

The Recent Financial Crisis, Start-up Financing, and Survival

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ABSTRACT

We investigate the effects of the recent financial crisis on start-up financing and survival using a data set that covers all Belgian new business registrations between 2006 and 2009. We find that bank debt is the single most important source of funding, even for start-ups founded during the crisis. However, start-ups founded in crisis years use less bank debt and have a higher likelihood to go bankrupt, even after controlling for their creditworthiness. These effects are stronger for start-ups that are more dependent on bank debt, such as start-ups founded in bank dependent industries and start-ups founded by entrepreneurs who are more likely financially constrained.

Keywords: Entrepreneurial finance; Start-up financing; financial crisis; survival; credit availability.

JEL classification: G01; G21; G32; G33; L26.

1. Introduction

The recent financial crisis has increased concerns among entrepreneurial finance scholars and policy makers about the financing and the survival of start-ups that may be the engines of economic growth. Although scholars have studied the capital structure of start-ups (e.g., Cassar, 2004; Cole and Sokolyk, 2015; Cosh et al., 2009; Cumming, 2005; Huyghebaert and Van de Gucht, 2007; Robb and Robinson, 2014), to date, we lack a deep understanding of two defining questions in entrepreneurial finance, namely: (a) how does credit availability at the time of founding determine how capital is allocated to start-ups and (b) how does this influence start-up survival?

The impact of credit availability on the financing and survival of start-ups is theoretically ambiguous.¹ On the one hand, Stiglitz and Weiss (1981) argue that frictions in capital markets may prevent start-ups, arguably the most informationally opaque firms, from

¹ Note that the focus of our paper is on start-ups, not small firms. While most start-ups are small firms, the vast majority of small firms are not start-ups. Thus, findings from small firms cannot necessarily be generalized to start-ups or as Chua et al. (2011) indicate: “what works for ... *small* firms may not work for *new* ventures” (p. 473, emphasis added).

accessing formal debt markets. Moreover, debt financing may be inappropriate for start-ups and increase their probability of going bankrupt (Carpenter and Petersen, 2002; Laitinen, 1992). This literature suggests that bank debt and hence credit availability plays a negligible role in the financing of start-ups and, if anything, may increase start-ups' probability of going bankrupt. On the other hand, Bolton and Freixas (1990) argue that riskier firms, such as start-ups, prefer to use bank loans. Moreover, market imperfections may force efficient start-ups to exit due to a lack of funds. By securing access to formal debt financing, entrepreneurs may relax financial constraints, which contributes to firm survival (Åstebro and Bernhardt, 2003). This literature suggests that bank debt and hence credit availability plays a crucial role in the financing and survival of start-ups.

In this paper, we address at least two hurdles that have refrained scholars from studying the effects of credit availability at the time of founding for start-up financing and survival. A first hurdle is the scarcity of data on start-ups. In many countries, start-ups are not required to publicly disclose their financial statements. Data scarcity explains why relatively few scholars have investigated the financing of start-ups, have relied on (survey) data of start-ups founded in one particular year (e.g., Cerqueiro and Penas, 2016; Cole and Sokolyk, 2015; Robb and Robinson, 2014, all rely on start-ups founded in 2004), or have focused on non-random samples of start-ups applying for financing at one particular financial institution (e.g., Cressy, 1996; Fracassi et al., 2016). We take advantage of the Belgian setting, where *all* non-financial firms have a legal obligation to annually file their financial statements, to construct a comprehensive sample of start-ups founded before and during the recent financial crisis. Our data allows us to provide first-time evidence on the role of credit availability at founding for the financing of start-ups by focusing on start-ups founded in periods where credit conditions were fundamentally different.

A second hurdle is the endogeneity of financing decisions. While several studies have focused on bank debt raised, or the intersection between the demand and supply for bank debt (e.g., Cassar, 2004) and its relationship with start-up bankruptcy (e.g., Åstebro and Bernhardt, 2003; Bates, 1990; Cole and Sokolyk, 2015; Cressy, 1996) these studies are often plagued by endogeneity issues. For example, several alternative explanations exist for a positive (or negative) correlation between bank debt raised and start-up bankruptcy: (a) bank debt may increase (or decrease) the likelihood of going bankrupt, (b) self-selection may occur, where only the highest quality start-ups may be the ones that are able to raise bank debt (or, alternatively, adverse selection may occur, where the highest quality start-ups do not apply for bank loans) and (c) unobserved factors may influence both access to bank debt and start-up bankruptcy. Scholars require a quasi-natural experiment, where one can consider an exogenous shift in the availability of bank debt, to provide empirical evidence on how credit market conditions affect start-up financing and survival. The 2008-09 financial crisis provides us with such a shift in credit market conditions for *start-ups*. Belgium was rather unique in that the growth in credit supply during crisis years—while decreasing sharply—did not turn negative *for firms in general*. However, the average amount of credit supplied to start-ups plummeted in 2008, relative to 2007 (National Bank of Belgium, 2009) and banks relocated credit from high-risk to low-risk firms (De Jonghe et al., 2016). Moreover, interestingly, the financial crisis was not caused by a weakening of business fundamentals in Belgium but by the subprime mortgage crisis that originated in the US. Still, the crisis eventually weakened business fundamentals in Belgium, especially in 2009. We investigate the impact of the crisis on start-up borrowing and survival, and whether its impact is conditional upon the dependence of start-ups on external finance.

Using a unique data set covering 14,846 independent, non-financial, Belgian start-ups founded between 2006 and 2009, we start by investigating the financial effects of the crisis

on start-ups. Controlling for firm, human capital and industry characteristics, start-ups founded in crisis years use less bank financing relative to start-ups founded in pre-crisis years. Consistent with the idea that supply-side forces mattered (e.g., Duchin et al., 2010), the financial effects of the crisis are stronger for start-ups with an innate demand for bank debt, i.e., start-ups in bank dependent industries and start-ups founded by entrepreneurs who are more likely financially constrained. Surprisingly, bank debt remains the single most important source of funding, even for start-ups founded during the height of the financial crisis. We then investigate the real effects of the crisis for start-ups. We focus on one specific real effect, namely firm survival (or its flip-side, bankruptcy), because survival is an important concern for entrepreneurs and investors in very early stage firms (Damodaran, 2009). We find that the reduction in borrowing by start-ups founded in crisis years is accompanied by a rise in firm bankruptcies, even after controlling for their creditworthiness. Again, consistent with the idea that supply-side forces mattered, the real effects are stronger for start-ups operating in bank dependent industries and start-ups founded by entrepreneurs who are more likely financially constrained. We finally discuss several additional tests and robustness checks related to the financial and real effects of the crisis for start-ups that broadly confirm our main tests.

This paper relates and contributes to the entrepreneurial finance literature. Much of what we know about entrepreneurial finance is based on small firms that have already raised venture capital or angel finance (e.g., Cumming, 2005; Kerr et al., 2014) or SMEs more generally (e.g., Cassia and Vismara, 2009; Chittenden et al., 1999; Petersen and Rajan, 1994). Research on how credit availability at the time of founding influences the financing of start-ups is scant. As argued by Robinson (2012, p. 154) “Because the economic implications of increasing the number of young firms are distinct from the implications of increasing the size of the small business sector, this distinction is critical for policy, and indeed for our

understanding of start-up activity as a whole”. We provide unique evidence on the financing of start-ups founded in fundamentally different credit environments. In addition, by exploiting the differential effect of the financial crisis for more (or less) bank dependent start-ups, we capture the importance of supply-side effects of the crisis for start-up bankruptcy.

Second, we add to a growing literature on the financial and real effects of the recent financial crisis (e.g., Cowling et al., 2012, 2015; Block and Sandner, 2009). Ivashina and Scharfstein (2010), for instance, show that new loans to large borrowers fell during the peak of the crisis relative to those at the peak of the credit boom. Several others illustrate how the decreased supply of credit during the crisis restricted investments for listed firms and SMEs (e.g., Almeida et al., 2012; Duchin et al., 2010; Vermoesen et al., 2013). Campello et al. (2010), for instance, survey chief financial officers and show that financial constraints forced firms to cancel valuable investments. However, more studies, like ours, are needed that examine how a financial crisis impacts start-ups and entrepreneurship more broadly (see Mian and Sufi (2010) for a call for research on this topic).

This paper proceeds as follows. Section 2 develops testable hypotheses related to the financial and real effects of the recent financial crisis for start-ups. Section 3 describes our research context, data set and variables. Section 4 presents our results on the financial effects of the crisis for start-ups. Section 5 presents our results on the real effects of the crisis for start-up survival. Section 6 illustrates the robustness of our results. Finally, Section 7 concludes.

2. Testable hypotheses

Current finance theory has emphasized the role of equity financing for start-ups. Damodaran (2009), for instance, when depicting financing decisions across the firm life cycle argues for start-ups: “Equity funding optimal, debt only if desperate”. Indeed, adverse selection and

moral hazard problems make start-ups vulnerable to being credit rationed because they are informationally opaque (Stiglitz and Weiss, 1981). Similarly, in the financial growth cycle paradigm (Berger and Udell, 1998) start-ups are expected to finance themselves with funds from founders (family or friends), trade credit and, if growth ambitions are high, angel financing. Berger and Udell (1998, p. 622), for instance, indicate that “start-up firms are arguably the most informationally opaque and, therefore, have much difficulty in obtaining intermediated external finance”. Start-ups first need to develop a track record, establish trusted relationships, generate steady cash flows and have high-quality collateral before they can obtain access to bank debt (Berger and Udell, 1998; Petersen and Rajan, 1994). In these traditional perspectives, credit availability will have a minimal impact on the financing of start-ups, as start-ups are generally excluded from accessing bank debt, irrespective of credit market conditions.

However, different theoretical work suggests that bank debt plays a crucial role in the financing of start-ups. Bolton and Freixas (1990) show that in equilibrium start-ups (and riskier firms more broadly) prefer bank loans because banks are particularly good at helping firms through financial distress. Moreover, entrepreneurs are often expected to prefer to raise bank debt, relative to external sources of equity financing to retain control over their firms (e.g., Brav, 2009; Sapienza et al., 2003). Recent empirical evidence also points to the critical role of debt financing for start-ups. Specifically, Robb and Robinson (2014) show that US firms founded in 2004 relied extensively on external debt sources in their initial year of operation. Similarly, Cassar (2004) shows that roughly half of his Australian sample of start-ups used some form of long-term and bank financing and Hanssens et al. (2016) illustrate that Belgian start-ups heavily rely on debt financing, including bank debt.

Still, previous studies have focused on the importance of bank debt for start-ups founded in relatively homogenous (‘normal’) credit environments. Start-ups founded in the

recent financial crisis are then expected to use less bank debt, relative to start-ups founded in pre-crisis years, for at least two reasons. First, a reduced supply of bank credit during a financial crisis makes it more difficult for start-ups to raise bank debt. Second, entrepreneurs may (simultaneously) demand less bank debt as a result of a weakened economic environment and increased uncertainty about the future. Thus,

Hypothesis 1 (Financial effects): *Start-ups founded in crisis years will use less bank debt, relative to start-ups founded in non-crisis years.*

To capture the supply-side forces of the crisis from Hypothesis 1, we focus on the potential differential impact of the financial crisis on distinct types of start-ups. More specifically, we draw on Rajan and Zingales (1998) who point out that industries differ in their dependence on external sources of financing and bank debt more in particular. These differences primarily stem from industry-specific technological factors that affect initial project scale, gestation period, cash-harvest period, and needs for further investments (Rajan and Zingales, 1998, p. 563). Thus, firms operating in different industries have a different dependence on—or innate demand for—bank debt. This finding may be particularly true for start-ups, which often have to conform to industry practices (Smith and Smith, 2004). In addition, entrepreneurs require financial capital to form a start-up (Cassar, 2004). However, those entrepreneurs that are unable to raise all capital from their own funds (or family and friends) will be more dependent on external financing. But, alternative sources of external equity financing, such as angel or venture capital investors are generally unavailable for start-ups (Huyghebaert et al., 2007). Thus, when start-ups are founded by more financially constrained founders (e.g., Huyghebaert and Van de Gucht, 2007) they will be more dependent on bank financing.

In an “experiment” designed to show that supply-side forces at least mattered during the crisis, we use start-ups in more bank dependent industries and start-ups founded by

founders who are more likely financially constrained as the treatment group, and start-ups founded in less bank dependent industries and start-ups founded by founders who are less likely financially constrained as a control group. If the supply-side forces of the crisis matter, start-ups in the treatment group (i.e., those that are dependent on bank debt or have an innate demand for bank debt) are expected to exhibit a stronger negative response to the crisis, relative to those in the control group (for a similar approach, see Cetorelli and Strahan, 2006; Duchin et al., 2010; Rajan and Zingales, 1998). We hence achieve identification by measuring the differential effect of the financial crisis between these different types of start-ups. Thus,

Hypothesis 2 (Financial effects—Supply-side forces): *The financial crisis will have a stronger negative impact on the financing of start-ups that are dependent on external financing, i.e. those start-ups that (a) operate in bank dependent industries and (b) are founded by financially constrained founders.*

There are indications that a limited availability of bank debt may not be problematic. Indeed, entrepreneurs seeking financing are often able to secure the requisite financing, although it may not be available in the form that they would like (Cosh et al., 2009). Moreover, Carpenter and Petersen (2002) suggest that debt financing may be inappropriate, especially for start-ups, as it increases their probability of going bankrupt. Others such as Cressy (1996, p. 1253) indicate that “human capital is the ‘true’ determinant of survival”. Hence, the worsened credit market conditions during the crisis may play a minimal role in the financing and survival of start-ups.

Nevertheless, there are also indications that access to bank debt may be critical for start-up survival. In the presence of market imperfections, Bolton and Scharfstein (1990) show that even efficient firms may be forced to exit due to lack of funds. Securing access to formal debt financing may then relax binding financial constraints and contribute to firm survival. Using the 1987 CBO survey, Åstebro and Bernhardt (2003) show that controlling

for human capital, company and industry variables, having a bank loan was a *ceteris paribus* positive predictor of start-up survival. However, as Åstebro and Bernhardt (2003) indicate, focusing on the relationship between bank debt raised (i.e., the intersection between the demand and supply for bank financing) and firm survival raises important endogeneity issues, which may explain the contradictory findings in prior research. We therefore take a different approach and focus on the impact of the recent financial crisis on start-up bankruptcy. Following the financial constraints literature, however, we maintain the following hypothesis,

Hypothesis 3 (Real effects): *Start-ups founded in crisis years will have a higher probability of going bankrupt, relative to start-ups founded in non-crisis years.*

When the supply-side forces of the crisis played a non-trivial role, we would expect—following Cetorelli and Strahan (2006), Duchin et al. (2010), Giannetti and Ongena (2009) and Rajan and Zingales (1998) among others—that the real effects of the crisis will also be stronger for those start-ups that are more dependent on bank debt (as was the case for the financial effects). When, in particular, those start-ups that are more dependent on bank debt have less access to bank debt in crisis years, all else equal, they will be more financially constrained. These stronger financial constraints of start-ups that are more dependent on bank debt in crisis years are expected to increase their subsequent probability of bankruptcy. Thus,

Hypothesis 4 (Real effects—Supply-side forces): *The financial crisis will have a stronger impact on start-ups' probability of going bankrupt when they are dependent on external financing, i.e. those start-ups that (a) operate in bank dependent industries and (b) are founded by financially constrained founders.*

3. Research method

3.1. Research setting

Belgium is a small, export-intensive economy located in the European Union (EU). Belgium is often seen as a bellwether for the wider EU economy. In Belgium, as in other Continental

European countries, banks play a leading role in mobilizing savings and allocating capital (Demirgüç-Kunt and Levine, 1999). Belgium experienced a significant wave of bank mergers in the period between 1997 and 2003, which resulted in a highly concentrated banking sector (Degryse et al., 2011). After this consolidation trend, the Belgian banking sector was dominated by four banks: Fortis Bank, KBC Group, Dexia and ING Belgium. In 2007, 110 banks were active in Belgium, of which the top three (five) banks held 71.6% (84.7%) of total assets (based on non-consolidated data) and provided 70.6% (83.6%) of total outstanding credit in Belgium.²

The financial crisis, which originated in the US, subsequently hit financial markets around the world. Belgian banks in particular were strongly affected by the financial crisis from 2008.³ By April 2008, for example, the four dominant banks had to write down approximately 2.6 billion Euros of their equity capital due to the US credit crisis, which led to speculations about the solvency and liquidity of Belgian financial institutions. After the collapse of Lehman Brothers in September 2008, Fortis Bank had to be bailed out by the Belgian, Luxembourg and Dutch governments. The Belgian entity of Fortis Bank was acquired by the Belgian government and afterwards sold to the French bank BNP Paribas. Dexia (today named Belfius) had to be bailed out by the Belgian, Luxembourg and French governments, and the KBC Group was bailed out by the Belgian government. The ING Group received a capital injection of 10 billion Euros from the Dutch government.

A deteriorated liquidity position, increasing costs and the restricted ability of banks to access market financing contributed to a tightening of credit standards in Belgium. Figure 1 depicts the yearly percentage growth in the total amount of credit granted to non-financial

² As in other continental European countries, public equity and debt markets are not very developed in Belgium. However, irrespective of where start-ups are founded, these markets are generally not accessible for start-ups.

³ The Belgian housing market did not experience the significant decline in prices that occurred in the US, which thus did not affect Belgian banks.

Belgian firms and shows a significant decline starting from the first quarter in 2008. It is noteworthy, however, that contrary to the situation in many other countries, Belgian banks were able to limit the impact of the market turmoil on their supply of credit to domestic firms *in general*, as growth barely turned negative. Still, there is evidence that Belgian banks relocated credit from high-risk to low-risk firms (e.g., De Jonghe et al., 2016) and that start-ups in particular were seriously hit by the financial crisis. For example, the average amount of credit supplied to start-ups plummeted in 2008 by 32%, relative to 2007 (National Bank of Belgium, 2009). A survey conducted by the National Bank of Belgium further analyzes the effect of the crisis on credit conditions for Belgian firms. Using data from this survey, Figure 2 reports a dramatic net tightening in credit volume *and* credit conditions in the 2008-09 period, relative to those in the 2006-07 period, as experienced by SMEs. These effects were arguably even stronger for start-ups, i.e. firms without a credit history and established relationships with banks.

[Figure 1 about here]

[Figure 2 about here]

3.2. Data sources and sample

The data for this paper are obtained from several sources. Balance sheet, income statement, social balance sheet (reporting the number of employees and composition of the workforce) and ownership information are obtained from the Bel-first database, which is compiled by Bureau van Dijk (BvD), one of Europe's leading electronic publishers of business information. Reporting requirements imposed by the Belgian government require all firms—irrespective of their size or age—to annually file financial statements in a predefined format with the National Bank of Belgium. When the financial statements are filed with the National Bank of Bank, they are processed and checked and subsequently made available to the public.

BvD collects these data to compile the Bel-first database. Bel-first includes not only data for active firms but also for firms that eventually go bankrupt. To collect current data on ownership and the status of firms, BvD uses a range of data sources, but most prominent is the Belgian Law Gazette. In the Belgian Law Gazette, Belgian firms are required to provide detailed information on their founding, capital increases and the like, and this official information is externally validated by a notary. We further obtain data on the firms that are involved in private equity and venture capital deals from the Zephyr database (also compiled by BvD), which we further updated with proprietary data from the Belgian Venture Capital and Private Equity Association and Business Angel networks.

Firms had to fulfill the following criteria to be part of our sample of Belgian start-ups. First, we select firms with employment (i.e., employees but also managers) that were legally founded between 2006 and 2009. Firms founded in 2006 and 2007 were founded before the financial crisis hit the Belgian banking sector, whereas 2008 and 2009 start-ups were founded at the height of the financial crisis in Belgium. Firms had to employ between 1 and 50 people in their initial year of operation because firms with no employees are often “empty shells” and it is extremely unlikely that firms starting with more than 50 employees in their initial year of operation are *de novo* start-ups. This resulted in an initial sample of 19,519 start-ups. Second, firms could be active over a broad range of sectors, but we excluded 2,125 firms active in the financial, educational and social sectors. The financing of firms in these sectors is influenced by regulatory and other issues. Third, firms could not belong to a group structure. Specifically, firms could not be controlled by a shareholder with an equity stake of 50% or more (except for equity stakes of families, employees, and directors) and could not have participations in other firms (ownership > 10%) in their initial year of operation. We focus on firms that are independent at start-up because firms that belong to a group structure may do much of their lending and borrowing within their group. Moreover, firms with

participations in other firms in their initial year of operation are unlikely to be *de novo* start-ups. This selection step further reduced the sample with 1,884 firms. Finally, we eliminate 664 firms that have missing (or implausible) data for any of the variables that are used in the first set of regressions estimated in Section 4. Thus, the final sample contains 14,846 firms, which represents a close approximation of the population of independent, non-financial start-ups with employment founded in Belgium between 2006 and 2009.

Using the Bel-first database, we additionally construct a sample of all non-financial Belgian firms operational at some point between 2003 and 2010. We require that these firms employ at least one person. This results in a sample of 110,940 firms and 743,597 firm-year observations. We use this data set to construct multiple industry-level variables, including the three-year median growth rate in total assets, the median ratio of bank debt to total assets and the median number of employees in the industry of our sample firms. We measure these variables using a four-digit industry classification code (NACE) that is similar to the SIC coding system.

3.3. Measures and summary statistics

Table 1 reports the definition, number of observations, mean, median, standard deviation, minimum and maximum for the key variables used in subsequent analyses. To determine the financial effects of the crisis for start-ups, an issue we study in Section 4, we focus on the use of bank debt ($Bank\ Debt > 0$) and the proportion of bank finance to total financing sources raised ($Bank\ Debt / TFS$). Total financing sources raised includes paid-in internal equity, external equity, personal debt, bank debt, trade debt and other non-bank debt. About 73% of start-ups raise bank debt in their initial year of operation. The mean (median) ratio of bank debt to total financing sources raised equals 30% (25%). Most bank debt raised by start-ups is

long-term debt with a maturity of over one year rather than short-term debt, which matures within one year.

[Table 1 about here]

To determine the real effects of the crisis for start-ups, an issue we study in Section 5, we study firm bankruptcy. About 4% of start-ups are declared bankrupt before the end of their second year of operation (*Bankrupt*). We focus on short-term bankruptcy because long-term bankruptcy rates may be confounded by other events (such as the Euro crisis). A record of when firms go bankrupt is made in the Belgian Law Gazette and subsequently incorporated into the Bel-first database. Although the bankruptcy rate may seem relatively low, it is in line with previous research on Belgian start-ups (Huyghebaert et al., 2000) and the 6% of 2004 US start-ups that closed operations in the Kauffman Firm Survey by the end of 2005 (Robb et al., 2009a). Our measure, however, only captures firms that exit the sample through a court-driven exit procedure (i.e., bankruptcy) but not voluntary exits because these voluntary exits may occur for a host of reasons that have nothing to do with the financial condition of start-ups.

The independent variable *Crisis* equals one for start-ups founded in 2008 or 2009 and zero for start-ups founded in 2006 or 2007. As we described in more detail in Section 3.1., the crisis hit the Belgian banking sector from early 2008 when banks already had to write down significant amounts of their equity capital and the crisis became painstakingly visible for the general public with a series of bail outs of Belgian banks towards the end of 2008. There was a dramatic net tightening in credit volume and credit conditions (particularly for start-ups) in the 2008-09 period, relative to those in the 2006-07 period. About 45% of start-ups in our sample were founded during crisis years.

We expect the financial and real effects of the crisis to be stronger for more bank dependent start-ups, i.e. start-ups in bank dependent industries and start-ups founded by entrepreneurs who are more likely financially constrained. Following previous research, we measure the dependence of start-ups on bank loans (*Bank dependence*) by calculating the four-digit industry median ratio of bank debt to total assets (Cetorelli and Strahan, 2006).⁴

To proxy for financing constraints experienced by founders, we use the ratio of uncalled equity to paid-in equity (*Uncalled Equity*). In Belgium, as in several other countries, founders are not required to fully invest the amount of committed equity in the first year of operation. Founders who do not fully invest committed equity are more likely to be financially constrained (Huyghebaert and Van de Gucht, 2007). An alternative explanation is that founders are not more financially constrained but simply wait to invest the additional amount of equity until the start-up needs the investment. This explanation is unlikely, however, for at least three reasons. First, we find evidence that start-ups founded by founders who do not fully invest the amount of equity committed in the first year of operation are more likely to raise bank debt and raise larger amounts of bank debt ($p < 0.01$). This finding suggests these start-ups do not require less financing but actually need more external funds. Second, we find evidence that firms in which a part of committed equity is uncalled are those in which committed equity is low and close to the legal minimum. Hence, start-ups that are most likely undercapitalized are the firms in which part of committed equity is uncalled. Because Belgian legislation requires founders to commit an amount of equity that is needed during the first two years after start-up (when this is not the case, limited liability can be

⁴ We also measured bank dependence by employing data from non-financial UK firms employing at least 20 people, drawn from the Amadeus database, to ensure the exogeneity of our bank dependence measure and to have a measure of the propensity to use bank debt in a financially developed country where financing constraints are less likely to be binding (see Giannetti and Ongena, 2009 for a similar approach). The correlation between the UK-based measure and Belgian-based measure of financial dependence is 0.51. Results remain virtually identical using the UK-based measure of financial dependence. Results are reported in the Internet Appendix A.6.

removed), the deliberate undercapitalization of start-ups is a risky strategy. Third, we find that in start-ups in which founders do not fully invest committed equity, the use of insider debt is also less likely ($p < 0.01$). This result suggests that entrepreneurs who do not fully invest committed equity capital do not compensate their reduced equity investment with insider debt that could be considered to be a preferred equity investment.

Several other variables are included in the multivariate regressions, including the four major determinants of capital structure, as highlighted by prior research (Brav, 2009; Rajan and Zingales, 1995). These four variables are profitability, tangibility, growth, and size. Mean profitability in the first year of operation equals -1% (*Profitability*).⁵ The ratio of property, plant and equipment to total assets is 33% on average (*Tangibility*). Although prior research has proxied for growth opportunities by using the market-to-book ratio, such a measure is not available for private firms. Other common proxies, including growth in sales or total assets, are also unavailable for start-ups because these firms have no operational history. We therefore proxy the growth opportunities of a start-up by using the median three-year growth rate in total assets for firms in the same four-digit industry as the sample firm (*Growth*).⁶ Firm size is measured as the total financing sources raised in the first year of operation (*TFS*). The average (median) start-up raises €432,966 (€159,367) of total financing sources.

In Belgium, limited liability firms can choose among several legal forms but NVs and BVBA are by far the most common legal forms. NV limited liability firms face higher equity requirements than BVBA limited liability firms. BVBA firms can only issue registered shares, which cannot be publicly issued and which can be transferred only after approval of

⁵ The length of the first year of operation is not necessarily equal to 12 months for all start-ups due to the reporting requirements imposed by Belgian legislation. We therefore transformed all flow variables by dividing these variables by the number of months of the first year of operation and multiplying by 12 to obtain comparable figures on a 12-month basis.

⁶ The use of the median three-year industry growth rate in sales as an alternative measure to proxy for growth opportunities provides qualitative similar results. Belgian firms, however, are only required to report sales data when they exceed a certain size threshold, which explains our preference for the growth opportunity proxy based on industry growth in total assets.

the other shareholders. NV firms cannot only issue registered shares but also bearer shares, which can be transferred without any restrictions. We construct a dummy variable (*NV*) that equals one when a firm is founded as an NV limited liability firm and zero otherwise. Approximately 8% of the start-ups in our sample are NV firms.

The creditworthiness of a firm is often proxied by ratings offered by agencies such as Standard & Poor's and Moody's. The start-ups in our sample, however, do not have such a rating. We use the unlevered FiTo score (which does not incorporate the impact of a firm's financial structure). The FiTo score is a default risk indicator from Graydon. In Belgium, Graydon is the market leader in commercial and marketing information as well as credit and debt management. The FiTo score lies between 0 (financially distressed firm) and 1 (financially healthy firms). Dummies are created to classify start-ups into three categories according to their default risk (see also Robb and Robinson, 2014). The bottom 25% of start-ups are classified as firms with a high default risk (*Low Creditworthiness*). The top 25% of start-ups are classified as firms with a low default risk (*High Creditworthiness*). Finally, the reference category is start-ups with a medium default risk, which are firms with a FiTo score between the 25th and 75th percentile.

We include several other variables that relate to the composition of a start-up's workforce. Note that a large number (46.7%) of our start-up "firms" consist of only one employee, most likely the founder. Hence, the terms "firm" and "workforce" should be interpreted in a broad sense and are likely to include only the founder(s). Prior research indicates that firms founded by females generally use fewer outside sources of financing and that firms founded by entrepreneurs who are college-educated or are advanced-degree holders use considerably more start-up capital—which primarily comes from the owner (Coleman and Robb, 2009; Robb et al., 2009b). Increased human capital may not only influence the financing of start-ups but also provides entrepreneurs with a greater ability to create and

manage viable firms (Åstebro and Bernhardt, 2003). In our sample, on average, 55% of employees are male (*Prop Male Empl*) and 10% of employees have a university (or equivalent) degree (*Prop Highly Edu Empl*).

Finally, the industry structure might influence the financing and survival of start-ups. We therefore include industry fixed effects in all our regression models. Prior research argues that start-ups may have lower survival rates in industries where larger size seems to be required (Åstebro and Bernhardt, 2003). We measure the median size of industry peers, as the median number of employees of firms operating in the same four-digit industry as the sample firm (*Size of Industry Peers*). The mean firm operating in the same four-digit industry as our sample firms employs, on average, 3.92 people. Cosh et al. (2009) further show how firms operating in less concentrated markets are more likely to apply for bank loans. We therefore proxy for industry concentration by including an asset-based Herfindahl–Hirschman index (*Industry Concentration*). The mean Herfindahl–Hirschman index is 0.08.

4. The financial crisis and start-up financing

4.1. Descriptive statistics

We start by presenting descriptive evidence on the effects of the financial crisis for start-up financing. Table 2 provides a snapshot of the financial structure of the median start-up founded before and during the financial crisis. To take debt heterogeneity into account, we make a distinction between insider debt, bank debt, trade debt and other sources of non-bank debt. Insider debt represents the total amount of money entrepreneurs (and other insiders) lent to their own firm.⁷ Insider debt could be viewed as preferred equity rather than debt financing

⁷ As a proxy for insider debt, we use the “other loans” category on the balance sheet. The category “other loans” may also include loans from affiliated firms. However, all start-ups in our study are independent, which suggests these loans will be non-existent. Moreover, Belgian accounting specialists indicate that insider debt should be included in the “other loans” category (de Lembre et al., 2014).

because insiders are unlikely to voluntarily file for bankruptcy when the debt service payments on insider debt cannot be met. Bank debt represents loans from banks, and we make a distinction between short-term and long-term bank debt using a one-year dividing line. Bank debt includes financial leasing, but only 1.6% of total assets are leased, making it unlikely that financial leasing is driving our results.⁸ Trade debt represents trade payables. Other sources of non-bank debt represent debt related to payroll or social security, taxes and the like.

Equity financing raised generally represents inside equity financing, and although firms may raise external equity financing at founding, we find that this is only the case for a very limited set of start-ups. For all firms in our sample, we verify whether they raised venture capital or angel financing in the Zephyr database and proprietary databases from the Belgian Venture Capital and Private Equity Association and Business Angel Networks. We find only 12 start-ups (or 0.08% of the sample) that raised external equity financing from venture capital or angel investors in their initial year of operation. Our findings correspond with those of Puri and Zarutskie (2012), who show that 0.10% of start-ups in the US receive venture capital financing.

[Table 2 about here]

Several interesting findings emerge from Table 2. First, bank debt is the single most important source of financing in terms of the median amount of financing raised by start-ups. In addition to bank debt, trade debt is a particularly important source of financing used by nearly all start-ups in our sample. Surprisingly, equity financing is only the third most important source of financing. Our finding that bank debt is an important source of financing for start-ups is surprising in view of the financial growth cycle paradigm (Berger and Udell,

⁸ Firms may also use operational leases to finance their start-up activities. Operational leases are booked off-balance sheet and are hence excluded from our calculations.

1998), which states that start-ups will mainly rely on inside financing and trade credit (perhaps angel financing as well if firms have sufficiently high growth ambitions). In the financial growth cycle, start-ups are expected to experience significant difficulties in obtaining intermediated financing, such as bank debt. The importance of bank debt for start-ups is unlikely to be unique to the Belgian context, however. Indeed, Robb and Robinson (2014) recently showed that US start-ups founded in 2004 also heavily rely on outside sources of debt financing, including bank debt. Our new evidence that bank debt is even exceptionally important for start-ups founded during the recent financial crisis is certainly remarkable.

Second, although bank debt is the single most important source of financing for start-up firms, irrespective of their founding period, the median amount of bank debt raised by start-ups that are founded in crisis years is significantly lower relative to the median amount of bank debt raised by start-ups that are founded in pre-crisis years. The median amount of bank debt raised by start-ups founded in pre-crisis years equals €33,614 and drops to €26,925 for start-ups founded in crisis years, which represents a decline of 20%. The drop in the median amount of debt financing raised by start-ups founded in crisis years relative to start-ups founded in pre-crisis years was not compensated for by a significant increase in the use of other sources of financing. Specifically, the median amount of trade debt also tends to decrease for start-ups founded in crisis years.⁹ The amount of equity financing raised remains quite stable for start-ups founded before and during the crisis.

It is also interesting to note that the creditworthiness distribution is not meaningfully different for start-ups founded before and during the crisis.^{10, 11} Moreover, we do not find

⁹ Unreported statistics further indicate that trade receivables also decrease from a median amount of €29,496 to €26,545.

¹⁰ As the cut-off values to determine low and high creditworthiness are based on the full sample of start-ups, we would expect a 25%(high)-50%(medium)-25%(low) distribution of the creditworthiness variable in both pre-crisis and crisis years when start-ups with similar creditworthiness are founded before and during the crisis.

evidence that the crisis is significantly correlated with the average bank dependence of the industries in which start-ups operate (not reported due to space considerations). Thus, we find no indication that more start-ups are founded in less bank dependent industries during crisis years relative to pre-crisis years.

In sum, this subsection provides preliminary evidence that firm borrowing decreases significantly for start-ups founded in crisis years relative to firm borrowing for start-ups founded in pre-crisis years. However, the descriptive analysis does not control for other factors that may have been driving start-ups' usage of bank debt. We now proceed with a more systematic testing of the financial effects of the crisis in a multivariate regression framework.

4.2. The financial effects of the crisis

We now investigate whether the descriptive findings from the previous section hold when we control for firm, human capital and industry characteristics. We first examine the impact of the recent financial crisis on start-up borrowing, without distinguishing among start-ups that are likely to have been more affected by the crisis. In particular, we estimate the following regression:

$$Y = \beta_0 + \beta_1 \text{Crisis} + \beta_2 \text{Profitability} + \beta_3 \text{Tangibility} + \beta_4 \text{Growth} + \beta_5 \text{TFS} + \beta_6 \text{NV} + \beta_7 \text{Low Creditworthiness} + \beta_8 \text{High Creditworthiness} + \beta_9 \text{Prop Male Empl} + \beta_{10} \text{Prop Highly Edu Empl} + \beta_{11} \text{Size of Industry Peers} + \beta_{12} \text{Industry Concentration} + \beta_{\text{YEAR}} \text{Year} + \beta_{\text{IND}} \text{Industry}. (1)$$

While we find slight differences between start-ups founded in pre-crisis and crisis years, these differences are statistically ($p > 0.10$) and economically not significant. We also checked for differences in the median of the continuous creditworthiness variable for start-ups founded before and during the financial crisis, but again these differences are statistically and economically not significant.

¹¹ We could also rely on propensity score matching to select a subsample of start-ups founded in crisis years and very similar start-ups (based only on *observable* characteristics) founded in non-crisis years. However, as differences in creditworthiness are not meaningfully different between pre-crisis and crisis start-ups, we prefer to use the full samples, which represent a close approximation of the population of independent, non-financial start-ups with employment founded in these periods (and control for observable characteristics).

Consistent with Hypothesis 1, we expect that the *Crisis* dummy variable will be negative and significant. We estimate Eq. (1) for six dependent variables. We consider total bank debt, long-term bank debt and short-term bank debt, and investigate the use of bank debt (i.e., is it positive) and the ratio of bank debt to total financing sources raised in their initial year of operation. Table 3 reports the estimated coefficients and robust standard errors for each of the six dependent variables. We present models without and with firm-level variables that may be endogenous and depend upon the amount of financing raised. We first consider total bank debt. Model 1 and 2 are Logistic regressions with as dependent variable the use of bank debt ($Bank\ Debt > 0$) and Model 3 and 4 are Tobit regressions with as dependent variable the amount of bank debt relative to total financing sources raised ($Bank\ Debt / TFS$). Similarly, we consider long-term bank debt in Models 5-8 and short-term bank debt in Models 9-12.

[Table 3 about here]

The results for the controls in Table 3 are generally in line with expectations.^{12, 13} Turning to Model 1, we see that, controlling for human capital and industry characteristics, start-ups founded in crisis years were 1.9 percentage points less likely to raise bank debt relative to start-ups founded in pre-crisis years. When adding firm-level controls, start-ups founded in crisis years were 1.2 percentage points less likely to raise bank debt relative to start-ups founded in pre-crisis years. Model 2 (3) shows that the ratio of bank debt to total financing sources raised was 2 (2.1) percentage points lower for start-ups founded in crisis

¹² One notable exception is that we find a strong positive correlation between bank debt and profitability. This result may seem surprising given that the negative relationship between leverage ratios and profitability is the single most cited fact in support of the pecking order theory (Harris and Raviv, 1991; Rajan and Zingales, 1995). Our findings, however, are consistent with those of Rauh and Sufi (2010), who show that there exists significant heterogeneity in the relationship between different types of debt and profitability and find a positive correlation between bank debt and profitability for established US firms.

¹³ The fact that high creditworthy firms—that all else equal have larger buffers of cash and cash equivalents—are less likely to raise bank debt is in line with the pecking order theory. We also tested for interactions between the crisis and the creditworthiness variables, but these interactions are not significant.

years relative to start-ups founded in pre-crisis years. With a median ratio of debt to total financing sources of 0.25, this decrease represents a decrease of 8% (8.4%).¹⁴ Findings are hence not only statistically but also economically significant.

Turning to Models 5-8, we can observe that the results for total bank debt are driven by a decreased use of long-term bank debt and a lower ratio of long-term bank debt. Specifically, start-ups founded in crisis years were 2.5-1.8 percentage points less likely to raise long-term bank debt relative to start-ups founded in pre-crisis years. The ratio of bank debt to total financing sources raised was 2-2.2 percentage points lower for start-ups founded in crisis years relative to start-ups founded in pre-crisis years. Models 9-12, however, suggest that there is no remarkable difference in the use of short-term bank debt and the ratio of short-term bank debt to total financing sources raised for start-ups founded in crisis years relative to start-ups founded in pre-crisis years (Model 8 is an exception with marginal evidence that start-ups founded in crisis years also has less short-term debt on total financing sources raised).

In summary, we find that the financial crisis had a statistically and economically significant effect on the financing of start-ups. Specifically, during crisis years start-ups use significantly less (long-term) bank debt. These findings support Hypothesis 1.

4.3. The impact of bank dependence and more financially constrained founders

When supply-side forces of the crisis mattered for the financing of start-ups founded in crisis years, we would expect that some start-ups will be more affected by the crisis than others. Consistent with Hypothesis 2, we investigate whether the impact of the crisis on bank

¹⁴ We also run Tobit regressions with as a dependent variable the natural logarithm of the absolute amount of debt financing raised (plus one). We find a significant decrease (between 21% and 26% depending on the model specification used; i.e., with or without firm-level controls) in the absolute amount of debt financing raised.

financing is affected by the start-ups' dependence on bank financing and the extent to which the founders of start-ups are more likely financially constrained.

We expect that the decline in borrowing for start-ups founded in crisis years will be particularly severe for start-ups that are founded in industries that are historically more dependent on bank debt (e.g., Cetorelli and Strahan, 2006) and hence have an innate demand for bank financing. We estimate the following regression:

$$Y = \beta_0 + \beta_1 \text{Crisis} + \beta_2 \text{Bank Dependence} + \beta_3 \text{Bank Dependence} * \text{Crisis} + \beta_4 \text{Profitability} + \beta_5 \text{Tangibility} + \beta_6 \text{Growth} + \beta_7 \text{TFS} + \beta_8 \text{NV} + \beta_9 \text{Low Creditworthiness} + \beta_{10} \text{High Creditworthiness} + \beta_{11} \text{Prop Male Empl} + \beta_{12} \text{Prop Highly Edu Empl} + \beta_{13} \text{Size of Industry Peers} + \beta_{14} \text{Industry Concentration} + \beta_{\text{YEAR}} \text{Year} + \beta_{\text{IND}} \text{Industry}. (2)$$

Table 4, Panel A, reports the estimated coefficients and robust standard errors for the six dependent variables. In Models 1 and 2, when focusing on the main effect of bank dependence, we observe that start-ups that operate in more bank dependent industries do not have a significantly higher likelihood of using bank debt; however, they do have a higher ratio of bank debt to total financing sources raised. This finding supports the idea that start-ups in these industries are more dependent on bank debt and raise larger amounts of bank debt. The interaction effect, however, shows that start-ups that operate in more bank dependent industries and are founded in crisis years, are significantly less likely to attract bank debt. Moreover, the relationship between bank dependence and a start-up's ratio of bank debt to total financing sources raised also becomes significantly weaker. These results suggest that in crisis years, start-ups that operate in industries that are more dependent on bank loans are less likely to raise bank debt and raise smaller amounts of bank debt to total financing sources relative to their peers founded in pre-crisis years. When we focus on long-term bank debt in Models 3 and 4, we find similar results. For short-term bank debt, we find no significant interaction effect. Overall, our findings support Hypothesis 2(a).

[Table 4 about here]

We further expect that the reduction in borrowing by start-ups founded in crisis years will be more severe for start-ups founded by entrepreneurs who are more likely financially constrained (i.e., firms in which founders do not fully invest committed equity in the initial year of operation). When entrepreneurs are more financially constrained, other sources of financing such as bank debt become more important for their firms. However, banks that tightened their credit standards as a consequence of the crisis are less likely to provide funding to more financially constrained entrepreneurs and their start-ups. We estimate the following regression:

$$Y = \beta_0 + \beta_1 \text{Crisis} + \beta_2 \text{Uncalled Equity} + \beta_3 \text{Uncalled Equity} * \text{Crisis} + \beta_4 \text{Profitability} + \beta_5 \text{Tangibility} + \beta_6 \text{Growth} + \beta_7 \text{TFS} + \beta_8 \text{NV} + \beta_9 \text{Low Creditworthiness} + \beta_{10} \text{High Creditworthiness} + \beta_{11} \text{Prop Male Empl} + \beta_{12} \text{Prop Highly Edu Empl} + \beta_{13} \text{Size of Industry Peers} + \beta_{14} \text{Industry Concentration} + \beta_{\text{YEAR}} \text{Year} + \beta_{\text{IND}} \text{Industry}. (3)$$

Table 4, Panel B, reports the estimated coefficients and robust standard errors for Eq. (3). Turning to Models 1 and 2, we observe that start-ups with a larger portion of uncalled equity capital are more likely to use bank debt and raise larger amounts of bank debt relative to total financing sources raised. This relationship is in line with the idea that entrepreneurs of start-ups with uncalled equity are more financially constrained and are hence more dependent on bank debt. As expected, in crisis years, the relationship between uncalled equity and debt financing becomes weaker. We find a negative and significant interaction effect between the crisis and uncalled equity variable in the models predicting the use of bank debt (Model 1) and bank debt raised on total financing sources (Model 2). This finding suggests that although start-ups with uncalled equity are dependent on bank debt, in crisis years, they were less likely to raise bank debt and raised smaller amounts of bank debt relative to their peers

founded in pre-crisis years. These findings are confirmed by Models 3 and 4 for long-term bank debt. These findings support Hypothesis 2(b).

Taken together, our results suggest that start-up firm borrowing declined significantly for start-ups founded in crisis years relative to start-ups founded in pre-crisis years. Consistent with the idea that supply-side forces of the crisis mattered, this decline is stronger for start-ups that are more dependent on bank loans and for start-ups founded by more financially constrained entrepreneurs who do not fully invest committed equity in the start-up year.

5. The financial crisis and start-up survival

We now analyze whether the financial effects of the crisis that we observe in Section 4 are accompanied by changes in firm bankruptcy. If supply-side forces matter, those start-ups that experienced the strongest decrease in borrowing will also be more likely to be financially constrained, eventually increasing their probability of going bankrupt.

We start by studying the impact of the crisis on bankruptcy controlling for firm, human capital and industry characteristics. Table 5, Model 1, reports estimated coefficients and robust standard errors for Eq. (1) with bankruptcy as the dependent variable. We show that start-ups founded in crisis years have a 2.4 percentage point higher probability of going bankrupt before the end of their second year of operation. This finding supports Hypothesis 3. One may wonder whether it are really the credit conditions at start-up that matter or whether the probability of bankruptcy increases when start-ups reach a crisis year. Because the bankruptcy rate is lower for start-ups founded in non-crisis years (that eventually enter into a crisis period) relative to start-ups that are founded in crisis years, our evidence is particularly strong that it are indeed the credit conditions in the start-up year that matter.

The results for the control variables suggest that more profitable start-ups and start-ups with more tangible assets have a lower probability of going bankrupt. Not surprisingly, start-ups with low (high) creditworthiness have a higher (lower) likelihood of going bankrupt relative to start-ups of average creditworthiness. Finally, start-ups in industries with larger industry peers have a higher probability of going bankrupt, while start-ups in more concentrated industries have a lower likelihood of going bankrupt.

[Table 5 about here]

Table 5, Model 2, reports estimated coefficients and robust standard errors for Eq. (2) with the dependent variable being bankruptcy. Table 5, Model 2, is analogous to Table 4, Panel A, and exploits the variation in bank dependence. We observe that start-ups that are founded in crisis years and operate in industries that are more bank dependent have a significantly higher probability of going bankrupt. This finding supports Hypothesis 4(a).

Table 5, Model 3, reports estimated coefficients and robust standard errors for Eq. (3). The dependent variable is again firm bankruptcy. Table 5, Model 3, is analogous to Table 4, Panel B, and exploits the variation in founder financing constraints. We observe that start-ups founded in crisis years by entrepreneurs who are more likely financially constrained have a significantly higher probability of going bankrupt. This finding supports Hypothesis 4(b).

Overall, our results are consistent with the hypothesis that the lower borrowing of start-ups founded in crisis years translated into a higher probability of going bankrupt, particularly for start-ups operating in industries that are more bank dependent and for start-ups founded by more financially constrained entrepreneurs (i.e., start-ups that also experienced the largest financial effects of the crisis). Again, these findings are consistent with the idea that supply-side forces of the crisis at least mattered for start-up bankruptcy.

6. Additional tests and robustness checks

Our main findings show that the 2008-09 financial crisis reduced start-up borrowing and increased bankruptcy. These effects were stronger for start-ups operating in more bank dependent industries and for start-ups founded by entrepreneurs who are more likely financially constrained.

Because the demand-side effects of the crisis became more apparent from 2009, we start with rerunning all regressions for a sample which includes only those start-ups founded in 2008 as start-ups founded in the financial crisis, and exclude start-ups founded in 2009. This analysis provides a more stringent test of the effect of the financial crisis on the financing and survival of start-ups (e.g., Duchin et al., 2010). Indeed, in 2008, the annual GDP growth rate was still positive at 1.0% in Belgium and gross fixed capital formation increased by 3.8%. In 2009, however, economic activity decreased dramatically; the annual GDP growth rate was -2.8% and gross fixed capital formation decreased by 7.5%. Moreover, in line with Kim et al. (2006), who indicate that liquidity constraints do not matter much for the creation of entrepreneurial firms, the number of start-ups founded in 2008 does not decrease significantly relative to the number of start-ups founded in pre-crisis years. The significant drop in the number of start-ups founded in 2009 is most likely a consequence of the economic crisis that emerged at that time. The effects of the crisis on start-up borrowing and survival, excluding the 2009 start-ups, are fully consistent with what we reported before (see Internet Appendix A.1 and A.2). Hence, we provide further evidence that supply-side forces of the crisis mattered for the financing and survival of Belgian start-ups.

We also considered other financial effects of the crisis for business start-ups, including their cost of debt, trade credit usage, and cash holdings. First, we examine the cost of debt, defined as financial expenses on total debt, conditional upon start-ups raising debt financing. The median cost of debt in our sample equals 5.6%. Results are presented in the

Internet Appendix A.3. Consistent with the perception of entrepreneurs as depicted in Figure 2, we find that the cost of debt is 0.5 percentage points higher for start-ups founded in crisis years.

Second, the crisis might also have affected the other sources of financing used by start-ups. However, start-ups generally do not have many alternative sources of external equity financing. Venture capital and business angel financing are typically only available for a tiny fraction of all start-ups (indeed, our statistics showed that 0.08% of the sample raised venture capital). Moreover, the availability of venture capital also decreased significantly during the crisis (e.g., Block and Sander, 2009 for evidence from the US; the European Private Equity and Venture Capital Association, 2010, for Europe). The most likely and widely used financing alternative is trade credit (Huyghebaert et al., 2007). Thus, we examine the effect of the crisis on trade credit. As reported in the Internet Appendix A.4, we do not find a statistically significant relationship between the financial crisis and trade credit. Thus, it seems that the financial crisis affected the use of bank debt but not trade credit for start-ups.

Third, prior work on publicly held firms suggests that start-ups may have potentially realized that a sudden future liquidity shock in the banking sector would make them more vulnerable to banks refusing to roll over existing loans and extend new loans. Research has shown that publicly listed firms, after having become aware of this ‘new’ risk, decided to increase their cash ratio as a buffer (Campello et al., 2010). One interesting observation in our data, however, is that start-ups particularly rely on long-term debt rather than short-term debt, which limits roll over risk. Moreover, as shown in the Internet Appendix A.4, we fail to find a statistically significant relationship between the financial crisis and the cash holdings in business start-ups.

Finally, we also consider other real effects of the crisis next to firm bankruptcy. Specifically, we also focus on revenues (using a subsample of larger start-ups that report

revenues) and investments (using the full sample of start-ups).¹⁵ Results are presented in Appendix A.5. We find that start-ups founded in crisis years realized lower revenues when they operate in bank dependent industries and are founded by entrepreneurs who are more likely financially constrained. We further find that start-ups founded in crisis years subsequently invested less when they are founded by entrepreneurs who are more likely financially constrained.

7. Conclusions

This study uses a novel data set to explore the effects of credit market conditions at founding on start-up financing and survival. Towards this end, we trace the firm-level impact of the recent financial crisis.

The use of bank debt and proportion of bank debt to total financing sources raised decreased significantly for start-ups founded in crisis years relative to start-ups founded in pre-crisis years. However, bank debt remains the single most important source of financing for start-ups, even when these start-ups are founded during the height of the crisis. This result is surprising in light of current theoretical models arguing that market imperfections, such as information asymmetry, will prevent start-ups—arguably the most informationally opaque firms—from accessing formal debt markets (e.g., Berger and Udell, 1998; Stiglitz and Weiss, 1981). This result is also surprising in view of the current focus on equity financing for start-ups (see also Cumming and Vismara, 2017). Our evidence on the importance of bank debt is consistent with recent evidence from US start-ups founded in 2004 (Robb and Robinson, 2014). However, we further extend this research by showing that the importance of bank

¹⁵ Smaller Belgian SMEs are allowed to report abbreviated financial statements when they comply with several requirements. Note that our regressions using the natural logarithm of revenues plus one as a dependent variable to study other real effects of the crisis are biased against finding an effect of the financial crisis because only larger startups—which are less likely to be financially constrained—are included in these regressions.

financing for start-ups reflects a broader pattern for start-ups founded in fundamentally different credit market conditions.

We further show that the financial effects of the crisis were stronger for start-ups that operate in bank dependent industries and start-ups that are founded by entrepreneurs who are more likely financially constrained. This finding is in line with the idea that supply-side forces hampered start-up borrowing, because those firms with an innate demand for bank debt, which is difficult to change, were most affected by the financial crisis. We further show that start-ups founded in crisis years have a higher probability of going bankrupt (after controlling for the ex ante risk of default); this effect is again particularly strong for start-ups that operate in bank dependent industries and start-ups that are founded by entrepreneurs who are more likely financially constrained. In sum, our evidence is consistent with start-ups founded in crisis years being more financially constrained relative to start-ups founded in pre-crisis years.

These findings also represent an opportunity to come back to our observation in the introduction, that any relationship between *the observed debt ratio* (i.e., the intersection between the demand for and supply of debt financing) of a start-up and survival can be explained by: (a) access to bank debt being crucial for start-up survival, (b) self-selection by start-ups, and (c) unobservable variables leading to a spurious correlation. Our approach of examining the financial and real effects of *the financial crisis*—a period of worsened credit market conditions—for start-ups that are more or less bank dependent, reduces the possibility that mechanisms (b) and (c) from above drive our findings. Thus, our evidence is in line with mechanism (a): access to bank debt is crucial for start-up financing and survival.

As with any study, the current study is not free of limitations, which provide interesting avenues for future research. One boundary condition for our study pertains to the generalizability of our findings beyond the population of Belgian start-ups. Future research

might establish the generalizability of our results to start-ups in other countries. It would be particularly interesting to construct a European sample of start-ups and investigate the importance of the strength of the recent financial crisis on start-up financing and survival. Moreover, it would be interesting to investigate how national investor protection laws and the support of governments moderated the impact of the financial crisis for start-ups.

This study has important implications for theory and practice. The critical role of bank debt in financing business start-ups, even during the height of the recent crisis—a financial crisis of historic breadth and depth—calls for additional theory on the role of bank debt in the earliest stages of a firm’s life cycle. While entrepreneurial finance scholars have sporadically studied the role of debt finance in start-ups, there is generally so much focus on equity finance in the literature that the field seems to have forgotten the importance of debt finance for start-ups. Moreover, for good reasons, European policy makers have focused on increasing the supply of venture capital and private equity to stimulate entrepreneurship. Nevertheless, our study suggests that for the average start-up initiative debt financing is crucial and policy makers can influence the survival (and success) of very early stage firms, the future engines of economic growth, through the implementation of policies that foster more favorable credit market conditions for start-ups.

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Figure 1: Changes in total amount of credit granted to non-financial Belgian firms

<<Figure_1>>

This figure depicts yearly percentage changes in the total amount of credit granted to non-financial firms in Belgium. Source: own calculations based on data from the National Bank of Belgium.

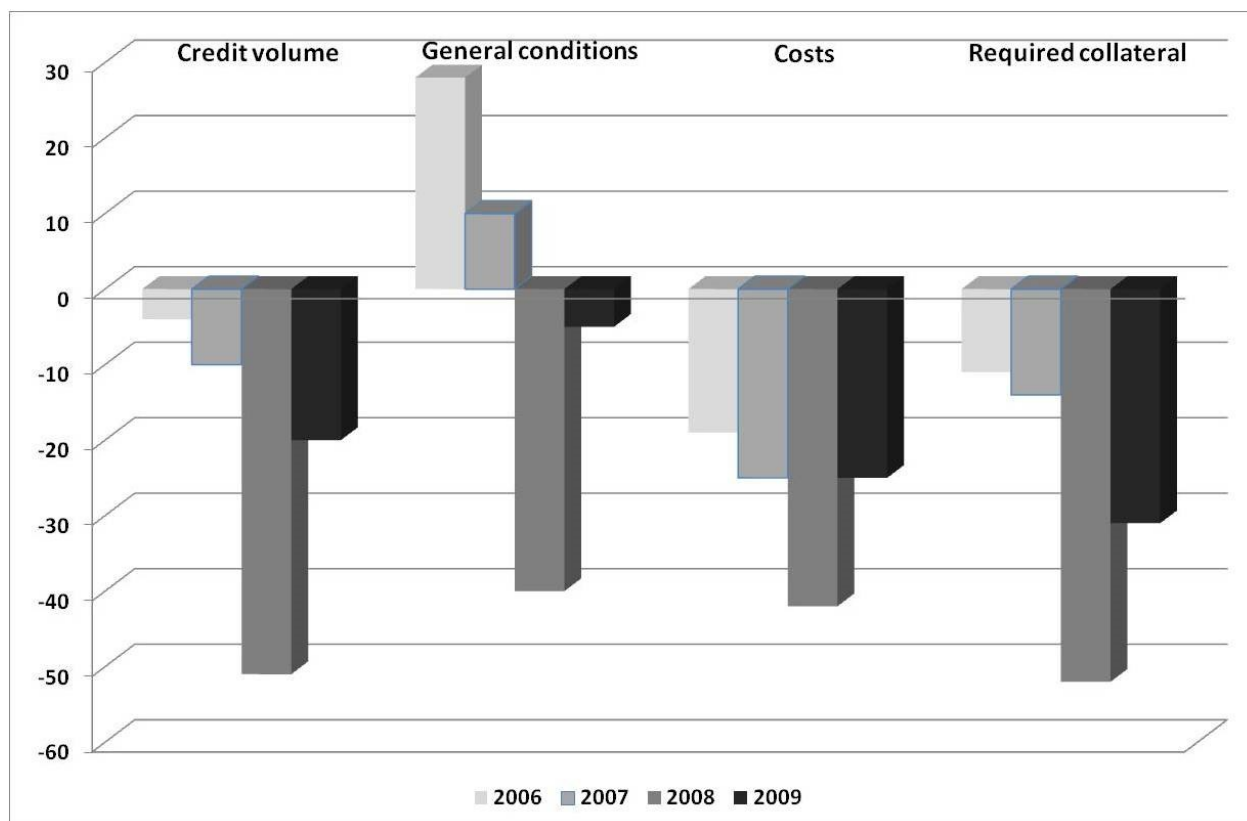


Figure 2: Net changes in credit conditions perceived by non-financial Belgian firms

<<Figure_2>>

This figure depicts net changes (where positive values equal a net improvement and negative values equal a net tightening) in credit conditions. Source: own figure based on data from the National Bank of Belgium.

Table 1: Variable definitions and descriptive statistics

Variable	Description	N	Mean	Median	Std. dev.	Min	Max
Dependent Variables							
Financial Effect	=	=	=	=	=	=	=
Bank Debt = 0	= 1 if firm raised bank debt in founding year, else 0	14,846	0.73	—	—	0.00	1.00
LT Bank Debt = 0	= 1 if firm raised long-term (maturing in more than one year) bank debt in founding year, else 0	14,846	0.67	—	—	0.00	1.00
ST Bank Debt = 0	= 1 if firm raised short-term (maturing within one year) bank debt in founding year, else 0	14,846	0.25	—	—	0.00	1.00
Bank Debt / TFS	Bank debt to total financing sources raised in founding year	14,846	0.30	0.23	0.28	0.00	0.98
LT Bank Debt / TFS	Long-term bank debt to total financing sources raised in founding year	14,846	0.27	0.20	0.27	0.00	0.98
ST Bank Debt / TFS	Short-term bank debt to total financing sources raised in founding year	14,846	0.03	0.00	0.09	0.00	0.98
Real Effect							
Bankrupt	= 1 if firm is declared bankrupt before the end of the second year of operation, else 0	14,846	0.04	—	—	0.00	1.00
Independent Variables							
Crisis	= 1 if firm is founded in 2008 or 2009, else 0	14,846	0.45	—	—	0.00	1.00
Bank Dependence	Median ratio of bank debt to total assets for Belgian firms in 4-digit industry measured in non-crisis years	14,846	0.22	0.21	0.08	0.00	0.75
Uncalled Equity	The ratio of uncalled equity to paid-in equity capital	14,843	0.68	0.00	0.89	0.00	4.32
Table 1- (Continued)							
Variable	Description	N	Mean	Median	Std. dev.	Min	Max
Firm Characteristics							
Profitability	EBIT on total assets	14,846	-0.01	0.04	0.38	-1.98	0.70
Tangibility	Property, plant and equipment on total assets	14,846	0.33	0.26	0.27	0.00	1.00
Growth	Median growth in total assets of firms in 4-digit industry measured as a moving average in the three years before founding	14,846	1.16	1.16	0.12	0.94	1.49
TFS *	Natural logarithm of total financing sources raised (in 000 EUR) plus 1	14,846	432.97	159.37	1,322.93	5.57	65,508.90
NV	= 1 if firm is founded as "NV" legal form, else 0	14,846	0.08	—	—	0.00	1.00
Low Creditworthiness	= 1 if firm has an unlevered ETC score that is in bottom 25%	14,846	0.25	—	—	0.00	1.00
High Creditworthiness	= 1 if firm has an unlevered ETC score that is in top 25%	14,846	0.25	—	—	0.00	1.00
Human Capital Characteristics							
Prop Male Emp	Proportion of male employees	14,846	0.55	0.67	0.44	0.00	1.00
Prop Highly Edu Emp	Proportion of employees with university (or equivalent) education	14,846	0.10	0.00	0.28	0.00	1.00
Industry Characteristics							
Size of Industry Peers *	Natural logarithm of the median number of employees of firms in 4-digit industry plus 1	14,846	3.92	3.00	3.88	1.00	232.00
Industry Concentration	Asset-based Herfindahl-Hirschman index at 4-digit industry level	14,846	0.08	0.04	0.11	0.00	1.00

This Table provides descriptive statistics. The sample is based on the complete set of business registration for Belgium from January 1, 2006 to December 31, 2009 and includes 14,846 start-ups. The descriptive statistics of the variables with a * represent descriptive statistics on the untransformed variables for ease of interpretation; in subsequent multivariate regressions the natural logarithm (plus one) of these variables is used. All euro values are inflation adjusted using the Belgian consumer price index.

Table 3: Financial crisis and start-up financing

	Bank- Debt < 0	Bank- Debt < 0	Bank- Debt/TFS	Bank- Debt/TFS	LT-Bank- Debt < 0	LT-Bank- Debt < 0	LT-Bank- Debt/TFS	LT-Bank- Debt/TFS	ST- Bank- Debt < 0	ST-Bank- Debt < 0	ST-Bank- Debt/TFS	ST-Bank- Debt/TFS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Crisis	0.019*** [0.007]	-0.012* [0.007]	-0.020*** [0.006]	-0.021*** [0.006]	0.025*** [0.005]	-0.013** [0.005]	-0.020*** [0.006]	-0.022*** [0.006]	-0.010 [0.007]	-0.003 [0.008]	-0.008* [0.005]	-0.004 [0.005]
<i>Firm characteristics</i>												
Profitability	-	0.057*** [0.010]	-	0.079*** [0.010]	-	0.073*** [0.011]	-	0.079*** [0.011]	-	0.033*** [0.012]	-	0.034*** [0.009]
Tangibility	-	0.536*** [0.016]	-	0.538*** [0.011]	-	0.605*** [0.016]	-	0.647*** [0.011]	-	0.058*** [0.014]	-	-0.002 [0.009]
Growth	-	-0.008 [0.045]	-	-0.069* [0.039]	-	-0.026 [0.050]	-	-0.102** [0.039]	-	0.099* [0.053]	-	0.073** [0.035]
TFS	-	0.105*** [0.003]	-	0.090*** [0.003]	-	0.114*** [0.003]	-	0.090*** [0.003]	-	0.047*** [0.003]	-	0.032*** [0.002]
NV	-	0.129*** [0.013]	-	-0.130*** [0.010]	-	0.134*** [0.014]	-	-0.131*** [0.011]	-	0.063*** [0.013]	-	-0.037*** [0.009]
Low creditworthiness	-	-0.005 [0.009]	-	-0.008 [0.007]	-	0.055*** [0.010]	-	-0.067*** [0.008]	-	0.138*** [0.009]	-	0.115*** [0.007]
High creditworthiness	-	0.032*** [0.008]	-	-0.029*** [0.006]	-	-0.021** [0.008]	-	-0.009 [0.007]	-	0.137*** [0.009]	-	-0.091*** [0.007]
<i>Human capital characteristics</i>												
Prop male emp	0.054*** [0.009]	0.015* [0.008]	0.018** [0.008]	-0.006 [0.007]	0.056*** [0.010]	0.016* [0.008]	0.020** [0.008]	-0.005 [0.007]	0.015* [0.009]	0.001 [0.009]	0.008 [0.006]	-0.003 [0.006]
Prop highly edu emp	0.061*** [0.013]	0.058*** [0.012]	-0.060*** [0.013]	-0.042*** [0.011]	0.068*** [0.014]	0.064*** [0.013]	-0.064*** [0.013]	-0.041*** [0.011]	-0.018 [0.015]	-0.024 [0.015]	-0.010 [0.010]	-0.015 [0.010]
<i>Industry characteristics</i>												
Size industry peers	0.037*** [0.014]	-0.002 [0.012]	0.023* [0.012]	-0.023** [0.010]	0.030** [0.015]	-0.016 [0.012]	0.022* [0.013]	-0.027*** [0.010]	0.008 [0.014]	-0.010 [0.014]	0.003 [0.009]	-0.009 [0.009]
Industry concentration	0.135*** [0.043]	-0.051 [0.037]	-0.108*** [0.038]	-0.033 [0.031]	0.151*** [0.045]	-0.046 [0.039]	-0.110*** [0.040]	-0.017 [0.033]	-0.068 [0.045]	-0.089** [0.045]	-0.040 [0.030]	-0.055* [0.029]
Pseudo R-squared	0.040	0.213	0.054	0.375	0.043	0.235	0.056	0.380	0.008	0.060	0.021	0.137

This Table examines the impact of the financial crisis on start-up borrowing. Models 1, 2, 5, 6, 9, 10 are Logistic regressions and Models 3, 4, 7, 8, 11, 12 are Tobit regressions. All variables are as defined in Table 1. Each specification is estimated using 14,846 observations, based on the complete set of business registrations for Belgium from January 1, 2006 to December 31, 2009. All specifications include 2-digit industry dummies (not reported due to space considerations). Marginal effects are presented so that the economic significance is shown alongside the statistical significance. ***, **, * denote statistical significance at 1%, 5%, and 10% level, respectively. Robust standard errors are reported in brackets.

Table 4: Financial crisis, bank dependence, financially constrained entrepreneurs, and start-up financing

Panel A: Bank dependence	Bank Debt <- 0 >	Bank Debt/TFS	LT-Bank Debt <- 0 >	LT-Bank Debt/TFS	ST-Bank Debt <- 0 >	ST-Bank Debt/TFS
	(1)	(2)	(3)	(4)	(5)	(6)
Crisis	0.010	0.010	0.010	0.019	0.002	-0.013
	[0.019]	[0.016]	[0.020]	[0.016]	[0.022]	[0.014]
Bank dependence	0.131	0.263***	0.188**	0.276***	-0.025	-0.033
	[0.087]	[0.063]	[0.089]	[0.065]	[0.086]	[0.056]
Bank dependence * Crisis	-0.160*	-0.133**	-0.172*	-0.176***	-0.051	0.062
	[0.087]	[0.065]	[0.090]	[0.067]	[0.083]	[0.058]
Pseudo R-squared	0.213	0.376	0.235	0.382	0.060	0.137
Panel B: Financially constrained entrepreneurs	Bank Debt <- 0 >	Bank Debt/TFS	LT-Bank Debt <- 0 >	LT-Bank Debt/TFS	ST-Bank Debt <- 0 >	ST-Bank Debt/TFS
	(1)	(2)	(3)	(4)	(5)	(6)
Crisis	-0.001	-0.016**	-0.006	-0.016**	-0.007	-0.006
	[0.009]	[0.007]	[0.009]	[0.007]	[0.009]	[0.006]
Uncalled equity	0.025***	0.034***	0.023***	0.031***	0.019***	0.014***
	[0.005]	[0.004]	[0.005]	[0.004]	[0.005]	[0.004]
Uncalled equity * Crisis	-0.016**	-0.010*	-0.017**	-0.011*	0.005	0.002
	[0.007]	[0.006]	[0.007]	[0.006]	[0.008]	[0.005]
Pseudo R-squared	0.215	0.381	0.236	0.385	0.062	0.140

This Table examines whether the impact of the financial crisis on start-up borrowing is affected by start-ups' dependence on bank debt and founders' financial constraints. Models 1, 3, 5 are Logistic regressions and Models 2, 4, 6 are Tobit regressions. All variables are as defined in Table 1. Specifications in Panel A (Panel B) are estimated using 14,846 (14,843) observations, based on the complete set of business registrations for Belgium from January 1, 2006 to December 31, 2009. All specifications include firm, human capital and industry characteristics and 2-digit industry dummies (not reported due to space considerations). Marginal effects are presented so that the economic significance is shown alongside the statistical significance. ***, **, * denote statistical significance at 1%, 5%, and 10% level, respectively. Robust standard errors are reported in brackets.

Table 5: Financial crisis, bank dependence, financially constrained entrepreneurs, and real effects

	Bankrupt (1)	Bankrupt (2)	Bankrupt (3)
Crisis	0.024*** [0.004]	0.012 [0.010]	0.020*** [0.004]
Bank dependence	—	-0.039 [0.042]	—
Bank dependence * Crisis	—	0.072* [0.038]	—
Uncalled equity	—	—	0.004 [0.003]
Uncalled equity * Crisis	—	—	0.008**

			[0.003]
<i>Firm characteristics</i>			
Profitability	-0.015*** [0.004]	-0.015*** [0.004]	-0.015*** [0.004]
Tangibility	-0.027*** [0.007]	-0.027*** [0.007]	-0.026*** [0.007]
Growth	0.026 [0.026]	0.021 [0.027]	0.025 [0.026]
TFS	0.003* [0.002]	0.003* [0.002]	0.004*** [0.002]
NV	-0.006 [0.006]	-0.006 [0.006]	-0.004 [0.006]
Low creditworthiness	0.025*** [0.004]	0.024*** [0.004]	0.025*** [0.004]
High creditworthiness	-0.025*** [0.006]	-0.025*** [0.006]	-0.026*** [0.006]
<i>Human capital characteristics</i>			
Prop male empl	-0.004 [0.004]	-0.004 [0.004]	-0.004 [0.004]
Prop highly edu empl	-0.005 [0.007]	-0.004 [0.007]	-0.005 [0.007]
<i>Industry characteristics</i>			
Size industry peers	0.012* [0.006]	0.012* [0.006]	0.012** [0.006]
Industry concentration	-0.039* [0.022]	-0.038* [0.022]	-0.039* [0.022]
Pseudo R-squared	0.077	0.078	0.081

This Table examines the real effects of the financial crisis. All specifications are estimated using Logistic regressions. All variables are as defined in Table 1. The first and second specification are estimated using 14,846 observations and the third specification is estimated using 14,843 observations, based on the complete set of business registrations for Belgium from January 1, 2006 to December 31, 2009. All specifications include 2-digit industry dummies (not reported due to space considerations). Marginal effects are presented so that the economic significance is shown alongside the statistical significance. ***, **, * denote statistical significance at 1%, 5%, and 10% level, respectively. Robust standard errors are reported in brackets.