



# Short-term financial constraints and SMEs' investment decision: evidence from the working capital channel

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**Abstract** This paper investigates the real effect of short-term financial constraints on small and medium-sized enterprises (SMEs). Under the working capital channel, cash credit constraints force entrepreneurs to forgo investment opportunities in order to finance their working capital needs. Building on survey data, I find that short-term credit constraints are as important as long-term ones in SMEs' investment decisions. Besides, the detrimental effect of cash credit constraints on corporate investment is stronger for SMEs with higher increase in working capital needs but lower for liquid ones that are able to adjust their accounts receivable and inventories. My results suggest that short-term finance is a major issue for SMEs.

**Plain English Summary** Short-term credit constraints turn out to be as important as long-term ones in SMEs' investment decisions. Building on survey data, this paper investigates the real effects of short-term financial constraints on small businesses through an under-explored transmission mechanism. While the bulk of research on the effects of financial constraints focuses on long-term liabilities, I stress the importance of short-term finance. Owing to the competition between working and fixed capital in cash-flow uses, cash credit constraints force entrepreneurs to

allocate additional cash-flow to finance the increase in their working capital needs to the detriment of long-term assets. The main implication of this work is that supports for short-term financing would provide a significant boost to long-term investment and economic growth.

**Keywords** Investment · Bank credit · Financial constraints · Working capital · Survey data

**JEL Classifications** D82 · E32 · E51 · G01 · G21

## 1 Introduction

The literature examining the firm-level implications of financing frictions has traditionally focused on long-term liabilities (Bernanke and Gertler 1989; Kiyotaki and Moore 1997; Holmstrom and Tirole 1997; Almeida et al. 2012). Yet, given the specific financial structure of SMEs, short-term credit constraints are likely to have significant effects on their investment decisions. Under imperfect capital market assumptions, firms that exhibit the highest agency problems (i.e. SMEs) primarily rely on internal financing capacity and prefer debt to equity if external financing is required (Myers and Majluf 1984; Vanacker and Manigart 2010; Serrasqueiro and Caetano 2015). According to this view, firms that are identified as financially constrained also show higher investment-cash flow sensitivity (Fazzari et al. 1988; Mulier et al.

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2016). In this context, cash-flow uses become of primary interest and increase in working capital needs may compete with fixed investment for the available pool of finance (Fazzari and Petersen 1993). Investigating this working capital channel, this paper shows that short-term financial constraints can reduce long-term investments.

The crucial role of working capital has been recognized since the emergence of classical economics.<sup>1</sup> In modern corporate finance, working capital accounts for the net position of firms' liquid assets, both real and financial. It is defined as the sum of accounts receivable and inventories minus accounts payable and other non-financial debts due in less than one year. In other words, working capital refers to the funds available and used for daily operations of an enterprise.

Working capital management is a critical issue for entrepreneurs that are willing to balance financial soundness with effective investment choices (Deloof 2003; Baños-Caballero et al. 2012). On the one hand, a positive working capital enables them to cover their current liabilities, which is a sign of financial strength in the short run. On the other hand, having too much working capital (i.e. unused inventories or uncollected accounts receivable) implies an ineffective way of using their current assets.

In this regard, one central motivation of this paper is the specific importance of working capital for SMEs' (Peel and Wilson 1996; Peel et al. 2000), in particular for sectors such as retail, construction or manufacturing where inventory management is a major issue (see Fig. 1).<sup>2</sup> For instance, in 2016, inventories and accounts receivable combined represented on average almost 40% of firms' total assets and this figure reached 50% in the construction sector (see Fig. 3).<sup>3</sup>

To assess the real effects of financial constraints, I take advantage of the quarterly French survey on the

access to finance of 7778 independent SMEs. Following the ECB's "Survey on the Access to Finance of Enterprises" (SAFE), the French survey was started in Q1 2012 and aims at providing information on the entrepreneurs or managers' experience in attempting to access finance. Most importantly for my research, the questionnaire is the first to focus on loan maturity distinguishing short-term from long-term loan applications. By summarizing quarterly responses, I am able to construct yearly indicators of investment and cash credit constraints that can be matched with firms' balance sheet information.<sup>4</sup>

My main empirical approach relies on a dynamic panel methodology in order to control for both unobserved time-invariant heterogeneity and lagged investment structure. Taking into account the changing composition in loan demand by means of a Heckman probit model, the first step estimates the firms' probability of being yearly financially constrained as a function of their financial situation. I end up with two different scores allowing me to create two indexes: an Index of Cash Credit Constraints (ICCC henceforth) and an Index of Investment Credit Constraints (IICC henceforth).

From there, the second step consists in incorporating these indicators into a standard dynamic model of investment where cash flow and sales growth control for investment opportunities. In the end, the dynamic panel approach reveals significant differences in corporate investment between financial constrained firms and their unconstrained counterparts. While both kind of credit constraints are associated with a lower investment, I find that short-term credit constraints have almost the same impact as long-term ones on SMEs' fixed investment (i.e. tangible and intangible): a short-term (resp. long-term) financial constraint decreases the annual increase in all fixed assets by 40 (resp. 50) basis points of total assets. Given that the average corporate investment (tangible and intangible) equals 3.3% of total assets for my whole sample, this amounts to a decrease of around 12 (resp. 15) %.

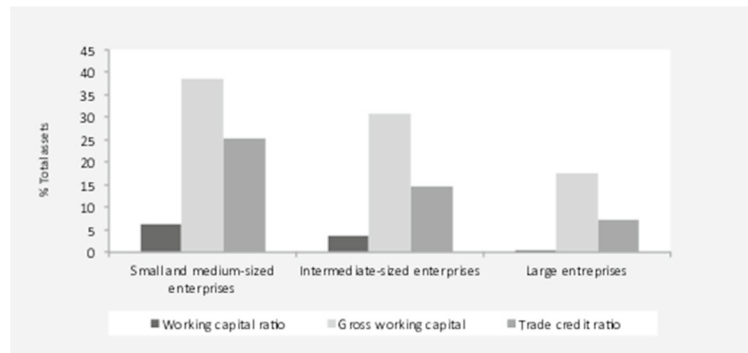
Importantly, the increase in working capital needs turns out to negatively affect investment decisions,

<sup>1</sup>Following the work of the physiocrats, Smith and Todd (1776) made the first explicit distinction between fixed and circulating capital.

<sup>2</sup>In line with the European Commission, my definition of SMEs is based on number of employees (less than 250), turnover (less than EUR 50 million) and total assets (less than EUR 43 million).

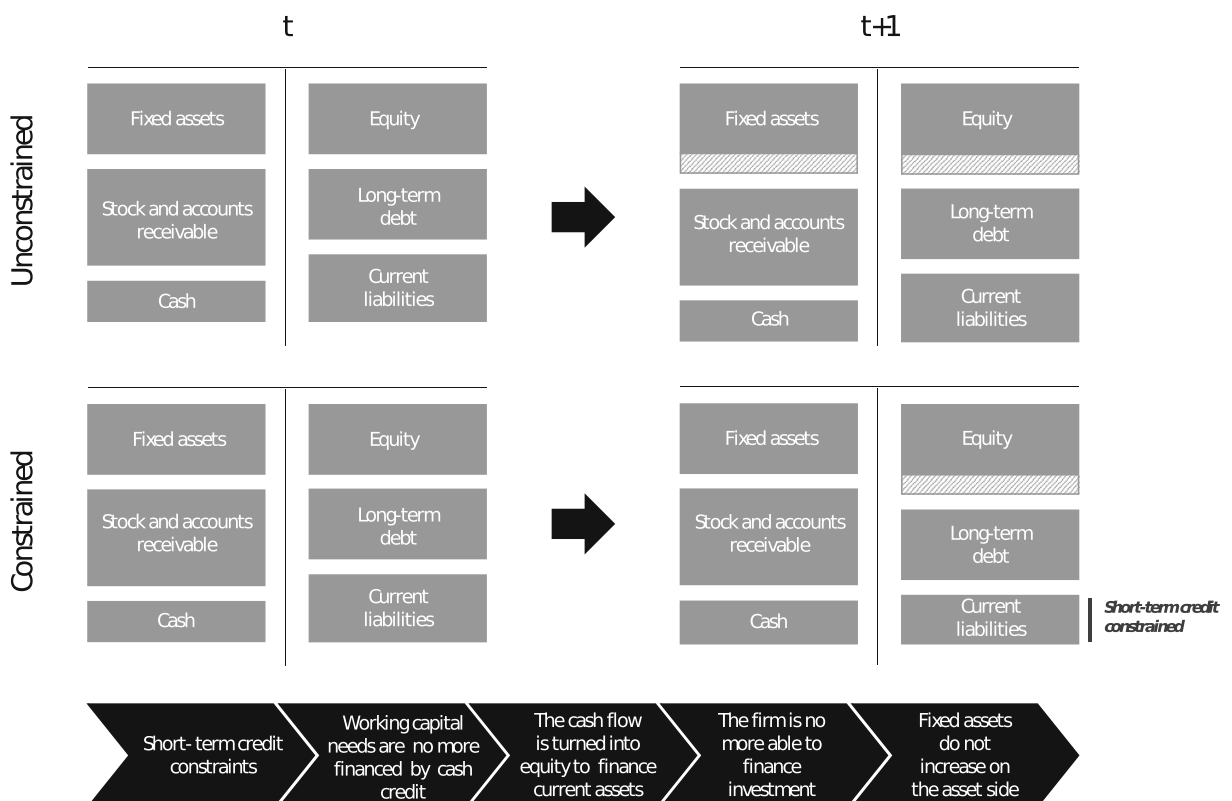
<sup>3</sup>Computations are made using the Fiben database described below.

<sup>4</sup>Note that I rule out from the analysis firms that were simultaneously credit constrained regarding both cash and investment credit in order to separately identify the causal effect of each credit constraint.



**Fig. 1** Importance of working capital and trade credit according to firm size. All the definitions of the variables are summarized in Table 3. The category *small and medium-sized enterprises* (SME) is made up of enterprises that employ fewer than 250 people and have an annual turnover of less than 50 million euro or a balance sheet total not exceeding 43 million euro. The category *intermediate-sized enterprise* (ETI) refers to companies with between 250 and 4999 employees, and a

turnover which does not exceed 1.5 billion euros or a balance sheet total which does not exceed 2 billion euros. The category *Large enterprises* stands for enterprise that has at least 5000 employees and an annual turnover greater than 1.5 billion euros or a balance sheet total of more than 2 billion euros. Based on the year 2016, calculations are made using the FIBEN database (Banque de France)



**Fig. 2** Diagram of the working capital channel. Interpretation: while in time  $t$  no firms are credit constrained, in time  $t+1$  constrained firms become short-term credit constrained and their current liabilities decrease. Hence, their working capital needs are no more financed by cash credit and short-term credit

constrained firms are forced to turn their cash-flow into equity to finance their current assets, thus maintaining the same balance sheet size. In contrast, firms which are not short-term credit constrained are able to turn their cash-flow into fixed assets to increase their balance sheet

but only for short-term credit constrained firms. The higher the increase in working capital needs, the more cash credit constraints are detrimental to firms' investment. In addition, interacting cash flow with my indexes of credit constraints, I find that credit constrained firms do not exhibit higher investment-cash flow sensitivities. Finally, investigating the firms' ability to sidestep those credit constraints I show that short-term credit constrained firms that have higher amounts of accounts receivable or inventories experience a lower decrease in their investment than the others.

Those results are robust to the inclusion of other instruments such as firm age, leverage, deeper lags of covariates but also alternative specifications (i.e. matching methods or quantile regressions). Above all, in the light of the working capital channel, they suggest that the dynamic of working capital needs is of major importance for SMEs in the presence of short-term financial constraints.

This paper contributes to a classic strand of research in corporate finance investigating how financial constraints and fluctuations in credit supply might affect investment (Fazzari et al. 1988; Kaplan and Zingales 1997; Chow and Fung 2000; Almeida and Campello 2007; Vermoesen et al. 2013). In particular, my work is close to the increasing literature that takes advantage of the recent advances in data collection to measure the effect of financial constraints on investment according to entrepreneurs or managers' self-assessment of their access to credit (Becchetti et al. 2010; Campello et al. 2010; Gómez 2019).

My results also relate to the literature on the effect of working capital on firm performance and investment. Inventories or accounts receivable are usually associated with better firm performance. While larger inventories can prevent interruptions in the production process and reduce supply costs (Blinder and Maccini 1991), granting trade credit not only serves as a warranty for product quality but also fosters long-term relationship with customers (Wilson and Summers 2002). However, as increases in working capital require additional financing and opportunity costs, firms with high working capital needs are likely to face high interest expenses and bankruptcy risk (Soenen 1993). This trade-off between risk and profitability involves a non-linear relation between working capital level and firm performance in which an optimal

working capital level maximizes the firm profitability (Baños-Caballero et al. 2012; Afrifa et al. 2014). Motivated by prior studies which suggest that working capital may compete with investment for the available pool of finance (Fazzari and Petersen 1993; Carpenter et al. 1994; Ding et al. 2013; Aktas et al. 2015), I argue in this paper that the working capital dynamic is a potential channel which may exacerbate the consequences of financial frictions in the short run by reducing investment.

Finally, this paper adds to the literature focusing on indicators of financial constraints. Since the seminal work of Fazzari et al. (1988), financially constrained firms (i.e. firms with low dividend payout ratios) are meant to exhibit higher investment-cash flow sensitivities (henceforth ICFS). Nonetheless, numerous studies have subsequently cast some doubt on the ICFS hypothesis (Kaplan and Zingales 1997; Kadapakkam et al. 1998; Cleary 2006). Above all, the usual strategy hinges on an indicator which is unidimensional, time-invariant and restricted to quoted firms. Hence, I implement a multidimensional (Cleary 1999; Lamont et al. 2001; Whited and Wu 2006) and qualitative (Becchetti et al. 2010) analysis to construct a time-varying indicator of financial constraints and find that the negative relationship between fixed and working capital needs is associated with short-term credit frictions. To my knowledge, this paper is the first to create such an indicator of both cash and investment credit constraints using qualitative survey data of small private firms.

The remainder of the paper is structured as follows. Section 2 presents the related literature associated with the working capital channel and the testable hypotheses. Section 3 presents the data and the summary statistics. Section 4 examines the real effects of financial constraints on corporate investment using a dynamic panel analysis. Section 5 discusses the robustness of the results and Section 6 concludes.

## 2 Literature review and research hypotheses

### 2.1 The supply-side effect of working capital

The firm-level implications of working capital under financial constraints have received little attention in the literature which traditionally focuses on long-term

finance (Bernanke and Gertler 1989; Kiyotaki and Moore 1997; Holmstrom and Tirole 1997). However, a more recent stream of papers dealing with macroeconomic implications of financial frictions over the business cycle suggest that working capital can have significant effects on real output through financial accelerator and supply conditions (Mendoza 2010; Jermann and Quadrini 2012).<sup>5</sup>

Following the seminal work of Metzler (1941), the main argument lies in inventory management whenever firms need to pay for inputs in advance of production. Given that firms' production capacity relies on their ability to finance their working capital, a short-term credit constraint may amplify the effect of economic shocks on their sales. Looking at the effect of oil shocks on firm profitability, Almeida et al. (2018) empirically found that working capital finance can be an important channel for understanding how the credit multiplier affects economic activity. More precisely, the effects of shocks to input prices are amplified by endogenous changes in net worth: as firms' profit and net worth are reduced, the latter find it difficult to finance their inventories, which ends up with a further decrease of their sales, profits, net worth, production capacity and so on.

## 2.2 The demand-side effect of working capital

While the previous working capital channel examines the propagation of shocks over time in the light of firms' production decisions, some authors have attempted to assess the effect of working capital on investment demand in presence of financial constraints. Building on this second strand of literature, this paper analyzes the effect of short-term financial constraints that can reduce investment at the firm level. In this section, I present several research hypotheses that I then test empirically.

Developing the atypical role of working capital as both an input and a readily reversible store of liquidity, some studies show that working capital can act

as an alternate source of financing to external capital, especially for the purpose of fixed-investment smoothing in order to maintain a stable fixed-investment path (Fazzari and Petersen 1993; Carpenter et al. 1994; Ding et al. 2013; Aktas et al. 2015).<sup>6</sup> Thus, even constrained firms can offset the impact of cash-flow shocks on fixed investment by adjusting their working capital. For instance, Fazzari and Petersen (1993) find a negative coefficient on working capital in a reduced-form investment model, emphasizing this potential substitution effect.

## 2.3 Research hypotheses

Under the working capital channel, the increase in working capital needs may compete with fixed investment whenever financial constraints are binding (Fazzari and Petersen 1993). Following the pecking order theory (Myers and Majluf 1984; Vanacker and Manigart 2010; Serrasqueiro and Caetano 2015), I assume that short-term financial constraints prevent SMEs to seize investment opportunities by forcing them to allocate additional cash-flow to finance their working capital (see Fig. 2 for the explanatory diagram). Although working capital can be used to buffer fixed capital investment from temporary changes in the availability of finance, I presume that firms cannot monetize their liquid assets so easily, thus both adjusting their working capital and fixed investment.

(H1) Short-term credit constraints negatively affect corporate investment.

An increase in working capital needs is likely to increase the outstanding amount of working capital that cannot be monetized in the presence of short-term financial constraints. This is especially the case for new accounts receivable that have, by definition, longer residual payment periods. In the context of short-term financial constraints, the additional funds allocated to new inventories or accounts receivable are not financed by short-term liabilities but rather long-term capital, which should be used for long-term

<sup>5</sup>In addition, the potential importance of these working capital effects has also been stressed in studies of monetary policy shocks, as interest rates changes affect supply conditions (marginal costs) through nominal rigidities in the presence of sticky wages (Christiano et al. 2005).

<sup>6</sup>As marginal adjustment costs of acquiring and installing capital rise as the rate of investment increases, firms are willing to maintain a stable fixed investment path (Lucas 1967).

investments. On the contrary, this amplifying effect should not be relevant for long-term financial constraints. Therefore, as cash credit constraints are likely to affect entrepreneurs' investment decisions through the working capital channel, the higher the increase in working capital needs, the lower their investment.

(H2) The detrimental effect of short-term credit constraints on corporate investment is stronger for firms with higher increase in working capital needs.

Changes in working capital are positively correlated with profits, output and the business cycle (Fazzari and Petersen 1993; Gertler and Gilchrist 1994). Indeed, while during growth periods, higher accounts receivable can easily be perceived as a sign of dynamic sales, some authors also found a positive correlation between sales and inventory investment (Haltiwanger and Maccini 1988; Blinder and Maccini 1991). Hence, the fact that changes in working capital is significantly and negatively related to fixed investment for cash credit constrained firms should be an indicator of capital market imperfections in the short run.

(H3) The negative relationship between fixed and working capital needs is only associated with short-term credit frictions.

Facing difficulties to finance working capital needs implies serious liquidity risks for entrepreneurs. Yet, cash credit constraints may have heterogeneous effects on investment according to the existing level of liquid assets. For instance, significant beginning-of-year cash holdings are likely to soften the working capital channel. In this regard, numerous studies highlight the negative relationship between cash and working capital needs (Opler et al. 1999; Harford et al. 2008; Bates et al. 2009). The higher cash holdings, the lower liquidity risks arising from the increase in working capital is likely to be. Finally, an active management of working capital may help entrepreneurs to alleviate the effects of financing constraints on fixed investment (Fazzari and Petersen 1993; Carpenter et al. 1994; Ding et al. 2013). Indeed, SMEs' ability to smooth investment in fixed assets is likely to be higher for those exhibiting a higher beginning-of-year outstanding amount of gross working capital. In this perspective, past accounts receivable and inventories are considered as almost substitutes for cash.

(H4) Highly liquid firms (i.e. with numerous current assets) are more able to offset the impact of short-term financial constraints on fixed investment.

To convincingly address these issues, I use a dynamic panel analysis to assess the effect of credit constraints on corporate investment according to loan maturity. In the following section, I first describe the various sources of data I merged and the variables involved.

### 3 Data and summary statistics

Combining two different supervisory databases available at the Banque de France, this study relies on a unique dataset of independent SMEs covering the period 2012–2016. The loan application outcomes stem from the survey on the access to finance of SMEs gathered by the Banque de France, while the firm-level data comes from the Banque de France database on non-financial firms.

#### 3.1 Measures of financial constraints

The core firm-level data comes from the quarterly French Survey on the access to Finance of SMEs. Following the ECB's "Survey on the Access to Finance of Enterprises" (SAFE), the French survey started in Q1 2012 after the financial crisis initially hit the Euro area and aims at providing information on the financing needs of SMEs and their experience in attempting to access finance. Unlike the SAFE survey which contains information on a respondent firm's characteristics (size, sector, firm autonomy, turnover, firm age and ownership), the survey focuses on the assessment of recent short-term developments regarding its financing including information on its access to finance. Most importantly, the questionnaire is the first to focus on loan maturity distinguishing short-term loan applications from long-term ones. The survey contains only non-financial firms and excludes firms in agriculture, public administration and financial services.<sup>7</sup>

In the first question of the questionnaire firms are asked whether they belong to a holding company or

<sup>7</sup>One should keep in mind that the manufacturing sector is over-represented in the sample (50%) so that the survey cannot be interpreted as a representative estimate of the opinion French firms have on their credit conditions.

**Table 1** Yearly credit constrained firms over 2012–2016

Year	2012	2013	2014	2015	2016	All sample
Short-term credit constrained	18%	16.92%	13.18%	12.26%	8.06%	13.30%
Long-term credit constrained	6.08%	6.20%	5.49%	4.16%	3.15%	4.84%

The table reports the percentage of yearly short-term (resp. long-term) credit constrained firms over 2012–2016, out of firms that exhibit a yearly positive demand for cash loans (resp. investment loans). Credit constrained refers to firms that declare themselves as credit constrained as explained in Section 3

not. If so, non-independent SMEs are ruled out from the sample, thereby avoiding the difficulty relating to financial flows between holdings and SME subsidiaries of a corporate group (Kremp and Sevestre 2000). This selection process retains 92,488 quarterly observations representing 7778 independent SMEs. Thereafter, firms are asked whether they have had a positive demand for cash (resp. investment) credit over the previous quarter. Out of these observations, only 6.46% (resp. 19.85%) exhibit a quarterly positive demand for cash (resp. investment) credit, representing 5981 (resp. 18,364) observations and 2509 (resp. 4582) independent SMEs. Besides, the survey enables to follow firms over time. Thus, over the sample period of 20 quarters, SMEs exhibit a positive demand for cash (resp. investment) credit during, on average, 2.5 (resp 4) quarters.

Summarizing quarterly responses to obtain annual information, I consider that a firm exhibits a yearly positive demand for cash or investment credit whether it has applied for those loans during at least one of the four quarters of the year. In the end, I rule out from the analysis firms that were simultaneously both cash and investment credit constrained in order to clearly distinguish these two different accesses to finance. This process leaves me with 2442 (resp. 4500) independent SMEs that exhibit a yearly positive demand for cash (resp. investment) credit, representing 4014 (resp. 10,335) observations.

According to the standard definition of financial constraints, I'm able to define a firm as "yearly constrained" when it does not obtain the loans it has applied for during the year. More precisely, a firm is considered as cash (resp. investment) credit constrained during the year  $t$  in three different cases: (a) the quarterly firm's application for a liquidity (resp. investment) loan was denied at least once per

year (loan application denied); (b) the firm received less than 75% of the quarterly loan amount it requested at least once per year (rationed); (c) the firm refused the quarterly loan offer because the rate was too high at least once per year (refused due to high cost). Alternatively, the firm is considered as not cash or investment credit constrained whether its quarterly loan applications were totally approved or at least if the firm obtain more than 75% of the loans amounts it requested over the year. Despite its yearly basis, the classification is in line with how studies using the semi-annual SAFE survey define the loan supply (Ferrando and Mulier 2015). More generally, this approach is common to the literature that uses survey data to study credit access (Popov and Udell 2012; Jiménez et al. 2012).

Overall, short-term credit constraints turn out to be more salient in France. Table 1 reports the qualitative yearly indicators of credit constraints for the two different loan maturity. Out of the 3655 (9801) cash (resp. investment) loan applications (i.e. firms that exhibit a yearly positive demand for cash or investment loan, respectively), 13.30% (resp. 4.84%) are on average "yearly constrained" over the sample period 2012–2016. In this regard, one should note that those constraints have constantly decreased since the beginning of the survey. Note that Table 15 in the Appendix explains in detail the number of initial firms and observations that are available and then how many are lost during each step.

### 3.2 Comparisons with standard proxies for financial constraints

One should wonder what is the relationship between these direct measures of credit constraints and traditional criteria of financial constraints. To investigate

**Table 2** Relationship between qualitative indicators of financial constraints and traditional measures

	Whited–Wu index	Kaplan–Zingales index	Hadlock–Pierce index	Banque de France speculative grade
Short-term credit constrained	0.013** (0.005)	0.001** (0.001)	0.055 (0.053)	1.668*** (0.104)
Long-term credit constrained	0.001 (0.001)	0.001 (0.001)	0.106** (0.054)	1.702*** (0.936)

The table reports the estimation of a logit model in which traditional indicators of financial constraints are used to explain indicators of Short-term or long-term credit constraints. Credit constrained firms refer to firms that declare themselves as cash or investment credit constrained as explained in Section 3. \*\*\* indicates significance at the 1% level, \*\* at the 5% level, and \* at the 10% level

$$\begin{aligned}
 WW &= -0.091 * \frac{CF}{TA} - 0.044 * \ln(TA) + 0.021 * \frac{longtermdebt}{TA} - 0.035 * salesgrowth + 0.102 * industrysalesgrowth - 0.062 * \frac{Dividends}{TA} \\
 KZ &= -1.001909 * \frac{CF}{TA} + 3.139193 * \frac{longtermdebt}{TA} - 1.314759 * cashratio + 0.2826389 * MarginalQ - 39.36780 * \frac{Dividends}{TA} \\
 HP &= -0.737 * \log(TA) + 0.043 * (\log(TA))^2 - 0.04 * age
 \end{aligned}$$

this issue, I estimate a logit model in which usual indicators of financial constraints are used to explain my indicators of short-term or long-term credit constraints: the Whited–Wu (WW) index, the Kaplan–Zingales (KZ) index<sup>8</sup> and the Hadlock–Pierce (HP) index (note that all three indices are supposed to be increasing with financial constraints). Finally, I also include the Banque de France speculative grade.<sup>9</sup> Coefficients of Table 2 indicate that the correlation is low (with WW and KZ for cash credit constraints and HP for investment credit constraints) or even not significant (with HP for cash credit constraints and WW and KZ for investment credit constraints). These results are not surprising given that the

existing indices were built using data on quoted US firms while my direct indicators are based on unquoted European SMEs. Besides, this low correlation is consistent with a recent research which suggests that the existing indices do not properly capture financial constraints (Farre-Mensa and Ljungqvist 2016). However, regarding the Banque de France rating, the speculative grade turns out to be strongly and positively correlated with my qualitative indicators of financial constraints.

### 3.3 What are financially constrained SMEs like?

To account for the observable firm heterogeneity driving financial constraints, I match the yearly credit constraints indicators with firm's balance sheet information coming from the FIBEN (Fichier Bancaire des Entreprises) database. The latter gathers accounting and financial data from the balance sheet on all companies with a turnover of at least 750,000 since 1990. Based on fiscal documents, firm's information is yearly collected by the Banque de France at the legal entity level (non-consolidated), through a unique national identifier called SIREN. In 2016, this dataset contains individual company accounts for 250,000 firms. These firms represent a third of all companies taxed under the "bénéfice industriel et commercial" or "bénéfice réel normal" regimes (Kremp and Sevestre 2013). The database thus covers a large share of the French economy. Above all, a great advantage of FIBEN is that it enables to focus on non-listed SMEs

<sup>8</sup>Given the lack of market data available for unquoted SMEs, traditional variables such as Tobin's Q or Fundamental Q cannot be computed. Following Honda and Suzuki (2000), D'Espallier and Guariglia (2015) developed an accounting proxy for marginal Q to control for investment opportunities. Their marginal Q is defined as the ratio of profit per unit of capital over the cost of capital.

<sup>9</sup>This credit ratings belongs to the in-house credit assessment systems (ICAS) validated by the Eurosystem, which means that the Eurosystem can rely on it when assessing the credit quality of eligible credit claims within its collateral framework. The information gathered and analyzed by the Banque de France is used to conduct a comprehensive assessment of a company's credit risk. The data are based on hard information such as balance sheet data, payment incidents data etc., as well as soft information gathered from interviews with company managers. Low, speculative-grade, BdF ratings rank from 9 to 5+.



that are often neglected by American studies based on the Compustat database.

To perform the analysis, I first rely on a traditional set of measures that potentially affect the bank loan supply, comprising the cash flow ratio (i.e. the ratio of cash flow over total assets of the firm), the cash ratio (i.e. the ratio of cash holdings over total assets of the firm), the capital ratio (i.e. the ratio of own funds over total assets of the firm) and variables that typically proxy the presence of asymmetric information such as firm size and age. To minimize the impact of gross outliers, I winsorize variables at the top and bottom first percentile. All the definitions of the variables I use in this paper are summarized in Table 3.

Considering that a large number of firms in my sample are not asking for a short-term or a long-term loan, one may be interested in knowing what are the main differences between firms that apply for a loan and those that do not. According to loan maturity, Table 4 presents those descriptive statistics and tests the equality of the median of both groups. In particular, some of the differences between these two groups are compatible with the idea that credit demand depends on financial soundness: applicant firms turn out to be less solvent and less liquid regardless of the type of loan. Besides, short-term credit applicants are also less profitable than non-applicant ones. These different sources of funding are likely to be negatively

**Table 3** Variable definitions

Variable	Definition
Capital ratio	The ratio of own funds over total assets of the firm.
Cash ratio	The ratio of cash holdings over total assets of the firm.
Cash flow ratio	The ratio of cash flow over total assets of the firm.
Age	The number of years since funding.
Ln(total assets)	The log of the total assets of the firm.
$\Delta S_{it}$	The annual percentage increase in sales: $S_{it}/S_{it-1}-1$ .
$I_{it}/A_{it-1}$ (tangible)	The annual increase in gross tangible fixed assets (i.e. property, plants and equipment) scaled by beginning-of-year total assets.
$I_{it}/A_{it-1}$ (all fixed assets)	The annual increase in both gross tangible (i.e. property, plants and equipment) and intangible (i.e. patents, copyrights, trademarks and franchises) fixed assets scaled by beginning-of-year total assets.
Investment rate	The ratio of all fixed assets investment over the value added of the firm.
Trade credit ratio	The ratio of accounts payable over total assets of the firm.
Working capital needs	The sum of accounts receivable and inventories minus accounts payable and other non-financial debt due in less than one year.
Working capital ratio	The ratio of working capital needs over total assets of the firm.
Gross working capital ratio	The sum of accounts receivable and inventories over total assets of the firm.
$\Delta W/A_{it-1}$	The annual increase in working capital needs scaled by beginning-of-year total assets.
ICCC	The Index of Cash Credit Constraint. The ICCC defines firms that can be considered as cash credit constrained using information derived from their financial situation and their access to finance. See Section 5 for more details.
IICC	The Index of Investment Credit Constraint. The ICCC defines firms that can be considered as investment credit constrained using information derived from their financial situation and their access to finance. See Section 5 for more details.
Uncertainty	The dispersion of firms' ROA (net income over total assets of the firm) within a given year and sector.

**Table 4** Firm characteristics by applicant group: median test

	Short-term credit			Long-term credit		
	Applicant <sub><i>t</i></sub>	Non-applicant <sub><i>t</i></sub>	Median test	Applicant <sub><i>t</i></sub>	Non-applicant <sub><i>t</i></sub>	Median test
Cash flow ratio <sub><i>t-1</i></sub>	4.86%	6.23%	0.00***	6.53%	5.58%	0.00***
Capital ratio <sub><i>t-1</i></sub>	23.07%	28.68%	0.00***	27.01%	28.26%	0.00***
Cash ratio <sub><i>t-1</i></sub>	3.36%	9.30%	0.00***	7.33%	8.55%	0.00***
Ln(total assets) <sub><i>t-1</i></sub>	9.07	8.58	0.00***	7.94	8.45	0.00***
Age <sub><i>t</i></sub>	28	28	0.48	29	29	0.00
Observations	3655	19,764		9801	13,596	
Firms	2225	6718		4220	5884	

The table reports the median values of the variables split by applicant-group and the p-value associated with the test of the equality of the median between applicant observations and non-applicant observations. All the definitions of the variables are summarized in Table 3. \*\*\* indicates significance at the 1% level, \*\* at the 5% level, and \* at the 10% level

correlated with the need for bank credit.<sup>10</sup> However, some other differences point to the opposite conclusions. For instance, long-term credit applicants are more profitable than non-applicant ones. One interpretation could be that a higher cash flow also captures better investment opportunities which in turn encourages firms to take out a loan. In addition, larger firms are more willing to ask for a cash credit while it is the opposite for investment credit.

Regarding financial constraint status, Table 5 finally reports the same descriptive statistics. This time the figures are clear and unambiguous. Overall, firms with financial constraints tend to be less profitable, less liquid, more leveraged, younger and smaller than firms without financing constraints, which is in line with the empirical literature (Becchetti et al. 2010; Ferrando and Mulier 2015).

### 3.4 How do financial constraints relate to corporate investment?

An investment is commonly perceived as the purchase of goods that are not consumed today but are used in the future to create wealth. Following the empirical literature on corporate investment (Fazzari et al. 1988; Kaplan and Zingales 1997; Kahle and Stulz 2013; Asker et al. 2014), I measure gross investment as the

annual increase in gross fixed assets (i.e. gross property, plant and equipment) scaled by beginning-of-year total assets.<sup>11</sup> In addition, I also construct another measure of investment using both tangible and intangible assets such as patents, copyrights, trademarks and franchises.

To illustrate how financial constraints described previously are related to corporate investment, Table 6 performs median tests to compare corporate investment according to short-term and long-term credit constraints. Thereby, short-term credit constrained firms exhibit a corporate investment (both in tangible and intangible assets) which is one percentage point lower than their unconstrained counterparts. As for investment credit, this assessment is similar and approximates – 80 basis points. Financial constrained firms are therefore associated with lower investment spending. Yet, to truly investigate this issue, one have to verify whether these differences still hold when dealing with constrained and unconstrained firms, everything else being equal.

## 4 A dynamic panel analysis

Given the very specific nature of SMEs and the working capital channel introduced above, short-term credit constraints are expected to have substantial real effects. To gauge those effects, I take advantage of

<sup>10</sup>In this regard, note that in 2015 the Banque de France included questions about the reasons why firms do not ask for bank credit in order to gauge the level of “discouraged borrowers”: only 2% of French SMEs are associated with such a phenomenon.

<sup>11</sup>To the extent that depreciation is likely to be somewhat arbitrary, I assume that gross investment better captures a firm’s investment decision.

**Table 5** Firm characteristics by constraint-group: median test

	Short-term credit			Long-term credit		
	Constrained <sub><i>t</i></sub>	Unconstrained <sub><i>t</i></sub>	Median test	Constrained <sub><i>t</i></sub>	Unconstrained <sub><i>t</i></sub>	Median test
Cash flow ratio <sub><i>t-1</i></sub>	2.02%	5.18%	0.00***	4.59%	6.86%	0.00***
Capital ratio <sub><i>t-1</i></sub>	16.08%	23.96%	0.00***	21.23%	27.35%	0.00***
Cash ratio <sub><i>t-1</i></sub>	2.13%	3.69%	0.00***	3.49%	7.57%	0.03***
Ln(total assets) <sub><i>t-1</i></sub>	8.62	9.13	0.00***	8.94	8.95	0.60
Age <sub><i>t</i></sub>	26	28	0.04**	27	29	0.02**
Observations	486	3169		474	9327	
Firms	392	1997		399	4097	

The table reports the median values of the variables split by constraint-group and the p-value associated with the test of the equality of the median between the constrained observations and the unconstrained observations. *constrained* firms refer to firms that declare themselves as cash or investment credit constrained as explained in Section 3. All the definitions of the variables are summarized in Table 3. \*\*\* indicates significance at the 1% level, \*\* at the 5% level, and \* at the 10% level

a dynamic panel analysis which both controls for firms unobserved heterogeneity and dynamic investment choices. Importantly, I ruled out from the analysis firms that were simultaneously credit constrained regarding both cash and investment credit in order to identify separately the causal effect of each credit constraints.

To assess the effects of the working capital channel on the dynamic of capital accumulation, I use a two-step methodology. The first step is to exploit the information derived from the Banque de France survey used previously, and to link it with firms' financial characteristics. This is the ICC (Indicator of Credit Constraints) indicator. From there, the second step consists in incorporating the indicator of cash or

investment credit constraints into a dynamic model of investment.

#### 4.1 Credit constrained firms: the ICC indicator controlling for selection bias

Following Ferrando et al. (2015), the Indicator of Credit Constraints (ICC) defines firms that can be considered as credit constrained using information derived from their financial situation. The analysis is based on a dataset which matches independent firms that participated in the Banque de France survey on access to finance with their FIBEN financial statements from Q1 2012 to Q4 2016. The construction of the index is based on several steps. The first step is the estimation of the equation which will be used in

**Table 6** Corporate investment by constraint-group: median test

	Short-term credit			Long-term credit		
	Constrained <sub><i>t</i></sub>	Unconstrained <sub><i>t</i></sub>	Median test	Constrained <sub><i>t</i></sub>	Unconstrained <sub><i>t</i></sub>	Median test
$I_{it} / A_{it-1}$ (tangible)	0.75%	1.72%	0.00***	1.47%	2.30%	0.00***
$I_{it} / A_{it-1}$ (all fixed assets)	0.94%	1.96%	0.00***	1.71%	2.59%	0.00***
Observations	486	3169		474	9327	
Firms	392	1997		399	4097	

The table reports the median values of corporate investment (i.e. the annual change in gross fixed assets, either tangible or intangible, scaled by the beginning-of-year total assets) split by constraint-group and the p-value associated with the test of the equality of the median between the constrained observations and the unconstrained observations. *constrained* firms refer to firms that declare themselves as cash or investment credit constrained as explained in Section 3. All the definitions of the variables are summarized in Table 3. \*\*\* indicates significance at the 1% level, \*\* at the 5% level, and \* at the 10% level

order to rank the firms according to their probability of being cash or investment credit constrained. Then, a threshold is obtained using the exogenous averages of credit constrained firms by year, taken from the Survey.

I estimate the probability of firms to be financially constrained as a function of their financial situation. In particular, based on the descriptive analysis presented in the previous section, I consider solvency, liquidity, and profitability, and I control for other possible determinants like year and sector specific effects as well as the size and the age of the firm. These variables are traditionally used in the literature on determinants of financial constraints (Jiménez et al. 2012; Ferrando et al. 2015). However, this strategy would fail to account for the changing composition of firms that demand bank credit, or in other words, for the fact that the sample of firms that apply for credit is not a random sub-sample of the population of firms (Popov and Udell 2012). To tackle this sample selection issue, I control for information on non-applicant firms in a standard 2-step Heckman procedure. The idea is that credit constraints are only observable when a firm needs bank credit. Let the dummy variable  $D$  equal 1 if the firm applies for credit, and 0 otherwise. The value of  $D$  is in turn determined by the latent variable:

$$d_{it} = \rho Z_{it} + e_{it} \tag{1}$$

where  $Z_{it}$  contains variables pertinent to firm  $i$  in year  $t$  that may affect the firm fixed costs and convenience associated with using bank credit. The variable  $D = 1$  if  $d > 0$  and  $Q = 0$  otherwise. The error  $e_{it}$  is normally distributed with mean 0 and variance  $\sigma^2$ . The second stage regression can now be updated by adding the term  $\sigma \frac{\phi(d)}{\Phi(d)}$  to the RHS, where  $\frac{\phi(d)}{\Phi(d)}$  is the inverse of Mills ratio (Heckman 1979) derived from the first step. Identification rest on the exclusion restriction which requires that  $d$  has been estimated on a set of variables that is larger by at least one variable than the set of variables in the second stage. Thereby, in the second stage in which I determine the effect of firm variables on the firm likelihood to be credit constrained, I estimate the following Heckman probit model:

$$Constrained_{it} = \beta_1 X_{it} + \beta_2 \sigma \frac{\phi(d)}{\Phi(d)} + \nu_j + \nu_t + e_{it} \tag{2}$$

where  $Constrained_{it}$  is a dummy variable equal to 1 if firm  $i$  is constrained by bank  $b$  in year  $t$  (according to the criteria outlined in Section 3);  $X_{it}$  is a matrix of firm characteristics accounting for credit-worthiness;  $\sigma \frac{\phi(q)}{\Phi(q)}$  is the selection term for the first stage regression and  $e_{it}$  is an idiosyncratic error term. I finally introduce sector fixed effects  $\nu_j$  to control for time-unvarying heterogeneity among sectors and add year fixed effects  $\nu_t$  to capture firms macroeconomic environment.

Tables 7 and 8 report the results of the two-stage estimation for cash and investment credit constraints, respectively. Regarding the first stage regression, columns (1) of both tables indicate that higher financial strength indicators reduce the firm probabil-

**Table 7** Index of Cash Credit Constraints: Heckman probit results

Dependent variable	The firm has a positive cash credit demand, (1)	The firm is short-term credit constrained, (2)
Capital ratio <sub><i>t-1</i></sub>	- 0.371*** (0.076)	- 1.345*** (0.208)
Cash ratio <sub><i>t-1</i></sub>	- 2.694*** (0.128)	- 2.622*** (0.454)
Ln(total assets) <sub><i>t-1</i></sub> (log)	0.030*** (0.007)	- 0.116*** (0.023)
Cash flow ratio <sub><i>t-1</i></sub>	- 0.407*** (0.185)	- 3.774*** (0.520)
Age <sub><i>t-1</i></sub>	- 0.042*** (0.016)	- 0.122*** (0.040)
Trade credit ratio <sub><i>t-1</i></sub>	0.250*** (0.087)	
Sector fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	23,419	3655
Number of firms	7028	2225

This table presents a probit estimation of the firm likelihood to be cash credit constrained using an Heckman two-step methodology to account for selection bias related to non-random positive credit demand. Column (1) and column (2) correspond to the first and the second stages, respectively. All regressions were estimated with a constant and include sector and year fixed-effects. See Section 5 for more details. All the definitions of the variables are summarized in Table 3. \*, \*\* and \*\*\* indicate significance levels at 10%, 5% and 1% respectively

**Table 8** Index of Investment Credit Constraints: Heckman probit results

Dependent variable	The firm has a positive investment credit demand <sub>t</sub> (1)	The firm is long-term credit constrained <sub>t</sub> (2)
Capital ratio <sub>t-1</sub>	0.030 (0.058)	- 1.108*** (0.179)
Cash ratio <sub>t-1</sub>	- 0.964*** (0.074)	- 1.068*** (0.259)
Ln(total assets) <sub>t-1</sub> (log)	0.035*** (0.006)	- 0.001 (0.015)
Cash flow ratio <sub>t-1</sub>	3.263*** (0.144)	- 1.209*** (0.443)
Age <sub>t-1</sub>	0.070*** (0.014)	- 0.091*** (0.033)
Investment rate <sub>t-1</sub>	0.195*** (0.049)	
Sector fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	23,419	9801
Number of firms	7028	4220

This table presents a probit estimation of the firm likelihood to be investment credit constrained using an Heckman two-step methodology to account for selection bias related to non-random positive credit demand. Column (1) and column (2) correspond to the first and the second stages, respectively. All regressions were estimated with a constant and include sector and year fixed-effects. See Section 5 for more details. All the definitions of the variables are summarized in Table 3. \*, \*\* and \*\*\* indicate significance levels at 10%, 5% and 1% respectively

ity to ask for a loan, while the larger the firm, the lower the demand for credit. In terms of the exclusion restriction, the variables trade credit ratio (i.e. the sum of trade credit over total assets of the firm) and investment rate (i.e. the annual increase in gross fixed assets over the value added of the firm) are included in cash and investment credit demand models, respectively, but excluded from the rest of the exercises. The rationale for using these particular variables as instruments for demand is the following. Firms with higher trade credit are likely to have a higher need for cash credit to finance working capital (Gobbi and Sette 2013), but it is unlikely that credit decisions will be correlated with the level of trade credit without comparing it to current assets in order to assess the

firm ability to repay its short-term liability.<sup>12</sup> Analogously, having a high investment rate is likely a signal for external financial needs (Gobbi and Sette 2013). These considerations make both variables good firm demand shifters. The latter are very positively correlated with the demand for bank credit, and their effects are statistically significant at the 1% level.

Turning to the determinants of cash and investment credit constraints, columns (2) of Tables 7 and 8 show that solvency, cash flow, cash holdings and firm age are strongly significant and with the expected signs, indicating that they indeed play a role into the decision of a bank to grant cash/investment credit or not. Besides, the size of the firm is also statistically significant and negative, but only for cash credit. The coefficients of the estimated probit can be used to compute the predicted index of cash credit constraints (henceforth ICC) and index of investment credit constraints (henceforth IICC). These scores are defined at the firm level, which vary across time. Importantly, these two scores cannot be directly interpreted but can be used in order to rank firms, from the less to the more financially constrained. Based on the estimated coefficients of the Heckman probit analysis, the ICC scores are defined as:

$$ICCC_{score} = -1.345 \cdot Capitalratio - 2.622 \cdot Cash \quad (3)$$

$$ratio - 3.774 \cdot Cashflowratio - 0.116 \cdot Ln(totalassets) - 0.122 \cdot Age$$

$$IICC_{score} = -1.108 \cdot Capitalratio - 1.068 \cdot Cash \quad (4)$$

$$ratio - 1.209 \cdot Cashflowratio - 0.091 \cdot Age$$

The key step is to select those firms which can be considered as cash or investment credit constrained. The underlying idea is to calibrate a threshold over the ICC and IICC scores distributions using the information from the survey data. Looking at the distribution of the ICC and IICC scores, I then select the top x% of the distribution of the ICC and IICC scores by year, where x is the yearly average number of constrained firms over 2012–2016, directly extracted

<sup>12</sup>One should note that the effect of trade credit on loan demand is ambiguous as trade credit can be seen as a substitute for bank credit.

from the survey (Table 1). Finally, for each year, short-term (resp. long-term) constrained firms are identified as those with a value of the ICC (resp. IICC) score greater than the empirical threshold. The ICC and IICC indicators will be equal to 1 for them and 0 otherwise.

Interestingly, the convenience of the procedure based on financial statements is that it can also be used to extrapolate the percentage of financially constrained firms that do not necessarily ask for a loan over the period 2012–2016. Above all, in contrast with the existing time-varying measures of financial constraints that rely on book-to-market, Tobin's Q or dividend payout (Kaplan and Zingales 1997; Whited and Wu 2006), the ICC and IICC can be extrapolated to every unquoted SMEs and circumvents the usual criticism related to the choices of single a priori indicators (Musso and Schiavo 2008).

#### 4.2 The augmented dynamic investment model

Once the indicators of cash and investment credit constraints are obtained, I'm now able to gauge their effects on corporate investment for the whole sample of independent firms taken from the survey. Since lagged values of investment are likely to determine, at least partially, the current level of investment, I consider an augmented dynamic investment model with an added ICC variable where cash flow and sales growth control for investment opportunities.<sup>13</sup> The latter has been widely used to replace Tobin's Q in presence of private firms that are not traded on a stock exchange (Bloom et al. 2007; Michaely and Roberts 2011). At the same time, this choice sidesteps the traditional measurement error problem coming from the use of Q in investment demand equations (Erickson and Whited 2000; Cummins et al. 2006).

To test my different hypotheses regarding the role of liquid assets and working capital needs, I also add a cash ratio, a gross working capital ratio and the increase in working capital needs in alternative versions of the model. Finally, given my panel data analysis, one should note that time-invariant variables that refer to intellectual property, venture funding or

**Table 9** Dynamic panel model: summary statistics

	Mean	Median	Sd	Min	Max
$I_{it}/A_{it-1}$	3.33%	1.71%	4.94%	0%	31.78%
$CF_{it}/A_{it-1}$	7.24%	6.40%	6.76%	-10.09%	30.21%
$\Delta S_{it}$	1.90%	0.94%	15.19%	-37.94%	63.19%
$\Delta W/A_{it-1}$	0.42%	0.34%	7.04%	-22.07%	23.09%
Cash ratio $_{it-1}$	12.86%	7.85%	13.87%	0%	60.50%
Gross working capital ratio $_{it-1}$	43.38%	42.15%	20.64%	0%	89.32%
Observations	22,608	22,608	22,608	22,608	22,608
Number of firms	5652	5652	5652	5652	5652

This table presents the summary statistics of the variables used in the dynamic model of investment.  $I$  denotes the firm's investment;  $A_{it-1}$  its beginning-of-year total assets;  $\Delta S_{it}$ , its sales growth;  $CF_{it}$  its cash flow;  $I$  the annual increase in its working capital, Cash ratio $_{it-1}$  the ratio of cash holdings over its total assets and Gross working capital ratio $_{it-1}$  the sum of accounts receivable and inventories over its total assets. All the definitions of the variables are summarized in Table 3

human capital characteristics of entrepreneurs are captured by my fixed effects.<sup>14</sup> All the definitions of the above variables are summarized in Tables 3 and 9 shows their descriptive statistics. I end up with 5652 independent firms for which I have exhaustive financial information since 2012. My baseline specification can be represented by the following equation:

$$\frac{I_{it}}{A_{it-1}} = \beta_1 \frac{I_{it-1}}{A_{it-2}} + \beta_2 \frac{CF_{it}}{A_{it-1}} + \beta_3 \Delta S_{it} + \beta_4 Uncertainty_{jt} + \beta_5 ICC_{it} + v_i + v_t + e_{it} \quad (5)$$

where  $I$  denotes the firm's investment;  $A_{it-1}$ , its beginning-of-year total assets;  $CF_{it}$ , its cash flow; and  $\Delta S_{it}$ , its sales growth, and  $Uncertainty_{jt}$  is a sector-specific uncertainty measure based on the dispersion of firms'ROA (net income over total assets of the firm) within a given sector  $j$  and a year  $t$  (Bloom et al. 2007);<sup>15</sup> ICC is the Index of Credit Constraints defined previously according to cash or investment credit;  $v_i$  is an individual-specific fixed effect;  $v_t$  is a year-specific fixed effects and  $e_{it}$  is the idiosyncratic error term. The subscript  $i$  and  $j$  index firms and sectors while  $t$  indexes year, where  $t = 2012-2016$ .

<sup>14</sup>Yet, as these types of information are not available in the Banque de France datasets, I'm not able to assess the differential effect of financial constraints according to these characteristics.

<sup>15</sup>Note that the sector classification builds on the Nace Rev. 2 classification of the European Community.

<sup>13</sup>The interpretation of cash flow is controversial in the literature. See the work of Fazzari et al. (1988) and Kaplan and Zingales (1997) for more details.

With such a model both the pooled and fixed effects estimator are likely to suffer from a dynamic panel bias (Nickell 1981). I implement a dynamic panel methodology that relies on the Generalized-Method of Moments (GMM) following Arellano and Bover (1995) and Blundell and Bond (1998) and refined by (Roodman 2009). This GMM estimator is called the system-GMM estimator since it combines, in a system, the regression in differences with the regression in levels.<sup>16</sup> The instruments for the equation in differences are the lagged exogenous variables (the environmental controls) and the lagged values of the potential endogenous variables. The instruments for the equation in levels are the lagged differences of the corresponding variables.<sup>17</sup> In this framework, exogenous time dummies are instrumented by themselves. These are appropriate instruments under the following additional assumption: although there may be correlation between the levels of the right-hand side variables, there is no correlation between the differences of these variables and the firm-specific effect. More specifically, I can rewrite a more general version of Eq. 1 as follows:

$$Y_{it} = \alpha Y_{it-1} + \beta' X_{it} + v_i + v_t + e_{it} \quad (6)$$

where  $Y$  is the investment scaled by beginning-of-year total assets, and  $X$ , my set of explanatory variables (including ICC, sales growth and cash flow but excluding the lagged dependent variable);  $v_i$  denotes a firm-specific component (encompassing the firm unobserved time-invariant heterogeneity);  $v_t$  represents a time-specific component (that I account for by including time dummies in all my specifications); and  $e_{it}$  is an idiosyncratic component.

The GMM panel estimator relies on first-differencing the estimating equation to eliminate the firm-specific fixed effect, and uses appropriate lags of the right-hand side variables as instruments. As can

<sup>16</sup>In dynamic panel data where the observations are highly autoregressive and the number of time series is small, the standard GMM estimator has been found to have large finite sample bias and poor precision in simulation studies. The weak performance of the standard GMM panel data estimator is also frequent in relatively short panels with highly persistent data where lagged endogenous variables are weak instruments. Hence, the system-GMM estimator improves the performances of the standard GMM (Blundell et al. 2001).

<sup>17</sup>Estimation is implemented in Stata using Roodman's `xtabond2` package in which I use two lags of instruments and collapse the instrument matrix, see Roodman (2009).

be seen from the following equation, first-differencing (2) allows us to eliminate the firm-specific effect  $v_i$ :

$$Y_{it} - Y_{it-1} = \alpha(Y_{it-1} - Y_{it-2}) + \beta'(X_{it} - X_{it-1}) \quad (7) \\ + (v_t - v_{t-1}) + (e_{it} - e_{it-1})$$

The use of appropriate instruments is necessary to deal with the likely endogeneity of the explanatory variables, and also to deal with the fact that the new error term  $e_{it} - e_{it-1}$  is correlated with the lagged dependent variable. Consistency of the GMM estimates depends on the validity of the instruments. I test for the validity of my instruments by using two tests suggested by Arellano and Bond (1991): the J-test and the test for second-order serial correlation of the residuals (m2). The former is the Sargan test for over-identifying restrictions, asymptotically distributed as a  $\chi^2$  with degrees of freedom equal to the number of instruments less the number of parameters, under the null of instrument validity. The m2 test is asymptotically distributed as a standard normal under the null of no second-order serial correlation, and provides a further check on the specification of the model and on the legitimacy of variables dated  $t - 2$  as instruments.

#### 4.3 Results

Table 10 shows the results of the dynamic panel data estimation regarding short-term credit constraints. Across all specifications, the values of the J-test and the test for second-order serial correlation of the residuals suggest that the instruments employed are appropriate. Focusing on tangible assets only, the first column presents the estimation of Eq. 5. In the latter, the lagged investment, the cash flow ratio and the turnover growth rate are significant and positive.<sup>18</sup> In this regard, the statistical significance of the lagged investment to total assets ratio emphasizes the importance of accounting for endogeneity when analyzing determinants of corporate investment. In contrast, the sectoral uncertainty is not significant. Incorporating both tangible and intangible assets in column (2), my baseline specification, the same results are found.

Regarding the main focus of the analysis, the index of cash credit constraints (ICCC) turns out to be negative and significant for all specifications, indicating that short-term credit constraints matter for

<sup>18</sup>Consistent with Bond (2002), note that the coefficient on lagged investment is in the range between the OLS and FE estimates (results not reported but available upon request).

**Table 10** Dynamic model of investment: Index of Cash Credit Constraints (ICCC) results

Dependent variable = $I_{it} / A_{it-1}$					
	Tangible (1)	All fixed assets (2)	All fixed assets (3)	All fixed assets (4)	All fixed assets (5)
$I_{it-1} / A_{it-2}$	0.147** (0.019)	0.129*** (0.017)	0.129*** (0.013)	0.132*** (0.017)	0.125*** (0.017)
$CF_{it} / A_{it-1}$	0.032*** (0.012)	0.037*** (0.014)	0.035*** (0.014)	0.038*** (0.012)	0.056*** (0.015)
$\Delta S_{it}$	0.023*** (0.003)	0.030*** (0.002)	0.030*** (0.003)	0.028*** (0.003)	0.030*** (0.003)
Uncertainty <sub>t</sub>	- 0.001 (0.002)	- 0.001 (0.002)	- 0.001 (0.002)	- 0.001 (0.002)	- 0.001 (0.002)
ICCC <sub>it</sub>	- 0.003** (0.001)	- 0.004*** (0.002)	- 0.004*** (0.002)	- 0.007*** (0.001)	- 0.005*** (0.001)
$\Delta W / A_{it-1}$			0.013** (0.006)		
ICCC <sub>it</sub> × $\Delta W / A_{it-1}$			- 0.034** (0.016)		
Cash ratio <sub>it-1</sub>				- 0.021 (0.003)	
ICCC <sub>it</sub> × Cash ratio <sub>it-1</sub>				0.010 (0.031)	
Gross working capital ratio <sub>it-1</sub>				- 0.054*** (0.009)	
ICCC <sub>it</sub> × Gross working capital ratio <sub>it-1</sub>				0.018** (0.009)	
ICCC <sub>it</sub> × $CF_{it} / A_{it-1}$					- 0.028 (0.031)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Number of instruments	14	14	18	22	16
H-test (p-value)	0.13	0.11	0.20	0.31	0.33
AR(2) (p-value)	0.17	0.14	0.15	0.15	0.15
Observations	22,608	22,608	22,608	22,608	22,608
Number of firms	5652	5652	5652	5652	5652

The table shows the output for the system-GMM estimation of specification 5 for cash credit constraints. All the definitions of the variables are summarized in Table 3. The estimates use one lag of instruments and are robust to heteroscedastic standard errors. All specifications were estimated with a constant and with year fixed-effects. AR(2) shows the p-value of the test of serial correlation in the error terms, under the null hypothesis of no serial correlation. Values presented for the Hansen test are p-values of the test of overidentifying restrictions of the instruments, under the null hypothesis of instrument validity. See Section 3 for exact definitions and data sources. \*, \*\* and \*\*\* indicate significance levels at 10%, 5% and 1% respectively

corporate investment (H1): a cash credit constrained firms decreases its investment to total assets ratio by around 40 basis points in column (2). This pattern still suggests that the working capital channel

is playing a essential role. Thus, switching to relative change, as the average investment (all fixed assets) to total assets ratio equals 3.3%, the estimated semi-elasticities amounts to decrease of 12%.



Looking at the mechanism at play, column (3) introduces the annual increase in working capital scaled by the beginning-of-year total assets of the firm. Interacting this variable with the ICCC, the specification reveals that the higher the working capital needs, the more cash credit constraints are detrimental to firm investment (H2). Hence, when a cash credit constraint is binding, working capital needs competes with investments in fixed assets. What is more, the annual increase in working capital has a positive and significant coefficient which is higher than the one related to the interaction term, thus showing that the negative relationship between working capital and fixed investment only holds for short-term financial frictions (H3).

Do liquid firms are able to make up for a lack of short-term finance? To address this issue, column (4) incorporates the cash and the gross working capital ratios as measures of firms' liquidity. While the interaction coefficient between the cash ratio and the ICCC appears not significant, the interaction between the ICCC and the gross working capital turns out to be positive and significant, showing that the deleterious effect of cash credit constraints is lower for liquid firms (H4). This result is consistent with previous work that finds smoothing benefits of current assets (Fazzari and Petersen 1993; Almeida et al. 2004; Duchin et al. 2010)<sup>19</sup>. Finally, in column (6), I interact the ICCC with the cash flow ratio to see whether the investment cash flow sensitivity hypothesis (Fazzari et al. 1988) is verified for cash credit. I find no significant effects.

Let's now focus on investment credit constraints. Table 11 exploits the same specifications than Table 10. Overall, instruments can be considered as valid and results are very similar: the lagged investment, the cash flow ratio and the turnover growth rate are significant and positive and very close to my previous findings in the benchmark specification (i.e. column (2)). Furthermore, long-term credit constraints also negatively affect capital accumulation insofar as the index of investment credit constraints (IICC) appears negative and significant for all specifications. Interestingly, the detrimental effect of long-term credit constraints is slightly higher than cash credit ones: an investment credit constrained

firms decreases its investment to total assets ratio by around 50 basis points in column (2) and the estimated semi-elasticities equals 15%.

However, a first major difference stands out in column (3): the coefficient on the interaction between the IICC and the annual increase in working capital is no more significant, thus strongly supporting the working capital channel hypothesis. Besides, the annual increase in working capital alone is still positive and significant which shows, once again, that working capital needs is still a proxy for investment opportunities in the absence of financial constraints. The second salient result comes with column (4) in which the interaction term is no more significant. Hence, the edging role of current assets turns out to be only associated with short-term credit constraints. As for column (5), as is the case for cash credit, I find no differential effects of cash flow on capital accumulation according to long-term credit constraints.

#### 4.4 Robustness analysis

##### 4.4.1 A non-parametric matching approach

To challenge my main result regarding the negative effect of short-term credit constraints (H1), I introduce matching estimator techniques. The idea behind this family of estimators consists of isolating treated observations (i.e. firms facing financial constraints) and then, from the population of non-treated observations, look for control observations that best "match" the treated ones regarding a set of covariates. In this estimation framework, the number of counterfactuals are restricted to the matched controls. To put it differently, I conjecture that the treated group would have behaved as the control group actually did if the treated group had not been treated.

To this end, my identification needs two conditions to be met: overlapping and unconfoundedness. The former require enough counterfactual firms that correspond to the treated ones. The second condition is that assignment to treatment needs to be exogenous to observed post-treatment outcomes (i.e. the so-called conditional independence assumption). Following the matching approach of Abadie and Imbens (2006), as implemented by Abadie et al. (2004), I make use of a matching estimator that minimizes a measure of distance (the Mahalanobis distance) between all the con-

<sup>19</sup>Note that I also use all current assets as an alternative measure of liquidity and find similar results.

**Table 11** Dynamic model of investment: Index of Investment Credit Constraints (IICC) results

Dependent variable = $I_{it} / A_{it-1}$					
	Tangible (1)	All fixed assets (2)	All fixed assets (3)	All fixed assets (4)	All fixed assets (5)
$I_{it-1} / A_{it-2}$	0.147*** (0.019)	0.129*** (0.017)	0.129*** (0.017)	0.132*** (0.017)	0.123*** (0.017)
$CF_{it} / A_{it-1}$	0.034*** (0.014)	0.042*** (0.013)	0.040*** (0.013)	0.041*** (0.013)	0.055*** (0.014)
$\Delta S_{it}$	0.023*** (0.003)	0.030*** (0.002)	0.030*** (0.003)	0.029*** (0.003)	0.030*** (0.003)
Uncertainty <sub><i>t</i></sub>	- 0.001 (0.002)	- 0.001 (0.002)	- 0.001 (0.002)	- 0.001 (0.002)	- 0.001 (0.002)
IICC <sub><i>it</i></sub>	- 0.004** (0.001)	- 0.005** (0.001)	- 0.005** (0.001)	- 0.011* (0.006)	- 0.005*** (0.001)
$\Delta W / A_{it-1}$			0.016** (0.006)		
IICC <sub><i>it</i></sub> × $\Delta W / A_{it-1}$			- 0.018 (0.019)		
Cash ratio <sub><i>it-1</i></sub>				- 0.009 (0.016)	
IICC <sub><i>it</i></sub> × Cash ratio <sub><i>it-1</i></sub>				- 0.006 (0.064)	
Gross working capital ratio <sub><i>it-1</i></sub>				- 0.045*** (0.013)	
IICC <sub><i>it</i></sub> × Gross working capital ratio <sub><i>it-1</i></sub>				0.007 (0.012)	
IICC <sub><i>it</i></sub> × $CF_{it} / A_{it-1}$					- 0.010 (0.022)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Number of instruments	14	14	18	22	16
H-test (p-value)	0.12	0.12	0.23	0.11	0.33
AR(2) (p-value)	0.21	0.14	0.14	0.15	0.18
Observations	22,608	22,608	22,608	22,608	22,608
Number of firms	5652	5652	5652	5652	5652

The table shows the output for the system-GMM estimation of specification 5 for investment credit constraints. All the definitions of the variables are summarized in Table 3. The estimates use one lag of instruments and are robust to heteroscedastic standard errors. All specifications were estimated with a constant and with year fixed-effects. AR(2) shows the p-value of the test of serial correlation in the error terms, under the null hypothesis of no serial correlation. Values presented for the Hansen test are p-values of the test of overidentifying restrictions of the instruments, under the null hypothesis of instrument validity. See Section 3 for exact definitions and data sources. \*, \*\* and \*\*\* indicate significance levels at 10%, 5% and 1% respectively

trol variables for firms in the treated group and their matches. The estimator allows control firms to serve as matches more than once, which compared with

matching without replacement lowers the estimation bias (but can increase the variance). In my estimations, I select one matched control for each treated firm. The

Abadie-Imbens estimator yields exact matches on categorical variables, while the matches on continuous variables are not exact but close.<sup>20</sup>

To ensure that covariates that might both influence the selection into treatment and observed outcomes are correctly accounted for in the estimation, I select determinants of corporate investment that could make a reasonable case for simultaneity in the treatment-outcome relation. Hence I match firms on two categorical variables (sector and year) and five continuous variables: cash-flow, investment opportunities, cash holdings, solvency and size as in Asker et al. (2014). Generally speaking, instead of comparing the average difference in policy outcomes across all of the constrained and all of the unconstrained firms, I now compare the differences in investment increase of firms that are similar (i.e. matched).<sup>21</sup>

Table 16 in the Appendix reports the median values of the variables used in my matching procedure across various data groups. I use the continuity-corrected Pearson statistic to test for differences in the medians of the variables of interest across the groups. As already outlined in Section 3.3, credit constrained firms turn out to have lower median profitability, cash holdings and investment opportunities (i.e. sale growth). Credit constrained firms are also smaller (except for the investment credit sample) and have a lower median capital ratio. Thereafter, panel B compares median values for treated and matched control firms. The Abadie-Imbens estimator identifies a match for each credit constrained firm as long as it is possible.<sup>22</sup> Importantly, there are no statistical differences in the median values of the covariates I consider across credit constrained firms and control firms.

Table 16 also compares the entire distributions rather than just the medians of the various matching covariates across the treated, non-treated and controls. Panel A shows that treated firms differ significantly

from non-treated firms. In particular, a Kolmogorov-Smirnov test of distributional differences rejects the null hypothesis that distributions are identical at the 1% threshold for all of the matching covariates. Once again, these differences disappear when I compare the treated firms to the group of closely matched control firms. In particular, panel B of Table 16 shows that there are no statistical differences in the distributions of the various matching covariates across the treated and control firms. These statistics support the assertion that the matching estimator moves my experiment closer to a test in which treatment and control groups differ only with respect to their access to finance.

**Table 12** Matching: difference in corporate investment between treated and control firms

	Difference between treated and control firms	
	Abadie-Imbens ATT	
	Short-term credit constraints (1)	Long-term credit constraints (2)
$I_{it} / A_{it-1}$ (tangible)	- 0.012*** (0.004)	- 0.007** (0.003)
$I_{it} / A_{it-1}$ (all fixed assets)	- 0.009** (0.004)	- 0.009** (0.002)
Number of treated	208	266
Number of controls	184	258

This table reports differences in annual increase in fixed capital between financial constrained firms and their matched controls. The corporate investment corresponds to the annual change in gross fixed assets (either tangible or both tangible and intangible), scaled by the beginning-of-year total assets. The financial constraint measures are based on the firm perception of its credit experience explained in Section 3. Columns (1) and (2) refer to cash and investment credit constraints, respectively. Differences are computed as average treatment effects on the treated via matching estimators (ATT). Firms are matched using firm size, cash flow, solvency, cash holdings and investment opportunities. All the definitions of the variables are summarized in Table 3. Matching firms are also required to be in the same sector and in the same year. The Abadie and Imbens (2006) estimates are obtained from the bias-corrected, heteroskedasticity-consistent estimator implemented in Abadie et al. (2004). *t*-statistics are in (parentheses) and \*\*\* indicates significance at the 1% level, \*\* at the 5% level, and \* at the 10% level

<sup>20</sup>The procedure takes into account this limitation and applies a bias-correction component to the estimates of interest. In addition, I use the estimator of Abadie et al. (2004) which produces heteroskedastic-robust standard errors

<sup>21</sup>Yet, as I do not know all of the factors that determine treatment assignment (i.e. financial constraints), I cannot make sure that there is no hidden bias that could undermine my inference.

<sup>22</sup>Based on overlapping tests, I select the best match using a caliper (i.e. the maximum permitted difference between matched subjects) of 0.45 standard deviations.

I'm now able to compare mean differences in annual increase in gross fixed assets between financial constrained firms and their counterfactual (i.e. matched pairs). Examining the average treatment effect on the treated, Table 12 shows that financial constraints turn out to have substantial effects on corporate investment. Looking at column (1), which presents the Abadie-Imbens estimates for cash credit, firms that report themselves as being short-term credit constrained appear to invest less in tangible assets. Thus, the average difference in annual increase in tangible assets between short-term credit constrained firms and their controls reaches 1.2 percentage point of total assets. Incorporating all fixed assets, this figure falls to 90 basis points. Given that the average corporate investment (tangible and intangible) equals 3.8% of total assets for the whole short-term credit sample, this effect is economically substantial and amounts to a decrease of around 24%.

Regarding investment credit, column (2) indicates that long-term credit constraints affect significantly the firm willingness to invest in both tangible and intangible assets. In particular the effect of long-term credit constraints on tangible assets is lower: the average difference in annual increase in tangible investment between long-term credit constrained firms and their controls equals 70 basis points of total assets. Interestingly, incorporating both tangible and intangible assets, investment and cash credit constraints have the same negative impact on corporate investment (i.e. – 90 basis points). This result supports the working capital channel. Short-term financial constraints affect long-term investment, thus corroborating H1.

#### 4.4.2 Quantile regressions

One other concern may stem from lumpy investment decisions (Doms and Dunne 1998; Caballero and Engel 1999). In the presence of important fixed costs related to equipment installations, firms are likely to invest sequentially so that investment decisions depend on an optimal level of capital. In this context, differences in average investment level between credit constrained firms and their controls could be driven by outliers.<sup>23</sup> To control for this possibility, Table 13 presents quantile regressions that allows to compare

<sup>23</sup>Yet, as outlined previously, all measures of investment, along with all other continuous variables are winsorized at the top and bottom first percentile.

gross investment in fixed assets for financially constrained and unconstrained firms at different points in their respective distributions (i.e. the first quartile, the median and the last quartile). More specifically, the latter hinges on the sample of treated (i.e. constrained firms) and controls firms obtained previously in panel B of Table 16. Overall, holding cash flow and investment opportunities constant, the negative effects of cash and investment credit constraints on investment are confirmed all along the distribution of investment to total assets ratio. Yet, those effects are increasing in the right tail of the distribution.

#### 4.4.3 Life cycle difference

Differences in life cycle or age could potentially produce differences in corporate investment. For instance, firms may invest less in fixed assets with regard to their total assets at the beginning of their life cycle. As credit constrained firms are likely to be less mature than unconstrained ones (Hadlock and Pierce 2010; Ferrando and Mulier 2015), such life cycle effects could explain my matching results. The rationale for this is that older firms are more likely to have successful track records and may have repeated relations with lenders, thereby decreasing both asymmetric information problems and the probability of being financially constrained.

To explore the role of firm age in my dynamic panel specification, I first add a dummy variable *Young SME* that takes the value 1 whether the firm age belongs to the first quartile of the distribution and 0 otherwise. In doing so, an SME that is less than 15 years old is considered as a *Young SME*. Columns (1) and (2) of Table 14 present the results for short-term and long-term credit constraints, respectively. The age dummy turns out be not significant in both columns and its presence does not change the coefficients and the economic importance related to my indexes of financial constraints.

Further, one can wonder about the interactions between the firm age and these constraints. Indeed, as young firms are likely to be more credit constrained, their investment may depend more on internal funds. If so, by forcing SME to allocate additional cash-flow to finance the increase in working capital needs, short-term financial constraints might be more severe for young SMEs. Hence, in Table 17 of the Appendix, I interact my two indexes of credit constraints (ICC)

**Table 13** Robustness: quantile regressions based on matching results

	Dependent variable = $I_{it} / A_{it-1}$ (all fixed assets)					
	Short-term credit			Long-term credit		
	Q1 (1)	Q2 (2)	Q3 (3)	Q1 (4)	Q2 (5)	Q3 (6)
$CF_t / A_{it-1}$	0.019** (0.009)	0.068*** (0.016)	0.096*** (0.022)	0.064*** (0.013)	0.136*** (0.019)	0.185*** (0.035)
$\Delta S_{it}$	0.002 (0.003)	0.017** (0.008)	0.051*** (0.013)	0.021*** (0.006)	0.037*** (0.009)	0.035** (0.017)
Constrained <sub>it</sub>	- 0.004*** (0.001)	- 0.006*** (0.002)	- 0.009*** (0.003)	- 0.003** (0.001)	- 0.006*** (0.002)	- 0.009*** (0.003)
Uncertainty <sub>t</sub>	- 0.001 (0.001)	- 0.001 (0.001)	- 0.001 (0.001)	- 0.001 (0.001)	- 0.001*** (0.000)	- 0.001 (0.003)
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	447	447	447	580	580	580
Number of firms	381	381	381	501	501	501
Pseudo $R^2$	0.05	0.05	0.05	0.04	0.05	0.08

The table shows the results of quantile regressions based on matching results obtained in Table 12. *Constrained* refers to firms that declare themselves as cash or investment credit constrained as explained in Section 3. All the definitions of the variables are summarized in Table 3. Columns Q1, Q2 and Q3 present the results associated with the first quartile, the median and the last quartile of the investment distribution. All regressions were estimated with a constant and include sector and year fixed-effects. See Section 3 for exact definitions and data sources. \*, \*\* and \*\*\* indicate significance levels at 10%, 5% and 1% respectively

with the same binary age dummy and find that there are no differential effects of cash and investment credit constraints according to the age of an SME.

#### 4.4.4 Additional instruments and alternative measures of investment opportunities

In Table 14, I introduce additional regressors in the benchmark specification. First, I make use of the firm's net worth (i.e. the sum of own funds over total assets of the firm) to assess whether over-indebtedness matters for corporate investment decisions. On the one hand, over-indebtedness may force firms to allocate additional cash-flow to reimburse its creditors, thus lowering internal finance devoted to investment. On the other, over-indebted firms may suffer from tougher access to finance that is likely to weaken its investment choices. In this regard, it seems reasonable to assume that changes in a firm's indebtedness

affect its investment decisions only when the indebtedness is already high, that is when the debt is getting close to some possible "maximum level". Hence, I construct a dummy variable "*Highly leveraged*" that takes the value 1 whether the firm can be considered as under-capitalized or highly leveraged (i.e. whose the firm capital ratio belongs to the first quartile of the distribution). Interestingly, columns (3) and (4) indicate that over-indebtedness significantly reduce firm's capital accumulation, without changing the significance of coefficients associated with ICC and IICC.

Turning to the investment opportunities bias related to the investment-cash flow sensitivity literature (Gilchrist and Himmelberg 1995; Erickson and Whited 2000; Bond 2002; Cummins et al. 2006), I test whether my results are sensitive to alternative definitions of investment opportunities. In columns (5) and (6), I use the marginal Q measure implemented

**Table 14** Robustness: life cycle, leverage and alternative measures of investment opportunities

	Dependent variable = $I_{it} / A_{it-1}$ (all fixed assets)							
	Age		Leverage		Marginal Q		GGAV	
	Short-term credit (1)	Long-term credit (2)	Short-term credit (3)	Long-term credit (4)	Short-term credit (5)	Long-term credit (6)	Short-term credit (7)	Long-term credit (8)
$I_{it-1} / A_{it-2}$	0.130*** (0.017)	0.130*** (0.017)	0.131*** (0.016)	0.131*** (0.016)	0.136*** (0.017)	0.137*** (0.017)	0.136*** (0.017)	0.136*** (0.016)
$CF_{it} / A_{it-1}$	0.039*** (0.014)	0.043*** (0.013)	0.041*** (0.013)	0.040*** (0.013)	0.030*** (0.014)	0.034*** (0.013)	0.032*** (0.014)	0.06*** (0.013)
$\Delta S_{it}$	0.030*** (0.003)	0.032*** (0.003)	0.030*** (0.003)	0.034*** (0.003)				
Uncertainty <sub><i>t</i></sub>	- 0.001 (0.001)	- 0.001 (0.001)	- 0.001 (0.001)	- 0.001 (0.001)	- 0.001 (0.001)	- 0.001 (0.001)	- 0.001 (0.001)	- 0.001 (0.001)
ICC <sub><i>it</i></sub>	- 0.004** (0.002)	- 0.005** (0.002)	- 0.004** (0.002)	- 0.005*** (0.001)	- 0.004** (0.001)	- 0.005** (0.002)	- 0.004* (0.002)	- 0.005* (0.002)
Highly leveraged <sub><i>it-1</i></sub>			- 0.004** (0.002)	- 0.004** (0.002)				
Marginal Q <sub><i>it</i></sub>					0.001*** (0.001)	0.001*** (0.001)		
GGAV <sub><i>jt</i></sub>							0.002 (0.015)	0.003 (0.015)
Young SME <sub><i>it</i></sub>	0.006 (0.006)	0.005 (0.006)						
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of instruments	16	16	14	14	16	16	16	16
H-test (p-value)	0.14	0.14	0.13	0.39	0.14	0.140.14	0.14	0.15
AR(2) (p-value)	0.16	0.17	0.14	0.24	0.14	0.150.14	0.13	0.13
Observations	22,608	22,608	22,608	22,608	22,608	22,608	22,608	22,608
Number of firms	5652	5652	5652	5652	5652	5652	5652	5652

The table shows the output for the system-GMM estimation of specification 5 for cash and investment credit constraints with some new instruments. ICC refers to Indexes of Credit Constraint. All the definitions of the variables are summarized in Table 3. Columns (1) and (2) introduce the dummy *Young SME* while columns (3) and (4) add the dummy *Young* as an additional regressor. Finally, columns (5), (6), (7) and (8) use alternative measures of investment opportunities such as Marginal Q or the industry-level Growth in Gross Value Added (GGAV). See Section 5 for more details on these variables. The estimates use one lag of instruments and are robust to heteroscedastic standard errors. All specifications were estimated with a constant and with year fixed-effects. AR(2) shows the p-value of the test of serial correlation in the error terms, under the null hypothesis of no serial correlation. Values presented for the Hansen test are p-values of the test of overidentifying restrictions of the instruments, under the null hypothesis of instrument validity. See Section 3 for exact definitions and data sources. \*, \*\* and \*\*\* indicate significance levels at 10%, 5% and 1% respectively

by D'Espallier and Guariglia (2015) and Mulier et al. (2016).<sup>24</sup> In addition, in columns (7) and (8), I also use the industry-level Growth in Gross Value

Added (GGAV) as an alternative proxy of investment opportunities (D'Espallier and Guariglia 2015). Overall, the main results hold when I use these measures instead of the turnover growth rate. Finally, in the same vein as Fazzari et al. (1988), I also control for two additional lags of cash flow and investment opportunities but none of these lags appears significant in the specifications.<sup>25</sup>

<sup>24</sup>Given the lack of market data available for unquoted SMEs, traditional variables such as Tobin's Q or Fundamental Q cannot be computed. Following Honda and Suzuki (2000), D'Espallier and Guariglia (2015) developed an accounting proxy for marginal Q to control for investment opportunities. Their marginal Q is defined as the ratio of profit per unit of capital over the cost of capital.

<sup>25</sup>Results are not presented but available upon request.

**Table 15** Dataset selection process

	Whole sample	Independent SME	Cash credit demand > 0	Investment credit demand > 0	Cash credit demand > 0	Investment credit demand > 0	Cash credit demand > 0	Investment credit demand > 0
Number of firms	9785	7778	2509	4582	2509	4582	2442	4500
Observations	140,044	92,488	5981	18,364	4235	10,556	4014	10,335
Periodicity	Quarterly	Quarterly	Quarterly	Quarterly	Yearly	Yearly	Yearly	Yearly
Firms with both short-term and long-term credit constraints	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Merge with balance sheet data	No	No	No	No	No	No	No	No

The table explains in detail the number of initial observations and firms that are available and then how many are lost during each step

## 5 Discussion

### 5.1 The case of French SMEs

The case of French SMEs is an excellent laboratory for several reasons. In practice, these firms have a very limited access to financial markets. Despite recent initiatives launched in the framework of the Capital Market Union (CMU) in order to steer households' savings towards SMEs ("PEA-PME"), it appears clearly that French SMEs are still highly bank-dependent. As a result, while large French firms are essentially financed through public debt markets, banking debt represents between 60 and 70% of SMEs' outstanding financial debt. In that context, credit constraints play a substantial role for their activity.

Yet, one could wonder whether we can expect similar findings regarding the working capital channel for other countries than France. Are French SMEs more vulnerable to the working capital channel? In particular, if European SMEs are on average less bank dependent, have lower working capital needs or rely less on short-term finance, the scope of my results would be reduced. In this regard, the SAFE survey implemented by the ECB enables to compare the SMEs' financial situation of 28 European countries. At the end of 2016, the report by country suggests that there is no substantial differences in financing needs. On average, long-term loan turns out to be relevant for 50% of European SMEs and this figure rises to 55% for France. Considering short-term loans, 55% consider credit line and bank overdraft as relevant and the same assessment holds for France. Importantly, on average, 34% of European SMEs declare to use external funding to finance their working capital while it is only 18% for France, thus indicating that other European countries could be more affected by the working capital channel.

### 5.2 Implications for research and practice

The previous results emphasize the crucial role of short-term finance for SMEs. Owing to the competition between working and fixed capital in cash-flow uses, cash credit constraints force entrepreneurs to allocate additional cash-flow to finance the increase in their working capital needs to the detriment of long-term assets. In contrast with previous studies analysing the outstanding amount of working capital

**Table 16** Robustness: characteristics of treated, non-treated and control firms: overlapping tests

	Short-term credit				Long-term credit			
	Treated <sub>t</sub>	Non-treated <sub>t</sub>	Median test p-value	Kolmogorov–Smirnov p-value	Treated <sub>t</sub>	Non-treated <sub>t</sub>	Median test p-value	Kolmogorov–Smirnov p-value
<b>Panel A: Characteristics of treated vs. non-treated firms</b>								
Cash flow ratio <sub>t-1</sub>	2.02%	5.18%	0.00***	0.00***	4.59%	6.86%	0.00***	0.00***
Capital ratio <sub>t-1</sub>	16.08%	23.96%	0.00***	0.00***	21.23%	27.35%	0.00***	0.00***
Cash ratio <sub>t-1</sub>	2.13%	3.69%	0.00***	0.00***	3.49%	7.57%	0.03**	0.00***
Ln(total assets) <sub>t-1</sub>	8.62	9.13	0.00***	0.00***	9.04	8.94	0.60	0.09*
ΔS <sub>t</sub>	- 3.29%	1.26%	0.00***	0.00***	- 1.28%	1.75%	0.00***	0.00***
Observations	486	3169			474	9327		
Firms	392	1997			399	4097		
<b>Panel B: Characteristics of Treated vs. Control firms</b>								
	Treated <sub>t</sub>	Controls <sub>t</sub>	Median test p-value	Kolmogorov–Smirnov p-value	Treated <sub>t</sub>	Controls <sub>t</sub>	Median test p-value	Kolmogorov–Smirnov p-value
Cash flow ratio <sub>t-1</sub>	2.96%	3.37%	0.74	0.25	4.65%	5.12%	0.51	0.41
Capital ratio <sub>t-1</sub>	16.08%	17.22%	0.20	0.35	19.71%	19.64%	0.51	0.95
Cash ratio <sub>t-1</sub>	1.74%	1.59%	0.23	0.31	2.45%	2.98%	0.26	0.33
Ln(total assets) <sub>t-1</sub>	8.77	8.88	0.48	0.34	9.12	9.18	0.51	0.38
ΔS <sub>t</sub>	- 1.64%	- 1.06%	0.96	0.50	- 0.91%	0.12%	0.24	0.35
Observations	245	202			305	275		
Firms	208	184			266	258		

The table compares the properties of treated, non-treated, and control firms. In panel A, firms are split into treated and non-treated group. The treated firms are firms that declare themselves as credit constrained as explained in section 3. In panel B, control firms are subset of non-treated firms selected as the closest match to the treated firms based on a set of firm characteristics: cash flow, size, solvency, investment opportunities, cash holdings, sector and year. All the definitions of the variables are summarized in Table 3. There are 208 (resp. 266) treated firms and 184 (resp. 258) control firms for short-term (resp. long-term) credit. The median of firm characteristics are displayed for the three samples of firms (treated, non-treated and controls). The test for the difference in the medians of a firm characteristic across two groups is conducted by calculating the Pearson chi-squared statistic, while the test for the difference in the distributions is conducted by calculated the corrected Kolmogorov–Smirnov’s D statistics. \*\*\* indicates significance at the 1% level, \*\* at the 5% level, and \* at the 10% level



**Table 17** Robustness: interactions between life cycle and financial constraints

	Dependent variable = $I_{it} / A_{it-1}$	
	Short-term credit (1)	Long-term credit (2)
$I_{it-1} / A_{it-2}$	0.131*** (0.017)	0.130*** (0.017)
$CF_{it} / A_{it-1}$	0.039*** (0.014)	0.043*** (0.013)
$\Delta S_{it}$	0.030*** (0.003)	0.030*** (0.003)
Uncertainty <sub><i>t</i></sub>	- 0.001 (0.002)	- 0.001 (0.002)
ICC <sub><i>it</i></sub>	- 0.003** (0.001)	- 0.005** (0.001)
Young SME <sub><i>it-1</i></sub>	0.008 (0.048)	0.005 (0.006)
ICC <sub><i>it</i></sub> × Young SME <sub><i>it-1</i></sub>	- 0.001 (0.005)	0.001 (0.006)
Year fixed effects	Yes	Yes
Number of instruments	18	18
H-test (p-value)	0.20	0.22
AR(2) (p-value)	0.13	0.13
Observations	22,608	22,608
Number of firms	5652	5652

The table shows the output for the system-GMM estimation of specification 5 for cash and investment credit constraints with some new instruments. ICC refers to Indexes of Credit Constraint. All the definitions of the variables are summarized in Table 3. See Section 6 for more details on the age dummy. The estimates use one lag of instruments and are robust to heteroscedastic standard errors. All specifications were estimated with a constant and with year fixed-effects. AR(2) shows the p-value of the test of serial correlation in the error terms, under the null hypothesis of no serial correlation. Values presented for the Hansen test are p-values of the test of overidentifying restrictions of the instruments, under the null hypothesis of instrument validity. See Section 3 for exact definitions and data sources. \*, \*\* and \*\*\* indicate significance levels at 10%, 5% and 1% respectively

as a reversible source of funds (Fazzari and Petersen 1993; Carpenter et al. 1994; Ding et al. 2013; Aktas et al. 2015), my results suggest that the dynamic of

working capital needs is of major importance. This is due to the non-reducible part of the working capital coming from the most recent operating cycle. Although working capital can be used to buffer fixed capital investment from temporary changes in the availability of finance, my results suggest that SMEs cannot monetize their liquid assets so easily, thus both adjusting their working capital and fixed investment. To my knowledge this paper is the first to insist on this working capital channel under which a simple cash credit constraints could reduce long-term investment.

Accordingly, I find that short-term credit constraints are as important as long-term ones in SMEs' investment decisions. Besides, the detrimental effect of cash credit constraints on corporate investment is stronger for SMEs with higher increase in working capital needs but lower for liquid ones that are able to adjust their accounts receivable and inventories. The latter result is consistent with the hedging role of liquid assets for investment during financial turmoil (Almeida et al. 2004; Arslan et al. 2006; Acharya et al. 2007).

From a methodological point of view, this paper contributes to the literature on indicators of financial constraints. The usual strategy builds on indicators which are either unidimensional, time-invariant or restricted to quoted firms (Fazzari et al. 1988; Kaplan and Zingales 1997; Kadapakkam et al. 1998; Cleary 1999; Lamont et al. 2001; Whited and Wu 2006). However, in line with Farre-Mensa and Ljungqvist (2016), I found only low correlations between these traditional indicators and the SMEs' self-assessment of their credit access, thus showing that the financial specificity of SMEs must be taken into account. Hence, I implement a multidimensional and qualitative analysis to construct a time-varying indicator of SMEs' financial constraints based on hard information. To my knowledge, this paper is the first to create such an indicator of both cash and investment credit constraints of small private firms.

In terms of policy recommendations, one way to deal with short-term financial frictions would be to strengthen the protection of SMEs against late payments which increase their working capital needs. Some governments have already tried to create a

culture of prompt payment in their country by ordering companies to pay their partners when a complaint against them for late payment has been investigated. Companies which do not do so could face further penalties, including fines. In France, the maximum delay is set at 60 days, but SMEs may benefit from a shorter delay.

Finally, short-term financing can not only provide financial support and back-up during business expansion, but also facilitate recovery, keeping SMEs afloat. In this perspective, the lockdown coming from the COVID-19 pandemic has raised new short-term finance issues. To avoid illiquid but solvent firms to go bankrupt, almost all OECD countries set up credit guarantee schemes for bank loans, particularly for SMEs. In the event of borrower default, the guarantor offsets a predefined portion of the outstanding loan, thereby reducing the risk to lenders in order to encourage lending to viable businesses that are limited in their access to finance. These public guarantees can act as a countercyclical instrument for SME growth (Martín-García and Santor 2019). In this regard, the understanding of the working capital channel could be useful to prevent the sharp but temporary crisis to turn into a very persistent one.

### 5.3 Limitations and future research

This paper suggests that underinvesting is not “optimal.” Yet, it depends on the nature of the investment made. For example, assume that an entrepreneur of a SME has a great year and purchases a luxury car. This “investment” cannot be done by the the constrained peers, but the investment will presumably hurt the business (e.g. maintenance costs), thus creating free cash flow problem. In the same vein, a simple replacement investment which is “necessary” to keep the business alive is different from a capacity investment which increases the potential output. Investigating these issues would make it possible in the future to measure more precisely the real effect of short-term financial constraints.

Furthermore, as outlined in my results, one may be concerned about the lack of important control variables identified in entrepreneurship research such as the

intellectual property or the human capital characteristics of the entrepreneur. Similarly, a large literature exists on different funding types and their effect on firm behaviour (e.g. venture capital). Yet, as these information are not available in the datasets I use, I’m not able to assess the differential effect of financial constraints according to these characteristics. While all these “time-invariant” characteristics are included in my fixed effects, it could be interesting to see whether my findings differ according to these variables.

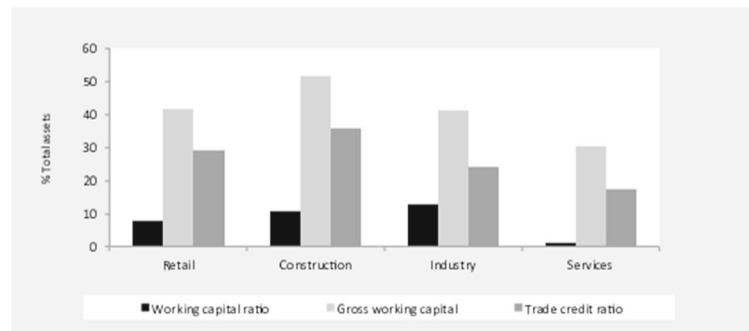
## 6 Conclusion

In this paper, I investigate the real effects of short-term financial constraints on small business through an under-explored transmission mechanism. While the bulk of research on the effects of financial constraints focuses on long-term liabilities, my results stress the importance of short-term finance. Owing to the competition between working and fixed capital in cash-flow uses, cash credit constraints force entrepreneurs to allocate additional cash-flow to finance the increase in their working capital needs to the detriment of long-term assets.

Making use of qualitative survey data on the access to finance of almost 8000 independent SMEs, I implement a dynamic panel specifications to assess the effect of short-term financial constraints on corporate investment. All in all, I find that short-term credit constraints are at least as important as long-term ones for entrepreneurs’ investment decisions. Besides, the detrimental effect of cash credit constraints on corporate investment is stronger for SMEs with higher increase in working capital needs but lower for liquid ones that are able to adjust their accounts receivable and inventories.

Although short-term credit constrained firms represent a narrow subset of my data, they are representative of a broader range of highly bank-dependent firms outside my sample that are smaller in size and account for a significant share of output. Thus, short-term credit constraints are likely to have potentially important macroeconomic implications.

## Appendix



**Fig. 3** Importance of SMEs' working capital and trade credit according to sectors. All the definitions of the variables are summarized in Table 3. The industry classification taxonomy comes

from the statistical classification of economic activities in the European Community (NACE Rev.2). Based on the year 2016, calculations are made using the FIBEN database (Banque de France)

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