Debt financing, survival, and growth of start-up firms ☆

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ABSTRACT

We analyze the relation between different forms of debt financing at the firm's start-up and subsequent firm outcomes. We distinguish between business debt, obtained in the name of the firm, and personal debt, obtained in the name of the firm's owner and used to finance the start-up firm. Start-up firms with better performance prospects are more likely to use debt and, in particular, business debt. Compared to all-equity firms, firms using debt at the initial year of operations are significantly more likely to survive and achieve higher levels of revenue three years after the firm's start-up. However, results hold for business debt only. Debt obtained in the name of the firm is associated with longer survival time and higher revenues, while debt obtained in the name of the firm's owner has no effect on survival time and is associated with lower revenues.

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1. Introduction

During the past few decades, academic researchers and policy makers have been trying to identify factors that determine success, measured by survival and growth, of entrepreneurial firms. Because of the limited availability of data on young entrepreneurial business ventures, most studies have focused on older, more established firms.[1] More recently, the Kauffman Firm Surveys (KFS) have provided a rich source of information on approximately 5000 start-up firms established during 2004 and

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surveyed annually through their early years of operation.[2] Using KFS data, Robb and Robinson (2014) analyze the capital structure decisions of new entrepreneurial firms and find that: (i) start-up firms rely heavily on external debt in the form of loans and credit lines from banks; and (ii) higher levels of external debt at start-up are associated with faster growth in revenues and employment.

This study extends Robb and Robinson (2014) by documenting the differential effects on a start-up firm's survival and growth attributable to the use of external debt obtained in the name of the business (business debt) versus external debt obtained in the name of the firm's owner and used to finance the start-up firm (personal debt). This distinction is not considered or explored by Robb and Robinson (2014), who pool bank loans granted to the firm with bank loans granted to the firm's owner(s) to define the external debt. Yet, we find that only business bank debt, and not personal debt, is associated with more successful outcomes for start-up firms. Thus, it is important to consider the form of a start-up's debt when evaluating the relation between the capital structure decisions and survival and growth of young entrepreneurial firms.

Our motivation for distinguishing between business and personal debt financing of a start-up firm stems from a fundamental theory of financial intermediation. The key issue in many external financing models is the information asymmetry between the entrepreneur who seeks capital to finance the firm and the firm's financier. The entrepreneur of a high-quality firm has incentive to reduce information asymmetry by retaining a high equity ownership stake in the firm (Jensen and Meckling, 1976; Leland and Pyle, 1977). If the firm is capital constrained, it must borrow to meet its capital needs. Diamond (1991) develops a model of bank loan demand asserting that a new borrower chooses to borrow from an informed bank that monitors rather than from an arm's length lender that does not. This is because banks, through screening and monitoring, play a special role in reducing information asymmetry about a borrowing firm (see Berlin and Loeys, 1988; Diamond, 1984; Fama, 1985; Ramakrishnan and Thakor, 1984), which is likely to be especially high for a new borrower. Since firms want to borrow repeatedly, credit record and reputation building through monitored bank contracts are valuable to new borrowers (see, also, Rajan, 1992).

Following these arguments, we hypothesize that a high-quality start-up firm is more likely to use business debt and less likely to use personal debt than other start-up firms. Furthermore, young entrepreneurial firms using business debt at start-up outperform no-debt firms; whereas, young entrepreneurial firms using personal debt do not outperform no-debt firms. These hypotheses are based on the premise that business debt is fundamentally different from personal debt in terms of firm screening and monitoring to the extent that business debt is obtained from an informed lender, while personal debt is obtained from an arm's length lender. When evaluating a business-loan application, the lender primarily evaluates the creditworthiness and performance prospects of the firm. If the lender provides business debt to the firm, then the lender typically will monitor the firm during the life of the loan. In contrast, when evaluating and extending a personal loan, a lender evaluates the creditworthiness of the entrepreneur – not the creditworthiness and performance prospects of the business entity. Consequently, the cost to the lender of underwriting a business loan is greater than the cost of underwriting a personal loan. Prospective lenders may choose to steer lower quality borrowers to personal loans because the lenders wish to avoid the more costly underwriting process associated with business credit, especially when the lender perceives the likelihood of a positive outcome to be low.[3]

Many personal loans, especially credit-card lines of credit, are underwritten largely upon information from credit rating bureaus, often with instant loan decisions. In addition, it is unusual for lenders to monitor personal loans after they are funded. In fact, the lender may not know that the proceeds of the personal loan are to be funnelled by the entrepreneur into her start-up firm. The borrower also will find a business loan application to be more costly than a personal loan application in terms of document preparation and production time. Hence, the owner of a start-up firm may self-select out of a business loan application in favor of a personal loan application. However, a personal loan puts the owner's personal wealth and assets at risk. Furthermore, such a loan does little to mitigate the asymmetric information between the lender and borrower – an important factor for a high-growth, high-quality firm which may need to borrow repeatedly.[4]

In practice, start-up firms borrow capital in the name of the firm not only from financial institutions but also from business suppliers; consequently, we separate business debt into two sub-categories: lending by financial institutions, which we refer to as "business bank credit," and lending by suppliers, which we refer to as "business trade credit." We argue that trade credit is a type of business debt, in that the supplier-creditor is evaluating and monitoring the creditworthiness and performance of the firm, rather than the creditworthiness and performance of the firm's owner. A number of studies, including Schwartz and Whitcomb (1977, 1978), Emery (1984), Freixas (1993), Biais and Gollier (1997), Jain (2001), and Burkart and Ellingsen (2004), argue that a supplier obtains information about its borrowers through the business relationships with those firms, mitigating the asymmetric information problem, just as a bank obtains information about its borrowers through its financial relationships with those firms. In fact, many of these studies theorize that suppliers have a monitoring advantage over banks through their repeated transactions with customers, which provides them with private information that banks do not have.[5] Giannetti et al. (2011) argue that while suppliers may possess monitoring abilities that are superior to those of bankers, their selection abilities

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[2] The KFS identified start-up (newly established) firms by using a random sample from Dun & Bradstreet's database of new businesses founded in 2004. The wholly owned subsidiaries of existing businesses, businesses inherited from someone else, not-for-profit organizations, and firms that had any kind of business activity prior to 2004 were excluded from the sample.

[3] Unfortunately, the KFS data do not provide information on loan applications during the start-up year, so we are unable to analyze this issue.

[4] In many cases, the lender may require a personal guarantee of repayment from the firm's owner for business loans, which may suggest that the distinction between business debt and personal debt is trivial for young entrepreneurial firms. However, even firms with unlimited personal liability of the owners have incentive to signal their high quality and initiate reputation and credit record building. Furthermore, even with personal guarantees, the lender will look first to the firm for repayment because of the costs of enforcing such a guarantee through the courts.

[5] Petersen and Rajan (1994, 1997), Fisman and Love (2003), Cuñat (2007) provide empirical support for this hypothesis.

are inferior to those of bankers because they can only select among firms in their supply chain and customer base, whereas bankers can select among firms across all industries. For these reasons, we consider trade credit as a form of business debt but separate trade credit from bank credit.

Our findings can be summarized as follows. As a starting point, we document that: (1) better quality start-up firms are more likely to obtain debt financing in the first year of operations, and (2) debt financing is associated with higher success of young entrepreneurial firms in terms of survival and revenue growth. Consistent with our argument that the distinction between business debt and personal debt is important, we document that higher-quality start-ups are more likely to obtain business debt (bank credit and/or trade credit), while lower-quality start-ups are more likely to obtain personal debt in the initial year of the firm's operations. Importantly, it is business bank credit, but not business trade credit or personal debt, that drives the positive relation between debt financing and performance outcomes of young entrepreneurial firms. Unfortunately, the data do not allow us to determine whether better performance outcomes of start-ups firms with bank credit are attributable to the bank's selection or monitoring. Furthermore, we are unable to disentangle the firm's self-selection to apply for business debt and the lender's screening and selection decisions to extend business lending. We infer from prior academic and anecdotal evidence that all three of these channels are likely to play a role, and we leave for future research to determine the relative importance of each channel.

Our study contributes to several strands of the entrepreneurship and finance literatures. First, we contribute to the literature that analyzes the importance of credit financing for the entrepreneurial firm's growth and development (e.g., Holtz-Eakin et al., 1994; Berger and Udell, 1998; Beck and Demirguc-Kunt, 2006). Of particular interest to our research are recent studies documenting the essential role of credit markets and credit financing during the most obscure and fragile stage of the firm's life – the start-up stage (e.g., Black and Strahan, 2002; Robb and Robinson, 2014; Schmalz et al., 2015; and Cerqueiro and Penas, 2016). Second, we contribute to the literature that analyzes the performance prospects of young entrepreneurial firms and argues that decisions made at the initial stage of business formation can have significant effects on subsequent firm outcomes. (e.g., Cooper et al., 1994; Audretsch and Mahmood, 1995; Cassar, 2004; Schwienbacher, 2013; Cassar, 2014). Third, our study contributes to the literature on financial intermediation and loan demand (e.g., Diamond, 1984, 1991; Fama, 1985; Ramakrishan and Thakor, 1984; Billett et al., 1995). Finally, we contribute to the literature on debt financing of privately held firms (see, e.g., Ang, 1992; Berger and Udell, 1995, 1998; Cole, 1998; Berger and Udell, 2002; Brav, 2009; Ang et al., 2010; Cole, 2013; Cole and Sokolyk, 2016; Mc Namara et al., 2017).

We acknowledge some limitations of our study. First and foremost, we do not have a natural experiment that enables us to make causal inferences about the relation between the use of business debt and survival and growth. Hence, our results are primarily descriptive in nature. Second, the KFS data do not identify firms that apply for business debt at start-up and get rejected. With data on loan-application details and outcomes, researchers could analyze the selection mechanisms and processes used by lenders in the case of start-up firms. Third, the KFS do not provide information on the terms and structure of the loans, or the identity and characteristics of the lenders. That information would enable researchers to better analyze how banks select and monitor start-up firms, the role of relationship lending in start-up financing, and policy implications regarding the types of lenders that are most successful in selecting and nurturing start-up firms. Nevertheless, our study provides new evidence on the importance of bank lending for firms with no record of business operations and very limited access to other types of financing.

The remainder of our study is structured as follows. In Section 2, we develop hypotheses. In Sections 3 and 4, we describe our data and methodology, respectively. In Section 5, we present empirical results, followed by a summary and conclusions in Section 6.

2. Hypotheses

Our first set of hypotheses relates to the differences between start-up firms that obtain debt financing and start-up firms that do not obtain debt financing. As outlined above, there is a high degree of information asymmetry between the start-up firm and its potential creditors due to the lack of a performance track record and a high degree of uncertainty about future performance. We hypothesize that a start-up firm with better performance prospects is more likely to apply for credit (what we refer to as "self-selection") and receive credit from its prospective lender (what we refer to as "lender selection") during the firm's start-up year.[6] Thus, a higher quality start-up firm is more likely to obtain debt financing than a lower quality start-up firm. Formally, our first hypothesis states:

H₁. There is a positive relation between the use of start-up debt financing and performance prospects of the firm: A high quality start-up firm is more likely to obtain debt financing than a low quality start-up firm.

Next, we differentiate between firms that obtain business debt and firms that obtain personal debt and compare them to other start-up firms. Robb and Robinson (2014) argue that it is important to distinguish between "insider" debt (obtained from the owner(s), family, and friends) and "outsider" debt (obtained from external sources, such as, banks). They conclude that outsider debt is most important for successful firm outcomes because of the superior enforcement technologies available to outsiders. We

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[6] We are grateful to a referee for pointing out to us this double-selection mechanism involved in obtaining credit. First, the firm must select to apply for a loan and, second, the bank must select to grant credit to the firm that applies. Cole and Sokolyk (2016) provide an analysis of this selection process for small U.S. firms. Unfortunately, the KFS data do not provide information on loan applications, but instead provides information on the incidence and amounts of various types of credit used by the firm.

argue that a much superior debt taxonomy is based upon the entity (i.e., the firm versus the firm's owner) being evaluated, and subsequently monitored, by the prospective lender. When the entity is the firm's owner, the lender is only tangentially, if at all, concerned with the firm's creditworthiness, finances, and prospects for success; instead, the lender is focused on the creditworthiness of the firm's owner. However, when lending directly to the firm, the lender screens and monitors the firm's finances and prospects for success. As discussed above, the theory of bank loan demand (see Diamond, 1991) predicts that high-quality new borrowers would choose to borrow from an informed bank that monitors to signal their quality and initiate credit record and reputation building. Informed lender selects high-quality firms out of pull of loan applicants. For these reasons, we expect that high-quality start-up firms are more likely to obtain business debt financing. On the other hand, high-quality firms are less likely to obtain personal debt because personal debt is a form of arm's length debt that does not involve screening and monitoring; hence, personal debt does not produce information about the quality of the firm. Furthermore, low quality start-up firms may be steered by lenders towards personal debt in the presence of personal assets that can be used as collateral; they may also choose to apply for a personal loan rather than go through a more costly business loan application. Formally, our next two hypotheses state:

H₂. A high-quality start-up firm is more likely to obtain business debt than a low-quality start-up firm.

H₃. A high-quality start-up firm is less likely to obtain personal debt than a low-quality start-up firm.

Whereas our first three hypotheses relate to the decision to obtain credit, our remaining set of hypotheses deals with how these decisions are related to the firm's future performance outcomes. We hypothesize that a firm obtaining debt at the firm's start-up will exhibit future performance superior to that of a no-debt firm. There are three alternative, but not mutually exclusive, explanations for this superior performance: (i) self-selection by high-quality firms to apply for debt; (ii) lender selection to approve loan applications of high-quality firms; and (iii) positive effects of monitoring by lenders once the credit has been extended. While we cannot distinguish directly among these channels with KFS data on debt financing, all three channels may play some role. We speculate that lender selection is likely to play the biggest role for the following reasons. Due to moral hazard and adverse selection, low quality firms may still apply for credit. Lenders then screen the borrowers and utilize their skill and expertise to select only high-quality firms. This credit financing at the initial stage of business formation helps firms grow and develop. Lender's monitoring and disciplinary actions (e.g., the threat of cutting off future financing) provide incentives for firms to undertake high-quality projects. But the lenders have to select high-quality firms in the first place for monitoring to be effective. Formally, our fourth hypothesis states:

H₄. A firm that obtains debt at the firm's start-up exhibits superior future performance outcomes compared to a firm that obtains no debt at start-up.

Next, we distinguish between the use of business debt and personal debt and its relation to future firm performance outcomes. We hypothesize that a firm obtaining debt in the name of the firm, rather than in the name of the firm's owner, is more likely to succeed, both in terms of survival and revenues. This effect could be due to self-selection, lender selection, and monitoring because business, but not personal, debt is likely to be informed about the firm's prospects and to involve monitoring of the firm. Formally, we formulate our fifth hypothesis as follows:

H₅. A firm that obtains business debt at the firm's start-up exhibits superior future performance outcomes compared to a firm that obtains no debt at start-up.

In the next section, we describe the data used to test these hypotheses.

3. Data

To test our hypotheses, we use data from the Kauffman Firm Surveys. This annual survey follows 4928 privately held firms that were established in 2004. The survey results are available for the baseline start-up year (2004) and eight follow-up years (2005–2012). The KFS represents the largest and the most comprehensive database on U.S. start-up firms. Along with detailed information on the firm's financing, the KFS provides data on various firm and owner characteristics.[7] The richness of the KFS data allows us to identify what types of firms use debt financing as well as the different types of debt at the firm's start-up and to explore the relation between the use of different types of debt at the firm's start-up and subsequent firm performance. Table I provides a summary and definitions of KFS variables used in the study.

Table II presents the descriptive statistics on firm and primary owner characteristics. On average, start-up firms generated about $230,000 in revenues, a surprising $486 in net income, and had $347,000 in total assets by the end of the first year of operations. The financial characteristics of a median firm, however, are quite different from the characteristics of an average firm. The median firm generated only $7500 in revenues, reported a net loss of $300, and had $20,000 in total assets. The 75th percentile start-up firm had values for revenues and assets that are substantially smaller than the sample averages, indicative of the highly skewed distributions for these financial variables with potential presence of significant outliers. To address the skewness of the distributions, we take the natural logarithms of firm financial characteristics' variables in our subsequent analysis.

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[7] For more detailed information about the KFS data, see Ballou et al. (2008) and DesRoche et al. (2012).

Table I
KFS variable definitions.
This table presents variable definitions. All variables are from the 2004 Kauffman Firm Survey.

Debt variables:	
Debt (any type)	Dummy variable, equals 1 if firm reports that it used either business bank credit, business trade credit, or personal debt.
Business bank credit	Dummy variable, equals 1 if firm reports that it used any of the following credit categories: business bank loan, business credit line, business loan from nonbank institutions, business credit card, business credit card issued on owner's name, business loan from the government, business loan from other businesses, business loan from other sources.
Business trade credit	Dummy variable, equals 1 if firm reports that it used trade credit.
Personal debt	Dummy variable, equals 1 if firm reports that it used any of the following credit categories: personal bank loan by the primary owner, personal bank loan by other owners, the primary owner's personal credit card used for business purposes, and the other owners' personal credit cards used for business purposes.
Debt amount	Aggregate dollar amount of credit used by the firm (sum of the amounts of business bank credit, business trade credit, and personal debt).
Other sources of capital:	
Insider equity	Dummy variable, equals 1 if either spouse or parent provided equity financing.
Insider debt	Dummy variable, equals 1 if either family, employee, any firm owner, or other individual loaned money to the firm, primary owner, or other owners.
Outsider equity	Dummy variable, equals 1 if informal investors (i.e., angel investors), businesses, government, venture capitalists, or other entities provided equity financing.
Outsider debt/Totcap	Outsider debt, divided by total financial capital (debt + equity). Outsider debt is as defined in Robb and Robinson (2014) as the sum of balances of the following sources of capital: personal bank loan by the primary owner, personal bank loan by other owners, business bank loan, business debt line, business loan from nonbank institutions, business credit card, business debt card issued on owner's name, business loan from the government, business loan from other businesses, business loan from other sources, other individual loans.
Owners equity/Totcap	Total equity invested by all owners divided by total financial capital (debt + equity).
Firm characteristics:	
Revenue	Annual revenue from sales of product or service.
Total assets	Total assets (sum of cash, current assets, and tangible assets)
Net income	Annual profit or loss (profit positive, loss negative)
ROA	Net income divided by total assets
Cash	Cash
Current assets	Sum of accounts receivable and inventory
Tangible assets	Sum of equipment, land/building, vehicles, other business property, and other assets such as intangibles
Credit risk	Categorical variable (1 to 5) based on the credit score of the firm derived from Dunn and Bradstreet U.S. Ratings and Scores. A firm with a credit risk of 1 has the highest credit quality; a firm with a credit risk of 5 has the lowest credit quality.
Corp	Firm is organized as an S-corporation, C-corporation, or Limited Liability Company/Partnership (LLC/LLP)
Non-Corp	Firm is organized as a Sole-proprietorship or Partnership
Multiown	Firm has more than one owner
Intell property	Dummy variable, equals 1 if firm reports that it has trademarks, patents, or copyrights.
Comp advantage	Dummy variable, equals 1 if firm reports that it has a comparative advantage.
Product	Dummy variable, equals 1 if firm only sells product.
Product & service	Dummy variable, equals 1 if firm sells product and service
Urban	Dummy variable, equals 1 if business location is in a metropolitan statistical area (MSA).
Owner characteristics:	
Primary owner	Owner with the highest percentage of firm ownership
Ownership	Firm ownership (in %) by primary owner
Owner age	Age of primary owner (in years)
Female	Primary owner is female
Asian	Primary owner is Asian
Black	Primary owner is Black
Hispanic	Primary owner is Hispanic
White	Primary owner is White
Other race	Primary owner is other than White, Asian, Hispanic, or Black
High school	Primary owner is either a high school graduate, has some high school education but no diploma, or has less than ninth-grade education
College education	Primary owner has either attended some college, has a bachelor's degree, or may have attended a graduate school but has no graduate degree
Graduate degree	Primary owner has a graduate degree
Prior experience	Prior work experience (in years) of the primary owner in the same industry
Prior start-ups	Number of prior business start-ups by the primary owner
Hours worked	Number of hours worked per week by the primary owner
Industry classifications:	*Two-digit NAICS code*
Agriculture, forestry, fishing and hunting	11
Mining and utilities	21, 22
Construction	23

Manufacturing	31–33
Wholesale trade	42
Retail trade	44–45
Transportation and warehousing	48–49
Information	51
Finance and insurance	52
Real estate and rental and leasing	53
Professional, management, and educational services	54, 55, 61
Administrative and support and waste management and remediation services	56
Health care and social assistance	62
Arts, entertainment, and recreation	71
Accommodation and food services	72
Other services, including public administration	81, 92

The small size of the median firm in terms of revenues and assets raises the issue of whether many of these are "hobby" businesses run for the enjoyment of the owner rather than as profit-making enterprises. We argue that this is unlikely because the KFS sampling frame was chosen from the Dun & Bradstreet Market Identifier (DMI) file, which in 2004 consisted of about 6 million firms that chose to be included by obtaining a DUNS number from Dun & Bradstreet. According to the U.S. Internal Revenue Service, there were approximately 30 million tax returns that included a Schedule C report for business income. Subtracting, we see that approximately 24 million small businesses chose not to seek inclusion in the DMI and, hence, were excluded from the KFS sampling frame. We suspect that "hobby" businesses are more likely to be among firms that chose not to seek inclusion in the DMI. Nevertheless, we run robustness tests in our multivariate analysis to examine whether very small firms drive our results.

In addition to firm financial characteristics, Table II reports that about two in three start-up firms are organized as corporations and one in three has more than one owner. At the firm's start-up, the primary owner, on average, is 45 years old, has almost

Table II
Descriptive statistics of start-up firms.
This table reports descriptive statistics of Kauffman Firm Survey 2004 start-up firms. Variable definitions are provided in Table I. Survey weights are applied.

Variable	25th percentile	Mean	Median	75th percentile	Standard error	Number of observations
Firm characteristics:						
Revenue ($)	0	229,789	7500	62,500	80,263	4741
Net income ($)	−10,000	486	−300	5000	6455	4586
Total assets ($)	3400	347,177	20,000	76,000	81,292	4818
ROA	−0.44	−20.69	−0.03	0.24	20	4123
Cash ($)	0	37,682	2000	10,000	6047	4680
Current assets ($)	0	125,983	1000	15,000	65,263	4755
Tangible assets ($)	0	186,548	5000	29,000	39,190	4810
Corp	0.00	0.62	1.00	1.00	0.0070	4928
Credit risk	3.00	3.40	3.00	4.00	0.0120	3606
Rural	0.00	0.17	0.00	0.00	0.0053	4928
Multiown	0.00	0.36	0.00	1.00	0.0068	4923
Ownership	50.00	80.49	100.00	100.00	0.3918	4880
Comp advantage	0.00	0.65	1.00	1.00	0.0069	4858
Product	0.00	0.52	1.00	1.00	0.0071	4928
Product & service	0.00	0.37	0.00	1.00	0.0068	4928
Insider equity	0.00	0.05	0.00	0.00	0.0031	4928
Insider debt	0.00	0.14	0.00	0.00	0.0050	4928
Outsider equity	0.00	0.05	0.00	0.00	0.0031	4928
Outsider debt/Totcap	0.00	0.17	0.00	0.26	0.0043	4928
Owners equity/Totcap	0.09	0.56	0.60	1.00	0.0059	4919
Primary owner characteristics:						
Owner age (years)	37.00	44.99	44.00	53.00	0.1561	4860
Hours worked	20.00	42.25	45.00	60.00	0.3449	4825
Prior experience (years)	3.00	12.84	10.00	20.00	0.1529	4907
Prior start-ups (number)	0.00	1.02	0.00	1.00	0.0453	4893
Female	0.00	0.26	0.00	1.00	0.0063	4920
Asian	0.00	0.05	0.00	0.00	0.0030	4888
Black	0.00	0.08	0.00	0.00	0.0040	4888
Hispanic	0.00	0.05	0.00	0.00	0.0033	4888
White	1.00	0.79	1.00	1.00	0.0059	4888
Other race	0.00	0.03	0.00	0.00	0.0023	4888
High school	0.00	0.12	0.00	0.00	0.0047	4895
College education	0.00	0.66	1.00	1.00	0.0067	4895
Graduate degree	0.00	0.21	0.00	0.00	0.0059	4895

Table III

Debt financing of start-up firms.

This table reports descriptive statistics on the incidence (percentage of firms using a debt type) and amounts of debt use at the firm's start-up. Data are from the Kauffman Firm 2004 Survey. Debt categories are defined in Table I. Descriptive statistics on debt amounts are presented for the full sample and for the subsample of firms with non-zero values for a given debt category [in brackets]. Survey weights are applied. All dollar amount variables are winsorized at the 99th percentile; mid-point range values are used where the exact dollar amounts are missing.

Debt category	Percentage of firms using a debt type	Mean debt Amount [if >0]	Median debt Amount [if >0]	Standard error [if >0]	Number of observations [if >0]
Debt (any type)	76%	$60,400 [$101,395]	$2200 [$20,000]	$2806 [$4498]	4918 [2874]
Business bank credit	44%	$23,503 [$86,525]	$0 [$10,000]	$1778 [$6102]	4913 [1319]
Business trade credit	24%	$18,094 [$76,529]	$0 [$20,000]	$1246 [$4735]	4886 [1122]
Personal debt	55%	$19,011 [$46,957]	$0 [$10,000]	$1071 [$2456]	4897 [1915]

13 years of prior experience in the same industry, and has one prior start-up experience.[8] One in four start-up firms has a female as its primary owner. Four out of five firms have a White primary owner; but less than one in ten have a Black primary owner; one in twenty has a primary owner who is Asian; and one in twenty has a primary owner who is Hispanic. With respect to educational attainment, two out of three primary owners have some college education or hold a college (bachelor's) degree, and one in five holds a graduate degree.

Table III presents descriptive statistics on incidence (percentage of firms reporting the use of a given type of debt) and dollar amounts by debt type. We present summary statistics for debt amounts for the full sample of KFS 2004 firms and for the sub-sample of firms with non-zero values for each credit category (reported in brackets in the table). As we discuss above, we distinguish between business debt (obtained in the name of the firm) and personal debt (obtained in the name of the firm's owner(s)). We separate business debt into business bank credit and business trade credit since these two types of business lending may involve different screening and monitoring mechanisms. *Business Bank Credit* includes business bank loans, business lines of credit, business credit cards (which are extended primarily by banks), loans from other financial institutions, such as, credit unions, and business loans from other sources (government, other business, unspecified sources).[9] *Business Trade Credit* includes lending by the firm's suppliers. *Personal Debt* includes personal bank loans and personal credit cards used by the firm's primary and other owner(s) to finance the firm. Dollar amounts for each debt type reported in the table are winsorized at the 99% percentile as the distributions are highly skewed.

Overall, 76% of start-up firms use some type of debt in the initial year of the firm's operations. This is quite similar to 80% of closely held U.S. firms of any age that use credit documented by Cole (2010) and suggests that entrepreneurial firms try to secure debt financing at the earliest stage of their formation. The full sample average (median) amount of debt is $60,400 ($2200) but these values include zero amounts for 24% of the firms that obtain no debt at the firm's start-up. When we restrict our sample to debt-users only, we find that the mean (median) amount of debt is $101,395 ($20,000) for borrowing start-up firms.

Furthermore, 44% of entrepreneurial firms successfully obtain business bank credit, suggesting that banks participate quite actively in the most informationally opaque market—the credit market for start-up businesses. This finding is inconsistent with the prediction of the credit-rationing theory of information asymmetry (see, e.g., Stiglitz and Weiss, 1981; Berger and Udell, 1998) but is in line with the arguments of the special role of banks in reducing information asymmetry about the borrowing firm (see Berlin and Loeys, 1988; Diamond, 1984; Fama, 1985; Ramakrishan and Thakor, 1984). The average (median) amount of business bank is $22,503 ($0) for the full sample, which again includes 56% of the firms with zero amounts of business debt. Once we exclude non-borrowers of business bank debt, the average (median) amount is $86,525 ($10,000). Moreover, 24% of the sample firms use business trade credit, with an average (median) amount of $18,094 ($0) for the full sample and $76,529 ($20,000) for the sample of trade credit users.

Finally, 55% of all start-ups use personal loans to the owners—not to the business—to finance the business start-up. When we consider the full sample of firms, the average (median) amount of personal debt is $19,011 ($0); the average (median) is almost $47,000 ($10,000) for the subsample of start-up firms with non-zero values of personal debt.[10] This suggests that the owners of more than half of start-up firms explicitly take on personal liability beyond their equity investment in the firm. While it is possible that business debt is also backed by personal guarantees and personal collateral, the fact that a majority of start-ups explicitly use personal debt and a large minority use business debt suggests that there are important differences in these firms and in their capital-structure decisions.[11]

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[8] Similar to prior studies using the KFS data, we define a firm's primary owner as the firm's owner who has the highest percentage ownership (see, e.g., Ballou et al., 2008; Robb et al., 2009).

[9] The incidence of borrowing from other sources and other financial institutions is less than 3%; suggesting that most of lending in this category is done by banks. When we exclude firms that obtain business credit from sources other than banks, the results do not change qualitatively.

[10] The median value of the amount of debt for personal debt category is $0 because some firms report that they use personal credit cards to finance the firm but carry $0 balance on the card.

[11] The KFS does not provide data on personal guarantees or personal wealth of the entrepreneurs in 2004; thus, we are unable to incorporate these measures into our analysis.

4. Methodologies

We employ several different methodologies to test our hypotheses. In all our analyses, we incorporate the survey sampling weights because the KFS sample is not a random sample, but instead, is a stratified random sample where high technology firms are over-represented relative to firms in other industries.

We focus on the incidence of credit use by start-up firms and control for the total amount of debt (*Ln(Debt Amount + 1)*), measured as the natural logarithm of one plus the sum of the amounts of business bank credit, business trade credit, and personal debt. The analysis of the incidence of credit use is important because of the mass of points at zero for most of the amounts of capital and highly skewed distributions for those firms with non-zero amounts of capital, meaning that the median amount is zero while the mean amount is large and positive. Our focus on incidence of different types of credit allows us to analyze whether the form of a start-up's debt financing relates to successful outcomes of young entrepreneurial firms, controlling for the total amount of debt financing.

4.1. Types of firms that use debt at start-up

In order to test H_1, whether higher quality start-up firms are more likely to obtain debt financing than lower quality start-ups, we use a multivariate probit model. The dependent variable, *Debt (Any Type)*, equals one if the firm reported using either one of the following; business bank credit, business trade credit, or personal debt at the firm's start-up (KFS 2004). Independent variables (defined in Table I), include *Firm Characteristics*, *Owner Characteristics*, *Other Sources of Capital*, and *Industry Classifications*, reported by the firm for its start-up year (KFS, 2004). Our primary indicators of firm quality are: firm revenue, credit rating, competitive advantage, intellectual property, owner experience and education, all measured at the firm's start-up year (KFS, 2004). We expect a positive coefficient on each of these variables.

Notably, the probability of using credit is likely to be influenced by the availability of credit, so we include a proxy for the supply of credit as our control variable (*State-Level SME Lending*), measured as the amount of 2004 state-level small-business bank lending per small business enterprise.[12] To make sure that the amount of state-level small-business bank lending is exogenous to the use of credit by start-up firms, we instrument it with the amount of state-level homestead bankruptcy exemption and use the predicted value from that regression as a proxy for the supply of credit to small businesses.[13]

We then examine whether high-quality start-up firms are more likely to use business debt than low-quality start-up firms (test of H_2) and whether high-quality start-up firms are less likely to use personal debt than low-quality start-up firms (test of H_3), conditional on the use of any type of debt. For these analyses, we employ the multivariate bivariate probit model. The bivariate probit selection model accounts for a non-random selection mechanism operating on those firms that decide to use debt and choose whether to use business or personal debt. The two equations in the bivariate probit model are as follows:

$$y^*_1 = \gamma_1' X_1 + \epsilon_1, y_1 = \text{sign}(y^*_1) \tag{1}$$

and

$$y^*_2 = \gamma_2' X_2 + \epsilon_2, y_2 = \text{sign}(y^*_2) \tag{2}$$

where:
$\epsilon_1, \epsilon_2 \sim$ Bivariate Normal $(0, 0, 1, 1, \rho)$

In the bivariate probit selection model, (y_1, x_1) are observed only when y_2 is equal to one, so the error terms in Eqs. (1) and (2) must be re-specified as $\epsilon_j = \exp(\gamma_j, z_j) u_j$, where (u_1, u_2) have the bivariate standard normal distribution. The estimated correlation coefficient ρ (the correlation between error terms ϵ_1 and ϵ_2) can be used to test for selection bias. If ρ is statistically significant, then we can reject the null hypothesis that selection bias is not present. X_1 and X_2 are the vectors of independent variables (defined in Table I), which include *Firm Characteristics*, *Owner Characteristics*, *Other Sources of Capital*, and *Industry Classifications*; all measured at the firm's start-up (KFS, 2004). The coefficients γ_1 and γ_2 in Eqs. (1) and (2) are estimated by the Maximum Likelihood Estimation Method.[14] Our proxies for firm quality are the same as for testing H_1.

The first/selection equation in this model estimates the probability of using any type of debt, as described above; the second/outcome equation estimates the probability of using business or personal debt (all reported at the firm's start-up, KFS, 2004). We use two different categories of business debt and run the regressions separately for *Business Bank Credit* and *Business Trade Credit*.

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[12] Data on bank lending to small businesses are from the FFIEC's Consolidated Reports of Condition and Income, which is a quarterly regulatory report filed by all U.S. commercial banks (see Part II of Schedule RC-C "Loans to Small Businesses and Small Farms"). Business loans with original amounts less than $1 million are reported on this schedule. We then scale the total amount of small business lending by the number of small business enterprises in each state, using the number of enterprises in each state as reported in the 2004 County Business Patterns, which summarizes results from a U.S. Census survey of businesses. Information on the amount of state-level homestead bankruptcy exemption as of 2003 is taken from Table I in Berger et al. (2011).

[13] These results, which show that the exemption amount is a valid instrument, are available from the authors upon request. Berkowitz and White (2004) show that small firms are more likely to be turned down for loans if they are located in states that have higher bankruptcy exemptions. We argue that there is no reason for the bankruptcy exemption to be correlated with the use of bank credit by entrepreneurial firms except through its impact on the supply of credit by lenders.

[14] We operationalize this methodology by using the "heckprobit" procedure of the Stata 12 software.

We expect positive coefficients on the measures of firm quality in these regressions. To test H_3, we use *Personal Debt* as our dependent variable and expect negative coefficients on the measures of firm quality.

4.2. Debt financing at start-up and performance of young entrepreneurial firms

We then analyze the relation between the use of debt at the firm's start-up and performance of young entrepreneurial firms (tests of H_4 and H_5). We examine two measures of performance: survival and revenue three years after the firm's start-up (KFS, 2007).[15] With these measures, we are capturing both the stability of the firm and its growth during the first critical years of the firm's operations. To measure the firm's use of debt at start-up we use *Debt (Any Type)* indicator to test H_4 and two measures of business debt (*Business Bank Credit* and *Business Trade Credit*) to test H_5; all reported at the firm's start-up year (KFS, 2004).[16]

The sections below provide details on each of these analyses.

4.2.1. Survival analysis

We use the Cox (1972) proportional hazard model to estimate the relation between the use of debt at the firm's start-up and the probability of survival of young entrepreneurial firms. The advantage of using a survival model, such as the Cox proportional hazard model, is that the survival functions follow the firm through time and observe at which point in time it experiences an event of interest (see Shumway, 2001). Also, survival models incorporate data truncation; that is, if some events are unobserved because they occur beyond the end of the sample period, they are taken into consideration through right censoring. The Cox proportional hazard model is a semi-parametric model that employs a maximum partial likelihood estimation method and has the following form (Cox, 1972):

$$h_i(t) = h_0(t) \exp(X_i'\beta), \tag{3}$$

where $h_i(t)$ is the time-t hazard of firm i ($t = 2005–2007$ in our analysis), which is the probability that firm i will be out of business at the end of year t, conditioning on firm i surviving up to time t; $h_0(t)$ is the baseline hazard function that is left unspecified and corresponds to the probability of an event when all explanatory variables are zero; X_i is a vector of explanatory (*Debt (Any Type)*, *Business Bank Credit*, *Business Trade Credit*, and *Personal Debt*) and control variables (*Ln(Debt Amount + 1)*, *Ln(Revenue + 1)*), *Firm Characteristics*, *Owner Characteristics*, *Other Sources of Capital*, *Industry Classifications* defined in Table I, corresponding to firm i; β is a vector of coefficients to be estimated.[17] A significant hazard ratio less than 1.0 on *Debt (Any Type)*, *Business Bank Credit*, and *Business Trade Credit* would support our hypotheses.

4.2.2. Revenue analysis

We then examine whether young entrepreneurial firms that use debt at the firm's start-up perform better in terms of revenue growth. We estimate a multivariate Weighted-Least-Squares (WLS) regression:

$$Revenue_i = X_i'\alpha + \mu_i \tag{4}$$

where the dependent variable $Revenue_i$ is measured as the natural logarithm of one plus the level of revenue of firm i three years after the firm's start-up (KFS, 2007)[18]; X_i is a vector of explanatory and control variables, as described above, corresponding to firm i; and μ_i is a normally distributed error term.

Our explanatory variables include: *Debt (Any Type)*, which indicates whether the firm used any type of debt at the firm's start-up. In the analysis that differentiates between the use of business bank credit, business trade credit, and personal debt, *Debt (Any Type)* is replaced with the indicators *Business Bank Credit*, *Business Trade Credit*, and *Personal Debt*, with firms obtaining *No Credit* being the omitted baseline category. Explanatory variables also include controls for *Ln(Debt Amount + 1)*, *Ln(Revenue + 1)*, *Firm Characteristics*, *Owner Characteristics*, *Other Sources of Capital*, *Industry Classifications*, and a proxy for credit supply. The variables are defined in Table I. We expect a positive coefficient on *Debt (Any Type)*, *Business Bank Credit*, and *Business Trade Credit*.

Because this analysis includes only firms that have survived three years from the firm's start-up, we use the Heckman (1979) two-step model to control for sample selection bias. This methodology involves first estimating a single-equation multivariate probit model to explain survival through 2007 (rather than the Cox proportional hazard model explained above:

$$y_i^* = X_i'\gamma + \epsilon_i, y_i = \text{sign}(y_i^*) \tag{5}$$

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[15] In the analysis unreported in the tables, we also examine performance measures (revenue and survival) one, two, five, and seven years after the firm's start-up. The results are qualitatively similar to the ones reported in the tables for measures three years after the start-up. As expected, the relation between debt financing at the firm's start-up and subsequent performance becomes weaker as the length of time between the start-up year and the performance measurement year increases.

[16] In unreported analysis, we apply the revenue and survival models to a subsample of firms that are matched by propensity scores in order to eliminate observable differences in the group of treatment firms that receive debt and the control firms that do not receive debt. Our results do not change qualitatively. However, because there remain unobservable variables that could explain these differences, this analysis does not provide conclusive evidence of causality.

[17] We operationalize the Cox proportional hazard model using the "stcox" procedure in the Stata 12 software package.

[18] For firms that do not report the amount of 2007 revenues, we use the midpoint value of the reported 2007 revenue range if it is available. Our results do not qualitatively change if we exclude these firms from our analysis. We add one to the level of revenue before taking the natural logarithm to avoid creating a missing value for a firm with zero level of revenues.

where y_i is equal to one if the firm survives through 2007 and is equal to zero otherwise, $\epsilon_i \sim$ Normal $(0, 1)$; and corr $(\mu_i; \epsilon_i) = \rho$. In the probit model, we use the same set of regressors X_i as in the Cox proportional hazard model discussed above. We then use the results of this probit estimation to calculate the Inverse Mills Ratio (*IMR*), and then include *IMR* as an additional regressor in the WLS model of revenues shown in Eq. (4).[19]

5. Empirical results

5.1. Types of firms that use debt at start-up

In this section, we examine what types of firms are more likely to use debt at the firm's start-up and, conditional upon use of debt, what types of firms are more likely to use business bank credit, what types of firms are more likely to use business trade credit, and what types of firms are more likely to use personal debt. Table IV presents the results of this analysis, utilizing a weighted bivariate probit selection model. In the first selection stage (results reported in column 1), the dependent variable takes a value of one if the firm uses any type of credit (*Debt (Any Type)*). The second stage estimates the probability of using business bank/business trade/personal debt, conditional upon using any type of debt estimated in the first stage. The dependent variables in the second stage regressions are: *Business Bank Credit*, *Business Trade Credit*, and *Personal Debt*; the results of this analysis appear in columns 2, 3, and 4, respectively. For the ease of economic interpretation, we report odds ratios, which are calculated as e^γ, where γ is a vector of estimated coefficients. *t*-Statistics are reported in parentheses below odds ratios.

As shown in column 1 of Table IV, firms that use debt at the firm's start-up have significantly higher level of revenue in the initial year of operations than firms that use no debt. The economic significance of that variable is also large: 4% higher odds of using debt for a 1% increase in revenues.[20] In general, corporations are 16% more likely to use debt than other forms of business organizations combined. Furthermore, firms with greater credit risk are less likely to borrow at the firm's start-up. A one-step decrease in the firm's credit category is associated with 10% lower odds of obtaining credit. Firms with a competitive advantage are 16% more likely to use debt. Firms that provide product only are 35% more likely to borrow, and firms that provide product and services are 18% less likely to borrow. Overall, the results suggest that better-quality firms are more likely to obtain debt financing at the firm's start-up. These results are different from prior findings on more mature privately held firms (see, e.g., Cole, 2009, 2013) and provide new evidence on the use of debt by start-up firms, supporting our H_1.

Furthermore, as shown in columns 2, 3, and 4 of Table IV, there are notable differences between firms that use business bank credit, business trade credit, and personal debt. Compared to other firms that use debt financing, firms that are larger in terms of revenue are more likely to use business bank and trade credit. In contrast, firms with higher level of revenue are less likely to use personal debt. Corporations are 35% more likely to use business bank credit, but being incorporated does not affect the probability of personal or trade credit use. Firms that have multiple owners are almost 15% less likely to use personal debt. Firms with lower credit scores are significantly less likely to use business bank and trade credit but are significantly more likely to use personal debt.

These findings suggest that, out of all credit users, better quality firms are more likely to obtain business debt, whereas lesser-quality firms are more likely to obtain personal debt. These results support our H_2 and H_3 that start-ups with better performance prospects are more likely to obtain business debt and less likely to use personal debt. The fact that firm characteristics affect the probability of obtaining personal debt suggests that firms with worse performance prospects either self-select, or are denied or discouraged from applying for business debt and they obtain personal debt instead to finance their start-up firm. Whereas we do not have data on the loans' application process to test this prediction, it is clear from Table IV that there are important differences between firms that obtain business debt and firms that obtain personal debt at the firm's start-up.

Table IV also demonstrates that several owner characteristics significantly relate to the probability of using debt at the firm's start-up. Firms with owners who are college educated are 18% more likely to borrow, and firms with owners who have a graduate degree are 52% more likely to borrow. However, when differentiating between the use of personal debt and the use of business debt, the results show that owners with graduate degrees are 20% more likely to use business bank credit, but the owner's education does not affect the probability of personal or trade credit use. Furthermore, consistent with prior studies documenting lower availability of credit to minorities (see, e.g., Coleman, 2002), our results show that firms with Black owners are 45% less likely to use credit at start-up; this result is also negative and significant for business bank credit use, but not significant for personal debt or trade credit use. Firms that are owned by females are 17% more likely to use personal debt, but are less likely to use business trade credit.

Finally, firms with equity contributions by insiders (i.e., friends and family of the owners) are 47% more likely to use debt at the firm's start-up. However, insider equity is not significant in business and personal debt regressions; instead, the insider debt variable is significant, but in opposite ways. Firms with insiders lending money to the firm are less likely to use business bank credit and are more likely to use trade credit and personal debt.

Overall, the results presented in Table IV support our H_1, H_2, and H_3 and suggest that high-quality firms are more likely to obtain debt, in particular, business debt, at the firm's start-up. We find that high-quality entrepreneurial firms secure debt financing at the earliest stage of business formation on the name of the firm, either through financial institutions or suppliers.

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[19] We operationalize the two-step Heckman sample-selection model using the "heckman" procedure in the Stata 12 software package.
[20] We add one to revenue in order to avoid creation of missing values when we perform logarithmic transformation of that variable.

Table IV

Factors explaining the use of debt at the firm's start-up.

This table reports odds ratios from a weighted bivariate probit selection model. The sample includes 3243 Kauffman Firm Survey 2004 start-up firms with non-missing data for all variables. Column 1 presents the results from the first-stage probit model, examining the determinants of the use of debt. Columns 2, 3, and 4 present the results from the second-stage regression, where the dependent variable is *Business Bank Credit*, *Business Trade Credit*, and *Personal Debt*, respectively. *t*-Statistics are in parentheses. Variable definitions are in Table I. *State-Level SME Lending* is a predicted value of the amount of state-level bank lending to small and medium enterprises, scaled by the number of small/medium firms in the state, on the amount of state-level homestead bankruptcy exemption. Industry dummies (based on two-digit NAICS codes) are included but omitted from the table for the sake of brevity. Survey weights are applied.

Variable	1	2	3	4
	First stage:	Second stage:	Second stage:	Second stage:
	Debt (any type)	Business bank credit	Business trade credit	Personal debt
Firm characteristics:				
Ln (Revenue + 1)	1.040	1.030	1.063	0.973
	$(6.25)^{***}$	$(5.27)^{***}$	$(2.89)^{***}$	$(-4.39)^{***}$
Corp	1.158	1.345	1.027	0.957
	$(2.12)^{**}$	$(4.70)^{***}$	(0.26)	(-0.63)
Multiown	0.955	1.102	1.104	0.848
	(-0.64)	(1.54)	(1.33)	$(-2.49)^{**}$
Credit risk	0.900	0.890	0.888	1.109
	$(-2.40)^{**}$	$(-2.98)^{***}$	$(-2.11)^{**}$	$(2.45)^{**}$
Intell property	0.915	1.103	0.993	1.067
	(-1.13)	(1.38)	(-0.07)	(0.86)
Comp advantage	1.163	0.991	1.050	0.917
	$(2.39)^{**}$	(-0.16)	(0.48)	(-1.33)
Product	1.352	1.000	1.250	0.933
	$(2.73)^{***}$	(0.00)	(1.27)	(-0.65)
Product & service	0.824	1.013	1.075	1.008
	$(-1.81)^{*}$	(0.14)	(0.56)	(0.08)
Rural	0.935	0.979	1.148	1.002
	(-0.85)	(-0.29)	(1.62)	(0.02)
Owner characteristics:				
Female	0.942	0.917	0.824	1.170
	(-0.84)	(-1.38)	$(-2.35)^{**}$	$(2.18)^{**}$
Hours worked	1.004	1.003	1.001	1.000
	$(2.71)^{***}$	$(2.25)^{**}$	$(2.00)^{**}$	(0.34)
Prior experience	0.990	0.996	1.005	0.993
	$(-3.10)^{***}$	(-1.36)	(1.01)	$(-2.15)^{**}$
Prior start-ups	0.993	0.986	1.010	0.987
	(-0.47)	(-1.25)	(0.84)	(-1.33)
Owner age	1.006	1.018	1.025	0.987
	(0.31)	(1.14)	(1.10)	(-0.71)
Owner age^2	1.000	1.000	1.000	1.000
	(0.36)	(1.23)	(-1.39)	(0.96)
Asian	0.972	1.122	0.951	1.029
	(-0.16)	(0.78)	(-0.30)	(0.18)
Black	0.553	0.687	1.055	0.968
	$(-5.76)^{***}$	$(-3.37)^{***}$	(0.17)	(-0.27)
Hispanic	0.971	0.884	0.775	0.977
	(-0.22)	(-1.09)	$(-1.66)^{*}$	(-0.20)
Other	1.028	1.280	1.285	1.194
	(0.14)	(1.36)	(1.19)	(0.89)
College education	1.175	1.082	1.101	1.065
	$(1.80)^{*}$	(0.95)	(1.19)	(0.73)
Graduate degree	1.521	1.202	1.073	0.962
	$(3.68)^{***}$	$(1.81)^{*}$	(0.35)	(-0.35)
Log (owners' equity + 1)	1.015	1.006	0.958	1.008
	$(1.93)^{*}$	(0.81)	(-0.16)	(1.03)
Insider equity	1.465	1.213	0.953	0.927
	$(2.42)^{**}$	(1.63)	(-0.29)	(-0.58)
Insider debt	0.972	0.837	1.204	1.236
	(-0.31)	$(-2.19)^{**}$	$(1.67)^{*}$	$(2.30)^{**}$
Outsider equity	0.919	0.925	1.133	1.044
	(-0.57)	(-0.63)	(0.82)	(0.34)
State-level SME lending	1.002			
	(1.36)			
F-statistic		7.80^{***}	5.97^{***}	3.66^{***}
p-Value		0.000	0.000	0.000

*** Indicate statistical significance at the 1% level.
** Indicate statistical significance at the 5% level.
* Indicate statistical significance at the 10% level.

Furthermore, while there is a common perception that entrepreneurs are often personally liable for business debts of the firm and that the distinction between personal and business debt is negligible, the results presented in Table IV suggest that it is important to differentiate between the use of business versus personal debt by start-up firms. Our results suggest that, of the credit users, better-quality firms are more likely to use business debt while lower-quality firms are more likely to use personal debt.

5.2. Credit use and firm performance

In this section, we test H_4 and H_5 by examining the relation between the use of debt and different types of debt at the firm's start-up and firm performance (survival and revenue) three years after the firm's start-up.

5.2.1. Survival

Table V presents the results from the survival analysis and alludes to the idea that firms that obtain debt at the firm's start-up are more stable, as measured by the hazard rate of going out of business. The table presents hazard ratios, which equal $100 * (e^{\beta} - 1)$; z-Statistics are reported in parentheses below the hazard ratios. All regressions control for the amount of debt ($Ln(Debt\ Amount + 1)$) and the level of revenue at the firm's start-up ($Ln(Revenue + 1)$).

In column 1 of Table V, the coefficient on *Debt (Any Type)* is a statistically significant 0.706, which indicates that a firm using debt at start-up has about a 30% lower hazard rate of going out of business; or, equivalently, a 42% greater survival rate (($1000 / 706) - 1 = 0.42$). Our control variable for the total amount of debt, $Ln(Debt\ Amount + 1)$ has a statistically significant coefficient of 1.029, indicating that firms using more debt have a greater likelihood of going out of business. This is consistent with the static trade-off theory of capital structure, as the probability of financial distress increases with the amount of firm debt. Furthermore, as shown in column 2, which differentiates between the use of business bank credit, personal debt, and business trade credit, the positive relation between debt financing and survival is driven by the use of business bank credit. The coefficient on *Business Bank Credit* is a statistically significant 0.842, indicating that a firm that uses business bank debt has about a 19% (($1000 / 842) - 1 = 0.19$) higher survival rate, after controlling for the total amount of debt. The 0.980 coefficient on *Personal Debt* and 0.940 coefficient on *Business Trade Credit* are not statistically significant in explaining the firm's survival rate.

In column 3, we add the control variables for *Firm Characteristics*, *Owner Characteristics*, *Industry Classifications*, *Other Sources of Capital*, and *State-Level SME Lending*, which proxies for the credit supply to small entrepreneurial firms. Thus, our analysis controls for a large range of firm, owner, and industry characteristics. For brevity, the results for control variables are not shown in Table V, but are reported in Appendix Table A. Column 3 shows that, after controlling for differences in various firm, owner, industry, and other financial capital characteristics, the coefficient on *Business Bank Credit* remains statistically significant at better than the 0.01 level, and the magnitude of the coefficient falls to 0.776, indicating that a firm obtaining business bank credit at start-up has a 29% (($1000 / 776) - 1 = 0.29$) higher survival rate than does a firm unable to obtain such financing.

Table V

Debt use and firm performance: survival analysis.

This table reports hazard ratios from the Cox proportional hazard model. The dependent variable is the probability that firm i will be out of business by year t, conditioning on firm i surviving up to time t ($= 2005$–2007). Independent variables are from KFS 2004 and are described in Table I. $Ln\ (Debt\ Amount + 1)$ is the natural algorithm of one plus the sum of amounts of business bank credit, business trade credit, and personal debt). $Ln(Revenue + 1)$ is the natural logarithm of one plus the level of revenue at the firm's start-up. Where indicated, regressions include controls for *Firm Characteristics*, *Owner Characteristics*, *Other Sources of Capital*, and *Industry Classifications*, all from KFS 2004. *State-Level SME Lending* is a predicted value from the regression of the amount of state-level bank lending to small and medium enterprises, scaled by the number of small/medium firms in the state, on the amount of state-level homestead bankruptcy exemption. The full set of results is presented in Appendix Table A column (1). Survey weights are applied. z-Statistics are reported in parentheses.

Variable	1	2	3
Debt (any type)	0.706		
	$(-3.301)^{***}$		
Business bank credit		0.842	0.776
		$(-2.413)^{**}$	$(-2.78)^{***}$
Business trade credit		0.940^{*}	0.980
		(-0.677)	(-0.173)
Personal debt		0.980	0.992
		(-0.274)	(-0.086)
Ln (debt amount + 1)	1.029	1.018	1.022
	$(3.201)^{***}$	$(2.074)^{**}$	(1.52)
Ln (revenue + 1)	0.986	0.986	0.996
	$(-2.231)^{**}$	$(-2.177)^{**}$	(-0.533)
Firm characteristics	No	No	Yes
Owner characteristics	No	No	Yes
Other sources of capital	No	No	Yes
State-level SME lending	No	No	Yes
Industry classifications	No	No	Yes
Number of observations	4143	4143	2869
F-statistic	6.29^{***}	2.79^{**}	3.43^{***}

*** Indicate statistical significance at the 1% level.
** Indicate statistical significance at the 5% level.
* Indicate statistical significance at the 10% level.

Table VI

Debt use and firm performance: revenue analysis.

This table reports Weighted Least Squares regressions of revenue, measured as the natural logarithm of one plus the level of revenue three years after the firm's start-up (KFS, 2007). Independent variables are from KFS 2004 and are described in Table I. *Inverse Mills Ratio* is estimated from the probit regression of the firm's survival to 2007. Where indicated, regressions include controls for *Firm Characteristics*, *Owner Characteristics*, *Other Sources of Capital*, and *Industry Classifications*, all from KFS 2004. *State-Level SME Lending* is a predicted value from the regression of the amount of state-level bank lending to small and medium enterprises, scaled by the number of small/medium firms in the state, on the amount of state-level homestead bankruptcy exemption. The full set of results is presented in Appendix Table A column (2). Survey weights are applied. *t*-Statistics are reported in parentheses.

Variable	1	2	3
Debt (any type)	0.266		
	(0.670)		
Business bank credit		0.832	0.647
		(3.077)***	(2.36)***
Business trade credit		0.724	0.317
		(2.152)**	(0.91)*
Personal debt		−0.934	−0.849
		(−3.401)***	(−3.12)***
Ln (debt amount + 1)	0.120	0.118	0.114
	(3.779)***	(3.414)***	(2.67)***
Ln (revenue + 1)	0.273	0.255	
	(9.999)***	(9.410)***	
Inverse mills ratio	1.849	1.554	−2.542
	(2.698)***	(2.297)**	(−0.14)
Firm characteristics	No	No	Yes
Owner characteristics	No	No	Yes
Other sources of capital	No	No	Yes
State-level SME lending	No	No	Yes
Industry classifications	No	No	Yes
Number of observations	1953	1953	1953
R^2	0.12	0.14	0.22

*** Indicate statistical significance at the 1% level.
 ** Indicate statistical significance at the 5% level.
  * Indicate statistical significance at the 10% level.

To confirm the robustness of the result that the type of debt matters for the firm's survival, aside from the effect of the amount of financial capital, we replace the log of the amount of total debt and the three indicators for *Business Bank Credit*, *Business Trade Credit* and *Personal Debt* with the logs of the amounts of business bank credit, business trade credit, and personal debt, respectively. In this analysis (unreported but available from the authors upon request), only the coefficient on the log of the amount of personal debt is significant and positive, indicating that a higher amount of personal debt reduces survival time of young entrepreneurial firms. The coefficient on the amount of business bank credit is insignificant, suggesting that the amount of business bank financing does not relate to the survival; while the indicator variable of business bank credit relates positively to survival. This provides additional evidence in support of the notion that the type of debt financing matters for the survival of start-up firms, not just the amount of debt.

5.2.2. Revenues

Table VI presents the results of the regressions examining the relation between credit use at the firm's start-up and the level of revenue three years after the firm's start-up. In each specification, which follow the set-up in Table V, we control for sample selection (i.e., we observe only the firms that have survived to 2007) by including the *Inverse Mills Ratio* estimated by using the probit model shown in Eq. (5).[21] All regressions control for the amount of debt (*Ln(Debt Amount + 1)*) and the level of revenue at the firm's start-up (*Ln(Revenue + 1)*). In column 1, the coefficient on *Debt (Any Type)* is insignificant when we control for the total amount of debt.[22] When *Debt (Any Type)* is decomposed into *Business Bank Credit*, *Business Trade Credit*, and *Personal Debt* in column 2, we find that both *Business Bank Credit* and *Business Trade Credit* have positive and significant coefficients, while *Personal Debt* has a negative and significant coefficient.

In column 3 of Table VI, we add our full set of control variables (*Firm Characteristics*, *Owner Characteristics*, *Industry Classifications*, *Other Sources of Capital*, and *State-Level SME Lending*) to the specification in column 2. This reduces the magnitude of each credit coefficient, but *Business Bank Credit* remains positive and significant at 0.647, while *Personal Debt* remains negative and significant at −0.849. *Business Trade Credit* remains positive at 0.317, but loses statistical significance. The results in column 3 show that, after controlling for the total amount of debt, industry, other sources of capital, and variety of firm and owner characteristics, a firm using business bank credit at start-up achieves the level of revenue three years after the start-up that is 91% (exp(0.647) − 1 = 0.91) higher than the level of revenue of firms that do not use business bank credit at the firm's start-up. In contrast, a

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[21] Initially, we estimated the simultaneous-equations version of the Heckman correction for sample selection, but were unable to obtain convergence.
[22] Halvorsen and Palmquist (1980) explain the correct interpretation of coefficients of dummy variables in semi-logarithmic equations. The percentage effect of the dummy variable equals $100 \times (e^{\beta} - 1)$.

firm using personal debt at start-up has a 57% ($\exp(-0.849) - 1 = 0.57$) lower level of revenue three years after the firm's formation. For brevity, the results for the control variables are not reported in Table VI, but are presented in Appendix Table A.

Similar to the survival analysis, we replace the log of the amount of total debt and the three indicators for *Business Bank Credit*, *Business Trade Credit*, and *Personal Debt* with the logs of the amounts of business bank credit, business trade credit, and personal debt. The results (unreported but available upon request) show that the amount of business bank credit and personal debt are not significant in explaining the revenue growth of young entrepreneurial firms; the coefficient on trade credit amount is positive and significant. In light of our findings that the indicators of business bank credit and personal debt are significant but in opposite directions in our revenue analysis, the insignificant coefficient on debt amounts support the notion that the type of debt financing matters for the revenue growth of start-up firms.

5.2.3. Discussion of results

Overall, the results presented in Tables V and VI indicate that firms that obtain debt at the firm's start-up, in particular, business bank credit, show better subsequent performance than do firms that do not obtain debt at start-up.[23] The traditional explanation for these findings is that the ability of the firm to secure credit financing at the firm's start-up makes the firm less capital constrained, and hence allows it to grow faster compared to the firms that cannot obtain such financing (see, e.g., King and Levine, 1993a, 1993b; Rajan and Zingales, 1998). The fact that business debt positively relates to firm performance after controlling for the total amount of debt, while personal debt does not, indicates that the type of debt matters aside from the amount of debt. This evidence is consistent with our reasoning that personal debt is fundamentally different from debt provided directly to the business. First of all, with business loan applications better quality firms self-select to signal their quality to prospective lenders and initiate credit record and reputation buildings. Secondly, with business loans, creditors evaluate, select, and monitor the business venture; with personal loans, creditors are looking at the individual borrower, but not necessarily at the business venture. These results support our business versus personal debt taxonomy, as an important dimension of the analysis of financing patterns of young entrepreneurial firms.

Unfortunately, the data do not allow us to resolve whether the superior performance of business debt-users is due to self-selection by high-quality borrowers, the lender's ability to choose high-quality loan applicants, or the lender's monitoring. The coefficients appear to be most supportive of bank selection, as the coefficient on trade credit is positive but insignificant while the coefficient on personal debt is insignificant or negative.

6. Summary and conclusions

In this study, we use data from the Kauffman Firm Survey to provide new evidence on the importance of debt financing of start-up entrepreneurial firms with no history of operations or performance track record. We find that firms obtaining bank credit in the name of the firm (business bank credit) at start-up outperform other firms in terms of revenue growth and firm survival. We offer three alternative explanations for this superior performance outcomes: self-selection by high-quality firms to apply for business bank credit to signal the firm's quality and initiate credit record and reputation building, selection of high-quality firms by bank lenders, and/or monitoring by lenders. The limitations of KFS data preclude us from definitively distinguishing among the three explanations. While all three channels are likely to play some role in the observed association between the use of business bank credit at the firm's start-up and firm performance, we leave it to future research to distinguish between the relative effects of each channel.

Despite the limitation of KFS data, our findings make an important contribution to the existing literature on entrepreneurial finance and to our understanding of the important of debt financing at the firm's initial stage of operations. We show that it is important to distinguish between debt financing in the name of the firm (business debt) and debt financing obtained in the name of the firm's owner and used to finance the start-up firm (personal debt). We argue and demonstrate through our analysis that business bank loans to the firm are fundamentally different from personal bank loans to the firm's owner. When evaluating a personal loan application, a lender is evaluating the creditworthiness of the person making the application and makes no commitment to monitor the firm if the loan is approved. In contrast, when the lender extends business debt to a start-up firm, it evaluates the creditworthiness and performance prospects of the firm and provides monitoring while the loan is outstanding. We document the importance of this distinction, which has not been addressed in prior literature.

Our study has several important implications for economic policymakers and investors interested in entrepreneurial start-ups. A better understanding of what types of firms obtain credit and the sources of credit financing at the initial stage of business formation can help policymakers take actions to increase the availability of credit to start-up firms with good performance prospects that will potentially lead to the creation of more jobs and faster economic growth.[24] Furthermore, a better understanding of the

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[23] In unreported results available upon request from the authors, we test whether our results are driven by the smallest firms in our sample, which may be thought of as "hobby" businesses. First, we create a variable *Hobby*, which is equal to one if the firm is in the lowest quintile of assets or hours worked per week, and equal to zero otherwise. We then interact *Hobby* with *Business Bank Credit*, *Business Trade Credit*, and *Personal Debt* and include these three interaction variables in the final specifications shown in Tables V and VI. None of these interaction terms are statistically significant suggesting that the link between credit types indicators and performance (survival and revenue growth) is independent of whether the firm is a small "hobby" business. Second, we drop the firms in the smallest deciles of assets or hours worked per week. We find that our results are qualitatively unchanged. Finally, we drop firms in the smallest quartiles of assets or hours worked per week. We find that our results are qualitatively unchanged, but the *p*-value on *Business Bank Credit* in our revenue regression rises to 0.20.

[24] In the U.S., such policies have included the Small Business Lending Fund, which provides capital to community banks and community development loan funds as an incentive to increase their lending to small firms, and the 7(a) Loan Program of the U.S. Small Business Administration, which provides loans to qualifying small firms.

importance of credit use at the firm's start-up stage should provide policymakers with guidance on how to tailor economic and tax policies to help start-up businesses obtain credit when they need credit, thereby increasing both employment and productivity. This information has especially important implications for tax reform proposals that would limit the deductibility of interest on business debt, which would increase the cost of credit to small firms. Additionally, the results of our study provide some guidance to investors considering new entrepreneurial firms. We show that entrepreneurial firms that are able to secure business debt at the firm's start-up tend to be of better quality firms; this finding is important given the large information asymmetry and uncertainty about the start-up's performance prospects. Finally, our results underscore the critical role that banks play in the success of start-up firms providing additional evidence of successful screening and monitoring performed by the banks in the most informationally opaque setting.

Appendix A

Appendix Table A

Debt use and firm performance: complete set of results from survival and revenue analysis.

This table reports the full set of results of debt use and firm performance. Column (1) reports hazard ratios for explanatory and control variables from the Cox proportional hazard model where the dependent variable is the probability that firm i will be out of business by year t, conditioning on firm i surviving up to time t ($=2005$–2007). Column (2) reports the results of Weighted Least Squares regressions of revenue measured as the natural logarithm of one plus the level of revenue three years after the firm's start-up (KFS, 2007). Independent variables are from KFS 2004 and are described in Table I. *Ln (Revenue + 1)* is the natural logarithm of one plus the level of revenue at start-up (KFS, 2004). *Inverse Mills Ratio* is estimated from the probit regression of the firm's survival to 2007. *State-Level SME Lending* is the predicted value from the regression of the amount of state-level bank lending to small and medium enterprises, scaled by the number of small/medium firms in the state, on the amount of state-level homestead bankruptcy exemption. Dummies for *Industry Classifications* are included in the regression but are unreported. t-Statistics are reported in brackets. Survey weights are applied. Survey weights are applied. z-Statistics are reported in brackets. Model p-values are less than 0.05 for every model.

Variable	(1) Survival	(2) Revenue
Business bank credit	0.776***	0.647**
	(−2.780)	(2.362)
Business trade credit	0.980	0.317
	(−0.173)	(0.907)
Personal debt	0.992	−0.849***
	(−0.086)	(−3.125)
Ln (debt amount + 1)	1.022	0.114***
	(1.521)	(2.669)
Ln (revenue + 1)	0.996	0.205***
	(−0.533)	(7.437)
Firm characteristics:		
Corp	1.204*	1.160
	(1.951)	(0.813)
Multiown	0.922	0.124
	(−0.845)	(0.222)
Credit risk	1.087	−0.253
	(1.453)	(−0.280)
Intell property	0.830*	−0.138
	(−1.714)	(−0.459)
Comp advantage	0.953	0.574
	(−0.566)	(0.657)
Product	1.235	−0.402
	(1.541)	(−0.281)
Product & service	0.687***	1.117
	(−3.036)	(0.416)
Rural	0.995	−0.247
	(−0.044)	(−0.752)
Owner characteristics:		
Female	1.154	−0.899
	(1.605)	(−0.850)
Hours worked	0.996**	0.030
	(−1.965)	(0.705)
Prior experience	0.986***	0.024
	(−3.166)	(0.208)
Prior start-ups	1.029**	−0.012
	(2.241)	(−0.066)
Owner age	0.960*	0.062
	(−1.932)	(0.103)
Owner age^2	1.000*	−0.001
	(1.768)	(−0.161)

Appendix Table A *(continued)*

Variable	(1) Survival	(2) Revenue
Asian	0.537**	−0.842
	(−2.354)	(−0.404)
Black	1.089	−1.662
	(0.575)	(−1.377)
Hispanic	1.111	−1.670
	(0.637)	(−0.560)
Other	1.221	−1.459
	(0.789)	(−1.173)
College education	0.713***	0.290
	(−2.984)	(0.092)
Graduate degree	0.621***	0.801
	(−3.181)	(0.160)
Other sources of capital:		
Owners' equity/Totcap	1.154	−0.209
	(0.809)	(−0.111)
Outsiders' debt/Totcap	0.985	−1.524
	(−0.072)	(−0.947)
Insider equity	1.285	−0.082
	(1.522)	(−0.065)
Insider debt	1.231*	1.226**
	(1.698)	(−2.211)
Outsider equity	0.986	−0.005
	(−0.080)	(−0.693)
State-level SME lending	0.995**	−2.542
	(−2.403)	(−0.136)
Industry classifications	Yes	Yes
Constant		7.634
		(0.455)
F-statistic/R^2	3.43***	0.216
Number of observations	2869	1953

*** Indicate statistical significance at the 1% level.
 ** Indicate statistical significance at the 5% level.
  * Indicate statistical significance at the 10% level.

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