Corporate cash holdings in Italy and their evolution during the crisis

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Summary

In this paper we analyze the evolution 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 2002-14 (over 450 thousands firms per year on average), we document a substantial increase in cash holdings, especially in the last three years of the period under analysis. We relate our findings to different motives to hold cash, such as precautionary reasons, presence of transaction costs, and effects of information asymmetries in financial markets. Our findings suggest that, while the liquidity rise is mainly due to the lower opportunity cost of holding cash (measured by the interest rates' decline), the fall in investment was the firm-specific factor that mattered the most. Due to the increase in corporate liquidity, the reduction of firms' leverage observed in recent years turns to be even sharper in terms of net debt ratio.

Index

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1. Introduction[1]

The recent global financial crisis and the sovereign debt crisis have drawn renewed attention to corporate liquidity management. Even if liquidity management is a mature topic,[2] academic work on this issue has spurred in the last 10 years, recognizing that the evolution of cash management has important economic implications.

First of all, the way firms administered their cash balances proved to be crucial for corporate survival in the years of the recent crisis, with the purpose of maintaining financial flexibility while credit markets were drying up.

Also, the analysis of corporate cash holdings is relevant for our understanding of the leverage 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, the debt is usually considered irrespective 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). If we adopt the alternative measure the decrease of leverage observed (in Italy and in many other countries) in more 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 study of corporate cash holdings has been analyzed thoroughly most of all for US firms. The literature has recognized a number of firm-specific characteristics that can explain corporates' demand for cash. These "cash determinants" are in fact related to the most important motives for holding cash identified by the economic theory, like the presence of transaction costs, asymmetric information in credit markets, uncertainty and risk aversion. In a complete and perfect markets world à la Arrow-Debreu, cash would be perfectly replaceable and its weight on firm's balance sheets would not matter much, as in the Modigliani-Miller theorem. But in the real world, transaction and precautionary reasons induce firms to hold liquid reserves.

In this paper we investigate the evolution of the cash holdings of Italian firms from 2002 to 2014, for which the evidence is still scant, to the best of our knowledge. We believe that Italy represents a very interesting case to study corporate liquidity, because of both structural and cyclical reasons: financial markets are less developed than in the US, there is a huge proportion of small non-listed firms, and in recent years the economic recession mixed with credit market downturns has severely challenged firms' financial conditions. Using a balance sheets dataset, we are able to covers a very large number of firms, averaging at about 460 thousands per year. Differently from previous studies based on surveys or restricted to listed

[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 thank Massimo Marcozzi for research assistance, Claudia Pigini and Elizabeth J. Casabianca (Polytechnic University of Marche) for helpful suggestions. All remaining errors are ours.

[2] As remembered by Campello (2015) it has been discussed at least since Keynes' examination in the 1930s.

corporates, we thus have the opportunity to account for much more firms, including many that are not listed.

We document an increase of cash holding (measured by the cash to assets ratio), particularly sharp in the final years of the period under analysis. This fact turns out not to be simply due to composition effects related to entrance and exit of firms, but significantly holds also within firms present in the whole interval.

After showing the pairwise relation between liquidity and cash determinants, we estimate a panel data model to isolate their effects *ceteris paribus* and identify the most important ones. In a nutshell, the econometric analysis suggests that, while a substantial contribution to the liquidity rise was given by the fall in the opportunity cost of holding cash (measured by the decrease in interest rates), among firm-specific variables a major role was played by the fall in investments. In the final years of the examined period, firms not only reduced their capital expenditure by a sizeable amount but also had a higher propensity to cumulate cash when they refrain from investing.

Our results are qualitatively similar to those found by Bates et al. (2009) for US firms, but with some important differences, concerning the relative ranking of cash determinants. This suggests that, while there are robust and sound determinants of firms liquidity across space and time, their relative importance may differ. In particular, in the Italian case it seems that capital expenditure and the cash-flow amounts matter more, while in the US other factors counts more, such as the R&D expenditure and idiosyncratic volatility.

The paper is organized as follows. In Section 2 we review extant literature on the determinants of cash holdings. Section 3 describes the sample at our disposal and provides a descriptive analysis. In Section 4 we present our econometric model and estimates. Section 5 discusses the main determinants of the significant increase of cash holdings we observed in the last years of our sample. Section 6 concludes.

2. Literature review

Questions like how much cash firms hold and why they change it over time, have attracted growing attention in the literature, given the evidence of a considerable increase in the cash share of assets of US corporations (see Almeida et al., 2014).

The increasing trend in cash holdings might look puzzling at a glance. Recalling the traditional transaction (Baumol, 1970; Miller and Orr, 1966) and precautionary (Keynes, 1936) motives to hold cash, firms could have been expected to hold less cash than in the past after improvements in financial markets, reductions in transaction costs, increased supply of alternatives to cash (derivatives, credit lines, debt capacity, etc.). Nevertheless, as shown in Almeida et al. (2014), the precautionary motive for holding cash can still be effective since cash proved to be not that easy to substitute: the availability of derivatives is limited only to risks traded in the market and involve counterparty risks. Also, credit lines may spillover bank

troubles to firms and may be subject to aggregate liquidity risk (Demiroglu and James, 2011).[3] Finally, debt capacity may fail to be viable when it is needed the most.[4]

Another motive to hold cash is related to financial market imperfections as a consequence of asymmetric information (Holmström and Tirole, 2011). External and internal funds are not perfect substitutes (Fazzari et al, 1988), as firms cannot credibly pledge their future cash flows nor communicate private information to outsiders (Chirinko and Schaller, 1995) because of moral hazard issues. This kind of agency costs generates financial frictions so that the access to external liquidity to cope with current or future financing needs is limited or particularly expensive, thus boosting a demand for cash reserves (Almeida et al., 2011).[5] The presence of financial constraints has been linked to the concept of the "cash-flow sensitivity" of cash (Almeida et al., 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.

Since the seminal work by Opler et al. (1999), these motives have been investigated by assessing the impact of a set of firm characteristics on corporate liquidity, linked to the different reasons to demand cash. To mention a few (see Sections 3 and 4 for a more detailed explanation of the links between them and cash holdings), firm size, capturing possible economies of scale in cash management, could be related to transaction cost models, while cash-flow volatility, connected to idiosyncratic uncertainty, could be associated to precautionary reasons. In an influential article, Bates et al. (2009) argue that changes in firm-specific features explain most of the increase in cash to assets ratios in the 2000s. In particular, they find that major roles were played by the decrease in net working capital and capital expenditures and by the increase in cash flow risk and R&D activity.[6]

In a more recent study, Graham and Leary (2015) extend the temporal depth of the analysis and highlight the role played by firm turnovers (in particular the entrance of small and high-tech investing firms) and by macro variables, which appear to have a greater explanatory power in the longer horizon. Extensions on this stream of literature have addressed the roles of economies of scope (Subramaniam et

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

[4] Also the liquidity provided through short term liabilities (e.g.: commercial papers and short term ABS) can decline suddenly and can be severely affected by demand shocks, like the runaway 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 haircut: it can dramatically decrease the actual liquidity under fire sales dynamics. Acharya et al. (2007) show that cash stocks and debt capacity are not equivalent when there is uncertainty about future cash flows.

[5] 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 evidence.

[6] 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.

al., 2011), expectations over future financial market tensions (Ang and Smedema, 2011), and cross-border activities (Pinkowitz et al., 2016).[7] Other works have put forward strategic motives to hold cash in order to gain competitive advantages, also with respect to mergers and acquisitions.[8]

Generally, these studies refer to listed corporates or are based on ad hoc surveys, thus not covering a large number of firms. On the one hand, this allows to include forward looking variables as a proxy for growth opportunities (e.g.: the market-to-book assets ratio); on the other hand, it leaves little or nothing to say about non-listed firms. Differently, in our dataset we have a very large number of non-listed firms, operating in a context with less developed capital markets than in the US.

Our findings on cash determinants are consistent with those found in previous works, but with a greater relative role played by investments. Theoretically, there are several channels through which capital expenditure might impact liquidity holdings. In presence of asymmetric information and capital market imperfections, investments drive the firm to use its own liquidity (Hubbard, 1998). Capital expenditures could create assets that can be used as collateral, increasing debt capacity and reducing the demand for cash (Bates et al., 2009). As shown by Riddick and Whited (2009), following a positive productivity shock, firms tend to invest more and save less. Moreover, cash holdings may increase following wait-and-see attitudes, when firms are not willing to invest given their expectations over future demand and at the same time they face a low opportunity cost from holding cash (a sort of liquidity-trap situation; see Krugman et al. 1998). All these links point out to a negative relationship between cash holdings and investment. Conversely, a positive connection may emerge if the propensity to invest is itself a proxy for firm characteristics affecting its economic strength.[9]

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[7] 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 holding according to the probability of future recessions. Pinkowitz et al. (2013) find that multinational firms tend to hold more cash. This could be partly related with fiscal issues, such as repatriation taxes which foster to keep cash in subsidiaries abroad (Foley et al., 2007).

[8] Morellec et al. (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 as they can access part of the target firm's income that cannot be pledged outside the industry. Erel et al. (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 et al. (2015) study if some firms acted as liquidity providers to their suppliers during the crisis, without finding robust evidence.

[9] We are able to purge from this (spurious) effect through panel data techniques (see Section 4). While we highlight the impact of investments on cash, the relationship between them was studied also (and more extensively) the other way round (Fazzari et al., 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* is not a significant determinant of investment, but it affects them positively by reducing the short net debt position. With all the caution due to the use of different samples, these works hint at moderating reverse causality issues by suggesting that, if any, the casual impact of investment on liquidity holdings could be even bigger than the one we estimate because of attenuation bias (see Section 4).

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 firms' liquidity. Duchin et al. (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 lower access to credit lines.[10]

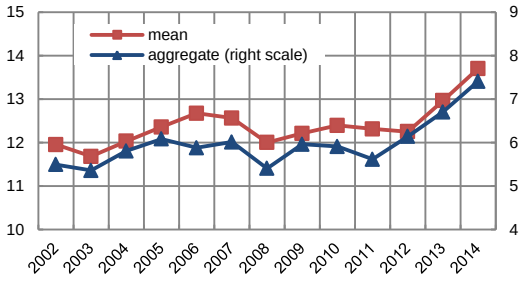
3. Dataset and descriptive statistics

We use a dataset from 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 public and private limited liability companies. The information provided includes company profiles and summary financial statements (balance sheets, income statements and financial ratios). We restrict the analysis to non-financial private firms. We have an unbalanced panel from 2002 to 2014, with a number of firms ranging from about 350 thousands in 2002 to more than 530 thousands in 2011 and 2012 averaging at about 460 thousand 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 financial assets.[11] For the sake of brevity, hereafter we refer to it as the firm's liquidity or (broadly speaking) as cash ratio.

As shown in Figure 1, the average cash ratio remained more or less stable in the decade between 2002 and 2012, scoring around 12 per cent, with a slightly increasing trend in the years before the crisis interrupted by a fall with the inception of the financial crisis. Then, after some years of roughly steady levels, in the last couple of sample years an upward trend has clearly emerged, with an average increase by about 2 percentage points, reaching 14 per cent.

Figure 1

Cash to assets ratio (1)
(per cent)



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

[10] 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 relation, 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).

[11] 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.

A similar pattern holds if we look at the aggregate cash ratio, for which the rise in recent years seems to begin earlier and appears even sharper, moving from 5.6 to 7.4 per cent between 2011 and 2014. The aggregate cash ratio is lower in level than the average one, suggesting an inverse relation between the cash ratio and the firm size. We find that this trend was not merely due to composition effects, since it is only attenuated but not cancelled out when we restrict the analysis to firms present throughout the sample years.[12]

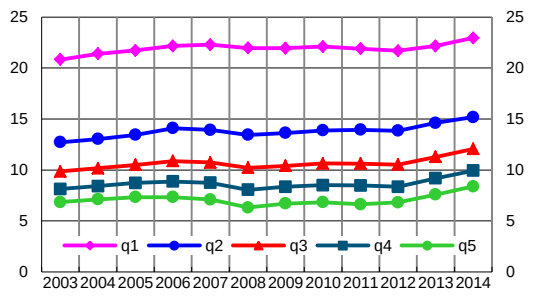
As shown in Table A1 in Appendix the increase in the cash ratio has occurred together with a decrease in firms' leverage.[13] A similar negative correlation between cash ratios and leverage has been found in previous studies (Bates et al. 2009, Graham and Leary 2015).[14] We find that on average firm leverage remained steady at about 52 per cent until 2010 and then fell by almost 10 percentage points in the years up to 2014.

As implicitly suggested by the comparison of aggregate and average cash ratios and as pointed out by the literature on transactional motives to hold cash,[15] corporate liquidity can be expected to be in an inverse relation with firm size. If there are economies of scale in cash management, bigger firms should be able to operate holding less cash.

As shown in Table A2, there is empirical evidence in this sense also for Italian firms: large firms show lower cash ratios than medium and small firms. In aggregate terms, the cash-holdings differential between large and small firms was above 3 percentage points in the first part of the sample, then shrinking at less than 2 points at the end of the sample, mainly because of a steeper increase in cash holdings for large firms. In average terms, the differential is even greater although more stable through time.

Figure 2

Average cash ratios by firm size quintiles
(per cent)



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

In Figure 2 we show the dynamics of average cash holdings over time according to firm-size quintiles. We can observe that: (i) the quintile-wise average cash ratio is monotonically decreasing in the firm size class in each and every year and (ii) time patterns and in particular the rising trend of later years appears very similar across all quintiles.

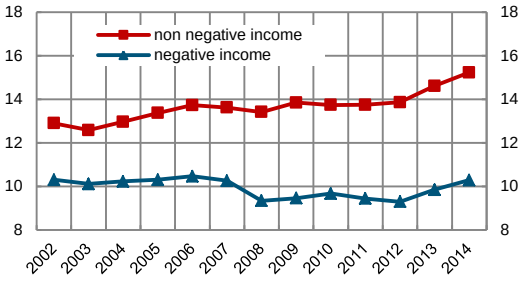
[12] Performing a simple regression of the average cash ratio on a time trend and a constant, we find a 5% significant positive coefficient of 0.10% and an R^2 of 47%.
[13] We compute leverage as the ratio between financial debts and the sum of financial debt and net worth.
[14] Running a simple regression of leverage on a time trend we obtain a negative and 1% cent significant coefficient of -0.80% and an R^2 of 77%.
[15] See e.g.: Vogel and Maddala (1967) and Miller and Orr (1966).

In comparing firms with a positive economic result to those with a negative one, on the one hand, it is expected that corporates with an economic loss are more likely to be financially constrained and hence they should hold more cash (this is actually what is found for US firms by Bates et al., 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.

The latter intuition seems to fit better than the former for Italian firms, as through the years firms that experienced an economic loss tend to exhibit on average a lower cash ratio than firms with non-negative income (Figure 3). Other three interesting facts emerge: (i) the cash holding differential between the two types of firms began to increase with the crisis and it widened further in recent years; (ii) the fall in cash holding ratio at the inception of the financial crisis is mainly due to firms with negative economic results (for them the cash ratio went back to its pre-crisis levels only in 2014); (iii) the recent rise in cash holdings is mainly attributable to firms with positive economic results, suggesting a propensity to retain cash flows in the most liquid forms.

Figure 3

Average cash ratios by economic result (1)
(per cent)

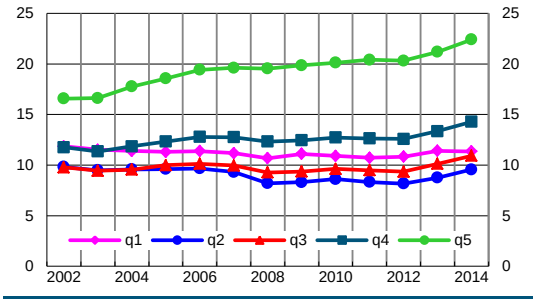


Source: Authors' computations on Cerved Group data.
(1) Economic result is defined as the net income of the year.

In this respect, it is interesting to look at the relationship between cash holdings and cash flows (Almeida et al, 2004).[16] As shown in Fig. 4, the largest cash ratios are highly concentrated in the highest quintile of the cash flow distribution; it is to this class that it is attributable most of the increase occurred in the late years.[17]

Figure 4

Average cash ratios by cash flow quintiles (1)
(per cent)



Source: Author's computations on Cerved Group data.
(1) Cash flows are computed as the EBITDA net of financial debt interest payments, taxes and dividend distribution, plus other (non-ordinary) net earnings. Cash flows are normalized by total assets.

This piece of evidence suggests that firms with higher cash flows are more willing to retain it in form of cash. While this is just a stylized fact, the explanation behind it may not be unique: the perception of a greater uncertainty, the

[16] We compute cash flow as the EBITDA net of financial debt interest payments, taxes and dividend distribution, plus other (non-ordinary) net earnings; like for cash holdings, we normalize cash flows by total assets.

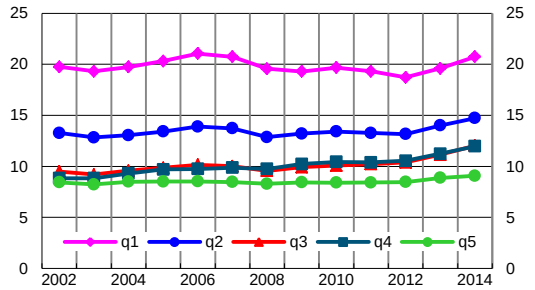
[17] For the other classes, the cash ratio is not monotonically sorted. Since the use of cash-flow could be lumpy, this evidence might be driven mechanically by the simultaneity in the measurement of cash flows and cash ratios. Nonetheless, basically the same pattern can be observed if we compute quintiles based on 1-year lagged cash flows. Results are available from the authors upon request.

perception of lack of investment opportunities, the willingness to keep liquid resources in fear of possible troubles in liquidity provision or, of course, a combination of the previous factors.

When considering the ways in which a firm can cope with its liquidity needs, it is important to take into account that holding cash is not the only possibility. Another instrument commonly considered in the literature as a covariate of cash is the net working capital, which is given by current assets (net of cash and liquid financial securities) minus current liabilities and normalized by total assets. It is related to the transactional demand for cash and it is generally interpreted as a substitute for cash, thus implying a negative relationship with cash ratios. When we plot cash-holdings by net working capital quintiles we observe a pattern consistent with this interpretation, with a higher average cash ratio for firms in the two lowest quintiles (Fig. 5).

Figure 5

Average cash ratios by net working capital quintiles (1)
(per cent)

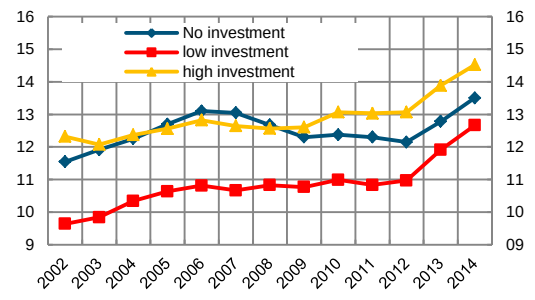


Source: Author's computations on Cerved Group data.
(1) Net working capital is computed as current assets (net of cash and liquid financial securities) minus current liabilities, normalized by total assets.

Moreover, we can observe that while a rising trend in the latest years can be detected for most classes, it is sharper for firms using net working capital the least. These are also the firms to which can be mostly attributed the fall in the cash ratio observed during the crisis. For firms that use net working capital the most, the cash ratio pattern looks quite flat across all the years. Again, this result is not mechanically driven by simultaneity, as it is confirmed when we compute quintiles based on 1-year lagged net working capital.

Figure 6

Average cash ratios by investment (1)
(per cent)



Source: Author's computations on Cerved Group data.
(1) 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 ratio below (above) the median taken of positive ratios in each year. The 2008 data is interpolated because of a monetary re-evaluation of tangible and intangible assets occurred in that year.

Firm liquidity is acknowledged to be an important source to fund investment (Riddick and Whited, 2009; Hubbard, 1998), in particular when access to external financing is limited either by financial frictions and asymmetric information as discussed in Section 2. As already mentioned, the pairwise correlation between cash holdings and capital investment is not trivial a-priori: there is obviously a negative effect whenever internal

liquidity is used to fund (part of) the investments; on the other hand, if the propensity to invest is a firm-specific characteristic, a positive relationship could be observed.[18]

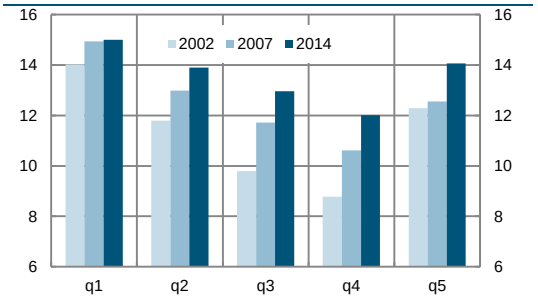
We construct a proxy for investments by taking the annual change in the balance sheet value of tangible and intangible assets over total assets.[19] When we split firms according to three investment classes (no investment, low investment, and high investment)[20] and we compute the average cash ratio for each class in every year, we observe some degree of non-linearity. Firms holding more cash are those which either do not invest at all or invest much, whereas firms featuring positive but low investments are generally characterized by lower cash ratios. Moreover, while before the crisis high investment and no investment firms showed similar cash ratio levels on average, during the crisis cash holding looks higher for high-investment firms. The uprising trend in recent years appears to be common to all classes (Fig. 6).[21]

As mentioned, according to the precautionary motive to hold cash, firms can be expected to keep more liquidity when they operate under uncertainty, in particular with respect to their own cash flows. Such an uncertainty is usually proxied by the rolling standard deviation of cash flows in the previous years: we consider the three years ending in the observation year.[22]

When we plot the average cash flow against volatility quintiles, we actually observe in every year a sort of U-shaped distribution with the higher cash holdings for firms with low and high volatility, while the cash ratios is lower for firms with moderate volatility (Fig. 7). Focusing on the increase in cash ratio in last years of our sample, it does seem to concern mostly the firms with higher cash-flow volatility, whereas in the lowest volatility quintile the

Figure 7

Average cash ratios
by cash flows volatility quintiles (1)
(per cent)



Source: Author's computations on Cerved Group data.
(1) Cash flows volatility is computed as 3 years rolling standard deviation of cash flow. At least three valid observations are required.

[18] It is hence important to control for other factors. For a deeper discussion on the linkages between firms' liquidity and investment see Section 2.

[19] In year 2008 these variable were subject to a monetary re-evaluation which created artificially a jump in the series. In order to curb this disturbance, we replaced the 2008 data with the average of the changes of tangible and intangible assets in the year before and the year after.

[20] For every year we classify a firm: (i) in 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) in the low-investment class if the ratio is below the median of firms with a strictly positive investment; (iii) in the high investment class if the ratio is above the median of firms with a strictly positive investment.

[21] Again, the result is robust if investment quantile are based on the 1 year lagged capital expenditure distribution.

[22] We consider three years instead of ten as in Bates et al. (2009) to prevent loosing many observations and to allow for a greater cyclical variability. Differently from the baseline model of Bates et al. (2009), but as done also 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.

average cash ratio did not change much.

The variables commented so far represent a core set of cash determinants at firm level according to previous literature. They are summarized in Table A3 together with other variables used in the multivariate analysis.[23]

4. Econometric analysis

The bivariate analysis has provided some suggestive evidence of the pairwise relationship between cash holdings and other firm level variables. However, we have to move to a multivariate analysis in order to isolate effects *ceteris paribus*. At first, we want to assess whether commonly acknowledged cash determinants have an explanatory power also for Italian firms and to what extent. Then, we tackle the issue of what can explain the dynamics of cash holding, in particular with respect to its increase in last years of our sample.

4.1 Baseline model of cash holding determinants

We consider the following baseline model:

$$l_{i,t} = \alpha + \boldsymbol{\beta}'\boldsymbol{X}_{i,t} + \boldsymbol{\delta}'\boldsymbol{M}_t + u_{i,t} \qquad (1)$$

where $l_{i,t}$ is the cash to asset ratio for firm *i* in year *t*, and $\boldsymbol{X}$ is a vector of firm-specific variables introduced in Section 3, namely: log of total assets (*lsize*) to control for firm size, log of cash flow volatility (*volatility*) to account for idiosyncratic risk, the cash flow to assets ratio (*cashflow*), the investment to asset ratio (*inv*), the net working capital to asset ratio (*nwc*), the leverage index (*leverage*). Like in Graham and Leary (2015), we consider flow variables a time *t* and stock variables at time *t-1*, in order to curb simultaneity issues. In Section 4.2 the vector $\boldsymbol{X}$ is augmented with other variables available in the dataset.

We also include a vector of macro variables $\boldsymbol{M}_t$ that vary with respect to time but not at the firm level; they are meant to control for the general economic context. According to Graham and Leary (2015), these factors are important in explaining variation of cash holdings through time. In our specification, the macro variables are the following: the GDP growth rate (*gdp*); the average yield on 6 month Treasury bills (*bot*) to proxy for the opportunity cost of holding cash and the average stock index volatility (*vstoxx*) to mirror surrounding macroeconomic uncertainty.[24] In order to account for any possible further (unobserved) macro factor, in several specifications

[23] While in Section 4 we add some other possible covariates, there are three variables commonly considered in this stream of literature that we cannot account for or that we can only measure approximately: (i) R&D expenditure relative to sales (which is taken as a covariate of cash ratios, since funding R&D through the external finance can be more difficult for its uncertainty and lower pledgeability) that we can only proxy by the change in intangible assets; (ii) the market-to-book assets ratio, which is just not defined for the bulk of firms in the dataset since they are not listed; (iii) the acquisition to assets, which is not available in our dataset and that should not play a major role in our context anyway.

[24] See Baum et al. (2006) for a study focusing on the impact of macroeconomic uncertainty on firms' cash holdings.

we also include time dummies: as expected, several of them (but not all) are automatically dropped because of collinearity with the macro vector $\boldsymbol{M}$.[25]

Following Bates et al. (2009), we perform baseline estimations by ordinary least squares (OLS), Fama – Mc Beth (FMB) and fixed effects (FE) estimators. In all cases robust standard errors clustered at the firm-level are considered.

The FMB estimator, based on Fama and MacBeth (1973), is often used in corporate finance; its estimates derive from the average of separate cross-section regressions at each year. In doing so, it may not account for macro variables and it does not exploit the panel data structure to control for individual unobserved heterogeneity, resulting in possible endogeneity issues.[26] Despite these drawbacks, we nonetheless perform the FMB, both because of and in order to gain some clues about whether and how coefficients changed through time.

The pooled OLS estimates takes 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 error term $u_{i,t}$. However, if the latter includes a firm-specific component of unobserved heterogeneity μ_i (i.e. $u_{i,t} = \mu_i + \varepsilon_{i,t}$) that is correlated with the regressors, the OLS estimator tends to be 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 in our dataset it is more likely that there are unobserved firm- specific features that we cannot observe.[27]

Regression results of the baseline model (1) are summarized in Table 1: in column (1), estimates are performed through a simple pooled OLS, while in column (2) year dummies are included; in columns (3) and (4) the FMB and FE estimates are shown, respectively. Across different estimators, results concerning the firm specific

[25] In every regression, we also include (without reporting it) a dummy variable for year 2008 interacted with the investment variable in order to control for the monetary evaluations of tangible and intangible assets occurred in that year (see Section 3).

[26] Moreover, in presence of serial correlation of the error terms, estimates tend to over-reject the null (Petersen, 2009). The FMB estimation is performed through the Stata routine developed by Hoechle (2011).

[27] We perform a robust Hausman test based on Mundlak (1978) as suggested in Wooldridge (2010), in order to check whether a random effects model could be used. The null hypothesis for coefficients on $\bar{X}_i$ jointly equal to zero is strongly rejected, thus suggesting to keep the FE estimator. The only coefficient for which the null cannot be separately rejected is *inv*. We also perform an exogeneity test à la Sims (1972) on model (1) where the vector $X_{i,t}$ is augmented by two lagged and two leading values of firm-specific regressors and we test whether the leading values are significantly different from zero. We find that the null hypothesis that the coefficients on the first and second leading values of *cashflow, inv, nwc, leverage* are jointly equal to zero cannot be rejected at the conventional 95 per cent level of significance.

regressors appear rather robust, to the extent that coefficients do not switch signs and significance levels are generally confirmed (except for *leverage* which is weakly significant in the first two columns and not significant in the fourth one). Coefficient signs are also consistent with expectations based on economic theory and with those found for US firms in the reference literature.

The coefficients' magnitude is also fairly similar across models except for the FMB regression (column 3) where they are generally higher in absolute values. As mentioned, the FMB, though less robust, allows to see how coefficients change through time: by inspecting year by year regressions, we observe that coefficients never switch signs and, while some of them (for instance *size* and *nwc*) remain quite steady over time, others get magnified in the later years (*cashflow, inv* and *volatility*). These patterns are consistent with what we find in Section 5 where we explicitly address the cash increase in the later years of our sample.[28]

Table 1

Regressions estimating the determinants of cash holdings: baseline model

In all regressions, the dependent variable is the cash to asset ratio at time t. Estimations refer to the whole sample from 2002 to 2014. All flow variables are taken at time t, while stock variables are taken at time t-1. Robust standard errors clustered at the firm level are used. In the Fama-MacBeth regression the average R^2 is shown. For details on the dataset see Table A4.

	(1) OLS		(2) OLS		(3) Fama-MacBeth		(4) Fixed Effect	
size	-3.051	***	-3.057	***	-2.932	***	-1.976	***
volatility	0.800	***	0.805	***	0.696	***	0.225	**
cashflow	0.506	***	0.507	***	3.299	***	0.330	***
inv	-0.510	***	-0.510	***	-1.380	***	-0.334	***
nwc	-0.499	***	-0.499	***	-1.044	***	-0.334	***
leverage	-0.963	*	-0.960	*	-2.254	***	-0.087	
gdp_growth	-0.026	***	-0.027	***			0.015	***
T-bill rate	-0.155	***	-0.127	***			-0.194	***
vstoxx index	-0.028	***	0.003				0.010	***
Year dummies	no		yes		no		yes	
Firm dummies	no		no		no		yes	
R^2	0.0755		0.0765		0.0827		0.0732	

Significance levels: *: 10%; **: 5%; ***: 1%

Focusing on results more in detail, the empirical evidence shows a negative effect of firm size. This is related to the transaction motive to hold cash and suggests the existence of **economies of scale** in cash management, so that smaller firms have to hold more cash than larger firms. Related with the precautionary motive, firms experiencing higher **idiosyncratic uncertainty**, as measured by a greater cash flow risk, tend to hold more cash *ceteris paribus*, consistently with a precautionary motive for liquidity. The point estimates suggest that a 1 per cent increase in volatility

[28] Results are available from the authors upon request.

is associated to an increase in the cash ratio ranging between 22 and 80 basis points, depending on the model. The effect is significant in every model.

A strong evidence emerges also for **cash flows levels**, which have a positive effect on the cash ratio, hinting that cash holdings is sensitive to changes in cash flows. According to the point estimate, if the cash flow to asset ratio increases by 1 percentage point, the cash ratio rises by about 33-55 basis points. As shown in Almeida et al. (2004) this positive effect may reveal the presence of credit market frictions so that firms prefer to increase their liquidity when their cash flow increases.

The coefficient on **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). Quantitatively, a 1 percentage point increase in the capital expenditure to total assets ratio is associated with a cash ratio decrease by at least 33 basis points.

It is important to note that, if any bias affects the *inv* coefficient because of potential issues of reverse causality, this would likely occur as an attenuation, so that the actual impact of investment on corporate liquidity could be even greater.[29] The impact of investment on liquidity is related to both the asymmetric information motive and the precautionary motive: the former channel holds because investments can hardly be funded entirely through external finance (for reasons discussed in Section 2) and the latter channel occurs whenever firms prefer to refrain from investing and remain liquid because of the well documented hindering effect of uncertainty on investment.[30]

The **net working capital** is confirmed to be a substitute for cash: firms which have a greater amount of net working capital available generally operate with less cash. This substitution, related to the transaction motive to hold cash, is nevertheless imperfect, as shown by the coefficient (statistically significantly) smaller than 1. The evidence on the degree of **leverage** is less strong. Although we find the expected negative sign for its coefficient, this is barely significant in the OLS regressions and non-significant in the FE one.

Coming to the **macro variables**,[31] the *T-bill rate* has the expected negative coefficient in all specifications, as it represents a proxy for the opportunity cost of holding cash. In all regressions with year dummies, the Vstoxx index has the expected positive coefficients, meaning that a greater uncertainty in the whole economy induces to hold more cash for precautionary reasons, in a complimentary

[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 from liquidity to investment since the latter is favored if more liquidity is available (Fazzari et al., 1988). This kind of relationship causes an attenuation bias in the estimate of (1). As mentioned, to limit this effect we measure cash holdings at the end of the period, while investment is taken as the period flow over initial assets.

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

[31] Including the macro variables in specifications with time dummies entails that several time dummies are automatically dropped because of collinearity.

way to idiosyncratic uncertainty (*volatility*).[32] Finally, the GDP growth rate coefficient switches sign from OLS to FE estimates; since the latter are more robust, economic growth effects could have a mild positive effect on cash holdings.

4.2 Augmented models of determinants of cash holdings

We now consider the following augmented model :

$$l_{i,t} = \alpha + \boldsymbol{\beta}'\boldsymbol{X}_{i,t} + \boldsymbol{\gamma}'\boldsymbol{Z}_{i,t} + \boldsymbol{\delta}'\boldsymbol{M}_t + u_{i,t} \quad (2)$$

where besides the vector $\boldsymbol{X}$ and $\boldsymbol{M}$ defined as in Eq. (1), we include in vector $\boldsymbol{Z}$ other variables available from balance sheets data concerning firm's economic performance and financial position. Hinging on the descriptive analysis in Section 3, we explicitly allow for non-linear effects of investments.[33]

In Table 2 we report, in the first two columns, the OLS and FE estimates from Table 1 (columns 2 and 4) as a benchmark; then in column (3) and (4) we include the squared investment (*sq_inv*) for both estimators. On top of that, in columns (5) and (6) we add the following variables[34]: a dummy for the occurrence of an economic loss in the previous year (*loss*); a dummy equal to 1 if dividends were distributed the year before (*divpay*); and a proxy of R&D activity obtained as the ratio between the annual change in the amount of intangible assets and sales (*intang*); the weight of bonds issued by the firm over its financial liabilities (*bond_share*). Similar variables have been considered in previous related works (e.g.: Bates et al., 2009).

As shown in columns (3) and (4), investments may indeed exhibit a non-linear effect even in the multivariate analysis: at small values the negative effect is largely dominant, but at higher values a contrasting positive effect grows through the coefficient on *sq_inv*. However, the latter coefficient's magnitude is very small and it can at most slightly attenuate the negative impact rather than reverse it. Noticeably, all other coefficients are comparable to those of the benchmark specification.

Moving to column (5) and (6), we find that the added variables have some explanatory power. Consistently with the descriptive analysis, firms that have experienced an economic loss show lower cash ratios. A possible explanation is that corporates draw from their liquidity after an economic loss or that the loss signals a period of the firm's poor performance. Conversely, a positive relationship with cash ratio is shown by the dividend payout: firms that distributed dividends tend to have a greater cash ratio. This is only apparently counterintuitive since dividend distribution is (conveniently) more likely to happen when the liquidity situation is sound.[35]

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[32] The macro uncertainty factor captured by *vstoxx* is different from volatility also because it is forward looking based.

[33] The descriptive analysis hints at a possible non-linear effect also of cash flow volatility. This is nonetheless partly captured in the regressions as volatility is taken in logs.

[34] All variables are taken at *t-1* in order to curb simultaneity issues.

[35] Noticeably, in the US context analyzed by Bates et al. (2009) the effects are reversed: the loss and dividend dummies have respectively a positive and a negative sign. In a highly market-oriented economy, such as the USA, incurring in a loss may imply lower access to external liquidity, thus requiring to increase internal liquidity. In a similar vein, firms that pay dividends are likely to be perceived as less risky and have greater access to capital markets, so their precautionary motive to hold

Table 2

Regressions estimating the determinants of cash holdings: extended model

In all regressions, the dependent variable is the cash to asset ratio at time 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 A3.

	Baseline		Non-linear effects		Augmented version	
	(1) OLS	(2) FE	(3) OLS	(4) FE	(5) OLS	(6) FE
size	-3.057 ***	-1.976 ***	-3.053 ***	-1.974 ***	-3.399 ***	-2.110 ***
volatility	0.805 ***	0.225 ***	0.802 ***	0.225 ***	1.069 ***	0.269 ***
cashflow	0.507 ***	0.330 ***	0.552 ***	0.359 ***	0.563 ***	0.366 ***
inv	-0.510 ***	-0.334 ***	-0.698 ***	-0.467 ***	-0.719 ***	-0.469 ***
nwc	-0.499 ***	-0.334 ***	-0.549 ***	-0.367 ***	-0.565 ***	-0.374 ***
leverage	-0.960 *	-0.087	-0.961 *	-0.087	-0.850 *	-0.080
sq_inv			$0.3 \cdot 10^{-3}$ **	$0.2 \cdot 10^{-3}$ **	$0.3 \cdot 10^{-3}$ **	$0.2 \cdot 10^{-3}$ **
loss					-4.376 ***	-1.023 ***
divpay					5.369 ***	0.875 ***
intang					-0.003	-0.003
bond_sh					0.115 ***	0.016 *
gdp_gr	-0.027 ***	0.015 ***	-0.027 ***	0.015 ***	0.000	0.028 ***
T-bill	-0.127 ***	-0.194 ***	-0.129 ***	-0.196 ***	-0.259 ***	-0.236 ***
vstoxx	0.003	0.010 ***	0.003	0.010 ***	0.005 **	0.015 ***
Yr-dum	yes	yes	yes	yes	yes	yes
Fir-dum	no	yes	no	yes	no	yes
R^2	0.0775	0.0732	0.0765	0.0735	0.0966	0.0832

Significance levels: *: 10%; **: 5%; ***: 1%

Firms that have issued bonds tends to have *ceteris paribus* a greater cash ratio, possibly because of inflows of external liquidity; in this sense, this would signal less financial market frictions. However, in the FE regression, the coefficient is quite low and barely significant. The proxy for R&D expenditure turns out to be statistically non-different from zero. However, we take this result with caution as it could be due to the proxy's poor accuracy (we can only account for it as the annual change in intangible assets over sales).

It is worth highlighting that the inclusion of further explanatory variables do not substantially alter the results on the main coefficients of interest in Eq. (1). Their effects thus turn out to be robust, being even magnified in some cases.

cash is dimer. 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. In the context of Italian firms, characterized by a substantially lower openness to capital markets, these effects are likely to be less important if compared to those commented in the text.

4.3 Dynamic model of determinants of cash holdings

Cash holdings may exhibit some degree of inertial persistence, so that a dynamic panel model could be advocated. We consider the following dynamic model :

$$l_{i,t} = \alpha + \theta y_{i,t-1} + \boldsymbol{\beta}' \boldsymbol{X}_{i,t} + \boldsymbol{\delta}' \boldsymbol{M}_t + u_{i,t} \quad (3)$$

The estimation of model (3) rises some econometric issues because the OLS estimator is inconsistent since $E(y_{t-1} ; \mu_i) \neq 0$ whenever $\mu_i \neq 0$. Inconsistency affects also the FE estimator because the within transformations of y_{t-1} and $u_{i,t}$ are correlated (through $\varepsilon_{i,t}$). The OLS estimates of $\hat{\theta}$ are upward biased, while FE estimates are downward biased (Bond, 2002).

Nevertheless, the FE bias is of order $(T-1)^{-1}$ thus fading out for high T (Nickell, 1981). When $T = 14$, like in our dataset, the dynamic FE estimator can still be useful to get appreciable estimates, also because the dependent variable's persistence is not very high.[36]

In addition, we consider the Anderson and Hsiao (1982) (AH) estimator. Under this approach, the model is transformed in first differences to remove the individual unobserved heterogeneity and Δy_{t-1} is instrumented by y_{t-2} or Δy_{t-2}. In our context, the AH provides the advantage of remaining computationally affordable in a huge dataset, in comparison to more efficient but computationally much heavier GMM-based approaches such as Arellano and Bond (1991) and Blundell and Bond (1998).

In column (1) an (2) of Table 3 we report the FE and AH estimator for the baseline model, while in columns (3) and (4) we consider the same estimators for the augmented version. The AH estimates consider the model in first differences.

The FE estimates are more directly comparable with their static counterpart in Table 1 (column 4) and Table 2 (column 6). While a significant degree of persistency is detected by the dynamic specifications, the coefficients on firm-specific variables generally appear quite similar in magnitude and significance to those found under the static specification. The only relevant exception concerns the magnitude of *size* which is reduced in the dynamic FE: this could occur because *size*, which is persistent on its own, could capture part of the inertial persistence in the dependent variable.[37]

The AH estimator yields a coefficient on the lagged dependent variable just slightly higher than under the FE, suggesting that T is high enough to sensibly attenuate the downward bias of the FE estimator. Interestingly, the AH coefficients associated with the firm-specific variables are also consistent with the FE ones, thus strengthening the robustness of our results. Less conclusive is the evidence for the

[36] By running a OLS regression for model (3) we obtain a coefficient estimate for θ of 0.767. Since the OLS is for certain upward biased, this represents a sort of upward bound. Even in this case, the hypothesis of unit root is largely rejected.

[37] Other differences concern mainly the macro variables: in particular, the *vistoxx* index is not significant in both dynamic specifications, while the *gdp growth* coefficient is significantly positive under the AH approach only.

macro variables, because for them the identification power is low as the high N dimension cannot help. Among these macro factors, however, the negative impact of interest rates appears robust. In the augmented model (column 4), the AH estimator returns coefficients for firm-specific variables still not too far from the FE one.[38]

All in all, we conclude that, while the coefficients' magnitude inevitably differ across different models, the empirical evidence appears is clear in establishing the direction and the statistical significance of the main variables of interest.

Table 3

Dynamic models for determinants of cash holdings

In all regressions, the dependent variable is the cash to asset ratio at time t. Estimations refers to the whole sample from 2002 to 2014. Robust standard errors clustered at the firm level are used. Anderson Hsiao (AH) estimates consider the model in first differences with Δy_{t-1} instrumented by y_{t-2}. For details on the dataset see Table A3.

	Baseline		Augmented	
	(1) FE	(2) AH	(3) FE	(4) AH
size	-1.511 ***	-1.082 ***	-1.586 ***	-1.046 ***
volatility	0.206 ***	0.153 ***	0.226 ***	0.143 ***
cashflow	0.334 ***	0.374 ***	0.371 ***	0.407 ***
inv	-0.350 ***	-0.353 ***	-0.492 ***	-0.508 ***
nwc	-0.339 ***	-0.375 ***	-0.379 ***	-0.410 ***
leverage	-0.045	0.026	-0.043	0.022
sq_inv			$0.2 \cdot 10^{-3}$ **	$0.2 \cdot 10^{-3}$ *
loss			-0.498 ***	0.498 ***
divpay			0.385 ***	-0.558 ***
intang			-0.003	-0.001
bond_sh			0.011 *	0.003
gdp_gr	-0.004	0.011 ***	0.002	0.008 ***
T-bill	-0.216 ***	-0.109 ***	-0.237 ***	-0.099 ***
vstoxx	0.002	-0.026 ***	0.004 **	-0.026 ***
liq(t-1)	0.273 ***	0.297 ***	0.272 ***	0.298 ***
Year-dummies	yes	no	yes	no
Firm-effects.	yes	yes	yes	yes
R^2	0.5254		0.5225	0.0735

Significance levels: *: 10%; **: 5%; ***: 1%

4.4 The economic relevance of cash determinants for the cash ratio changes

The impact of a cash determinant on the cash ratio depends on the size of the change and on the sensitiveness of the latter to the former (i.e. β): for each continuous variables we consider a change equal to the average within standard deviation, while for dummy variables we consider a switch from 0 to 1. For example,

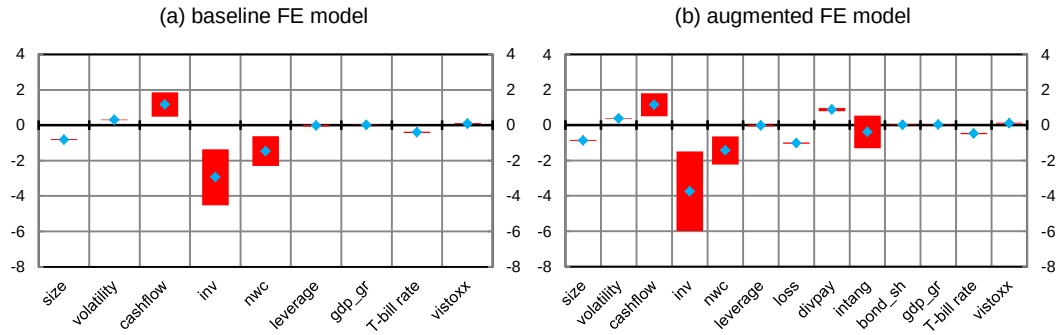
[38] The firm-specific regressors measured as dummies, such as the occurrence of loss or dividend payment, have the reverse sign but similar magnitude between FE and AH, because of the first differencing transformation in the latter.

in model (1) we compute the impact φ for the k-th continuous variable as: $\varphi_k = \beta_k \sigma_k$ where σ_k is the within standard deviation of the k-th variable. Figure 8 shows the impacts under the FE baseline and augmented models (columns 2 and 6 in Table 2).[39]

Across all specifications, we find that the greatest impact pertains to the investment variable: a standard deviation decrease in investment explains an increase by about 3-4 percentage points in the cash ratio *ceteris paribus*. Thus, the highest increase in cash holdings (explained by a comparable variation in the considered determinants of cash) occurs when firms refrain from investing.

Figure 8

Impact of a standard deviation increase in cash determinants (1)
(percentage points)



(1) Impacts are derived multiplying 1 within standard deviation of each cash determinant by its coefficient as estimated in Table 2 (column 2 for panel a and column 6 for panel b). The red bar represents the 95% confidence interval width of the impact. The blue diamond marks the point estimates of the impact. In panel b the impact of *inv* is computed taking into account *sq_inv*.

A relevant positive impact concerns the cash flow levels: one standard deviation rise in cash flows explains up to almost 2 percentage points of the increase in the cash-ratio. On the other hand, a standard deviation increase in the net working capital reduces liquidity holdings by a similar amount, by providing a (imperfect) substitute for cash. Also, dividend distribution and the occurrence of an economic loss show a non-negligible impact, as does the firm size. An increase in the opportunity cost of cash holding, proxied by the interest rates on government bills, tends to depress cash holdings. Other variables, even if significant, do not show a substantial impact.

Relating our findings to cash-holding motives, the transactional motive emerges through the evidence of economies of scale in cash management (*size*) and the availability of cash substitutes (*net working capital*), but also the precautionary motive and the financial frictions channels are sizeable. In particular, the effect of investment could be related to the intertwined effect of both motives. For instance, firms may prefer to accumulate cash instead of investing for precautionary reasons. The uncertainty over future demand or fear about the possible recurrence of credit

[39] The effects from the other models (available from the authors upon requests) are qualitatively easy to catch by considering coefficients in Table 2. For example, the OLS estimates tend to show larger impacts. The AH model shows narrower confidence intervals.

market tensions make preferable having own liquidity available instead of relying on expensive external finance.

Our results are qualitatively similar to those found by Bates et al. (2009) in the US context, but with some important differences. In their work the most predictive variables for changes in cash holdings were changes in (in order of importance): (i) net working capital, (ii) cash-flow volatility, (iii) capital expenditure, and (iv) R&D. As underlined above, we have (using analogous words): (i) capital expenditure, (ii) net working capital, (iii) cash-flow levels, and (iv) firm size.[40] This comparison suggests that there are robust and sound determinants of firm liquidity across space and time but their relative importance may differ. In particular, in the Italian case it seems that capital expenditure plays a relevant role and the levels of cash-flows matters more than their volatility, while R&D expenditure seems to count less.[41]

5. Explaining the rise in cash holdings in recent years

In Section 4.4 we have assessed the impact of a change by 1 standard deviation in the cash determinants. In this section, we tackle more explicitly the issue of what can explain the substantial increase in the cash ratio in the last years of our sample. In principle, this effect could be split into a within firms component and a composition effect. In turn, the former may be due to changes in cash determinants, in responsiveness of cash holdings or to a (unexplained) level shift. The composition effect is related to firms' turnover out and into the market: the resulting impact depends on how many of these firms are and on how much they differ with respect to cash holdings.

We proceed as follows. We consider the three sample years after 2011, corresponding to the period where the aggregate cash ratio took off (see Table A1 and Fig. 1) and we begin by considering the possible role of compositional effects. For the sake of brevity, let us call "outgone" the firms which were present in the dataset in 2011 but not in 2014, "newcomers" the firms which were absent in 2011 but were present in 2014, and "stayers" the firms that were present in both years. A simple tabulation reveals the following: (i) stayers are on average bigger than outgone and newcomers; (ii) newcomers are even smaller than outgone; (iii) there are more outgone than newcomers (consistently with the negative economic cycle in the interval); (iv) in 2011 stayers and outgone did not differ much with respect to their liquidity holdings (the average cash ratios were respectively 12.2 and 12.4 per cent), while in 2014 newcomers had a substantially higher cash ratio than stayers (15.8 versus 12.8).

Point (iv) may contribute to explain the increase in the average cash holdings through the composition effect: in presence of economies of scale in cash

[40] If we also consider the dummy variables then (iv) is the occurrence of an economic loss.
[41] This result should be taken with caution because of possible measurement errors.

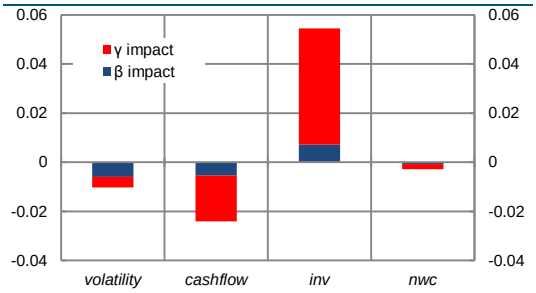
management, a net entrance of small firms makes the average cash ratio increase because they tend to be more liquid. However, points (i) to (iii) altogether suggest

that composition effects fail to explain in full the increase in the aggregate cash ratio. This seems to be better explained by changes in other factors.

Therefore, we move to see what happened for stayers. After creating a dummy variable *D* equal to 1 from 2012 to 2014, we estimate the following model by the FE estimator:

Figure 9

The 2011 – 2014 cash ratio increase: the impact of firms' variables (1)



(1) The *θ*-impact is computed according to the slope *θ* valid for all the sample years; the *γ*- impact depends on the slope *γ* valid for years 2012, 2013 and 2014 only. Impacts are formally defined in Eq. (3).

$$l_{i,t} = \alpha + D_{(t>2011)} + \boldsymbol{\beta}'\boldsymbol{X}_{i,t} + \boldsymbol{\gamma}'\boldsymbol{X}_{i,t}D_{(t>2011)} + \boldsymbol{\delta}'\boldsymbol{M}_t + \boldsymbol{\theta}'\boldsymbol{M}_t D_{(t>2011)} + u_{i,t} \quad (4)$$

Estimates are shown in Table A4. The coefficient vector $\boldsymbol{\gamma}$ is informative of whether the sensitivity has changed in later years. We find that this is indeed the case for most explanatory variables and in particular for *inv* whose coefficient moves from -0.26 to -1.7.

It turns out that model (4) has a great predictive power in explaining the change in the cash ratio for stayers: when we compare the actual differences in the cash ratios between 2011 and 2014 with the predicted ones, a mean difference test largely fails to reject the null hypothesis that they are equal.[42]

In order to assess which cash determinants had stronger impacts, we disentangle the predicted cash holding by each component's effect. In particular, provided that β_k and γ_k are significant, the change in the cash ratio due to regressor *k* ($\widehat{\Delta y_k}$) is given by:

$$\widehat{\Delta y}_{k,i,2014-2011} = \hat{\beta}_k \Delta X_{k,i,2014-2011} + \hat{\gamma}_k \Delta X_{k,i,2014-2011} \quad (5)$$

Among the firm-specific factors, we find again that a major role was played by the investment variable. For the staying firms, the capital expenditure to asset ratio fell between 2011 and 2014 on average by almost 3 percentage points. The investment decrease, alone, had an impact on the cash ratio that more than counterbalanced the negative effect by lower volatility and lower cash flows and by a slightly higher net working capital. The overall effects of lower investments scores at 5.4 basis points reaching up to 8.2 basis points taking into account the 95 confidence interval for the estimation of β and γ in Eq. (3), corresponding respectively to 10 and 15 per cent of the average increase in cash ratios. By allowing for changes in

[42] More in detail, the t test for the null hypothesis that $\overline{\Delta y}_{2014-2011} = \overline{\Delta \hat{y}}_{2014-2011}$ has a p-value of 0.67.

responsiveness, we see that the higher impact of *inv* was driven by a greater sensitivity occurred after 2011 (as captured by γ; Figure 9).[43]

Overall, we find that a substantial part of the average increase in the cash ratio was explained by the fall in the opportunity cost of holding cash. The decrease in T-bill rates (by more than 2 per cent in the period) reduced by a sizeable amount the opportunity cost of keeping cash: about 40 basis points of the increase in cash holdings comes from that. Since there is no evidence of a change in responsiveness, this effect appears entirely driven by the fall in interest rates.[44]

All in all, we conclude that - while part of the increase in the average cash ratio is affected by firms turnover occurred in the last years of the period under analysis – the take-off of aggregate cash holdings is mostly due to both firm specific and macro factors. Among the former, the fall in capital expenditure had an important role, intensified by a higher propensity in later years to keep liquid the non-invested resources. Amid the macro factors, a significant contribution came from the lower opportunity cost of cash holdings related to the substantial decrease in interest rates.[45]

6 Concluding remarks

We have analyzed the evolution of corporate cash holdings in Italy between 2002 to 2014. While previous works on the topic have mainly concerned listed corporates in US or UK, for the Italian context the empirical evidence is still scant, to the best of our knowledge. We have considered a very large dataset, with an average of more than 450 thousands non-financial firms per year, including many non-listed small and medium enterprises.

As the time interval under analysis spans from 2002 to 2014, we have been able to assess firms' behavior with respect to their liquidity holdings throughout a very interesting period, encompassing the recessions caused by the global financial crisis of 2007-08 and by the following sovereign debt crisis. We have documented a clear and remarkable increase in the cash to asset ratio in the last years of our sample. This rise in cash holdings was somewhat broad-based, occurring at all points in the distribution of firms.

We have turned to a deeper analysis of the determinants of corporate cash holdings, considering in particular a set of firm-specific factors related to different motives for demanding cash as identified in previous literature, also enriching the

[43] A significant negative β-impact on cash holdings is related to the size variables. However, we would take with caution this result: while it is important to control for firms' size along the *N* dimension, we would not emphasize its change for any given firm within such a short horizon. Moreover, its coefficient might be overestimated under that baseline static specification (see Section 4.3).

[44] In Table A4 estimates of model (4) are reported also for the OLS and AH estimator (in this case, as usual, the model is augmented with the lagged dependent variable and taken in first differences). Results for firm-specific variables are qualitatively in line with those shown in Figure 9. For reasons discussed in Section 4.3, under the AH estimator the effect of the firm size is substantially lower.

[45] All in all, this evidence appears consistent with a liquidity trap situation.

analysis with other micro and macro variables. Across different econometric approaches, we have found a rather robust evidence that traditional motives to demand cash are at work: the transaction motive, according to which a larger size or the availability of cash substitutes (such as the net working capital) tend to reduce the demand for cash; the precautionary motive, which spurs firms to hold more cash when uncertainty (in particular the idiosyncratic one) increases; the presence of information asymmetries in financial markets that induces 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 what factors were behind the recent increase in the cash ratio. Our findings suggest that the effect is only partly attributable to firms' turnovers, as in fact it concerned also firms present throughout the interval. While an important role was played by the fall in the opportunity cost of holding cash (as measured by the interest rates' decline), the empirical evidence suggests that the fall in investment was by far the firm-specific factor that mattered the most. In the last years of our sample, firms both reduced their investment and increased their propensity to cumulate cash in lieu of investing.[46] This can be related both to the precautionary motive and to the credit-market frictions channel, and their interplay: cash holdings might have increased as a consequence of a wait-and-see attitude given firms' poor expectation over future demand, or because of the aim of strengthening financial and liquidity conditions after the severely challenging years of crisis; at the same time, also the recent experience of downturns in credit markets and worries that they could come back again might have induced firms to refrain from investing and instead increase their cash ratio.

We have also shown that in the period under analysis firms' leverage has distinctly declined, while in our empirical analysis we have not found evidence of a direct effect of leverage on firms' cash holdings *ceteris paribus*. If cash is considered as negative debt, a measure of net leverage should be based on net debt, i.e.: financial debt minus cash. According to this measure, due to the increase in corporate liquidity, the reduction of firms' leverage observed in recent years turns to be even sharper. A comparison of the distributions of leverage and net leverage reveals that the lowering effect of cash on leverage is fairly widespread across firm distribution. All in all, we can argue that, taking into account the increased relevance of cash, the decrease in Italian non-financial firms' leverage 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.

[46] Reading the relation in the other way round, we can rephrase it by saying that the (relatively few) firms that actually have made investments in the last years of our sample have increased their propensity to fund them through their own cash.

Appendix

Table A1

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	4.72	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	51.4	46.1	43.9	46.8	37.7	51.6
2014	7.4	13.7	5.7	49.3	42.6	41.3	44.3	35.3	49.3

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

Table A2

Cash ratio by firm dimensional class
(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	9.7	7.4

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

Table A3

Dataset Description

Type	Variable	Name	Description	Source
Dep var	*liquid*	Cash holdings	Ratio between cash and liquid financial assets	Cerved Gr
Firm specific	*size*	Firm size	Log of total assets	Cerve Gr.
	volatility	Volatility of firm's cash flow	Log of Standard deviations of cash flows in the previous three years	Cerved Gr.
	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 Gr.
	inv	Net Investment	Ratio between yearly change in tangible and intangible assets and total assets	Cerved Gr.
	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 Gr.
	leverage	Leverage	Ratio between financial debts and the sum of financial debt and net worth	Cerved Gr.
	loss	Loss	Dummy (1 if net earnings are negative)	Cerved Gr.
	divpay	Dividend payment	Dummy (1 if part of dividends are paid)	Cerved Gr.
	intang	Intangible assets expenditure	Ratio between yearly change in intangible assets and revenues	Cerved Gr.
	bond_sh	Bank debt incidence	Ratio between outstanding bonds issued and total financial debts	Cerved Gr.
Macro	*gdp_gr*	GDP growth	Growth rate of GDP (chain linked volumes, 2010)	Istat
	T-bill	T-bill	Average rate of 6-months T-Bill (at issuance) in the year	Bank of Italy
	vstoxx	Euro Stoxx 50 volatility	Average VSTOXX Index (based on the volatility of Euro Stoxx 50 option prices) in the year	Reuters

Table A4

Regressions for determinants of cash ratios with slope changes after 2011

In all regressions, the dependent variable is the cash to asset ratio at time t. Estimations refers to the whole sample from 2002 to 2014. All flow variables are taken at time t, while stock variables are taken at time t-1. Robust standard errors clustered at firm level are used. The dummy variable D takes the value 1 in years 2012, 2013, 2014. For details on variables see Table A3.

	(1) FE		(2) OLS		(3) HS	
size	-1.939	***	-3.018	***	-0.991	***
volatility	0.180	***	0.775	***	0.164	***
cashflow	0.234	**	0.497	**	0.288	**
inv	-0.258	***	-0.419	***	-0.276	***
nwc	-0.264	***	-0.401	***	-0.299	***
leverage	-0.074		-0.991	*	0.078	**
*size*D*	0.000		-0.106	***	-0.413	***
*volatility*D*	0.127	***	0.080	***	-0.028	*
*cashflow*D*	0.806	**	0.408		0.732	*
*inv*D*	-1.705	***	-1.248	***	-1.521	***
*nwc*D*	-0.780	**	-0.504		-0.723	*
*leverage*D*	-0.034		0.087		-0.107	***
gdp_growth	0.014	***	-0.027	***	-0.059	***
T-bill rate	-0.193	***	-0.128	***	-0.039	***
vstoxx index	0.010	***	0.003		-0.038	***
*gdp_growth*D*	0.485	***	0.953	***	0.264	***
*T-bill rate*D*	==		==		==	***
*vstoxx index*D*	0.035	***	0.120	***	0.004	***
$liquid_{t-1}$					0.295	***
Year dummies	yes		yes		yes	
Firm fixed effect	yes		no		yes	
R^2	0.0730		0.0765			

Significance levels: *: 10%; **: 5%; ***: 1%. Regressor omitted because of multicollinearity: ==.

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