inside equity	1,333	2,798	38,408	0	0
Outside equity	1,309	25,382	360,814	0	0
Personal debt	1,801	43,168	413,511	0	65,000
Business debt	1,574	73,369	699,397	0	75,000
Year: 2008. Fourth follow-up					
Owner equity	1,682	18,082	140,584	0	30,000
Inside equity	1,235	1,019	11,692	0	0
Outside equity	1,213	31,214	616,722	0	0
Personal debt	1,596	312,650	7,436,362	0	60,000
Business debt	1,489	76,483	517,324	0	81,976

This table reports yearly financial injections (in dollars) made in start-ups. Complete definitions for all variables are provided in Appendix A.

Table 1. Evolution of start-up financial injections (2004 – 2011) cont.

	Obs.	Mean ($)	Std. dev.	p50	p90
Year: 2009. Fifth follow-up					
Owner equity	1,589	21,177	319,023	0	20,000
Inside equity	1,198	1,787	27,080	0	0
Outside equity	1,177	310,543	7,717,939	0	0
Personal debt	1,515	35,472	280,633	0	50,000
Business debt	1,301	99,821	1,200,185	0	50,000
Year: 2010. Sixth follow-up					
Owner equity	1,398	18,316	778,237	0	18,000
Inside equity	1,060	4,153	72,441	0	0
Outside equity	1,047	27,306	700,297	0	0
Personal debt	1,347	46,326	1,047,406	0	40,000
Business debt	1,162	57,380	431,453	0	40,000
Year: 2011. Seventh follow-up					
Owner equity	1,343	23,175	337,422	0	10,000
Inside equity	1,040	1,296	23,134	0	0
Outside equity	1,025	18,954	275,798	0	0
Personal debt	1,279	19,668	184	0	30,000
Business debt	1,131	65,248	742,377	0	52,000
Total firm-year observations (2004-2011)					
Owner equity	15,075	29,693	685,626	0	47,000
Inside equity	10,962	2,920	49,097	0	0
Outside equity	10,798	75,331	2,667,902	0	0
Personal debt	14,714	67,049	2,524,599	0	60,000
Business debt	13,703	113,875	2,613,924	0	60,000

Table 1 continued: This table reports yearly financial injections (in dollars) made in start-ups. Complete definitions for all variables are provided in Appendix A.

Table 2. Descriptive statistics (2004 – 2011)

	Obs.	Mean ($)	Std. dev.	p50	p90
Main variables					
Ln(Debt)	12,884	8.07	4.79	9.99	12.32
Ln(Personal debt)	14,714	4.36	4.96	0.00	11.00
Ln(Business debt)	13,703	3.18	4.83	0.00	11.00
Ln(Out_E)	10,798	0.56	2.50	0.00	0.00
Out_E_Dum	10,798	0.05	0.22	0.00	0.00
Control variables					
Crisis dummy	15,748	0.24	0.42	0.00	1.00
Firm characteristics					
Revenues	14,785	1,086,461	12,800,000	85,000	1,206,292
Profits	14,524	29,214	1,516,361	1,200	100,000
Credit risk	13,490	2.98	0.98	3.00	4.00
Employees	15,628	4.61	14.08	1.00	10.00
High tech	15,748	0.07	0.26	0.00	0.00
Ln(Cash)	14,862	7.29	4.06	8.52	11.23
Ln(Accounts Receivable)	14,976	5.29	5.17	6.91	11.65
Ln(Inventory)	15,152	3.76	4.93	0.00	11.16
Ln(Fixed Assets)	15,618	7.75	4.84	9.55	12.64
ROA	12,526	1.06	374.30	0.04	1.31
Owner characteristics					
Age	15,336	46.70	10.56	46.00	61.00
Years experience	15,341	12.71	10.52	10.00	27.00
Week hours	15,143	43.45	22.49	50.00	70.00
Start-up experience	15,342	0.95	1.34	0.00	3.00
US citizen	15,341	0.96	0.19	1.00	1.00
Male	15,343	0.74	0.44	1.00	1.00
US born	15,343	0.89	0.32	1.00	1.00

Categorical variables

1. Legal form	**Freq.**	**2. Education**	**Freq.**	**3. Race**	**Freq.**
1: LLC	7,977	1: Less than 9th grade	14	1: White	13,007
2: S-Corporation	5,786	2: High school not finished	144	2: Hawaiian	33
3: C-Corporation	1,985	3: High school	1050	3: Asian	649
Total	**15,748**	4: Technical degree	702	4: Black	944
		5: College not finished	3,053	5: Indian	169
		6: Associate degree	1079	6: Other	532
		7: Bachelor	4,143	**Total**	**15,334**
		8: Graduate studies not finished	1189		
		9: Master	2,773		
		10: Profess. schools/Doctorate	1195		
		Total	**15,342**		

Complete definitions for all variables are provided in Appendix A.

Table 3. Heckman selection model

Panel A. Heckman two-step model. First-stage (Probit regressions)							
	DV: Out_E_Dum (1=Receiving outside equity)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ln(Debt)	0.02**		0.03***		0.03***		
	(0.01)		(0.01)		(0.01)		
Ln(Personal debt)		0.02***		0.03***		0.03***	0.03***
		(0.01)		(0.01)		(0.01)	(0.01)
Ln(Business debt)		0.02***		0.03***		0.03***	
		(0.01)		(0.01)		(0.01)	
Ln(Bank Business debt)							0.02**
							(0.01)
Ln(Non-bank Business debt)							0.04***
							(0.01)
Out_E_Dum $_{(t-1)}$	1.39***	1.36***	1.16***	1.10***	1.06***	1.00***	0.99***
	(0.11)	(0.11)	(0.13)	(0.14)	(0.12)	(0.12)	(0.12)
Crisis	-0.12*	-0.12*	-0.11	-0.14*	-0.31**	-0.34***	-0.33***
	(0.07)	(0.07)	(0.08)	(0.08)	(0.12)	(0.12)	(0.12)
Credrisk	0.02	0.01	0.03	0.02	0.02	0.01	0.01
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Revenues	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Employees	0.00**	0.00**	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Hightech	0.21**	0.23**	0.12	0.15	0.19*	0.17	0.17
	(0.08)	(0.08)	(0.09)	(0.09)	(0.11)	(0.11)	(0.11)
Financial Information							
Ln(Cash)			0.03**	0.04***	0.03**	0.04***	0.04***
			(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Ln(Accounts Receivable)			-0.02**	-0.03***	-0.02**	-0.03***	-0.03***
			(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Ln(Inventories)			0.01	0.00	0.00	0.00	0.00
			(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Ln(Fixed Assets)			-0.00	-0.01	-0.01	-0.01	-0.01
			(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
ROA			-0.00*	-0.01*	-0.00*	-0.01*	-0.01*
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Profits			-0.00	-0.00	-0.00	-0.00	-0.00
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legal status							
S-Corp			0.00	-0.02	0.03	0.01	0.01
			(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
C-Corp			0.49***	0.49***	0.51***	0.50***	0.49***
			(0.10)	(0.10)	(0.11)	(0.11)	(0.11)
Owner characteristics	N	N	Y	Y	Y	Y	Y
Year dummies	N	N	N	N	Y	Y	Y
Industry dummies	N	N	N	N	Y	Y	Y
Observations	5,077	5,088	4,259	4,262	4,259	4,262	4,262

This table summarizes the Heckman selection model. Panel A reports the selection equation in which the dependent variable (outside equity) is a dummy variable that takes the value of 1 if the start-up receives outside equity and 0 otherwise (equation (1)). Appendix A defines all variables, including the owner characteristics, which are not reported in this table for brevity purposes. Robust standard errors are presented in parenthesis. * p<0.10, ** p<0.05, *** p<0.01.

Table 3. Heckman selection model cont.

Panel B. Heckman two-step model. Second-stage (OLS regressions)							
	DV: Ln(Out_E)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ln(Debt)	0.06**		0.03		0.05**		
	(0.03)		(0.03)		(0.02)		
Ln(Personal debt)		-0.10***		-0.03		-0.01	-0.01
		(0.02)		(0.03)		(0.02)	(0.02)
Ln(Business debt)		0.07***		0.03		0.04**	
		(0.03)		(0.02)		(0.02)	
Ln(Bank Business debt)							0.05*
							(0.03)
Ln(Non-bank Business debt)							0.03
							(0.03)
Crisis	0.08	0.04	0.04	0.05	0.10	0.05	0.05
	(0.28)	(0.29)	(0.25)	(0.26)	(0.39)	(0.42)	(0.42)
Credrisk	-0.48***	-0.50***	-0.26**	-0.28**	-0.13	-0.12	-0.12
	(0.14)	(0.14)	(0.11)	(0.11)	(0.12)	(0.13)	(0.13)
Revenues	0.00	0.00	0.00	0.00	0.00**	0.00**	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Employees	-0.01	-0.01	0.01	0.01	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Hightech	0.73*	0.58	0.89***	0.80**	0.95***	1.03***	1.03***
	(0.39)	(0.38)	(0.30)	(0.33)	(0.37)	(0.38)	(0.39)
Financial Information							
Ln(Cash)			0.17***	0.15***	0.20***	0.20***	0.20***
			(0.04)	(0.05)	(0.04)	(0.04)	(0.04)
Ln(Accounts Receivable)			-0.01	0.00	-0.04*	-0.04*	-0.04*
			(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
Ln(Inventories)			0.04	0.04	0.04	0.04	0.04
			(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Ln(Fixed Assets)			0.07***	0.06**	0.03	0.03	0.03
			(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
ROA			0.00	0.00	0.00	0.00	0.00
			(0.02)	(0.01)	(0.02)	(0.01)	(0.01)
Profits			-0.00	-0.00	-0.00	-0.00	-0.00
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Legal status							
S-Corp			-0.65*	-0.73**	-0.42	-0.48	-0.47
			(0.35)	(0.34)	(0.35)	(0.34)	(0.34)
C-Corp			0.24	0.16	0.09	-0.00	-0.00
			(0.49)	(0.50)	(0.50)	(0.49)	(0.50)
Owner characteristics	N	N	Y	Y	Y	Y	Y
Year dummies	N	N	N	N	Y	Y	Y
Industry dummies	N	N	N	N	Y	Y	Y
State dummies	N	N	N	N	Y	Y	Y
Observations	250	254	215	218	215	218	218

Table 3 continued: Panel B reports the measurement (outcome) equation in which the dependent variable is ln(outside equity) (equation (2)). Appendix A defines all variables, including the owner characteristics, which are not reported in this table for brevity purposes. Robust standard errors are presented in parenthesis. * p<0.10, ** p<0.05, *** p<0.01.

Table 4. Propensity score matching results

Matching results across two groups (187 matched pairs)					
Variable	***Mean values***				***t-test p-value***
	High Ln(Debt)	***(Std.dev.)***	***Low Ln(Debt)***	***(Std.dev.)***	
Ln(Out_E)	1.10	(0.25)	1.00	(0.24)	0.77
Revenues	134,074	(32,714)	149,066	(27,447)	0.73
Profits	-7,884	(16,309)	-11,182	(6,482)	0.85
Credit risk	3.28	(0.05)	3.20	(0.06)	0.28
Employees	2.48	(0.25)	2.40	(0.51)	0.89
High tech	0.14	(0.03)	0.14	(0.03)	0.88
Total Assets	248,701	(34,611)	245,335	(72,271)	0.97
Ln(Cash)	7.32	(0.29)	7.09	(0.29)	0.58
ROA	-0.59	(0.18)	-0.20	(0.27)	0.24
Age	44.87	(0.82)	45.26	(0.85)	0.74
Years experience industry	12.67	(0.79)	11.52	(0.72)	0.28
Week hours	45.67	(1.73)	44.88	(1.82)	0.75
Start-up experience	1.02	(0.10)	1.03	(0.09)	0.94
US citizen	0.95	(0.02)	0.97	(0.01)	0.28
Male	0.82	(0.03)	0.81	(0.03)	0.69
US born	0.86	(0.03)	0.88	(0.02)	0.54
Education	6.62	(0.14)	6.52	(0.15)	0.67
Race	1.42	(0.09)	1.40	(0.09)	0.87

This table reports the means and standard deviations for the 187 treatment firms (high debt in 2004) and the matched 187 control firms (low debt in 2004) (see equation (3)). T-test p-values (right column) confirm that the matching has been successful on the specified covariates since no significant differences across groups are observed. The sample is also matched by legal status (LLC, S-Corp and C-Corp) and by industry according to NAICS 2-digit codes, and spans the following sectors: agriculture, forestry, fishing and hunting; construction; manufacturing; wholesale trade; retail trade; transportations and warehousing; information; finance and insurance; real estate and rental and leasing; professional, scientific and technical services; administrative and support services; educational services; health care and social assistance; arts, entertainment and recreation; accommodation and food services; other services. Complete definitions for all variables are provided in Appendix A.

Table 5. Propensity score matching: Differences in means between groups

	2004	2005	2006	2007	2008	2009	2010	2011
Panel A: Debt mean values (see Figure 1)								
Low debt group	2.97	3.92	5.43	4.65	4.55	3.74	3.95	3.75
High debt group	10.95	7.50	6.96	7.51	7.27	6.67	6.19	5.25
t-test p-value	0.00***	0.00***	0.05**	0.00***	0.00***	0.00***	0.03**	0.13
Panel B: Outside equity mean values. Matching allows for Ln(Debt) differences (see Figure 2)								
Low debt group	1.00	1.02	0.36	0.24	0.10	0.27	0.47	0.17
High debt group	1.10	1.25	0.84	1.29	1.07	0.61	0.18	0.37
t-test p-value	0.77	0.59	0.16	0.01**	0.00***	0.36	0.36	0.52
Panel C: Outside equity mean values. Matching allows for Ln(Personal debt) differences (see Figure 3)								
Low debt group	1.26	1.37	0.91	0.48	0.71	1.13	0.45	0.21
High debt group	1.29	0.86	0.80	0.90	0.69	0.48	0.32	0.56
t-test p-value	0.94	0.20	0.76	0.26	0.94	0.15	0.71	0.33
Panel D: Outside equity mean values. Matching allows for Ln(Business debt) differences (see Figure 3)								
Low debt group	1.32	0.99	0.50	0.61	0.32	0.45	0.12	0.38
High debt group	1.10	1.04	0.75	0.82	0.94	0.50	0.72	0.32
t-test p-value	0.50	0.90	0.42	0.55	0.08*	0.89	0.07*	0.85
Panel E: Revenues mean values								
Low debt group	149,066	450,352	508,738	433,357	416,354	591,481	536,485	1,294,781
High debt group	134,074	363,364	1,551,727	1,018,347	1,455,441	1,108,742	4,170,943	5,943,388
t-test p-value	0.73	0.52	0.33	0.04**	0.06*	0.30	0.19	0.28
Panel F: ROA mean values								
Low debt group	-0.20	0.26	0.29	0.07	0.09	-0.04	-7.64	-1.93
High debt group	-0.59	-0.41	-0.36	0.51	-0.49	-0.53	0.19	0.18
t-test p-value	0.24	0.17	0.13	0.63	0.21	0.54	0.26	0.23

This table reports mean differences between the 187 treatment firms (high debt in 2004) and the matched 187 control firms (low debt in 2004). The first two panels report mean differences for debt (Panel A, see also Figure 1) and outside equity (Panel B, see also Figure 2). To disentangle the effect of debt into personal and business debt, we redo the PSM analysis for each debt category. Panel C reports mean differences when the treated variable is personal debt, while Panel D reproduces the analysis for business debt (see also Figure 3). Panel E and Panel F report the evolution of revenues (i.e. growth measure) and ROA (i.e. profitability measure), respectively, for high versus low debt start-ups. * p<0.10, ** p<0.05, *** p<0.01.

Table 6. Asset decomposition (years 2005 and 2006)

Asset decomposition for 2005 and 2006					
Variable	***Mean values in 2005***				***t-test p-value***
	High Ln(Debt)	***(Std.dev.)***	***Low Ln(Debt)***	***(Std.dev.)***	
Ln(Cash)	8.36	(0.28)	7.56	(0.33)	0.07*
Ln(Accounts Receivable)	5.68	(0.43)	4.78	(0.43)	0.14
Ln(Inventories)	4.56	(0.43)	3.55	(0.41)	0.09*
Ln(Fixed Assets)	9.23	(0.38)	7.45	(0.38)	0.00***
	Mean values in 2006				***t-test p-value***
	High Ln(Debt)	***(Std.dev.)***	***Low Ln(Debt)***	***(Std.dev.)***	
Ln(Cash)	8.52	(0.31)	7.31	(0.38)	0.01**
Ln(Accounts Receivable)	6.02	(0.46)	6.40	(0.47)	0.55
Ln(Inventories)	4.99	(0.48)	3.61	(0.45)	0.04**
Ln(Fixed Assets)	9.05	(0.40)	8.21	(0.38)	0.13

This table reports differences in the asset structure for the two matched groups of start-ups (i.e. high and low debt) for the two years prior to the financial crisis. Appendix A defines all variables. * p<0.10, ** p<0.05, *** p<0.01.

Table 7. OLS and Tobit regressions

OLS and Tobit regressions on the restricted sample to firms which seek outside equity finance				
	DV: Ln(Out_E)			
	(1)	(2)	(3)	(4)
Model	OLS	OLS	Tobit	Tobit
Ln(Debt)	0.09		0.49	
	(0.14)		(0.32)	
Ln(Personal debt)		-0.05		-0.19
		(0.10)		(0.26)
Ln(Business debt)		0.39***		0.78***
		(0.11)		(0.20)
Credrisk	-0.17	-0.10	-0.05	0.05
	(0.51)	(0.45)	(1.03)	(0.90)
Revenues	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Employees	0.06	0.03	0.18*	0.08
	(0.06)	(0.06)	(0.10)	(0.09)
Hightech	0.22	1.19	7.93**	5.09*
	(1.44)	(1.35)	(3.80)	(2.88)
Financial Information				
Ln(Cash)	0.38**	0.31**	0.69**	0.64**
	(0.19)	(0.15)	(0.34)	(0.32)
Ln(Accounts Receivable)	0.01	0.04	0.54*	0.59**
	(0.17)	(0.15)	(0.28)	(0.26)
Ln(Inventories)	0.10	0.08	0.42*	0.23
	(0.16)	(0.14)	(0.25)	(0.23)
Ln(Fixed Assets)	-0.23	-0.36***	-0.94***	-1.01***
	(0.15)	(0.13)	(0.35)	(0.30)
ROA	0.18	0.19	0.47	0.42
	(0.14)	(0.13)	(0.57)	(0.43)
Profits	-0.00**	-0.00***	-0.00*	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Legal status				
S-Corp	0.60	-0.29	2.93	0.84
	(1.55)	(1.47)	(3.32)	(3.01)
C-Corp	5.00**	5.26***	12.26***	10.51***
	(2.05)	(1.58)	(3.21)	(2.58)
Owner characteristics	Y	Y	Y	Y
Year dummies	Y	Y	Y	Y
Industry dummies	Y	Y	Y	Y
R2	0.65	0.71		
χ^2			78.05***	103.05***
Observations	106	106	106	106

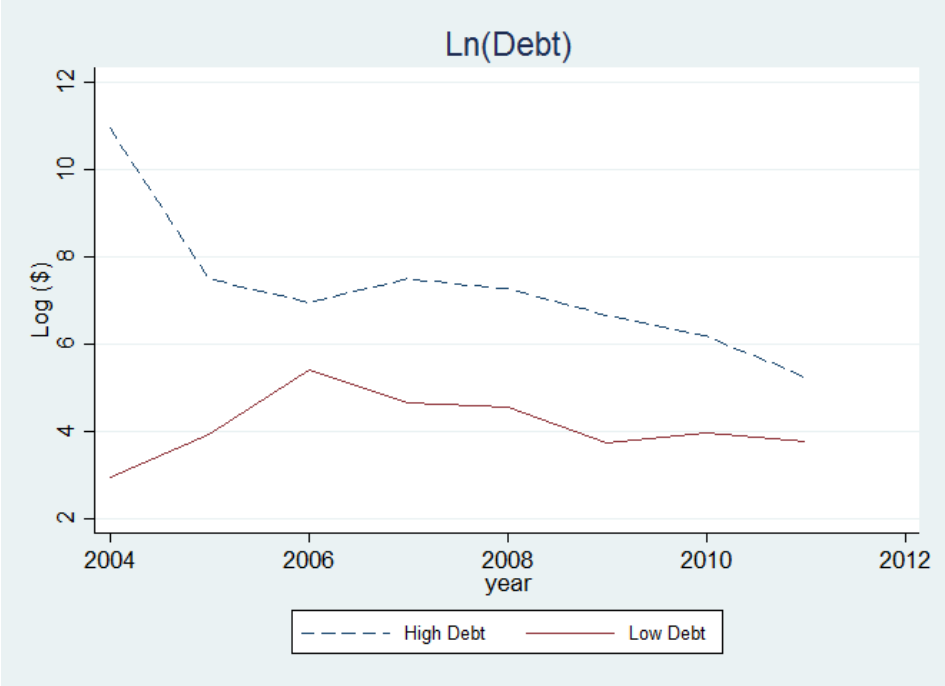
This table reports OLS and Tobit regressions for a subsample restricted to start-ups that seek outside equity financing during 2009-2011 (equation (4)). Appendix A defines all variables, including the owner characteristics, which are not reported in this table for brevity purposes. Robust standard errors are presented in parenthesis. * p<0.10, ** p<0.05, *** p<0.01.

Table 8. 2SLS regressions

First- and Second-stage 2SLS regression results				
	(1)	(2)	(3)	(4)
Dependent variable	Ln(Debt)	Ln(Out_E)	Ln(Debt)	Ln(Out_E)
Model	IV first stage	Second-stage IV	IV first stage	Second-stage IV
Ln(county_branches_2004)	0.11**		0.09**	
	(0.05)		(0.05)	
Ln(Debt) instrumented		1.047**		1.188*
		(0.50)		(0.63)
Credrisk	-0.32***	0.366**	-0.34***	0.390*
	(0.06)	(0.18)	(0.06)	(0.23)
Crisis	0.30**	-0.562***	1.04***	-1,09
	(0.13)	(0.22)	(0.27)	(0.73)
Revenues	0,00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Employees	0.02***	-0,01	0.02***	-0,0154
	(0.00)	(0.01)	(0.00)	(0.01)
Hightech	-0,27	0.575**	-0,26	0.611**
	(0.17)	(0.24)	(0.18)	(0.30)
Financial Information				
Ln(Cash)	0.04**	0,0159	0.05***	0,01
	(0.02)	(0.03)	(0.02)	(0.04)
Ln(Accounts Receivable)	0.11***	-0.142**	0.11***	-0.148**
	(0.01)	(0.06)	(0.01)	(0.07)
Ln(Inventories)	0.10***	-0,0817	0.10***	-0.109*
	(0.01)	(0.05)	(0.01)	(0.06)
Ln(Fixed Assets)	0.10***	-0.116**	0.11***	-0.141**
	(0.01)	(0.05)	(0.01)	(0.07)
ROA	0.00***	-0.00	0.00***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Profits	-0.00*	-0.00	-0.00**	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Legal status				
S-Corp	0,16	-1.510***	0,22	-1.509***
	(0.19)	(0.27)	(0.19)	(0.31)
C-Corp	0.31*	-1.898***	0.42**	-1.946***
	(0.19)	(0.30)	(0.19)	(0.38)
Owner characteristics	Y	Y	Y	Y
Year dummies	N	N	Y	Y
Industry dummies	N	N	Y	Y
F-statistic	60.12***		52.72***	
Observations	5,669	5,669	5,669	5,669

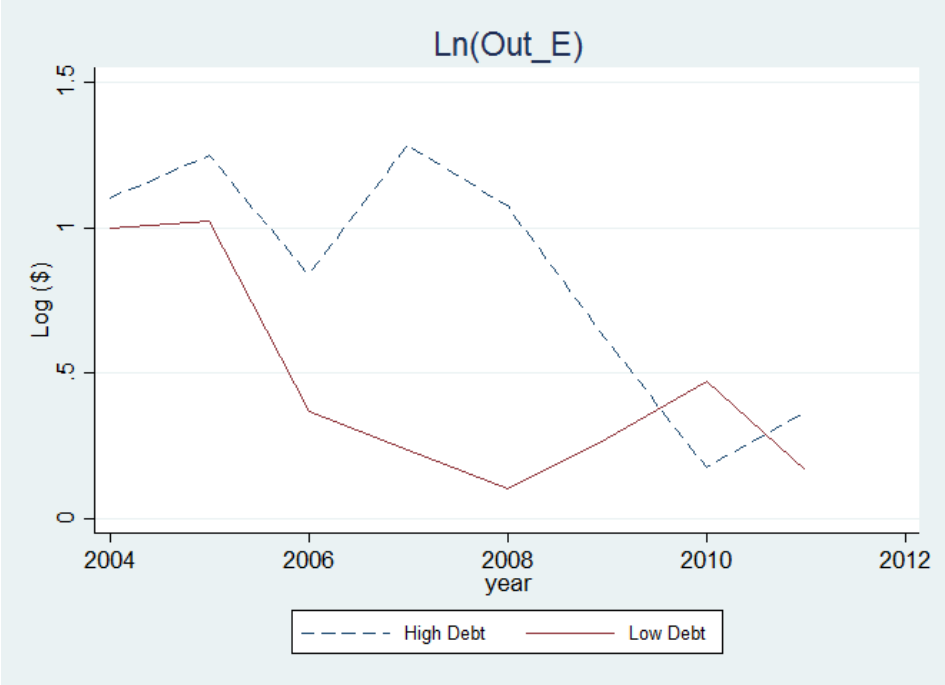
This table reports 2SLS regression results. In the first-stage we use Ln(county_branches_2004) as an instrument for Ln(Debt), the dependent variable. The second-stage IV regressions use the predicted values of Ln(Debt) in the first-stage to regress Ln(Out_E) on the instrumented Ln(Debt). Appendix A defines all variables, including the owner characteristics, which are not reported in this table for brevity purposes. Robust standard errors are presented in parenthesis. * p<0.10, ** p<0.05, *** p<0.01.

Figure 1. Evolution of debt (2004 – 2011)



This figure presents the evolution of the treatment variable: ln(total debt). In 2004, we force this variable to differ across the two groups. Table 5 reports mean differences between groups.

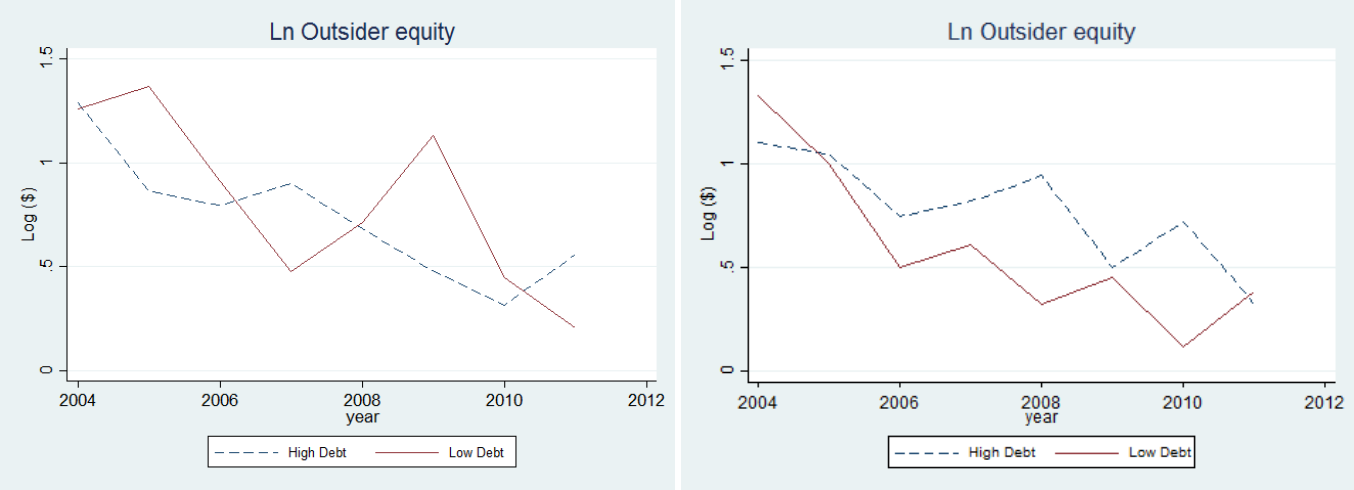
Figure 2. Evolution of outside equity (2004 – 2011)



This figure presents the evolution of outside equity injections across years for the treatment (high debt) and control (low indebted) groups. Table 5 reports mean differences between groups.

Figure 3. Evolution of outside equity by different types of debt (2004 – 2011)

Matching by personal debt **Matching by business debt**



This figure presents the evolution of outside equity injections for personal (left) and business debt (right). Table 5 reports mean differences between groups. For personal debt, there are no significant differences in any year between the two groups. In contrast, when matching by business debt in 2004, results show that high indebted start-ups receive significantly more outside equity both in years 2008 (p-value = 0.04) and 2010 (p-value = 0.06).

Appendix A. Variable definition

Variable	Description
Main variables	
Ln(Debt)	Ln (total debt in $ + 1)
Ln(Personal debt)	Ln (personal debt in $ + 1)
Ln(Business debt)	Ln (business debt in $ + 1)
Ln(Bank Business debt)	Bank Business debt: Ln (bank business debt in $ + 1)
Ln(Bank Business debt)	Non-bank Business debt: Ln (non-bank business debt in $ + 1)
Ln(Out_E)	Ln (outside equity in $ + 1)
Out_E_Dum	Dummy variable (1: positive $ amounts of outside equity, 0: $0 amount)
Debt_Dum	Dummy variable (1: high debt, that is, the highest quartile of Ln(Debt) distribution and 0:low debt, that is, the lowest two quartiles of Ln(Debt) distribution
Control variables	
Crisis dummy	Dummy variable that takes the value of 1: years 2007 – 2009, and 0 otherwise
Firm characteristics	
Revenues	Revenues amount in dollars
Profits	Profits amount in dollars
	Dummy variable that takes the value of 1: years 2007 – 2009, and 0 otherwise
Credit risk	Dun & Bradstreet credit risk score: 1 (lowest probability of delinquency) to 5 (highest probability of delinquency)
Employees	Number of employees
High tech	Technology generator: NAICS defined by the NSF's Survey of Industrial Research and Development as industries that exceed the U.S. average
Ln(Cash)	Ln(cash in $ + 1)
Ln(Accounts Receivable)	Ln(accounts receivable in $ + 1)
Ln(Inventories)	Ln(inventories in $ + 1)
Ln(Fixed Assets)	Ln(fixed assets in $ + 1). Fixed assets is the sum of land, buildings, equipment and vehicles
Ln(Total Assets)	Ln(total assets in $ + 1)
ROA	Profits divided by total assets
Legal form	1: Limited Liability Company, 2: S-Corporation, 3: C-Corporation
Owner characteristics	
Age	Age of the primary owner
Years experience	Primary owner's years of experience in industry
Week hours	Weekly hours dedicated to the venture by the primary owner
Start-up experience	Number of businesses previously created by the primary owner
US citizen	1: US citizen (primary owner)
Male	1: Male (primary owner)
US born	1: US born (primary owner)
Education	Educational level of the primary owner. See Table 2 for more details
Race	Race of the primary owner. See Table 2 for more details
Instrumental variable	
Ln(county_branches_2004)	Ln(county_branches in 2004). Number of bank branches in each county in 2004, collected from the FDIC website

Appendix B. Correlations

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	Ln(Out_E)	1.00																				
2	Ln(Debt)	0.08	1.00																			
3	Ln(Personal debt)	0.06	0.52	1.00																		
4	Ln(Business debt)	0.11	0.49	0.28	1.00																	
5	Crisis	-0.06	0.04	-0.01	0.04	1.00																
6	Credit risk	0.00	-0.11	0.03	-0.07	-0.14	1.00															
7	Revenues	0.06	0.06	0.00	0.07	0.00	-0.04	1.00														
8	Employees	0.12	0.13	0.00	0.17	0.02	-0.03	0.28	1.00													
9	High tech	0.08	-0.02	-0.06	-0.00	-0.00	-0.06	0.00	0.01	1.00												
10	Ln(Cash)	0.11	0.22	0.00	0.13	0.05	-0.16	0.08	0.17	0.05	1.00											
11	Ln(Acc. Receivable)	0.03	0.28	0.11	0.27	0.07	-0.11	0.11	0.21	0.08	0.39	1.00										
12	Ln(Inventories)	0.07	0.21	0.16	0.22	0.02	-0.01	0.06	0.15	-0.04	0.17	0.24	1.00									
13	Ln(Fixed assets)	0.04	0.26	0.15	0.23	0.04	-0.09	0.06	0.16	-0.04	0.29	0.31	0.29	1.00								
14	ROA	0.00	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.03	0.02	0.01	0.01	0.01	1.00							
15	Profits	-0.02	-0.00	-0.02	0.01	0.00	-0.01	-0.13	0.06	-0.01	0.02	0.02	-0.02	-0.01	0.00	1.00						
16	Age	0.04	-0.00	-0.03	-0.01	0.14	-0.10	0.01	0.01	0.01	0.04	-0.02	0.00	-0.02	-0.00	-0.00	1.00					
17	Years of ind. exp.	0.03	-0.01	-0.09	0.00	0.02	-0.06	0.02	0.04	0.11	0.07	0.09	-0.07	0.04	-0.02	-0.01	0.43	1.00				
18	Week hours	0.09	0.23	0.20	0.17	-0.03	-0.00	0.03	0.11	0.01	0.20	0.32	0.18	0.28	-0.00	0.02	-0.10	0.05	1.00			
19	Start-up experience	0.11	0.01	0.01	0.05	-0.00	-0.00	0.04	0.05	0.01	0.05	0.03	0.08	-0.00	-0.01	-0.01	0.18	0.09	-0.02	1.00		
20	Us citizenship	-0.03	0.03	0.00	0.01	0.00	0.00	0.01	-0.01	-0.06	0.01	0.00	0.00	0.01	-0.00	0.00	0.06	0.07	-0.04	0.01	1.00	
21	Male	0.05	0.04	-0.02	0.06	0.01	-0.03	0.03	0.04	0.09	0.09	0.10	0.02	0.04	-0.00	0.00	0.00	0.19	0.09	0.10	-0.02	1.00
22	US born	-0.02	0.00	-0.01	0.00	0.00	0.00	-0.01	-0.01	-0.09	0.01	-0.00	-0.03	0.02	-0.00	0.01	0.05	0.08	-0.03	0.01	0.56	-0.04