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The series is available online at www.bancaditalia.it .

ISSN 1972-6627 (print)
ISSN 1972-6643 (online)

Printed by the Printing and Publishing Division of the Bank of Italy

CORPORATE LIQUIDITY IN ITALY AND ITS INCREASE IN THE LONG RECESSION

by Davide Dottori* and Giacinto Micucci*

Abstract

In this paper we analyse the evolution over time and the determinants of corporate liquidity in Italy, for which the empirical literature is still scant. Using a very large sample of firms for the period 2002-15 (about 460,000 firms per year on average), we document a substantial increase in cash holdings since 2011. We show that the rise in the cash ratio is mainly related to macro factors common to all firms. Among these macro factors, a strong correlation emerges with the lower opportunity cost of holding cash, as measured by the interest rate decline. We also assess the role of cash determinants at the firm level, relating them to different motives for holding cash, such as precautionary reasons, transaction costs, and the effects of information asymmetries in financial markets. Among firm-specific factors, the liquidity rise was initially linked primarily to the fall in investment and then to improved cash flows and enhanced deleveraging.

JEL Classification: G01, G30, G32.
Keywords: corporate finance, firm liquidity, Italian SMEs.

Contents

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1. Introduction[1]

Firms use liquidity as a way of maintaining financial flexibility in case of payment delays or difficulties in securing funds in the capital markets or from financial intermediaries (Bates, Kahle and Stulz, 2009; Campello 2015; Gao, Harford and Li, 2013). At the same time, liquidity is an investment in short term assets alternative to other forms of resource allocation with important implications for corporate profitability, risk and financial soundness, and, more generally, for economic growth (Campello et al., 2012; Graham and Leary, 2015; Denis, 2011).

The literature has recognized a number of firm-specific characteristics that can explain corporate demand for cash (e.g.: Opler et al., 1999; Ferreira and Vilela, 2004). These determinants are related to the most important motives for holding cash, like the presence of transaction costs, information asymmetry in credit markets, uncertainty and risk aversion. Even though liquidity management is not a new topic,[2] in recent years more academic work on the subject has been spurred by the global financial crisis of 2008-09 and by the sovereign debt crisis that followed which have highlighted the relevance of liquidity and financial flexibility (Campello et al., 2011). However, the study of corporate cash holdings has been thoroughly analyzed, especially with regard to listed companies in the US. For these firms a substantial increase in cash holdings during the 2000s is well documented: the trend began before the global financial crisis and seems to be continuing (Almeida et al., 2014). Cash-rich firms have thus received considerable attention both in the business press and in academic research, spurring a debate on the motives behind the unprecedented accumulation of corporate cash and the economy-wide implications.

In this paper we investigate how cash holdings of Italian firms has evolved from 2002 to 2015, thus encompassing the period heavily influenced by the sovereign debt crisis and by its negative impact on the real economy. To the best of our knowledge, the data for Italy is still scant, especially for the years following 2007.[3]

We believe that Italy is a very interesting case study in corporate liquidity, on account of both structural and cyclical factors: financial markets are less developed in Italy than in the US, there is a high proportion of small non-listed firms, and in recent years the economic recession together with the credit market downturns have severely challenged the financial soundness of firms. Using a balance sheets dataset, we are able to cover a very large number of firms, averaging about 460,000 per year.

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[1] The views expressed in this paper are solely those of the authors and do not necessarily represent those of the Bank of Italy. The authors would like to thank the participants at the AISRe conference and the Mofir seminar held in Ancona on 2016, Paolo Sestito, Antonio De Socio, Tiziano Ropele (Bank of Italy), Claudia Pigini and Elizabeth J. Casabianca (Polytechnic University of Marche), for helpful suggestions. Research assistance by Massimo Marcozzi is gratefully acknowledged. All remaining errors are ours.

[2] It has been discussed at least since Keynes' examination of in the 1930s.

[3] Ferreira and Vilela (2004) and Calcagnini, Gehr and Giombini (2009) include data from Italian firms in a multi-country framework to study the determinants of corporate liquidity. However, their focus is more on the comparison between different institutional settings and their sample interval does not include the global financial crisis of 2008-09 and the years that follow.

Unlike previous studies, we have the opportunity to account for many more firms, including those that are not listed.

We first document a sharp increase in cash holdings (measured by the cash-to-asset ratio) from 2011 to 2015. This fact is not simply due to composition effects relating to the entrance and exit of firms, but rather it significantly holds also within firms present in the whole interval.

In order to describe the relationships between cash and its covariates instead of identifying causality links, we then perform an econometric analysis exploiting the longitudinal and multivariate nature of the dataset. We assess the role of cash determinants at the firm level, such as firm size, cash flow level and volatility, investment, leverage and working capital. We relate them to different reasons for holding cash, such as precautionary concerns, transaction costs, and the effects of information asymmetries in financial markets, in line with the existing literature.

Using our estimates, we then address the recent rise in the cash ratio by decomposing it into the contributing factors common to all firms, the cash determinants at firm level, and the changing composition of firms' fixed factors. Our findings suggest that a major role was played by macro factors common to all firms, and a strong correlation emerges between these macro factors and the generalized decline in interest rates in the period. This relationship could be driven, among other possible links, by the lower opportunity cost of holding cash when interest rates are lower. Among firm-specific variables, in the first years of the rise a major contribution was associated to the fall in investments as firms reduced their capital expenditure by a sizeable amount and showed a higher propensity to cumulate cash when they refrain from investing; in the last years under analysis, a growing role was played by the improvement in cash flows and the enhanced deleveraging process.

The paper is organized as follows. In Section 2 we review extant literature on the determinants of cash holdings. Section 3 describes the sample and provides a descriptive analysis. In Section 4 we present our econometric model and estimates. Section 5 introduces into the analysis macro variables common across firms. In Section 6 we decompose the recent rise in the cash ratio into the firm-specific factors and macro variables. Section 7 concludes.

2. Literature review

In a world with complete and perfect markets à la Arrow-Debreu, cash would be completely replaceable by other fully pledgeable and tradable assets and its weight on firm's balance sheets would not matter much, as in the Modigliani-Miller (1958) model. However, in the real world firms do hold liquid assets because of the presence of imperfections like transaction costs (Baumol et al., 1970; Miller and Orr, 1966), uncertainty (Keynes, 1936), asymmetric information resulting in financial market frictions (Holmstrom and Tirole, 2011), etc.

The investigation into how much cash firms hold and why it changes over time is not new (it dates back to 1960 if not earlier, e.g.: Frazer, 1965; Meltzer, 1963), but

it has been attracting renewed attention in recent years following evidence of a considerable increase in the cash share of assets of US corporations. Such a growing trend might in fact look puzzling at a glance: one would have expected firms to hold less cash than in the past following improvements in the financial markets, reductions in transaction costs, and an increased supply of cash alternatives (derivatives, credit lines, debt capacity, etc.). Nevertheless, as shown in Almeida et al. (2014), cash proved to be not that easy to substitute: the availability of derivatives is limited only to risks traded in the market and involves counterparty risks, credit lines may transmit bank troubles to firms and may be subject to aggregate liquidity risk (Demiroglu and James, 2011),[4] and debt capacity may not be viable when it is most needed.[5]

Also, the channel of asymmetric information and financial market frictions should not be overlooked. From a theoretical viewpoint, these frictions arise from moral hazard issues as firms cannot credibly pledge their future cash flows or communicate private information to outsiders (Chirinko and Schaller, 1995). Access to external liquidity to deal with current or future financing needs is then limited or particularly expensive, so that external and internal funds are not perfect substitutes (Fazzari et al., 1988) and the demand for cash reserves is increased (Almeida, Campello and Weisbach, 2011).[6] The presence of financial constraints can also be linked to the concept of "cash flow sensitivity" (Almeida, Campello and Weisbach, 2004): if a firm is, or fears to be, financially constrained in the future it reacts to an increase in its cash flow by holding more cash.

From an empirical point of view, since the seminal work by Opler et al. (1999), cash holdings at firm level have been studied by assessing the impact on the cash-to-asset ratio of a set of firm characteristics linked to the different motives for demanding cash. For instance, firm size, by capturing possible economies of scale in cash management, is traditionally related to transaction cost models, while cash-flow volatility, being connected to idiosyncratic uncertainty, can be associated with precautionary reasons (we enumerate these firm characteristics more in detail in Section 3). In their analysis, Bates, Kahle and Stulz (2009) argue that changes in firm-specific features explain most of the increase in cash-to-asset ratios in the 2000s in the US. In particular, they find that major roles were played by the decrease in net

[4] Sufi (2009) underlines that credit line-based liquidity may involve implicit costs since banks are usually allowed to restrict drawdowns under some circumstances. Since these circumstances tend to be related to declines in firm profitability, the liquidity source risks being dried up when it is needed the most.

[5] The liquidity provided through short term liabilities (e.g.: commercial papers and short term ABS) can suddenly decline and can be severely affected by demand shocks like the exit of typical investors such as money market funds (Chernenko and Sunderam, 2014). Moreover, the liquidity that debt securities 'buy' as collateral is subject to market price fluctuations and haircuts: it can dramatically decrease the actual liquidity under fire sale dynamics. Acharya et al. (2007) show that cash stocks and debt capacity are not equivalent when there is uncertainty about future cash flows.

[6] A different type of agency cost, underlined by Jensen (1986), deals with the moral hazard problem of entrenched managers who would prefer retaining cash than increasing payouts to shareholders when the firm has poor investment opportunities. Harford (2008) and Dittmar and Mahr-Smith (2007) provide empirical evidence in support of this theory.

working capital and capital expenditures and by the increase in cash-flow risk and R&D activity.[7]

In a more recent study, Graham and Leary (2015) extend the temporal depth of the analysis and highlight the role of firm turnovers (in particular the entrance of small and high-tech investing firms) and macro variables, which appear to have greater explanatory power in the longer horizon. Extensions on this stream of literature have addressed the roles of economies of scope (Subramaniam et al., 2011), expectations over future financial market tensions (Ang and Smedema, 2011), cross-border activities (Pinkowitz, Stulz and Williamson, 2016)[8], and institutional settings (Ferreira and Vilela, 2004; Calcagnini, Gehr and Giombini, 2009)[9]. Other works have put forward strategic motives to hold cash in order to gain competitive advantages, also with respect to mergers and acquisitions.[10]

Our findings are consistent with those resulting from previous works and highlight, in particular at the beginning of the cash-ratio take-off, the link with investments. Theoretically, there are several channels through which capital expenditure is connected with liquid holdings. With regard to the financial market frictions motive, the pecking order theory underlines that firms tend to use own liquidity to fund investments, before or instead of more expensive external liquidity (Myers, 1984; Myers and Majluf, 1984; Hubbard, 1998). A negative relation between investment and cash holdings may also emerge because capital expenditures could create assets that can be used as collateral, increasing debt capacity and reducing the demand for cash (Bates, Kahle and Stulz, 2009), or because firms tend to invest more and save less after a positive productivity shock (Riddick and Whited, 2009). Moreover, when expectations over future demand are uncertain and wait-and-see attitudes prevail, firms may both refrain from investing (because the risk-adjusted return is too low) and accumulate cash to increase the degree of liquidity of their

[7] R&D expenditure tends to be funded more heavily by own funds since it can be usually pledged less than tangible capital. See Brown and Petersen (2011) for a study focusing on the relationship between cash holdings and R&D expenditure.

[8] Subramaniam et al. (2011) show that diversified firms have lower cash holdings than focused corporates. Ang and Smedema (2011) find some evidence that non financially constrained firms seem to adjust their cash holdings according to the probability of future recessions. Pinkowitz, Stulz and Williamson (2016) find that multinational firms tend to hold more cash; this could be partly due to fiscal issues, such as repatriation taxes which foster keeping cash in subsidiaries abroad (Foley et al., 2007).

[9] Ferreira and Vilela (2004) find that firms hold more cash in countries with stronger investor protection schemes; Calcagnini, Gehr and Giombini (2009) focus on employment protection rights, finding that in countries where they are stricter, cash holdings tend to be higher.

[10] Morellec, Nikolov and Zucchi (2014) show that firms in more competitive industries tend to display a more accentuated cash hoarding behavior. Almeida et al. (2011) argue that a relatively liquid firm can be in a privileged position to acquire distressed firms in the same industry since they can access part of the target firm's income that cannot be pledged outside the industry. Erel, Jang and Weisbach (2015) study changes in liquidity position of merged firms before and after the acquisition, finding a significant decline in cash holdings and cash-flow sensitivity. Maksimovic, Tham and Yook (2015) study whether some firms acted as liquidity providers to their suppliers during the crisis, without finding robust evidence.

assets in order to be ready to invest as soon as it is deemed convenient again.[11] A negative link between investments and cash also arises in situations similar to liquidity traps, when investment opportunities are (perceived as) lacking and further accumulation of liquidity is not discouraged given its low opportunity cost (Krugman, Dominquez and Rogoff, 1998). Conversely, a positive relationship may emerge if the propensity to invest is itself a proxy for a firm's unobserved characteristics affecting its economic and financial strength.[12]

Finally, since the period we consider encompasses the years of the financial crisis and economic recession, our work is related to studies addressing the impact of the crisis on firm liquidity. Duchin, Ozbas and Sensoy (2010) find that during the financial crisis the decline in investment was greater for firms with low cash reserves. Campello et al. (2010) find that cash stocks decreased more for financially constrained firms, while Campello et al. (2011) show that the trade-off between saving cash and investing became more severe for firms with more limited access to credit lines.[13]

3. Dataset and descriptive statistics

We use a dataset from the Cerved Group (henceforth, CG) containing information on company accounts. CG draws information from official data recorded at the Italian Registry of Companies and from financial statements filed annually at the Italian Chambers of Commerce on a compulsory basis. CG provides information on the universe of Italian joint stock companies as well as on public and private limited liability companies. The information includes company profiles and summary financial statements (balance sheets, income statements and financial ratios). We restrict the analysis to non-financial private firms. From 2002 to 2014, the unbalanced panel ranges from about 350,000 firms in 2002 to more than 530,000 firms in 2011-2013, with an average of about 460,000 firms per year. Our main variable of interest is the firm's liquidity position which - as commonly done in the literature - is measured as the share of total assets represented by cash and liquid

[11] This is reminiscent of a preference for liquidity à la Hicks, i.e. to keep the hands unlocked as much as possible so as to be ready to act when necessary, without incurring disinvestment costs.

[12] We are able to eliminate this (spurious) effect through panel data techniques (see Section 4). While we highlight the link between investments and cash, the relationship between them was (more extensively) studied the other way round (Fazzari, Hubbard and Petersen, 1988; Chirinko and Schaller, 1995; Hubbard, 1998). Among more recent contributions, Kahle and Stulz (2013) find weak evidence that firms holding more cash invested more. In a recent work based on listed firms in the euro area and in the UK, Mäkinen and Silvestrini (2016) find that cash reserves *per se* are not a significant determinant of investment, but they affect it positively by reducing the short net debt position. With all the caution due to the use of different samples, this evidence hints at moderating reverse causality issues by suggesting that the casual impact of investment on liquidity holdings, if any, could be even bigger than the one we estimate because of attenuation bias (see Section 4).

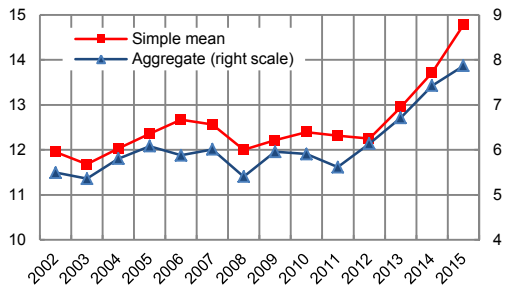
[13] Other papers focusing on the bank lending channel during the crisis are Ivashina and Scharfstein (2010) and Campello et al. (2012). The latter show that cash and credit lines, though naturally linked through a substitution relationship, also display some degree of complementarity, in so far as greater cash increases the likelihood of having/renewing a credit line. For a survey of the empirical literature on the use of bank credit lines see Demiroglu and James (2011).

financial assets.[14] For the sake of brevity, hereafter we refer to it as the firm's liquidity or (broadly speaking) as the cash ratio.

As shown in Figure 1, we find that the aggregate cash ratio remained more or less stable in the decade between 2002 and 2011, scoring little below 6 per cent. Since 2011 a rising trend has clearly emerged, with an overall increase of about 2.3 percentage points, reaching 7.9 per cent. A similar pattern holds if we look at the average cash ratio, for which the rise in recent years seems to begin a bit later, in 2012.[15]

Figure 1

Cash-to-asset ratio (1)
(per cent)

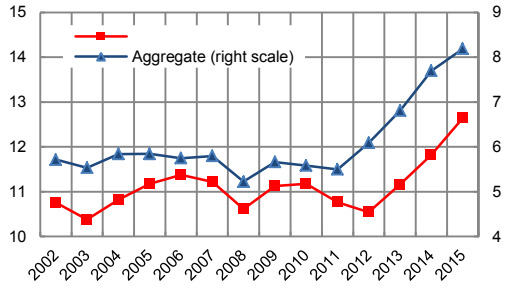


Source: Authors' calculation based on Cerved Group data.
(1) Cash and liquid financial assets over total assets.

We find that the upward trend was not merely due to composition effects related to the entrance and exit of firms, although they play a role. In Figure 2 we show the mean and aggregate cash ratios for persistent firms, defined as the firms present throughout all the sample years. The aggregate ratio shows a similar pattern as that in the whole sample, since bigger firms are also those with a longer history and are more likely to survive throughout the sample years. The dynamics for the mean cash ratio is also confirmed but the level is somewhat below its full sample counterpart, suggesting that firms with higher turnover operate with higher liquidity. The average cash ratio is higher than the aggregate one, suggesting that smaller firms tend to operate with more liquidity than bigger firms. This is related to the transaction-costs motive to holding cash and the possible presence of economies of scale in cash management (e.g.: Miller and Orr, 1966; Vogel and Maddala, 1967; Lotti and Marcucci, 2006). As shown in Table A3 in Appendix, firms classified as 'large' have indeed lower cash ratios than 'medium' and 'small' firms and that the cash ratio can be monotonically sorted across quintiles of firm's assets (Figure A1 in Appendix).[16] In aggregate terms, the cash-holdings

Figure 2

Cash-to-asset ratio for persistent firms (1)
(per cent)



Source: Authors' calculation based on Cerved Group data.
(1) Cash and liquid financial assets over total assets. Persistent firms are those present throughout all the sample years.

[14] Cash represents overall more than 80 per cent of our measure of liquidity, with a minimum of 77 per cent in 2014 and a maximum of 83 per cent in 2012. Financial securities are basically entirely concentrated into the highest 10 per cent of the firms' distribution.
[15] Performing a simple regression of the average cash ratio on a time trend and a constant, we find a statistically significant positive trend coefficient of 0.14 per cent.
[16] In the different panels of Figure A1 we split the sample according to quintiles of a variable of interest (e.g.: size) in each year and plot the evolution of the average cash ratio for each group.

differential between large and small firms was above 3 percentage points in the first part of the sample, then shrank to less than 2 points between 2012 and 2014, mainly on account of a steeper increase in cash holdings for large firms, and went back up in 2015.

Firm size is just one of the determinants of corporate cash holdings identified in the literature. In our empirical analysis we label it *size* and we measure it by the log of a firm's assets. In addition, among the core set of explanatory variables at the firm level we consider the following:

- *Cash flow*: the ratio between a firm's cash flow and assets. We compute cash flow as earnings after interests, dividends and taxes but before depreciations and amortizations, plus other (non-ordinary) net earnings. As explained in Section 2, the sensitivity of cash holdings to cash flow is expected to be positive; this suggests that cross-sectionally we should observe higher cash ratios for firms with higher cash flows: as shown in Figure A1, the largest cash ratios do indeed appear concentrated in the highest quintile of the cash-flow distribution.
- *Net working capital* (*nwc*): net working capital is given by current assets (net of cash and liquid financial securities) minus current liabilities, normalized by total assets. It is a proxy of instruments alternative to cash that a firm can use to meet its liquidity needs; therefore it is generally interpreted as a substitute for cash, thus implying a negative relationship with cash ratios. It can be related to the transaction-cost motive for demand liquidity. The cash ratio is on average higher for firms in the two lowest quintiles of *nwc* (Figure A1). Moreover, for firms using net working capital the most, the cash ratio pattern looks quite flat across the years, while for firms using less net working capital the least, the rise in the cash ratio is sharper.[17]
- *Investment (inv):* we construct a proxy for investments by taking the annual change in the balance sheet value of tangible and intangible assets over total assets.[18] When investments are undertaken, firms considerably rely on internal financial resources to fund them, in addition or as an alternative to external liquidity (Hubbard, 1998; Riddick and Whited, 2009). For the reasons discussed in Section 2, this is related to the presence of financial frictions and asymmetric information in credit markets. As shown in Figure A1, firms that do not invest exhibit higher cash ratios on average while firms with high investments have more or less the same level of liquidity as firms which invest less[19].

[17] Again, this result is not mechanically driven by simultaneity, as it is when we compute quintiles based on 1-year lagged net working capital.

[18] In 2008 these variables were subject to a monetary re-evaluation which artificially created a jump in the series. In order to curb this disturbance, we replaced the 2008 data with the average of the changes in tangible and intangible assets in the year before and the year after. In all the regressions we include a variable resulting from the interaction of investment and year 2008 to control for this issue.

[19] For each year we classify a firm as being in: (i) the no-investment class if the ratio between the annual change in the value of tangible and intangible assets and total assets is negative; (ii) the low-investment class if the ratio is below the median of firms with a strictly positive investment; (iii) the high investment class if the ratio is above the median of firms with a strictly positive investment.

- *Idiosyncratic uncertainty* (*volatility*): it is usually proxied by the rolling standard deviation of cash flow in the previous years. We consider the three years ending in the observation year.[20] It is related to the precautionary motive for holding cash since firms subject to a greater cash-flow volatility are expected to remain more liquid from a prudential standpoint. This is consistent with the descriptive evidence shown in Figure A1 which demonstrates that higher cash-flow volatility is associated with higher cash ratios.
- *Leverage:* we compute leverage as the ratio between financial debts and the sum of financial debt and net worth. For more leveraged firms, financial debts absorb a larger share of cash flow; on the other hand it could be argued that more indebted firms are forced to remain more liquid (Calcagnini et al., 2009); hence the relationship between corporate liquidity and leverage has to be established empirically. As shown in Table A2, the increase in the cash ratio has occurred together with a decrease in firms' leverage; we find that on average firm leverage remained steady at about 52 per cent until 2010 and then fell by almost 10 percentage points in the years up to 2014. Moreover, firms in the two lowest quintiles of leverage clearly exhibit a greater cash ratio than those in the highest quintiles (Figure A1). A negative correlation between cash ratios and leverage was also found in Bates, Kahle and Stulz (2009) and Graham and Leary (2015).

With regard to the relationship between leverage and cash, it is worth mentioning that the analysis of corporate cash holdings is relevant for our understanding of the financial condition of firms. Leverage is often measured as the ratio of financial debt to assets (or to the sum of equity and financial debt or to equity); in any case, debt is usually considered separately from firm liquidity. An alternative measure (Bates, Kahle and Stulz, 2009) is the net debt ratio (financial debt minus cash, scaled on total assets or other variables). Were this alternative measure adopted, the decrease in leverage observed (in Italy and in many other countries) in recent years would be even more marked. Thus, the growing importance of cash should be taken into account when evaluating the financial condition of firms.

The variables mentioned above represent the core set of cash determinants at firm level that we consider in our baseline model. The literature on determinants of corporate cash have mainly focused on them, also on account of their being linked with the economic motives for holding cash. On top of that, we are able to replicate in our dataset the construction of other possible covariates of cash, which we consider in the augmented version of the model. Namely, they are:

- *Economic loss (loss):* it is measured as a dummy variable equal to 1 when a negative economic result occurs. From a theoretical viewpoint, firms with an economic loss are more likely to be financially constrained and hence should hold more

[20] We consider three years instead of ten as in Bates, Kahle and Stulz (2009) to prevent the loss of many observations and to allow for greater cyclical variability. Unlike the baseline model used by Bates, Kahle and Stulz (2009), but also as done in Opler et al. (1999), we measure volatility at the firm level instead of at the industry level, since what ultimately characterizes the idiosyncratic uncertainty is the firm's own cash-flow volatility.

cash (this is actually what was found to be true for US firms by Bates, Kahle and Stulz, 2009); on the other hand, when firms are willing to retain cash flows, those having a positive economic result are clearly better suited to achieve this purpose, thus showing more liquidity.[21]

- *Dividend payment (div):* it is measured by a dummy equal to 1 if dividends have been distributed. In the US context analyzed by Bates, Kahle and Stulz (2009), firms that pay dividends, *ceteris paribus,* tend to hold less cash; this happens either because they are perceived as less risky (thus having better access to capital markets and fewer precautionary reasons to hold cash), or because of the agency motive highlighted by Jensen (1986), according to which entrenched managers would rather retain cash than increase payouts to shareholders when investment opportunities are low. However, in the Italian context, characterized by a substantially more limited openness to capital markets, these effects are likely to be less important and they could be counteracted by the fact that dividends are distributed by more financially sound (and liquid) firms.
- *Expenditure on intangibles (int)*: we measure it by the ratio between the change in intangible assets and total sales. Unfortunately, our dataset does not provide explicit information on R&D expenditure which should ideally be considered among the covariates: the relationship works through the financial-friction motive, since funding R&D by means of external sources is difficult/expensive because its outcomes are more uncertain and difficult to pledge.[22]
- *Bond share (bond_sh)*: we measure it as the share of bonds, if any, over firms' financial liabilities. The relationship with cash holding is not clear a-priori, since on the one hand access to the financial markets can be a source of liquidity, but on the other hand it could work as a substitute for cash.

The description, construction and sources of all these variables are reported in Table A1.

4. Econometric analysis

As a first objective of the analysis, we want to assess whether the main cash determinants highlighted in the existing literature explain the liquidity dynamics of Italian firms and to what extent. Then we augment the baseline model with further variables at the firm level. In Section 5 we tackle the issue of what drove the dynamics of cash holding in the last few years of our sample.

4.1 Baseline model of cash holding determinants

We consider the following baseline model:

[21] The descriptive evidence (not reported but available from the authors upon request) suggests that the latter channel seems to fit better for Italian firms.

[22] There are also other two variables commonly considered in this stream of literature that we cannot account for: (i) the market-to-book assets ratio, which is actually not defined for most of the firms in the dataset since they are not listed; (ii) the acquisition to assets ratio, which in our context should likely play a minor role, if any.

$$l_{i,t} = \boldsymbol{\beta}'\boldsymbol{X}_{i,t} + \boldsymbol{\delta}'\boldsymbol{Y}_t + \mu_i + \varepsilon_{i,t} \quad (1)$$

where $l_{i,t}$ is the cash–to-asset ratio for firm *i* at the end of year *t*, and $\boldsymbol{X}$ is a vector of firm-specific variables introduced in Section 3, namely: log of total assets (*size*), cash flow volatility (*volatility*), the cash flow-to-assets ratio (*cashflow*), the investment-to-asset ratio (*inv*), the net working capital-to-asset ratio (*nwc*), and the leverage index (*leverage*).[23] The vector $\boldsymbol{Y}$ consists of year dummies to account for time varying factors common to all firms. The error term consists of a firm-specific component of unobserved heterogeneity μ_i and an idiosyncratic component $\varepsilon_{i,t}$.[24]

The aim of the analysis is not to identify causal links in the relationships between cash and its covariates (albeit loosely speaking we may refer to them as cash determinants, in line with the previous literature), but rather to describe those relationships by exploiting the longitudinal and multivariate nature of the dataset. Nonetheless, in order to curb simultaneity issues and reverse effects, we measure the cash ratio at the end of time *t*, while for all covariates in $\boldsymbol{X}$ the stocks are taken at time *t-1* and flows are taken between *t-1* and *t* (e.g. the cash flow-to-assets ratio is measured as the cash flow between *t-1* and *t* over total assets at *t-1*), like in Graham and Leary (2015). This way regressors are less likely to be simultaneously determined with respect to the variable of interest, i.e. the cash ratio at *t*.

Moreover, in order to limit the impact of outliers, the following variables are winsorized in each year at the 1st and 99th percentiles: cash flow, volatility, investment, net working capital and leverage.[25] A summary of the descriptive statistics is provided in Table A4.

Following Bates, Kahle and Stulz (2009), we perform baseline estimations by using ordinary least squares (OLS), Fama – MacBeth (FMB) and fixed effects (FE) estimators. In all cases robust standard errors clustered at the firm-level are computed.

The FMB estimator, based on Fama and MacBeth (1973), is often used in the field of empirical corporate finance; its estimates derive from the average of separate cross-section regressions at each year.[26] The pooled OLS estimates take into account the panel structure and are consistent as long as the assumption of (contemporaneous) exogeneity holds between the explanatory variable $x_{i,t}$ and the

[23] In Section 4.2 the vector X is augmented with other variables available in the dataset.

[24] Not reported, we also add the interaction between *inv* and a year dummy for 2003 and 2008 to further control for level shifts in the dataset in those years.

[25] Leverage is also winsorized at the 99th percentile when values are either higher or negative. Since leverage is computed as the share of financial debts over financial debts and net equity, firms having a negative net equity have a leverage higher than 1. While this is still meaningful as a measure of high indebtedness, when negative net equity is close to the value of financial debts, leverage rises to unrealistically high levels. When net equity is even larger (in absolute terms) than financial debts, leverage becomes negative: if no correction is applied, these firms would be wrongly analysed as having less leverage than firms with zero financial debts; for the same reason it would also be wrong to normalize negative values of leverage to zero: they represent a totally different situation with respect to no indebtedness. Therefore we winsorize negative values of leverage to the 99th per cent level of non-negative values in each year.

[26] The FMB estimation is performed through the Stata routine developed by Hoechle (2011).

error term $(\mu_i + \varepsilon_{i,t})$. However, if the firm-specific heterogeneity μ_i is correlated with any regressor, the OLS estimator is biased.

This source of endogeneity can be removed through panel data techniques such as first differencing or taking the so-called within transformation. We do the latter, applying the FE estimator which is robust to the possible correlation between $x_{i,t}$ and μ_i. Nevertheless, the FE estimator requires a strict exogeneity assumption between the regressors and the error term, which might not hold in the presence of feed-back effects, while the OLS works under the milder assumption of contemporaneous exogeneity. In this trade-off, we consider the FE estimator more robust than the OLS, as it is very likely that there are unobserved firm-specific features that we are not able to observe or control for.[27]

Regression results of the baseline model (1) are summarized in Table 1, where in column (1), (2) and (3) the estimations are performed by the pooled OLS, the FMB and the FE estimators, respectively. Across different estimators, results concerning the firm specific regressors generally appear rather robust, to the extent that coefficients do not switch signs and significance levels are confirmed.

Focusing on the economic interpretation of the results, all coefficients have the expected sign. The effect of *firm size* is negative, so that smaller firms have to hold more cash: this supports the existence of economies of scale in cash management and is related to the transaction costs motive for holding cash. Consistent with the precautionary motive for liquidity demand, firms experiencing higher *idiosyncratic uncertainty*, as measured by a greater volatility in cash flows, tend to hold more cash.[28] A positive relationship exists between *cash flow levels* and the cash ratio: according to the point estimates, if the cash flow-to-asset ratio increases by 1 percentage point, the cash ratio rises by between 15 and 20 basis points. The fact that cash holdings are sensitive to changes in cash flow can be read as being related to credit market frictions that make firms prefer to increase their internal liquidity when their cash flow rises. The coefficient of *investments* is negative and highly significant. This suggests that when firms undertake an investment they use a substantial amount of own liquid funds, so that the cash ratio falls (Hubbard, 1998 and Riddick and Withed, 2009). This is consistent with the presence of financial market frictions that limit access to external liquidity or prohibitively increase its cost. It is important to note that, if any bias affects the *investments* coefficient because of potential issues of reverse causality, this would likely occur as an attenuation, so that the actual impact

[27] Another reason to prefer the FE estimator is that in regressions with a very high number of observations and a relatively low number of coefficients, standard errors tend to be small thus increasing the likelihood of finding a significant effect. The FE estimator contrasts this problem as it implies a huge loss of degrees of freedom in comparison to the OLS estimator (because of the within transformation). Moreover, in order to check whether a random effects model could be used, we also perform a robust Hausman test based on Mundlak (1978) as suggested in Wooldridge (2010). The null hypothesis for coefficients on $\bar{X}_i$ jointly equal to zero is strongly rejected, thus suggesting that we keep the FE estimator.

[28] The fall in the magnitude of the volatility coefficient when we move from the OLS or the FMB to the FE estimates might suggest that there are actually some time-invariant firm-specific unobserved factors positively correlated with volatility that tend to inflate its coefficient in columns (1) and (2).

of investment on corporate liquidity could be even greater than the estimated one.[29] The impact of investment on liquidity can be related to both the asymmetric information channel and the precautionary motive: the former holds because investments can hardly be funded entirely through external finance (for reasons discussed in Section 2) while the latter occurs whenever firms prefer to refrain from investing and remain liquid because of surrounding uncertainty.[30]

Table 1

Regressions estimating the determinants of cash holdings: baseline model (1)

	(1) OLS	(2) Fama-MacBeth	(3) Fixed-Effect
Size	-0.017***	-0.017***	-0.012***
	[0.000]	[0.001]	[0.000]
Volatility	0.185***	0.175***	0.041***
	[0.002]	[0.010]	[0.002]
Cashflow	0.193***	0.182***	0.156***
	[0.001]	[0.010]	[0.001]
Inv	-0.189***	-0.180***	-0.141***
	[0.001]	[0.011]	[0.001]
Nwc	-0.142***	-0.142***	-0.178***
	[0.001]	[0.002]	[0.001]
Leverage	-0.128***	-0.127***	-0.047***
	[0.000]	[0.003]	[0.000]
Year dummies	YES	NO	YES
Firm fixed effects	NO	NO	YES
Constant	0.300***	0.280***	0.236***
	[0.001]	[0.005]	[0.002]
Observations	3,998,049	3,998,049	3,998,049
R-squared	0.249	0.245	0.154
Number of groups			744,544

(1) In all regressions, the dependent variable is the cash-to-asset ratio at the end of year t. Estimations refer to the whole sample from 2002 to 2014. All flow variables are taken between t-1 and t, while stock variables are taken at the end of year t-1. Robust standard errors clustered at the firm level are used. In the Fama-MacBeth regression the average R2 is shown. For details on the dataset see Table A1. Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

It is confirmed that *net working capital* is a substitute for cash: firms which have available a greater amount of net working capital generally operate with less cash. This substitution, which can be related to the transaction-cost motive for holding cash, is nevertheless imperfect as suggested by the coefficient smaller than 1 (in a statistically significant way). The effect of *leverage* is negative and so more leveraged firms exhibit lower liquidity *ceteris paribus*. Hence the empirical evidence does not

[29] The attenuation derives from the mutual link between investment and cash holding having opposite signs: since liquidity is used to fund investment, an exogenous increase in investment has a negative impact on liquidity, but at the same time there is a positive link going from liquidity to investment since the latter is favored if more liquidity is available (Fazzari, Hubbard and Petersen, 1988). This kind of relationship causes an attenuation bias in the estimate of model (1). As mentioned, to limit this effect we measure cash holdings at the end of the period, while investment is taken as the flow during the period over the level of assets at the beginning of the period.

[30] See for example Carruth et al. (2000) and Bloom, Bond and van Reenen (2007). In particular, for the Italian context see Guiso and Parigi (1999) and Busetti, Giordano and Zevi (2016).

support the hypothesis that highly-leveraged firms are forced to operate with more liquidity; conversely, our results, as in Bates, Kahle and Stulz (2009), suggest that when debt is more constraining, firms use cash to reduce leverage.

The year dummy variables prove to be significant, both individually and jointly. If we plot their coefficients we observe a clear upward pattern (Fig. A2): this highlights the role played by time varying factors common to all firms in enhancing corporate liquidity in recent years. We delve deeper into this issue in Sections 5 and 6.

4.2 Augmented model of cash holdings determinants

We now consider the following augmented model:

$$l_{i,t} = \boldsymbol{\beta}'\boldsymbol{X}_{i,t} + \boldsymbol{\gamma}'\boldsymbol{Z}_{i,t} + \boldsymbol{\delta}'\boldsymbol{Y}_t + \mu_i + \varepsilon_{i,t} \qquad (2)$$

where besides the vectors $\boldsymbol{X}$ and $\boldsymbol{Y}$ as defined in Eq. (1), we include in vector $\boldsymbol{Z}$ other variables available from balance sheet data concerning the economic performance and financial position of firms. Namely, they are: a dummy for the occurrence of an economic loss (*loss*); a dummy for the distribution of dividends (*divpay*); a proxy of R&D activity obtained as the ratio between the annual change in the amount of intangible assets and sales at the beginning of the period (*intang*); and the weight of bonds issued by the firm over its financial liabilities (*bond_share*). Similar variables have been considered in Bates, Kahle and Stulz (2009). The dummy variables for loss and dividend payment are taken at *t-1*, as well as the bonds' share.

In Table 2, the baseline model OLS and FE estimates from Table 1 are reported in columns (2) and (4) as a benchmark; while in columns (3) and (4) the results for the augmented model are shown. The added variables have explanatory power, without dramatically changing the magnitude and significance of the core-covariates in $\boldsymbol{X}$ with respect to the baseline version.

Firms that have experienced an economic loss have lower cash ratios, while firms that have distributed dividends tend to have higher cash ratios. Both findings are in contrast with the empirical evidence in Bates, Kahle and Stulz (2009), likely mirroring the different institutional contexts: in a highly market-oriented economy like the US, incurring a loss may imply more limited access to external liquidity, thus requiring an increase in internal liquidity, whereas paying dividends likely makes the firm more attractive to investors and increases its access to capital markets.[31] In the Italian economy, where the capital markets are substantially less developed, these effects are arguably minor. Instead, it is more likely that the incurrence of an economic loss forces the firm to draw from own liquid resources or it may signal a period of poor performance; conversely, dividend distribution (conveniently) occurs when the liquidity situation is expected to be sound.

[31] Another possibility is the agency motive highlighted by Jensen (1986): entrenched managers would rather retain cash than increase payouts to shareholders when investment opportunities are low.

Table 2

Regressions estimating the determinants of cash holdings: extended model (1)

	OLS		FE	
	(1) Baseline	(2) Augmented	(3) Baseline	(4) Augmented
size	-0.017***	-0.018***	-0.012***	-0.013***
	[0.000]	[0.000]	[0.000]	[0.000]
volatility	0.185***	0.192***	0.041***	0.044***
	[0.002]	[0.002]	[0.002]	[0.002]
cashflow	0.193***	0.181***	0.156***	0.154***
	[0.001]	[0.001]	[0.001]	[0.001]
inv	-0.189***	-0.201***	-0.141***	-0.144***
	[0.001]	[0.001]	[0.001]	[0.001]
nwc	-0.142***	-0.145***	-0.178***	-0.180***
	[0.001]	[0.001]	[0.001]	[0.001]
leverage	-0.128***	-0.124***	-0.047***	-0.045***
	[0.000]	[0.000]	[0.000]	[0.000]
loss		-0.016***		-0.011***
		[0.000]		[0.000]
divpay		0.032***		0.008***
		[0.001]		[0.000]
intang		0.039***		-0.003**
		[0.002]		[0.001]
bond_sh		0.002***		0.001***
		[0.000]		[0.000]
Year-dum	YES	YES	YES	YES
Firm Fixed Eff	NO	NO	YES	YES
Constant	0.300***	0.282***	0.236***	0.205***
	[0.001]	[0.001]	[0.002]	[0.002]
Obs	3,988,049	3,962,966	3,988,049	3,962,966
R-squared	0.249	0.254	0.154	0.157
Number of groups			774,544	770,849

(1) In all regressions, the dependent variable is the cash-to-asset ratio at the end of year t. Estimations refers to the whole sample from 2002 to 2014. Robust standard errors clustered at the firm level are used. For details on the dataset see Table A1. Robust standard errors in brackets. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Firms that have issued bonds tends to have a higher cash ratio, *ceteris paribus,* possibly because of inflows of external liquidity. The proxy for R&D expenditure (*intang*) has a positive sign in the OLS model and a negative one (but not 1 per cent statistically different from zero) in the FE model. Beyond issues related to the poor accuracy of the proxy (see Section 3), this may suggest that firm-specific time-invariant unobserved characteristics play a role in the positive relationship between

intang and *liquid* that emerges in the OLS model; when they are netted out through the FE transformation the relationship is weaker and possibly negative.[32]

4.3 Robustness checks

We tackle three major issues for robustness: (i) the non-linear effects of the investment variable; (ii) the dynamic persistence of the dependent variable; and (iii) the investigation of sub-samples of interest (i.e. companies present throughout the sample years, medium and big firms, industrial firms only). For the sake of simplicity, we carry out the analysis taking the baseline model as a benchmark. Results are shown in columns 2 to 6 of Table A5.

Non-linearity of the investment variable. The investment variable could affect the cash ratio in a non-linear way. As mentioned, asymmetric information in the credit market induces firms to use own liquidity to fund capital expenditure; if these issues are more relevant when expenditure is higher (relative to firms' assets), one could expect to observe a convex effect of *inv* on the cash ratio.

In order to address this issue, we add *inv* squared to the baseline version. As shown in column 2, the coefficient on *inv_squared* is indeed negative, reinforcing the linear effect. To roughly gauge the magnitude of this effect, the partial effect of investment computed at the third quartile of the sample distribution of the variable is higher (in absolute terms) by about 8.6 basis points than the one computed at the median.[33] Therefore, the cash-enhancing effect of the fall in investment discussed in previous sections can be expected to be even higher for firms that used to invest more.

Dynamic persistence of the cash ratio. Cash holdings may exhibit some degree of inertial persistence. Therefore, the use of a dynamic panel model could recommended because the omission of the lagged dependent variable may potentially affect the estimation of other regressors. In order to see whether this is the case in our context, we consider the following dynamic model :

$$l_{i,t} = \theta l_{i,t-1} + \boldsymbol{\beta}' \boldsymbol{X}_{i,t} + \boldsymbol{\delta}' \boldsymbol{Y}_t + \mu_i + \epsilon_{i,t} \qquad (6)$$

The estimation of model (6) raises some econometric issues regarding the bias of the FE estimator because, after the within transformation, l_{t-1} and $u_{i,t}$ are correlated. The OLS estimator does not help as it is inconsistent because $E(y_{t-1} ; \mu_i) \neq 0$ whenever $\mu_i \neq 0$ (Bond, 2002). Moreover, the Arellano-Bond (1991) and Blundell-Bond (1998) GMM estimators, specifically designed for dynamic panels, are particularly cumbersome to compute in such a big dataset as ours.

In order to overcome these difficulties, we rely on the fact that the FE bias is lower the higher the value for T. More precisely, the FE bias in a dynamic panel is of order $(T-1)^{-1}$, thus fading out for high T values (Nickell, 1981). When $T = 14$, like in our

[32] The economic interpretation is that there may be unobserved firm factors (constant through time) that are associated with both higher R&D and liquidity and once they are controlled for the relation becomes mildly negative possibly because own liquidity is used to fund R&D.

[33] The partial effect is computed by taking the derivative with respect to *inv*: $\beta_{inv} + 2\,\beta_{inv\_sq}\,inv$.

dataset, the dynamic FE estimator can still be useful in getting appreciable estimates, also because the dependent variable's persistence is not very high.[34]

In column (3) we report the FE estimate for the dynamic model. The inclusion of the lagged dependent variable (whose coefficient scores at 0.30), attenuates the effects of size and idiosyncratic volatility most of all, which we already found to play a rather minor role; the effect of investment is instead slightly strengthened thus resulting robust to the dynamic specification.

Investigation of sub-samples. We want to see if our main findings are confirmed when we restrict the analysis to particular sub-samples of interest. In column (4) we consider only firms that were almost always present in our dataset (namely, we require cash ratio data for at least 13 out of 14 years). Again, the main results concerning investments are confirmed.

Then, we restrict the analysis to medium or big firms which numerically represents a minority (less than 6 per cent).[35] Even if this implies a relevant reduction in the sample size, coefficients basically maintain their significance, signs and roughly the same order of magnitude (column 5). We find that the effect of size gets weaker and loses the 1 per cent significance once we do not consider small firms: this could hint at decreasing returns in economies of scale in cash management. Compared with the baseline model, the investment effect is reduced, suggesting that the use of own liquidity to fund investment is more important for small firms.

Finally, we restrict the sample to firms in the industrial sector. Numerically, they represent almost a fourth of the firms in our original sample. As shown in column (6), the signs are all confirmed with respect to the benchmark model, with the coefficient for the idiosyncratic uncertainty associated with cash flow volatility playing a bigger role in comparison to the baseline model.

5. The role of macro factors

In the models considered so far, factors common to all firms are accounted for by means of year dummies; while this is a proper way to isolate firm-specific effects, it leaves little to say in economic terms about the role of macro factors related to the general economic context, which can nevertheless be relevant and interesting to explore (Graham and Leary, 2015).

Therefore, in our baseline model we substitute time fixed effects with a vector $\boldsymbol{M}$ of macro variables of interest: the opportunity cost of holding cash (measured by the average T-Bill rate), general uncertainty on the money market (measured by the Euribor index volatility), the economic cycle (measured by annual GDP growth) and

[34] The OLS regression for model (6), which by construction estimates θ with an upward bias, returns $\hat{\theta}$=0.720 Even in this case, the hypothesis of unit root is largely rejected.

[35] The classification is based on the amount of sales per year: firms are classified as small if sales are below €10 million.

the average level of yields on bank lending to non-financial firms (as a proxy of the cost of outside funding):[36]

$$l_{i,t} = \boldsymbol{\beta}' \boldsymbol{X}_{i,t} + \boldsymbol{\delta}' \boldsymbol{M}_t + \mu_i + \epsilon_{i,t} \qquad (5)$$

First, we check that the firm-specific coefficients are not dramatically affected by the change in the model specification. As shown in Table 3, the relative magnitude of FE coefficients generally does not change much moving from the model with time dummies to the model with macro variables, either under the baseline specification or the augmented one;[37] the R-squared decreases very slightly.

Table 3

Regressions for the determinants of cash holdings including macro factors (1)

	Baseline		Augmented	
	(1)	(2)	(3)	(4)
size	-0.012***	-0.009***	-0.013***	-0.010***
	[0.000]	[0.000]	[0.000]	[0.000]
volatility	0.041***	0.040***	0.044***	0.042***
	[0.002]	[0.002]	[0.002]	[0.002]
cash flow	0.156***	0.153***	0.154***	0.151***
	[0.001]	[0.001]	[0.001]	[0.001]
inv	-0.141***	-0.141***	-0.144***	-0.143***
	[0.001]	[0.001]	[0.001]	[0.001]
nwc	-0.178***	-0.178***	-0.180***	-0.179***
	[0.001]	[0.001]	[0.001]	[0.001]
leverage	-0.047***	-0.047***	-0.045***	-0.044***
	[0.000]	[0.000]	[0.000]	[0.000]
loss			-0.011***	-0.010***
			[0.000]	[0.000]
divpay			0.008***	0.007***
			[0.000]	[0.000]
intang			-0.003**	-0.003**
			[0.001]	[0.001]
bond_sh			0.001***	0.000***
			[0.000]	[0.000]
Gdp_gr		0.002***		0.002***
		[0.000]		[0.000]
T-bill		-0.007***		-0.008***
		[0.000]		[0.000]
Mkt Vol		0.011***		0.011***
		[0.000]		[0.000]
b_lend_yield		0.003***		0.003***
		[0.000]		[0.000]
Time dummies	YES	NO	YES	NO
Observations	3,988,049	3,884,808	3,962,966	3,860,004
R-squared	0.154	0.151	0.157	0.154
Number of groups	774,544	759,863	770,849	756,216

(1) In all regressions, the dependent variable is the cash-to-asset ratio at the end of year t. All flow variables are taken between t-1 and t; stock variables are taken at the end of year t-1. Estimations refers to the whole sample from 2002 to 2014. Robust standard errors clustered at the firm level are used. The dummy D takes value 1 since 2011. For details on the dataset see Table A1. Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

After this check, we can focus on the macro variables: in every model, all their coefficients are significant and have the expected sign. Namely: the T-bill rate, as a

[36] Details are provided in Table A6. Time dummies are removed because of multicollinearity, given that they are unit-invariant just like the macro factors.

[37] The main changes involve the attenuation in the size effect and the intensification of the volatility effect.

proxy of the opportunity cost of holding cash, has a negative sign; market volatility has a positive and significant effect, in accordance with greater precautionary demand for liquidity when surrounding uncertainty is high; the GDP growth coefficient is positive, hinting at a pro-cyclical feature of the cash cycle; the yields on bank lending to non-financial firms has a positive sign, as firms tend to increase their own liquidity as a precaution when access to external funding becomes more costly.[38]

6. Decomposing the rise in cash holdings observed in recent years

In this section we disentangle the factors behind the substantial increase in the average cash ratio in the last few years of our sample. We consider the fitted values obtained from the augmented model in Eq. (2)[39] as their year-wise sample average almost perfectly overlaps with the actual pattern of the cash ratio. At each time t, the sample average can be written as:

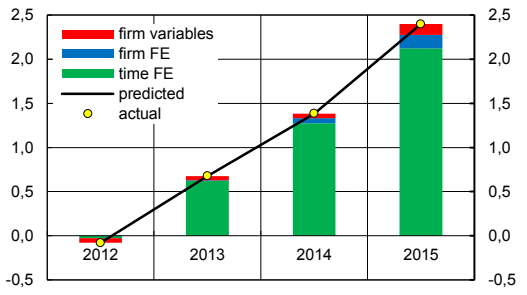
$$\overline{\hat{l}_t} = \alpha + \hat{\beta}\ \overline{X_t} + \overline{\hat{\mu}_t} + \hat{\delta}_t$$

where – for the sake of notation - we have included all firm time-varying variables in vector X. The change between a reference year *s* and a following year *t* can be decomposed into three different components: (i) the change in the effect of observable firm variables $\hat{\beta}\ (\overline{X_t} - \overline{X_s})$; (ii) the change in time factors common to all firms $\hat{\delta}_t - \hat{\delta}_s$; and (iii) the change in the effect of unobservable firm factors $\overline{\hat{\mu}_t} - \overline{\hat{\mu}_s}$. Note that although μ is time-invariant at the firm level, its yearly sample average may vary because of turnover of firms with different unobservable characteristics[40].

Our reference year is 2011 since the take-off of the average cash ratio begins thereafter (see Figure 1); we let *t* vary from 2012 to 2015. The decomposition results are reported with their 95 per cent confidence interval in Table A6, while centered estimates are graphically shown in Figures 3 and 4. As shown in Figure 3, factors common across firms play by far the largest role in explaining the rise in average liquidity. Though less prominent, firm

Figure 3

Decomposition of the rise in cash ratio (1)
(per cent points)



(1) The year 2011 is used as a reference. The point-coefficient estimate of the FE model in Eq. (2) is used.

[38] *A priori* the effect of the bank lending yield could also be negative if firms trade their internal liquidity for external financing from banks for any given amount of resources, i.e.: when borrowing from banks grows more costly, more internal liquidity is used. Whether this negative relationship or the positive one descried in the text dominates is an empirical matter: we find that the positive one slightly prevails but the small magnitude of the net effect suggests that the two channels might almost compensate for each other.

[39] We consider model 2 that includes all covariates at the firm level, but results are basically confirmed under the baseline model with fewer firm variables.

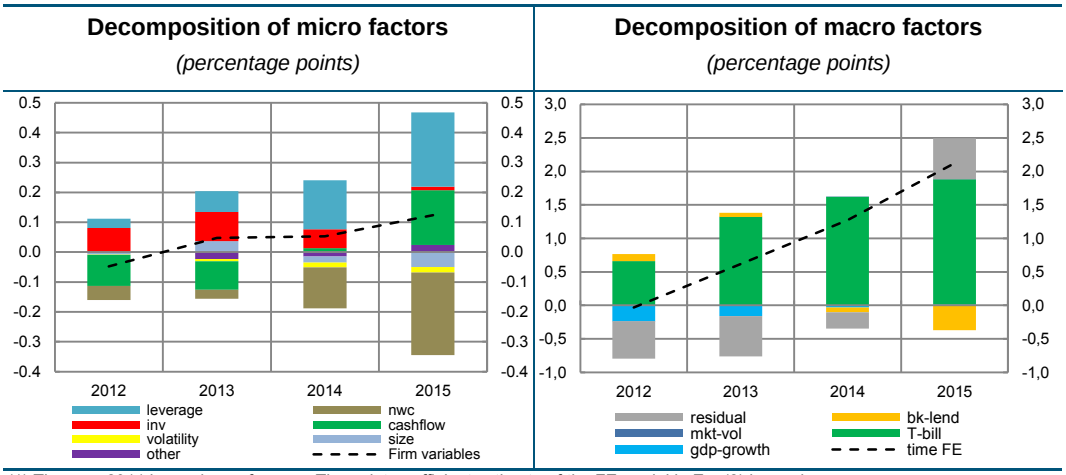
[40] In a fully balanced panel this effect would be zero.

variables also play a role, both through the observed factors and the changing composition of fixed effects[41].

As far as changes in the observables features of firms are concerned, we can disentangle the effect of each covariate (Fig. 4a). It turns out that in the first years under analysis, it was the fall in investment that most contributed to the growth in the cash ratio. Then in 2014 and, most of all, in 2015 this effect diminished as investment started to slowly recover. During this period, the role of leverage became more important; in 2015, an important contribution came from the significant increase in cash flows. However, the concurrent increase in net working capital (a substitute for cash) attenuated the overall net effect.

Figure 4

Decomposition of micro and macro factors (1)



(1) The year 2011 is used as reference. The point-coefficient estimate of the FE model in Eq. (2) is used.

As mentioned, the general increase in the average cash-ratio is mainly associated with time-varying factors common to all firms. In order to go more in depth on the issue, we decompose the time fixed firm effects $\widehat{\delta_t} - \widehat{\delta_s}$ into a linear combination of the macro variables considered in Section 5.2 (GDP growth rate, T-bill rate, Euribor volatility and the bank lending yield) plus a residual.[42] Clearly, this procedure is not intended to detect causality, but a simple correlation.

As shown in Fig. 4b, among the considered macro variables, the greatest role is played by the fall in the interest rate. It can be straightforward to associate this relationship to the lower opportunity cost of holding liquidity when interest rates decline. However, behind the link between low interest rates and high firm liquidity, many channels can be at work: just as an illustrative example, in a liquidity trap situation, the combination of low interest rates and poor expectations regarding the

[41] The change in the fixed effect is greater in 2015 partly because the sample size is smaller in the last year of the dataset because not all the data are readily available.

[42] We obtain this linear combination by using as weights the coefficients of a regression of the time dummy coefficient on the four macro variables and a constant, plus a residual term. The coefficients (standard errors) are: GDP growth 0.070 (0.023), T-bill -0.749 (0.705), market volatility -0.013 (3.282), and bank lending 0.309 (0.512).

future may induce firms to stay liquid; a link between low interest rates and higher corporate liquidity may also arise when an expansionary monetary policy is undertaken to accommodate fiscal measures that in the short term do not foster demand and transactions. Thus, based on the descriptive nature of our analysis, we refrain from drawing any causality implications.

We have maintained so far that the cash ratio's responsiveness to variations in firm covariates is constant over time. However this relationship could have intensified so that in recent years a given variation in covariates is associated with a higher variation in liquidity holdings. In order to explore this issue more closely, we allow for a slope change since 2011 by adding to the set of regressors an interaction term with a dummy taking the value 1 since 2011 ($D_{t\geq 2011}$):

$$y_{i,t} = a_0 + \beta X_{it} + \gamma D_{t\geq 2011} X_{it} + \mu_i + \delta_t + \varepsilon_{i,t}$$

Results are available in Table A7, while the decomposition of the implied effects for the rise in the cash ratio are provided in Table A8. We can observe that the γ coefficients are generally significant and share the same sign of the β coefficients, implying that the effects of covariates was higher in recent years. However, the enhanced responsiveness to the firm-specific factors remain minor compared with the common macro factors.

7. Concluding remarks

We have descriptively analyzed the evolution of corporate cash holdings in Italy between 2002 and 2015. While previous work on the topic mainly concerned listed companies in the US, empirical evidence on Italian firms is still scant to the best of our knowledge. We used a very large dataset containing an average of more than 460,000 non-financial firms per year, including many non-listed small and medium enterprises.

As the time interval under analysis spans from 2002 to 2015, we have been able to assess firm behavior with respect to liquidity holdings during a very interesting period which includes the recessions caused by the global financial crisis of 2008-09 and by the ensuing sovereign debt crisis. We have documented a clear and remarkable increase in the cash-to-asset ratio in the last few years of our sample (from 2011 to 2015).

We have closely analyzed the factors associated with corporate cash holdings, particularly, a set of variables at firm level related to the different motives for holding cash as identified in the existing literature, and have added other micro variables to the analysis. Using different econometric approaches and robustness checks, we have found rather robust evidence that traditional motives behind the demand for cash are at work: the transaction motive, according to which a larger firm size or greater access to cash substitutes (such as the net working capital) tends to reduce the demand for cash; the precautionary motive, which spurs firms to hold more cash when cash-flow volatility increases; and the presence of frictions in financial markets

that induce firms to retain part of their cash flow in the most liquid form and draw from it when an investment is undertaken.

We have also addressed the issue of which factors were behind the recent increase in corporate liquidity. We have shown that the recent rise in the cash ratio is a generalized phenomenon concerning a wide range of firms. It appears to be more related to macro rather than idiosyncratic factors. Among the macro factors (whose effects are more difficult to disentangle in our dataset), a strong correlation emerges with the fall in interest rates: it could be related to the lower opportunity cost of holding liquidity but it is fair to say that this relation could also be partly spurious, reflecting unmeasured factors which lead firm liquidity and interest rates to move in opposite directions.

That said, it does not imply that firm-level features do not matter: we have shown that, especially in the first part of the cash-ratio rise, the fall in investment (which is considerably funded by own liquidity) has contributed to the increase in cash. This link could have worked through both the precautionary motive and the credit-market frictions channel: cash holdings might have increased as a consequence of a wait-and-see attitude given firms' uncertainty over future demand, and/or because of the need/aim of strengthening financial and liquidity conditions after the severely challenging years of the crisis. In most recent years, when the decline in investment became milder and eventually reversed, the rise in liquidity was sustained by the strengthening of the deleveraging process undertaken by many firms and by improved cash flows levels.[43]

Our findings have implications for our understanding of the deleveraging process undertaken by firms. If cash can be considered a negative debt, a measure of net leverage based on net debt (i.e.: financial debt minus cash) would show an even sharper deleveraging due to the increase in corporate liquidity. This lowering effect of cash on net leverage turns out to be fairly widespread across firm distribution, as revealed by a comparison of the distributions of gross and net leverage. All in all, we can argue that, taking into account the higher relevance of cash, the decrease in the leverage of Italian non-financial firms appears to be particularly strong. This underlines the importance of not overlooking cash holdings in assessing firms' net debt and the inheritance of the crisis on firms' financial structure.

[43] Firm turnover has also played a role: new entrant firms initially have a higher liquidity level than outgoing firms for reasons related to firm life cycle (firms exiting the market may experience liquidity shortages in the last part of their life cycle, while newborn firms may initially have liquidity to undertake the necessary investments for future years).

APPENDIX

Tables

Table A1

Dataset Description

Type	Variable	Name	Description	Source
Dep var	*liquid*	Cash holdings	Ratio between cash and liquid financial assets	Cerved
Firm specific	*size*	Firm size	Log of total assets	Cerved
	volatility	Volatility of firm's cash flow	Ratio between standard deviations of cash flows in the previous three years over total assets	Cerved
	cashflow	Cash flow to asset	Ratio between EBITDA net of financial debt interest payments, taxes, dividend distribution, plus other (non-ordinary) net earnings and total assets	Cerved
	inv	Net Investment	Ratio between yearly change in tangible and intangible assets and total assets	Cerved
	nwc	Net working capital	Ratio between current assets (net of cash and liquid financial securities) minus current liabilities and total assets, normalized by total assets	Cerved
	leverage	Leverage	Ratio between financial debts and the sum of financial debt and net worth	Cerved
	loss	Loss	Dummy (1 if net earnings are negative)	Cerved
	divpay	Dividend payment	Dummy (1 if part of dividends are paid)	Cerved
	intang	Intangible assets expenditure	Ratio between yearly change in intangible assets and revenues	Cerved
	bond_sh	Bank debt incidence	Ratio between outstanding bonds issued and total financial debts	Cerved
Macro	*gdp_gr*	GDP growth	GDP growth rate (chain-linked volumes, 2010)	Istat
	T-bill	T-bill	Average rate of 6-month T-Bill (at issuance) in the year	Bank of Italy
	mkt_vol	Money market volatility	Standard deviation of daily data on 3-month Euribor rate in the year	ECB
	b_lend_yield	Bank lending yield	Average bank lending yield to non-financial corporations (≠ c/c) in the year	Bank of Italy

Table A2

Aggregate, Average and Median Cash and Leverage

(per cent)

Year	Aggregate Cash Ratio	Average Cash Ratio	Median Cash Ratio	Aggregate Leverage	Average Leverage	Median Leverage	Aggregate Net Leverage	Average Net Leverage	Median Net Leverage
2002	5.5	12.0	4.7	51.6	52.6	55.2	47.5	50.9	63.0
2003	5.4	11.7	4.5	51.0	52.7	56.1	47.1	50.0	63.4
2004	5.8	12.0	4.6	51.6	53.5	56.5	47.5	49.4	63.2
2005	6.1	12.4	5.0	51.8	53.1	55.9	47.4	51.1	62.9
2006	5.9	12.7	5.2	52.0	51.1	56.1	47.7	47.7	63.3
2007	6.0	12.6	5.1	53.8	52.6	56.5	49.6	49.4	63.6
2008	5.4	12.0	4.4	52.4	51.6	53.6	48.8	46.3	60.0
2009	6.0	12.2	4.5	52.5	51.3	52.4	48.6	47.5	58.8
2010	5.9	12.4	4.7	52.1	51.6	51.6	48.1	41.0	58.0
2011	5.6	12.3	4.7	53.0	48.9	50.0	49.4	42.1	56.7
2012	6.1	12.3	4.5	52.7	48.0	47.4	48.5	38.2	53.9
2013	6.7	13.0	5.0	51.5	46.1	43.9	46.9	37.9	51.7
2014	7.4	13.7	5.7	49.7	43.1	40.9	44.7	35.9	49.4
2015	7.9	14.8	6.6	47.9	42.7	39.0	42.2	35.4	47.3

Source: Authors' computations based on Cerved Group data. See Appendix for dataset details.

Table A3

Cash ratio by firm size

(per cent)

	Aggregate			Average		
Year	Small	Medium	Large	Small	Medium	Large
2002	7.6	6.0	4.3	12.3	7.2	5.6
2003	7.3	6.8	3.9	12.0	7.2	5.4
2004	7.7	6.5	4.6	12.3	7.6	5.9
2005	8.2	6.7	4.8	12.7	7.8	6.1
2006	7.9	6.9	4.5	13.0	7.9	6.2
2007	7.9	6.5	5.0	12.9	7.5	6.1
2008	6.9	5.6	4.5	12.3	7.0	5.6
2009	7.0	6.4	5.2	12.4	7.6	6.4
2010	7.1	6.6	5.0	12.6	7.9	6.3
2011	7.0	6.4	4.6	12.6	7.6	6.0
2012	7.1	6.6	5.4	12.5	7.9	6.2
2013	7.7	7.8	5.8	13.2	8.9	7.0
2014	8.5	8.4	6.6	14.0	9.6	7.4
2015	9.2	9.1	6.9	15.1	10.4	8.2

Source: Authors' computations based on Cerved Group data. See Appendix for dataset details.

Table A4

Summary of descriptive statistics (1)

Variable	Obs	Mean	Std. Dev.	Min	Max	Within std	Btw Std
liquid	6,472,572	0.1259	0.1777	0.0000	1.0000	0.1008	0.1693
size	5,105,480	6.4681	1.7274	0.0000	18.2542	0.4161	1.6502
volatility	4,350,733	0.0516	0.0731	0.0000	0.4565	0.0459	0.0734
cash flow	5,105,480	0.0407	0.1382	-0.5913	0.5839	0.0989	0.1349
inv	4,813,107	0.0078	0.1124	-0.2962	0.9632	0.0951	0.0884
nwc	5,105,480	-0.0037	0.3727	-1.5250	0.9919	0.2121	0.3654
leverage	5,033,979	0.5206	0.4429	0.0000	2.8750	0.2487	0.4357
loss	5,105,480	0.3139	0.4641	0.0000	1.0000	0.3576	0.3544
divpay	5,105,480	0.0407	0.1977	0.0000	1.0000	0.1413	0.1350
intang	4,960,309	-0.0025	0.0574	-0.3299	0.3532	0.0471	0.0491
bond_sh	5,105,480	0.0736	1.2450	0.0000	501.5000	0.7964	0.8822

(1) Summary of the descriptive statistics for the variables used in the regressions in Sections 4, 5 and 6. Variables are described in Table A1. The following variables are winsorized each year at the 1st and 99th percentile: volatility, cash flow, Inv, nwc, dimifatt; leverage is winsorized as described in Section 4. Sample ranges from 2002 to 2015.

Table A5

Robustness check (1)

	baseline (1)	non-linear (2)	dynamic (3)	almost-always (4)	medium-big (5)	industrial (6)
size	-0.012***	-0.012***	-0.009***	-0.009***	-0.002**	-0.007***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.001]
volatility	0.041***	0.043***	0.028***	0.053***	0.038***	0.062***
	[0.002]	[0.002]	[0.002]	[0.004]	[0.007]	[0.005]
cash flows	0.156***	0.157***	0.152***	0.182***	0.153***	0.171***
	[0.001]	[0.001]	[0.001]	[0.002]	[0.004]	[0.002]
inv	-0.141***	-0.130***	-0.161***	-0.130***	-0.091***	-0.114***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]
nwc	-0.178***	-0.178***	-0.172***	-0.187***	-0.167***	-0.172***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.001]
leverage	-0.047***	-0.047***	-0.032***	-0.072***	-0.061***	-0.055***
	[0.000]	[0.000]	[0.000]	[0.001]	[0.001]	[0.001]
inv_squared		-0.030***				
		[0.002]				
liquid (t-1)			0.299***			
			[0.001]			
Constant	0.197***	0.199***	0.136***	0.194***	0.125***	0.156***
	[0.002]	[0.002]	[0.002]	[0.004]	[0.007]	[0.004]
Time dummies	YES	YES	YES	YES	YES	YES
Observations	3,988,049	3,988,049	3,988,049	1,371,391	401,087	935,017
R-squared	0.154	0.154	0.238	0.16	0.143	0.143
Number of groups	774,544	774,544	774,544	114,833	125,732	151,748

(1) In all the regressions the dependent variable is the cash ratio (liquid) at the end of period t. In column (4) the sample is restricted to firms present in at least 12 out of 13 years. In column (5) the sample is restricted to medium or big firms defined as those with at least €10 million sales per year. In column (6) the sample is restricted to firms operating in the industrial sector. Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table A6

Decomposition of the rise in cash ratio from 2011 to 2015

	2012			2013			2014			2015		
	Lower	Central	Upper	Lower	Central	Upper	Lower	Central	Upper	Lower	Central	Upper
Size	-0,005	-0,005	-0,005	0,039	0,037	0,036	-0,021	-0,021	-0,020	-0,051	-0,049	-0,047
Vol	-0,001	-0,001	-0,001	-0,006	-0,007	-0,008	-0,014	-0,016	-0,017	-0,017	-0,019	-0,020
Cash flow	-0,103	-0,104	-0,105	-0,095	-0,096	-0,097	0,013	0,013	0,014	0,181	0,183	0,185
Inv	0,082	0,081	0,080	0,098	0,097	0,096	0,064	0,063	0,062	0,011	0,011	0,011
Nwc	-0,047	-0,047	-0,046	-0,030	-0,030	-0,030	-0,138	-0,137	-0,136	-0,278	-0,276	-0,274
Leverage	0,032	0,031	0,031	0,071	0,070	0,069	0,166	0,164	0,161	0,253	0,249	0,245
Loss	-0,002	-0,002	-0,002	-0,021	-0,021	-0,020	-0,014	-0,013	-0,013	0,024	0,023	0,023
Divpay	-0,001	-0,001	-0,001	-0,002	-0,002	-0,002	-0,001	-0,001	-0,001	0,001	0,001	0,001
R&d	0,000	0,000	0,000	0,001	0,000	0,000	0,001	0,000	0,000	0,001	0,001	0,000
Obbpass	0,000	0,000	-0,001	0,000	-0,001	-0,001	0,000	0,000	-0,001	0,000	0,000	0,000
Firm var	**-0,045**	**-0,048**	**-0,050**	**0,053**	**0,048**	**0,042**	**0,056**	**0,053**	**0,050**	**0,124**	**0,124**	**0,123**
Gdp	-0,240	-0,237	-0,233	-0,163	-0,161	-0,158	-0,034	-0,034	-0,033	0,011	0,011	0,011
T-bill	0,656	0,659	0,662	1,313	1,319	1,325	1,611	1,619	1,626	1,862	1,871	1,879
Mkt-vol	0,000	-0,002	-0,004	0,000	0,002	0,005	0,000	0,001	0,003	0,000	0,002	0,004
Bk_lend	0,106	0,106	0,107	0,062	0,062	0,062	-0,070	-0,070	-0,071	-0,371	-0,373	-0,375
Residual	-0,555	-0,559	-0,562	-0,595	-0,603	-0,610	-0,239	-0,241	-0,244	0,612	0,613	0,613
Time FE	**-0,033**	**-0,032**	**-0,030**	**0,616**	**0,620**	**0,623**	**1,268**	**1,274**	**1,281**	**2,114**	**2,123**	**2,132**
Firm FE	**-0,001**	**-0,001**	**0,000**	**0,006**	**0,008**	**0,011**	**0,057**	**0,057**	**0,057**	**0,155**	**0,153**	**0,150**
Predicted	**-0,079**	**-0,080**	**-0,080**	**0,675**	**0,676**	**0,676**	**1,380**	**1,383**	**1,387**	**2,393**	**2,399**	**2,405**
Actual	**-0,080**	**-0,080**	**-0,080**	**0,676**	**0,676**	**0,676**	**1,383**	**1,383**	**1,383**	**2,399**	**2,399**	**2,399**

Allowing for slope changes since 2011 (1)

	Fixed Slope	Slope Change
	(1)	(2)
size	-0.013***	-0.013***
	[0.000]	[0.000]
volatility	0.044***	0.035***
	[0.002]	[0.002]
cash flow	0.154***	0.123***
	[0.001]	[0.001]
inv	-0.144***	-0.116***
	[0.001]	[0.001]
nwc	-0.180***	-0.178***
	[0.001]	[0.001]
leverage	-0.045***	-0.039***
	[0.000]	[0.000]
loss	-0.011***	-0.007***
	[0.000]	[0.000]
divpay	0.008***	0.008***
	[0.000]	[0.000]
intang	-0.003**	-0.002
	[0.001]	[0.002]
bond_sh	0.001***	0.001***
	[0.000]	[0.000]
size_D		-0.002***
		[0.000]
volatility_D		0.041***
		[0.003]
cash flow_D		0.077***
		[0.002]
inv_D		-0.087***
		[0.002]
nwc_D		-0.011***
		[0.001]
leverage_D		-0.011***
		[0.000]
loss_D		-0.010***
		[0.000]
divpay_D		-0.001
		[0.001]
intang_D		0.004
		[0.003]
bond_sh_D		0.000***
		[0.000]
Firm dummies	YES	YES
Time dummies	YES	YES
Observations	3,860,004	3,860,004
R-squared	0.154	0.187
Number of groups	756,216	756,216

(1) In all the regressions, the dependent variable is the cash-to-asset ratio at the end of year t. All flow variables are taken between t-1 and t; stock variables are taken at the end of year t-1. Estimations refer to the whole sample from 2002 to 2014. Robust standard errors clustered at the firm level are used. The dummy D takes the value 1 since 2011 (its inclusion implies that a year dummy is dropped for collinearity). For details on the dataset see Table A1. Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table A8

Decomposition of the rise in cash ratio between 2011 and 2015 allowing for slope change (1)

	2012			2013			2014			2015		
	Lower	Central	Upper	Lower	Central	Upper	Lower	Central	Upper	Lower	Central	Upper
Size	-0,005	-0,005	-0,005	0,038	0,037	0,035	-0,021	-0,020	-0,019	-0,051	-0,049	-0,047
Vol	-0,001	-0,001	-0,001	-0,005	-0,006	-0,006	-0,011	-0,012	-0,014	-0,013	-0,015	-0,017
Cash flow	-0,082	-0,083	-0,085	-0,075	-0,077	-0,078	0,011	0,011	0,011	0,144	0,146	0,149
Inv	0,067	0,066	0,064	0,080	0,079	0,078	0,052	0,051	0,050	0,009	0,009	0,009
Nwc	-0,046	-0,046	-0,046	-0,030	-0,029	-0,029	-0,137	-0,136	-0,135	-0,275	-0,273	-0,271
Leverage	0,028	0,028	0,027	0,062	0,061	0,060	0,147	0,144	0,141	0,224	0,219	0,215
Loss	-0,001	-0,001	-0,001	-0,014	-0,013	-0,012	-0,009	-0,008	-0,008	0,015	0,014	0,014
Divpay	-0,001	-0,001	-0,001	-0,002	-0,002	-0,003	-0,001	-0,001	-0,001	0,001	0,001	0,001
Intang	0,000	0,000	0,000	0,000	0,000	0,000	0,001	0,000	0,000	0,001	0,000	0,000
Obbpass	0,000	-0,001	-0,001	-0,001	-0,001	-0,001	0,000	0,000	-0,001	0,000	0,000	0,000
Firm var	**-0,041**	**-0,045**	**-0,048**	**0,056**	**0,049**	**0,043**	**0,032**	**0,028**	**0,024**	**0,054**	**0,053**	**0,052**
γ Size	-0,001	-0,001	-0,001	-0,006	-0,007	-0,008	-0,012	-0,015	-0,017	-0,015	-0,018	-0,021
γ Vol	-0,001	-0,052	-0,054	-0,046	-0,048	-0,050	0,006	0,007	0,007	0,087	0,091	0,095
γ Cash flow	-0,050	0,049	0,047	0,061	0,059	0,057	0,040	0,038	0,037	0,007	0,007	0,007
γ Inv	0,051	-0,003	-0,002	-0,002	-0,002	-0,002	-0,009	-0,008	-0,007	-0,018	-0,016	-0,015
γ Nwc	-0,003	0,008	0,007	0,018	0,017	0,015	0,043	0,039	0,036	0,065	0,060	0,054
γ Leverage	0,008	-0,002	-0,001	-0,019	-0,018	-0,017	-0,012	-0,011	-0,011	0,021	0,020	0,019
γ Loss	-0,002	0,000	0,000	0,001	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
γ Divpay	0,000	0,000	-0,001	0,000	0,000	-0,001	0,000	-0,001	-0,001	0,000	-0,001	-0,001
γ Intang	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
γ Obbpass	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
γ firm-effect	**0,004**	**-0,001**	**-0,006**	**0,008**	**0,002**	**-0,005**	**0,056**	**0,049**	**0,043**	**0,147**	**0,142**	**0,138**
Gdp	0.135	0.170	0.206	0.091	0.116	0.140	0.019	0.024	0.029	-0.006	-0.008	-0.009
T-bill	0.889	0.908	0.928	1.777	1.816	1.855	2.181	2.229	2.277	2.521	2.577	2.632
Mkt-vol	-0.354	-0.385	-0.415	0.404	0.438	0.473	0.217	0.236	0.254	0.325	0.353	0.381
Bk_lend	0.207	0.215	0.223	0.121	0.125	0.130	-0.137	-0.142	-0.147	-0.727	-0.755	-0.782
Residual	-0.887	-0.917	-0.947	-1.725	-1.823	-1.921	-0.946	-1.006	-1.066	0.056	0.009	-0.037
Time FE	**-0,011**	**-0,008**	**-0,006**	**0,668**	**0,673**	**0,677**	**1,335**	**1,341**	**1,348**	**2,169**	**2,176**	**2,184**
Firm FE	**-0,027**	**-0,027**	**-0,027**	**-0,048**	**-0,046**	**-0,044**	**0,014**	**0,014**	**0,014**	**0,171**	**0,170**	**0,168**
Predicted	**-0,079**	**-0,080**	**-0,081**	**0,676**	**0,676**	**0,676**	**1,381**	**1,383**	**1,386**	**2,394**	**2,399**	**2,404**
Actual	**-0,080**	**-0,080**	**-0,080**	**0,676**	**0,676**	**0,676**	**1,383**	**1,383**	**1,383**	**2,399**	**2,399**	**2,399**

(1) The slope change is denoted by the gamma effect. See Section 6.

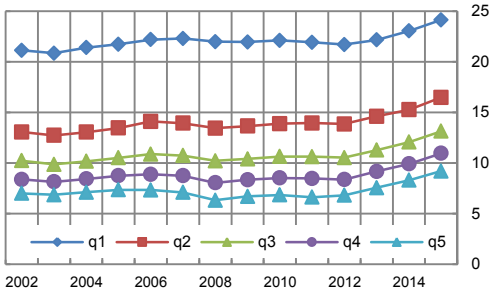
Figures

Figure A1

Average cash ratio by… (1)

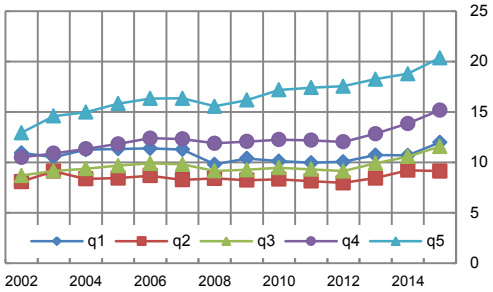
(per cent)

firm size quintiles



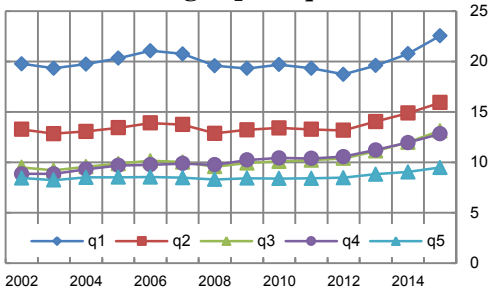
Firm size is measured by total assets

cash flow quintiles



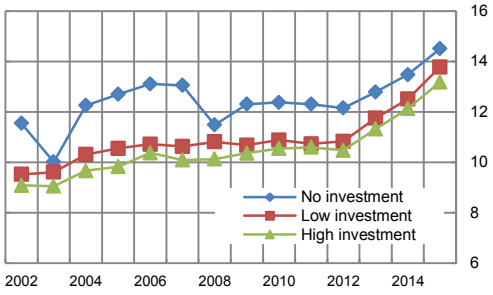
Cash flows are computed as earnings after financial debt interest payments, taxes and dividend distribution but before amortization and depreciation, plus other (non-ordinary) net earnings. Cash flows are normalized by total assets.

net working capital quintiles



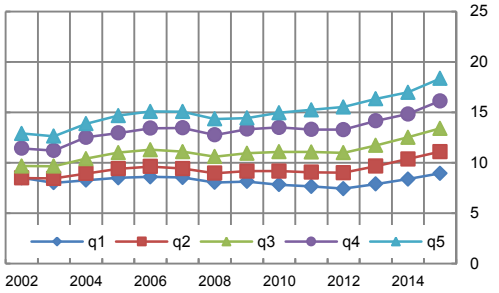
Net working capital is computed as current assets (net of cash and liquid financial securities) minus current liabilities, normalized by total assets

investment class



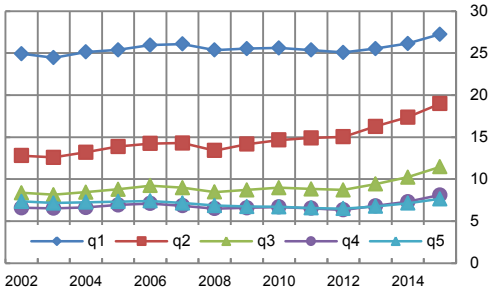
Investment classes are computed on the basis of the annual change in tangible and intangible assets over total assets: the no investment class is assigned when the ratio is negative; the low (high) investment class corresponds to a ratio below (above) the median taken of positive ratios in each year. The 2003 and 2008 data is interpolated because of a monetary re-evaluation of tangible and intangible assets which occurred in that year.

cash flow volatility quintiles



Cash flow volatility is computed as a 3-year rolling standard deviation of cash flow to total assets. At least 3 valid observations are required.

leverage



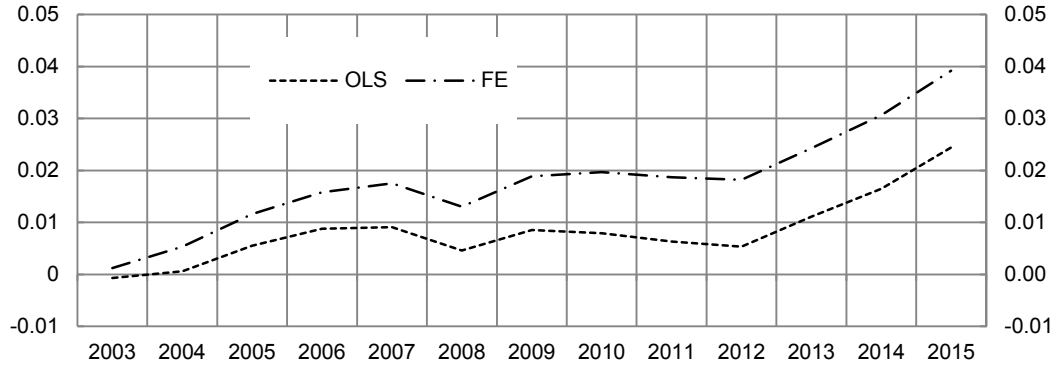
Leverage is defined as the ratio between financial debt and the sum of financial debt and net worth. Leverage is ensured to be non-negative as described in Section 4.

Source: Authors' computations on Cerved Group data.
(1) Cash and liquid financial assets over total assets.

Figure A2

Year dummy coefficients (1)

(point estimate)



Source: OLS and FE estimation described in Table 1.

(1) The year 2002 is used as reference.

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