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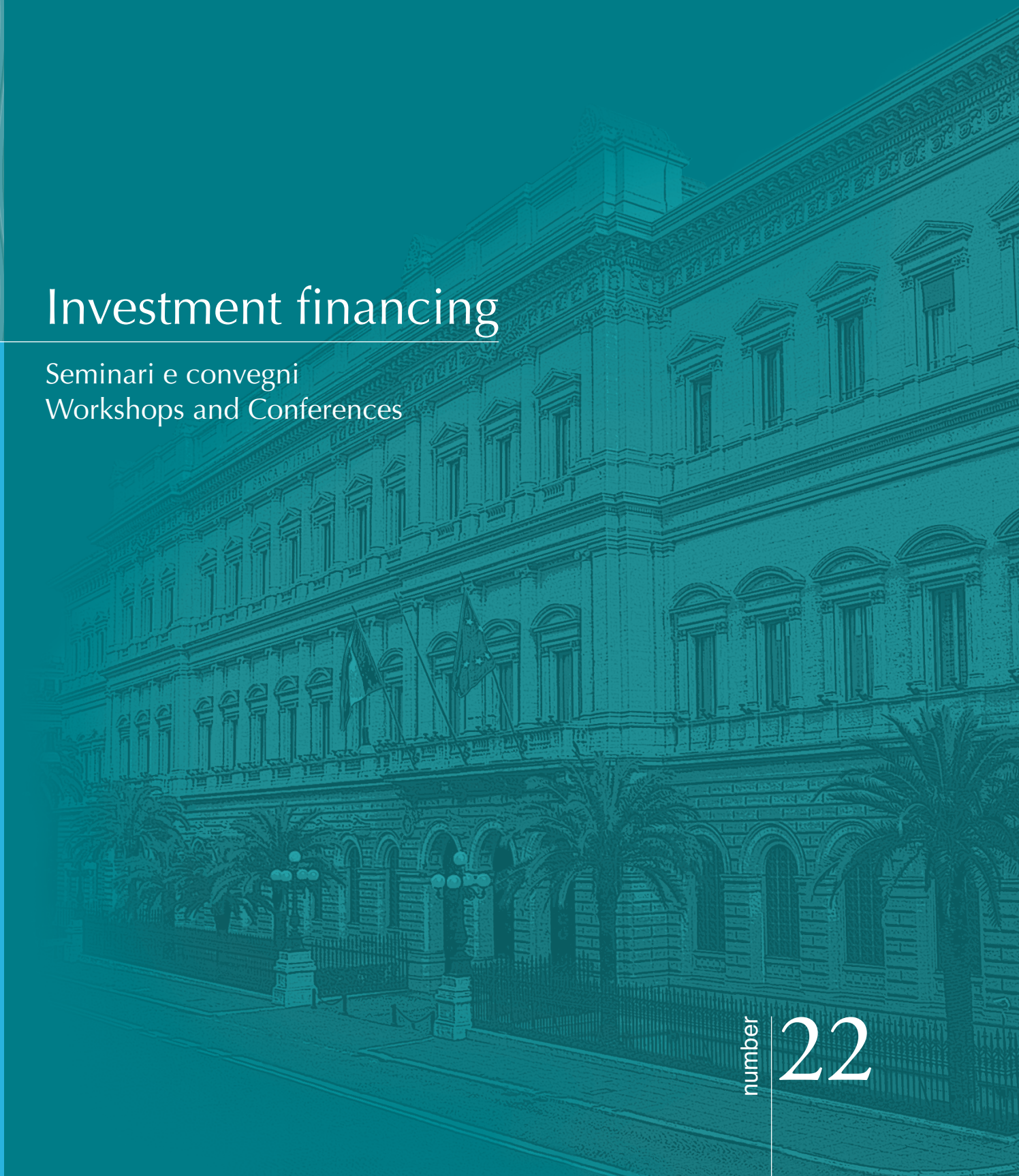

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This volume contains papers whose earlier versions were presented at Banca d'Italia's research workshop on "*Investment financing*", held in Rome on 13 November 2015. The workshop and the preparation of this volume of papers were organized by Matteo Bugamelli, Giuseppe Grande, Silvia Magri, Francesco Manaresi, Matteo Piazza and Andrea Silvestrini, with the collaboration of Marco Romani.

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Foreword

Stefano Siviero[1]

The global financial crisis caused an exceptional decline in investment in most advanced economies. In some euro-area countries, including Italy, real investment is still well below pre-crisis levels, generating concerns about the medium to long-term growth prospects.

The large fall in capital formation in the euro area was mainly driven by real factors, namely weak demand and heightened uncertainty. But those factors were in turn deeply connected to the instability of the global financial system, which started in the summer of 2007 with the subprime mortgage crisis, reached its peak in September 2008 with the Lehman Brothers collapse, and spiked again between 2011 and 2012 with the euro-area sovereign debt crisis. In such circumstances, financial shocks propagated to the real economy through banks and financial markets, as banks tightened lending standards and equity and credit risk premia soared.

In Italy, in particular, the decline in investments was aggravated by the tensions in credit supply: at the peak of the crises in 2008-09 and 2012-13, a rising number of Italian firms could not access bank credit. The strain in the availability of external finance had a negative effect especially on the capital expenditure of small- and medium-sized enterprises and start-up companies.

This volume, which collects the proceedings of a research workshop held in November 2015, is dedicated to the effects of financial factors on corporate investment in Europe. First of all, it focuses on the "dark side" of finance, that is the impact of credit crunches and financing constraints. Finance can indeed be a source of instability. Shocks originating in the financial sector may have widespread and long-lasting effects on corporate investment, and financial factors may also act as amplifying mechanism of shocks arising from the real side of the economy.

But the volume also discusses other factors that constitute the "bright side" of finance, such as the role of non-bank financing institutions, the function played by public guarantees on bank loans to SMEs, and effective ways of facilitating private sector's funding of infrastructures. In fact, as the Governor has frequently stressed, finance is a force for good.[2] "Good finance" channels savings from households to entrepreneurs, transforms short-term liabilities into long-term funding, allows investors to diversify risks across geographical locations, industries and firms, and makes it possible to fund innovative businesses through private sector resources.

All these issues are very relevant. In the euro area, some features of the financial system contributed to cause or aggravate the collapse of corporate investment. Others made capital accumulation more resilient and are now helping its recovery. This volume draws on the recent experience of the euro area to provide new and sound insights on both the dark and the bright side of finance.

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[2] Visco I. (2013), "The aftermath of the crisis: Regulation, supervision and the role of central banks", CEPR Policy Insight, No. 68, December 2013.

Introduction

Matteo Bugamelli,[3] *Giuseppe Grande*,[4] *Silvia Magri*,[5] *Francesco Manaresi*,[3] *Matteo Piazza*[6] *and Andrea Silvestrini*[4]

This volume is a collection of the papers presented at a research workshop on investment financing held at the Bank of Italy in November 2015. It consists of eight papers covering a wide range of issues at the intersection of corporate finance, banking and non-bank finance. These versions benefit from comments and suggestions made by the discussants and other participants at the workshop.

The papers are readily divided into three sections, which closely correspond to workshop's sessions: financial factors and corporate decisions, bank and non-bank financing, and financing infrastructure investment.

The first section is dedicated to the role played by credit and other financial factors on corporate investment. The first paper quantifies the real effects of the bank lending channel in Italy, exploiting the liquidity drought in interbank markets that followed the global financial crisis as a source of variation in credit supply. The impact of credit supply on firm investment is found to be stronger during the global financial crisis than in pre-crisis times, as those banks that relied more on interbank borrowing before the crisis tightened credit supply more than others. The second paper empirically identifies the lending standards applied by banks to small and medium-sized enterprises (SMEs) over the business cycle, by relying on an institutional feature of the Italian credit market. Lending standards to SMEs are found to vary according to the different phases of the business cycle. During the global financial crisis, in particular, the abrupt tightening of credit standards led to the exclusion of substandard firms from credit, which as a result invested significantly less. The last paper presented in the session studies the time-varying influence of financial resources on European firms' investment before and during the crisis. It shows that, even if the downturn in investment following the onset of the global financial crisis was mainly driven by depressed future investment opportunities, it was exacerbated by the lack of net liquid assets (i.e. liquid assets net of liabilities coming due over the short term), whose impact was instead marginal prior to the crisis. All in all, the evidence presented in this section seems to support the view that the influence of credit supply and other financial factors on investment behaviour depends on the phase of the economic cycle and becomes stronger in crisis periods.

The second section focuses on specific issues in bank and non-bank financing. The first paper is related to public guarantees on bank loans, a widely used tool in advanced countries for supporting credit availability to firms in periods of financial turbulence, and examines their impact on the access to bank lending for Italian SMEs. The main finding is that, in Italy, during the financial crisis the public guarantee scheme exerted a positive impact on bank loans to SMEs, even

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though it did not have any significant effect on the interest rates charged by banks. The second paper analyses the effects of venture capital on venture capital-backed firms in Italy. It finds that the Italian start-ups financed by venture capitalists experience faster growth than other start-ups. The third and last paper of this section focuses on the role of shadow banks (defined as money-market mutual funds, special purpose vehicles, and other financial institutions) in the financing of non-financial corporations in the euro area. It documents that, in the euro area, debt finance has become more available in recent years also thanks to the development of such non-bank financial institutions. Compared with bank lending, shadow banks' financing is more correlated with the business cycle than with structural features of the financial system.

The final section considers the impact of public-private partnerships on infrastructure investments, as well as the quality of the existing datasets in the area of infrastructure investment and long-term investment finance. Infrastructure is a type of asset considered to be more conducive to sustainable growth than others. The first paper deals with the involvement of private capital in the financing of investment projects, which is essential given the growing disproportion between the need for infrastructures and available public money. It is argued that in Italy, as well as in all the other G20 countries, it is essential to promote a greater involvement of private investors through public-private partnerships. The Italian regulatory environment is meant to contribute to this process, but it still suffers some limitations. The second paper brings to light the shortage of readily accessible, consistent and comparable data on infrastructure investment and on the provision of long-term finance. Information on individual projects at the micro level is also lacking. This seriously limits policy analysis and evaluation. The indicators at the macro level should be extended. They should also be complemented not only with qualitative survey-based information but also with more granular data at the firm level.

Conclusions

Eugenio Gaiotti[7]

The research workshop on investment financing provided an in-depth investigation of the link between financial factors and corporate investments. I personally wish to express my gratitude to all participants and especially to the discussants for sharing their research ideas and providing valuable feedbacks on the papers. The workshop has allowed our researchers to considerably improve their studies, whose revised versions are included in this volume.

A common thread connecting these works is that they all have significant policy implications. Let me only mention a few of them.

A result that stands out, I think, is how difficult it is, even in crisis times, to identify the impact of financial shocks on investments. Considering bank lending, you first need to assess how much its contraction is due to a genuine tightening in banks' lending standards, for given borrowers' characteristics, and how much it stems from demand-driven factors. Then you have to measure the impact of the financial shock on borrowers' investment decisions, controlling for all the other determinants of corporate investments. Another example is given by financial constraints. Our research suggests that, contrary to what some studies argue, during the financial crisis capital accumulation in the euro area was affected neither by firms' short-term liabilities nor by their stock of liquid assets, but by their *net* indebtedness. These difficulties in detecting the impact of lending standards or financing constraints on investment suggest that one has to be extremely careful when imputing a causal interpretation to conditional correlations.

One more important result is that financially vulnerable Italian firms, such as small and young firms as well as firms with a high dependence on bank loans, face greater difficulties in tapping alternative sources of finance to compensate for a given fall in bank lending. This has two major policy implications. The first is the importance of providing public support for bank lending, through for instance credit guarantee schemes. The second is to strengthen the supply of non-bank forms of finance. This volume gives sound evidence and insights on both fronts.

The volume also deals with infrastructure spending. While it does not address whether and how infrastructure spending may make a difference at the macroeconomic level, it helps shed light on two necessary conditions, which should be not just a concern of Italy but of any other G20 countries. The first is that major gaps in data on infrastructure investments and their financing need to be filled. This was also highlighted in an OECD report to the G20 on addressing data gaps in long-term investment, for which our findings were instrumental. The second is that in order to attract private capital, it is key to have a sound and transparent regulatory framework.

As the Governor of the Bank of Italy often points out, investments are the bridge between today's demand and tomorrow's supply. Relaunching them is a double policy priority, as it helps both to sustain domestic demand and to lift potential output. This workshop was but a starting point. We are continuing our endeavour to enhance our understanding of the drivers and impediments of investment and its financing.

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DOES CREDIT CRUNCH INVESTMENT DOWN?

Federico Cingano, Francesco Manaresi, Enrico Sette

The presented working paper has been superceded by "Does credit crunch investment down? New evidence on the real effects of the bank-lending channel" published in *The Review of Financial Studies*, Volume 29, n. 10, 2016, pp. 2737-2773, available at: https://doi.org/10.1093/rfs/hhw040

LENDING STANDARDS OVER THE CREDIT CYCLE

Giacomo Rodano, Nicolas Serrano-Velarde, Emanuele Tarantino

The presented working paper has been superceded by “Lending standards over the credit cycle” available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2699553

Investment decisions by European firms and financing constraints

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Abstract

We reinvestigate the question of whether corporate investment during the financial crisis depended to a significant extent, and differently than in the pre-crisis period, on firms' short-term liquidity and indebtedness. Using data on listed firms in the euro area and the United Kingdom, we employ a correlated random coefficient panel data model estimated with instrumental variables in order to address potential endogeneity concerns. First, we find that to attain plausible identification it is necessary to allow for the possibility that the unobserved firm-specific component of investment changed with the onset of the financial crisis. Second, our results suggest that neither cash reserves nor short-term debt, considered separately, were significant determinants of investment. However, we do find evidence of a negative conditional dependence between corporate investment and short-term debt net of cash reserves.

Keywords: Capital expenditure; financing constraints; financial crisis; correlated random coefficient panel data models; instrumental variables
JEL classification: G01; G31; G32

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1 INTRODUCTION

During the financial and sovereign debt crises investment in Europe declined markedly and has recovered only marginally since then. In the euro area, gross fixed capital formation decreased by 16 per cent in real terms between 2007 and 2012, a sizeable drop both in a historical perspective and compared to other advanced economies.

Existing studies examining the decrease in investment during the financial crisis employing firm-level US data largely focus on the degree to which the fall can be attributed to financial factors, and reach rather different conclusions. On the one hand, Duchin, Ozbas and Sensoy (2010) and Almeida et al. (2012), among others, present evidence showing that firms' short-term liquidity and indebtedness significantly influenced their capital expenditures during the crisis. On the other hand, Kahle and Stulz (2013) find no stark differences between the capital expenditures of similar firms with different degrees of leverage or different cash holdings.

The recent studies build on the extensive empirical literature analysing the relationship between corporate investment, firms' financial resources and financing constraints (see Hubbard, 1998, for a survey). In a seminal paper, Fazzari, Hubbard and Petersen (1988) provide evidence that financing constraints exert a significant impact on investment decisions. Specifically, their results suggest that investment decisions of financially constrained firms are more sensitive to fluctuations in firm liquidity than those of less constrained companies, lending support to a financing hierarchy in which internal funds have a cost advantage over issuing new equity and debt.

Another important contribution to the literature on the relationship between corporate investment and financial constraints is Kaplan and Zingales (1997). In their paper, the generality of the conclusions drawn in the previous literature is examined. In particular, contrary to the previous studies, it is found that firms classified as less financially constrained have a higher sensitivity of investment to cash flow than firms classified as more financially constrained. This is argued to arise from investment-cash flow sensitivities not being monotonic in the degree of financing constraints (see also Kaplan and Zingales, 2000).

As to the works investigating the impact of financial factors on corporate investment during the financial crisis mentioned above, Duchin, Ozbas and Sensoy (2010) study the sensitivity of firms' capital expenditures to their pre-crisis cash holdings and short-term debt. They document that the decline in investment following the outset of the financial crisis was more pronounced for firms which had low cash reserves or high short-term debt and argue that due to financing constraints these firms were more severely affected by the credit supply shock which realised. Similarly, Kahle and Stulz (2013), using a matching approach, compare the investment of cash-rich and highly levered firms

to that of firms which are similar along characteristics other than cash reserves and indebtedness, respectively. However, they find no evidence of highly levered firms having cut their investment more and only weak evidence of cash-rich firms having invested more than their respective control group.

In a paper related to Duchin, Ozbas and Sensoy (2010), Almeida et al. (2011) find that firms whose long-term debt was largely maturing during the financial crisis cut their investment more than otherwise similar firms whose debt was scheduled to mature after the crisis. Focusing more explicitly on financing constraints, Campello, Graham, and Harvey (2010) present evidence showing that the impact of the crisis is particularly severe on credit-constrained firms, bringing about deep cuts in research and development, employment and capital spending. More recently, working with a panel of 1,200 Italian firms, Gaiotti (2013) concludes that reduced credit availability played a non-negligible role in contributing to the Great Recession in 2008–2009.

The theoretical framework underlying this empirical literature is based on models of investment with financing frictions (see, among others, Jaffee and Russell, 1976; Stiglitz and Weiss, 1981; Holmström and Tirole, 1997), which feature the relevance of financial factors upon corporate investment owing to the existence of capital market imperfections. According to these models of investment behaviour, negative shocks to the supply of external finance might hinder investment in cases where firms lack sufficient financial slack to fund any profitable investment opportunities internally. Moreover, this theory suggests that such effects could be particularly severe for firms which are particularly financially constrained, or dependent upon external finance.

Our work is related to the above-mentioned empirical studies, which deal with the relationship between financial factors and investment decisions. In particular, we reinvestigate the role of financial resources in corporate investment decisions during the financial crisis, working with data on listed firms in the euro area as well as in the United Kingdom. In addition, we examine whether the relationship between investment and firms' financial positions changed when the financial crisis turned into a sovereign debt crisis. More specifically, we evaluate whether firms with different financial positions displayed different investment intensities before and during the financial crisis.

We employ a panel data approach in which we study the investment of firms both before and after the onset of the crisis, as a function of their financial resources: cash reserves and short-term debt, defined as debt maturing within one year. We control for unobserved individual heterogeneity and for observed investment opportunities, proxied by Tobin's Q. Our econometric specification belongs to the family of correlated random coefficient panel data models (Wooldridge, 2005; Murtazashvili and Wooldridge, 2008) and allows unobserved heterogeneity at the firm level to interact with a crisis indicator. Due to this latter feature, the effect of unobserved firm-specific characteristics on

investment is allowed to change as we move from the pre-crisis to the crisis period.

Given that firms' financial positions may be correlated with unobserved changes in their investment opportunities, not measured by Tobin's Q and thus captured by the error term, our regressors of interest are possibly endogenous. In order to take the consequent identification issues into account, we adopt the methodology of instrumental variables in the context of correlated random coefficient models (Murtazashvili and Wooldridge, 2008) to estimate the sensitivity of investment to cash reserves and short-term debt prior to and after the outbreak of the crisis. More specifically, we instrument the endogenous variables with their lagged values. The number of lags is carefully selected in order to ensure that instruments are strongly correlated with the endogenous regressors and at the same time uncorrelated with unobserved investment opportunities captured by the error term. To attain this goal, we employ numbers of lags such that all values of the selected instruments pre-date the sample period under analysis. In this way, we expect to remove the confounding effect produced by the non-zero correlation between changes in a firm's financial position and unobserved variation in its investment opportunities.

To preview the results, we find that neither cash reserves nor short-term debt, considered separately, were significant determinants of investment over our sample period. Moreover, no evidence emerges to suggest that the effects of these two variables changed with the onset of the financial crisis. However, our results indicate that investment depended negatively on short-term debt net of cash – a measure of net short-term indebtedness – during the financial crisis, while there was no such conditional dependence either in the pre-crisis period or during the sovereign debt crisis.

The rest of the paper proceeds as follows: Section 2 describes how the dataset has been constructed and presents some descriptive statistics. Section 3 states our main research question and presents some preliminary evidence based on sample averages. Section 4 details the empirical strategy as well as presenting the econometric results. Section 5 concludes and discusses future research directions.

2 DATA OVERVIEW

2.1 Data description

We employ quarterly, firm-level data from the Standard and Poor's Capital IQ database. Our main sample, for which we obtain data on all of our variables of interest, covers the period 2006:Q3–2012:Q2. In addition, we extract data on cash reserves, short-term debt and total assets from 2001:Q3 to 2006:Q2, allowing us to instrument these variables with their lagged values. We in-

clude in the sample all listed corporations in the euro area as well as in the United Kingdom other than financial firms and utilities, with Standard Industrial Classification (SIC) codes in the intervals 4900–4949 and 6000–6999, respectively. We exclude the latter as in many cases they are subject to heavy regulation.

Table 1 shows the distribution of listed firms by country. The full sample is constituted of 4197 listed firms. The largest number of firms is based in the UK (1419), France (705) and Germany (654). These three countries account for more than the 65% of the full sample. They are followed by Italy (236) and Greece (227), amounting to 5.6% and 5.4% of the full sample.

[TABLE 1 ABOUT HERE]

For each firm and for each quarter over the period 2006:Q3–2012:Q2, we obtain, whenever reported, their capital expenditures, total assets, short-term debt, common equity, deferred tax liabilities, cash reserves and market capitalization. From these raw data, we construct the following variables, which will be used in the econometric analysis (Standard and Poor's Capital IQ item names in parentheses):

- investment = capital expenditures (CAPEX) / total assets (TOTAL_ASSETS);
- cash reserves = cash and short-term investments (CASH_ST_INVEST) / total assets (TOTAL_ASSETS);
- short-term debt = debt in current liabilities (TOTAL_DEBT_CURRENT) / total assets (TOTAL_ASSETS);
- net short-term debt = (debt in current liabilities (TOTAL_DEBT_CURRENT) - cash and short-term investments (CASH_ST_INVEST)) / total assets (TOTAL_ASSETS)
- Tobin's Q = market value of assets / (0.9 total assets (TOTAL_ASSETS) + 0.1 market value of assets),

where market value of assets = total assets (TOTAL_ASSETS) + market value of common equity (MARKETCAP) - common equity (TOTAL_COMMON_EQUITY) - deferred tax liabilities (DEF_TAX_LIAB_LT).

All variables are defined as in Duchin, Ozbas and Sensoy (2010) to make our results comparable to theirs. As is usual in the literature, we measure corporate investment by employing the capital expenditures item of the income statement (over total assets), which records expenditures incurred

by the company for the acquisition of or upgrade of physical assets such as property, industrial buildings or equipment. Short-term debt is made up of debt liabilities maturing within a year, while those maturing beyond one year are referred to as long-term debt. Turning to liquidity, cash reserves to total assets is a ratio that measures the portion of a company assets held in cash or marketable securities to cover payable accounts, short-term debt, and other liabilities. Net short-term debt over total assets is defined as the ratio of short-term debt minus cash to total assets and represents a measure of net short-term indebtedness.

Another important variable, which will be employed in the subsequent econometric analysis, is the average Tobin's Q, defined as the market value of assets divided by the book value of assets (replacement cost of physical assets). Indeed, according to the Q-theory of investment based upon the work of Tobin (1969), investment is stimulated when the market's valuation of capital exceeds the cost of its production or, in other words, when market returns on equity are low relative to the real returns on investment in physical assets. In order to calculate Tobin's Q, we use the market capitalization, which is given by the product of stock price and number of shares outstanding. As in Kaplan and Zingales (1997), we employ market capitalization at the beginning of the quarter in which book values are reported.

2.2 Descriptive statistics

Table 2 reports summary statistics for the variables under consideration. These statistics refer to the firm-quarter observations, i.e., they are computed across firms and over quarters. Before calculating them, the data have been adjusted as follows. Firms with a market capitalization of less than 40 million euros as of June 30, 2006, have been excluded. In addition, firms with a quarterly sales or asset growth greater than 100% at any point during our sample period have been dropped. These adjustments ensure that the smallest firms with volatile accounting data as well as firms which merged or underwent restructuring during our sample period have been eliminated. Finally, all variables other than Tobin's Q have been winsorized at the 1st and the 99th percentile, in order to mitigate the influence of outliers. Tobin's Q is calculated as in Baker, Stein and Wurgler (2003) and is by construction bounded above at 10. As a result of these adjustments, 945 companies have been excluded. Therefore, the final sample consists of 3252 listed firms.

[TABLE 2 ABOUT HERE]

The average quarterly capital expenditures in our sample is 1.1% of total assets. Cash reserves and other liquid assets account for an average of 14% of total assets, and show considerable variation

among firms. Short-term debt, on the other hand, is equal to 8% of total assets. Average net short-term debt over total assets is negative and equal to -3%. Firms are rather heterogeneous in size, as evidenced by the high standard deviation of their market capitalization.

We also examine the dynamics of the variables through time. We focus on capital expenditures over total assets, cash reserves over total assets, short-term debt over total assets, net short-term debt over total assets and Tobin's Q. In order to provide a synthetic representation of the main trends along the time series dimension, we calculate cross-sectional averages of firm-level data over the period 2006:Q3–2012:Q2. Figure 1 illustrates the cross-sectional averages of capital expenditures and Tobin's Q. Figure 2 refers to cash holdings (reserves) and short-term debt, while Figure 3 displays net short-term debt.

[FIGURES 1, 2 and 3 ABOUT HERE]

Investment declines pronouncedly between the end of 2008 and the first quarter of 2010, with a moderate increase thereafter. A similar pattern may be observed for Tobin's Q, even though its fall, which started in 2007:Q4, precedes the decrease in capital expenditures. Similarly, cash reserves decline markedly from 2007:Q4 to 2008:Q3, probably as a result of the financial turbulence in that period. In 2010:Q4 cash reserves increase to the pre-crisis level, before falling again considerably with the onset of the sovereign debt crisis. This pattern lends support to the view that, after the outbreak of the financial crisis, companies hoarded cash as a response to increased uncertainty and downside risks related to future economic prospects. Short-term debt follows a different pattern. In particular, it increases constantly from 7.5% of total assets in 2007:Q3 to 9.5% in 2008:Q4. Then, it declines to less than 8% in 2010:Q4, evidencing a deleveraging process, before rising again after the outbreak of the sovereign debt crisis. Net short-term debt, which is given by the difference between short-term debt and cash holdings, also increases from -4% of total assets in 2007:Q4 to -1.8% in 2009:Q2. Then, in 2010:Q4, it reverts to its level in 2007:Q1. In 2011 and 2012 net short-term debt increases again steadily, reaching a level of -0.020 in 2012:Q2, the last data point in the sample.

Then, we present time series plots of the medians together with 25th and 75th percentiles in order to provide a better representation of the distribution of the variables over the sample period. Figure 4 refers to investment, Figure 5 to Tobin's Q, Figure 6 to cash reserves, Figure 7 to short-term debt and Figure 8 to net short-term debt.

[FIGURES 4, 5, 6, 7 and 8 ABOUT HERE]

The interquartile range, which is equal to the 75th percentile minus the 25th percentile, provides information about the variability and symmetry of the data around its central value. For instance,

both for investment and for Tobin's Q, this indicator shrinks moderately during the financial crisis period (particularly in 2009). In addition, Figures 6 and 7 show that that the distribution of cash reserves and short-term debt is slightly non-symmetric and positively skewed (as also evidenced by the fact that the corresponding sample averages in Table 2 are larger than the medians).

3 RESEARCH HYPOTHESIS AND PRELIMINARY EVIDENCE

As discussed above, a strand of investment literature argues that financial constraints exert a significant impact on investment (Fazzari, Hubbard, and Petersen, 1988, among others). In a more recent work, Duchin, Ozbas and Sensoy (2010) examine how the financial crisis affected corporate investment. Working with a panel of US firms, they find that the decrease in capital expenditures during the first year of the financial crisis was greatest for firms with low cash reserves or with high short-term debt. This is the hypothesis we are going to test in the sequel.

Following Duchin, Ozbas and Sensoy (2010), we begin by examining average corporate investment before and after the financial crisis. In order to investigate whether firms with different initial financial positions altered their investment to different degrees, we group firms in terciles based on their average cash reserves, short-term debt and net short-term debt in 2006:Q2, before the sample period under consideration. Table 3 shows average investment in the period 2006:Q3–2008:Q2 ("Before crisis") and in 2008:Q3–2010:Q2 ("Financial crisis"). In order to examine separately the impact of the sovereign debt crisis, average investment is also calculated for the period 2010:Q3–2012:Q2 ("Sovereign debt crisis").

In panel A, firms are sorted based on their cash reserves, in panel B based on short-term debt and in panel C based on net short-term debt. All the values reported in Table 3 correspond to sample averages across firms and over time. Mean comparison test results are also reported.

[TABLE 3 ABOUT HERE]

Focusing on the first two columns in panel A, we note that investment fell considerably for firms in the first cash reserves tercile (-0.43 percentage points of total assets), while firms in the second (medium cash reserves) and third (high cash reserves) terciles recorded more modest declines (-0.33 and -0.29 percentage points, respectively). All these variations are significantly different from zero at conventional levels. On the other hand, average investment during the sovereign debt crisis remained essentially unchanged from that during the financial crisis, with no discernible differences between firms with low, medium and high cash reserves.

A comparable picture emerges from an inspection of panels B and C: in each tercile, investment was lower during the financial crisis than the pre-crisis period. What is more, the pre-crisis and crisis means are statistically different from each other in each tercile. Furthermore, firms in the third tercile (high short-term debt and high net short-term debt) recorded the steepest investment decline, while the negative variations in capital expenditures among all the other firms were less pronounced. Again, also in panels B and C, average investment was broadly constant across the financial crisis and the sovereign debt crisis. This is confirmed by the t-statistics in the last column, indicating no statistically significant differences in the means.

This evidence, based on simple sample averages, appears consistent with the conclusion in Duchin, Ozbas and Sensoy (2010), namely that the negative credit supply shock due to the financial crisis affected more severely firms that had low cash reserves or high short-term debt. In what follows, we investigate whether this preliminary finding obtains also when applying more formal econometric methods.

4 EMPIRICAL ANALYSIS: MODEL SPECIFICATION AND ECONOMETRIC RESULTS

In this section, we test the dependence between the financial positions of firms and their investment both before and during the financial crisis, focusing on a panel of firms in the euro area and in the United Kingdom. The analysis is conducted controlling for unobserved firms heterogeneity and observable measures of investment opportunities, namely Tobin's Q. We take also into account potential endogeneity concerns.

The rest of this section is organized as follows: in Section 4.1 we set up the panel approach and we describe the econometric specification, which is a correlated random coefficient model (Wooldridge, 2005; Murtazashvili and Wooldridge, 2008). In Section 4.2 we describe the pre-crisis and two crises subsamples. In Section 4.3 we present results on the dependence between investment and financial resources of firms. In Section 4.4, the same analysis is carried out working with a longer crisis sample, which includes the sovereign debt crisis. In Section 4.5, we study the sensitivity of our results to different definitions of the financial crisis subsample. Lastly, in Section 4.6, we examine the robustness of our findings to the exclusion from the sample of the most financially vulnerable countries, which we expect to have been most affected by the financial crisis. In addition, we exclude in turn the smallest and the largest listed companies and assess how results change when the sample composition is altered in this way.

4.1 Model specification

We wish to examine the sensitivity of firms' corporate investment to their financial resources before and after the outbreak of the crisis. To this aim, we consider the following panel data specification, belonging to the family of correlated random coefficient (CRC) models (Wooldridge, 2005; Wooldridge and Murtazashvili, 2008):

$$\begin{aligned} &investment_{it} = c_i + \delta_i d_t + \beta_{1i}^f f_{it} + \beta_{2i}^f f_{it} d_t + \beta_{1i}^q q_{it} + \beta_{2i}^q q_{it} d_t + u_{it}, \\ &i = 1, 2, \ldots, N; \;\; t = 1, 2, \ldots, T \end{aligned} \tag{1}$$

where f_{it} is the financial variable of our interest (cash reserves, short-term debt or net short-term debt) for firm i at time t, d_t is an indicator variable equal to 1 during the crisis period and 0 otherwise, q_{it} is our control variable (Tobin's Q), while the terms c_i and δ_i capture unobserved heterogeneity at the firm level. Note that due to the presence of the interaction terms containing d_t the relationship between investment and both the observed and the unobserved covariates is allowed to change when entering the crisis period. Moreover, the conditional dependence between investment and the observed explanatory variables can differ across firms as the coefficients β_{hi}^k ($h = 1, 2$, $i = 1, 2, \ldots, N$ and $k = f, q$) are firm-specific.

The reason why we allow for a change in firm-specific investment levels, represented by the $\delta_i d_t$ term, is twofold. First, this feature in combination with the other interaction terms containing d_t ensures that all the parameters, including the intercept, of the affine function representing the conditional mean of investment can change when entering the crisis period. Second, omitting the interaction term $\delta_i d_t$ could bias the point estimates of the coefficients on the other interaction terms β_{2i}^k. In particular, if our financial variable of interest f_{it} were correlated with the change in the firm-specific component of investment δ_i, one would obtain a biased estimate of β_{2i}^f.

The coefficients we are mainly interested in are β_{1i}^f and β_{2i}^f, the former capturing the influence of the financial variable f_{it} on investment during the non-crisis period and the latter the differential impact of f_{it} on investment during the crisis period. Another object of our interest is the sum $\beta_{1i}^f + \beta_{2i}^f$, which represents the impact of the financial variable $f_{i,t}$ on investment during the crisis period.

Estimating consistently the model coefficients is complicated by a potential correlation between the financial variable $f_{i,t}$ and within-firm changes in unobserved investment opportunities, i.e., the idiosyncratic error term $u_{i,t}$. For instance, in the case of $f_{i,t}$ being cash reserves, such correlation may arise due to firms accumulating cash in anticipation of future investment opportunities (Almeida, Campello and Weisbach, 2004; Baum, Caglayan and Talavera, 2013). Or alternatively, firms lacking investment opportunities may accumulate cash. That is, future (or contemporaneous)

values of $u_{i,t}$ may be correlated with $f_{i,t}$, implying that the strict exogeneity assumption guaranteeing the consistency of the fixed effects estimator is violated.

To address these endogeneity concerns, we employ instrumental variables (IV) estimators. More specifically, we make use of the results in Wooldridge and Murtazashvili (2008), in which assumptions required for the consistency of the FE two-stage least squares estimator (FE-2SLS) are stated. As Wooldridge and Murtazashvili (2008), we seek to estimate consistently the population averaged effects, i.e. $\mathbb{E}[\boldsymbol{\beta}_i]$. These authors prove that the FE-IV estimator, applied to data transformed in such a way that the unobserved heterogeneity is eliminated, is consistent for $\mathbb{E}[\boldsymbol{\beta}_i]$ provided that a full set of time period dummies is included in the estimating equation and the following conditions are satisfied:

$$\mathbb{E}[u_{it}|\boldsymbol{z}_{i,1}, \boldsymbol{z}_{i,2}, \ldots, \boldsymbol{z}_{iT}] = 0, \;\; t = 1, 2, \ldots, T \tag{2}$$

$$\mathbb{E}[\boldsymbol{\beta}_i|\ddot{\boldsymbol{z}}_{it}] = \mathbb{E}[\boldsymbol{\beta}_i], \;\; t = 1, 2, \ldots, T \tag{3}$$

$$Cov(\ddot{x}_{itj}, \beta_{ij}|\ddot{\boldsymbol{z}}_{it}) = Cov(\ddot{x}_{itj}, \beta_{ij}), \;\; j = 1, 2, \ldots, K; \;\; t = 1, 2, \ldots, T, \tag{4}$$

where $\ddot{\boldsymbol{z}}_{i,t}$ denotes the K-element vector of instrumental variables and $\ddot{\boldsymbol{x}}_{i,t}$ the K-element vector of the endogenous covariates, both transformed to eliminate the unobserved heterogeneity. In the specification in (1), $\boldsymbol{x}_{it} = (f_{it}, f_{it}d_t, q_{it}, q_{it}d_t)'$ and $\boldsymbol{\beta}_i = (\beta_{1i}^f, \beta_{2i}^f, \beta_{1i}^q, \beta_{2i}^q)'$.

In our case, in order to eliminate the compound unobserved heterogeneity – represented by the term $c_i + \delta_i d_t$ – the standard within-transformation is applied separately in the non-crisis and the crisis sample period to the dependent variable, the control, the endogenous explanatory variables and their instruments (i.e., $investment_{i,t}$, $q_{i,t}$, $f_{i,t}$ and $z_{i,t}$). Thus, our procedure is akin to applying the standard fixed effects estimator to equation (1) without the interaction terms, separately for the non-crisis and the crisis periods. However, estimating (1) with the interaction terms has the advantage that we can directly test for coefficient stability between the two sample periods.

As to the instrumental variables employed, we consider lagged values of the endogenous regressors. The number of lags is carefully chosen to ensure that the instruments are strongly correlated with the endogenous regressors and at the same time can be expected to satisfy the strict exogeneity condition on the instruments (equation (2) above). To achieve the latter requirement, we select the number of lags such that all values of the instruments pre-date the sample period under analysis by a considerable margin. Consequently, even though the financial variables we consider are potentially forward-looking in nature, we do not expect the instruments to be correlated with the idiosyncratic error terms. To more formally evaluate whether our instruments satisfy the strict exogeneity assumption, we employ the test proposed in Wooldridge (2010).

Regarding the second condition required for the consistency of the FE-IV estimator stated in equation (3), we presume that it is satisfied as $\boldsymbol{\beta}_i$ is allowed to be arbitrarily correlated with the systematic components of $\boldsymbol{z}_{i,t}$. Consequently, we do not expect there to be any correlation between the within-firm variations in our instruments and the random coefficients $\boldsymbol{\beta}_i$. Finally, the third condition stated in equation (4) is relatively weak as it merely requires the covariance between the transformed covariates and the random coefficients $\boldsymbol{\beta}_i$ not to depend on the transformed instrumental variables.

In addition to the specification in (1), we consider the following alternative model:

$$\begin{aligned} &investment_{it} = c_i + \beta_{1i}^f f_{it} + \beta_{2i}^f f_{it} d_t + \beta_{1i}^q q_{it} + \beta_{2i}^q q_{it} d_t + u_{it} \\ &i = 1, 2, \ldots, N; \;\; t = 1, 2, \ldots, T. \end{aligned} \tag{5}$$

This is a simpler version of specification (1), featuring c_i without the $\delta_i d_t$ term. That is, the unobserved firm-specific component of investment is restricted to be the same in the non-crisis and the crisis period. We estimate this specification employing the fixed effects estimator, both without and with instrumental variables. In the former case, we obtain our estimates by applying results in Wooldridge (2005), whereas in the latter case we can again apply the findings in Wooldridge and Murtazashvili (2008). Differently from when employing instrumental variables, estimating the coefficients in equation (5) under the assumption that all the covariates are strictly exogenous does not require including time dummies in the estimating equation.

We call specification (5) a correlated random coefficient (CRC) model and specification (1) a CRC model with compound unobserved heterogeneity (CRC-CUH). The three sets of estimates (CRC, CRC-IV and CRC-IV-CUH) enable us to evaluate the importance of both instrumenting our explanatory variables of interest and allowing unobserved heterogeneity at the firm level to change when entering the crisis period.

4.2 The pre-crisis and crisis samples

In order to study the sensitivity of investment to financial resources before and during the financial crisis, we split the whole sample (2006:Q3–2012:Q2) into a pre-crisis and a crisis subsample. What is more, we partition the crisis period into a financial crisis and a sovereign debt crisis subsample.

A natural candidate indicator to date the beginning of the financial crisis is the three-month Euribor-OIS spread (Figure 9), which is the difference between the three-month Euribor and the corresponding overnight index swap (OIS) rate. Both the Euribor and the OIS rate measure the cost of unsecured borrowing in the interbank market, but unlike the Euribor, the OIS entails only a nominal counterparty risk. Therefore, the Euribor-OIS spread can be viewed as an indicator of

banks' perception of counterparties' creditworthiness and availability of funds for interbank lending purposes.[1]

[FIGURE 9 ABOUT HERE]

As Figure 9 illustrates, the Euribor-OIS spread was stable and relatively low at the beginning of the sample period (less than 10 basis points). Then, in August 2007, because of the rising number of defaults on subprime mortgages in the US, it increased to a level of 60 basis points. In October 2008, after the collapse of Lehman Brothers, the spread soared to a record of 195 basis points, marking the eruption of the credit crunch. For this reason, we date the beginning of the financial crisis in Europe in 2008:Q3, just before the bankruptcy of Lehman Brothers, which occurred on September 15, 2008.

Furthermore, in order to isolate the impact of the sovereign debt crisis, the crisis period is divided into a financial crisis and a sovereign debt crisis subsample. Conventionally, we date the start of the sovereign debt crisis in 2010:Q3. The last part of the sample in Figure 9 shows that the Euribor-OIS spread jumped again in August 2011, owing to fears of contagion of the sovereign debt crisis to Spain and Italy, and remained at historically high levels in the following months.

In total, as illustrated in Figure 10, we consider four different sample periods to perform the econometric analysis. The full sample covers the period 2006:Q3–2012:Q2. The first sample period starts in 2006:Q3 and goes on until 2010:Q2. The pre-crisis and crisis periods both span 8 quarters, in order to average out any seasonal patterns in the data (Duchin, Ozbas and Sensoy, 2010). In the second sample period, the pre-crisis lasts only four quarters and the crisis starts one year earlier (2007:Q3). This alternative dating of the financial crisis is motivated by the evolution of the Euribor-OIS spread, which started to increase already in the summer of 2007.

[FIGURE 10 ABOUT HERE]

The third sample covers the period 2006:Q3–2008:Q2. In this case, the crisis period lasts only four quarters (2007:Q3–2008:Q2), and it is used in order to obtain results for the same time span as in Duchin, Ozbas and Sensoy (2010). The fourth sample is simply the first one appended with the sovereign debt crisis period (2010:Q3–2012:Q2).

4.3 Investment and financial positions of firms during the financial crisis

In this section, we examine the relationship between capital expenditures and financial positions of firms prior and during the financial crisis, employing the three estimators discussed in Section 4.1.

[1] See Caballero, Farhi and Gourinchas (2008).

The first (CRC) is a standard fixed effects estimator applied to the specification in (5) which does not rely on instrumental variables.[2] The second, addressing the potential endogeneity of the financial variables of our interest, is a fixed effects instrumental variables estimator of the specification in (5), termed CRC-IV. Similarly, the third estimator (CRC-IV-CUH) relies on instrumental variables but it is instead applied to the specification in (1). Throughout the analysis, we employ standard errors clustered at the firm level. In order to provide evidence in support of the validity of the instruments employed, we report the outcome of the Kleibergen-Paap Lagrange Multiplier (LM) underidentification test (Kleibergen and Paap, 2006). The null hypothesis of the Kleibergen-Paap LM test is that the structural equation is underidentified (i.e., the rank condition fails).

Table 4 focuses on the sensitivity of investment to cash holdings and displays estimates for the baseline sample period, 2006:Q3–2010:Q2, with the financial crisis starting in 2008:Q3.

[TABLE 4 ABOUT HERE]

In column (1), the CRC coefficient estimates imply that a higher Tobin's Q was accompanied by a higher investment intensity over the whole sample period, given that the coefficient on q is positive and significant (0.410) whereas the one on $q \times d$ (which measures the change in the correlation when moving from the pre-crisis to the crisis) is negative and significant, but lower in magnitude (-0.178). On the other hand, higher cash reserves were associated with lower capital expenditures in the pre-crisis period, even though the relationship became less strong during the crisis. However, this negative correlation could merely reflect that firms lacking investment opportunities accumulated cash, which would imply that cash reserves are endogenous to investment.

To address this potential endogeneity of cash reserves,[3] we proceed by estimating the same specification as in column (1) with instrumental variables, instrumenting cash with its lagged values. We use as an instrument cash reserves lagged 18 quarters. The Kleibergen-Paap LM test statistics is 7.49, and at this value the null hypothesis is strongly rejected, suggesting that the instruments are adequate to identify the equation. Furthermore, by using cash holdings lagged 18 quarters, all values of the instrumental variable pre-date the sample period under analysis – which consists of sixteen

[2] For all the fixed-effects models (cash, short-term debt and net short-term debt), we carried out the Hausman test and we always rejected the random effects specification in favour of the fixed effects. Results are available from the authors upon request.

[3] Formal tests indicate that cash reserves (as well as short-term debt) are not exogenous (Wooldridge, 2010, p. 132). More specifically, when plugging the residuals obtained in the first-stage instrumental variables regression into the CRC specification, the corresponding coefficients are jointly significantly different from zero. Results are available from the authors upon request.

quarters – and therefore our identification assumption can be expected to be satisfied.[4]

The CRC-IV estimates, contained in column (2), differ considerably from those in column (1) and lend support to cash being correlated with unobserved within-firm changes in investment opportunities. Notably, the coefficient on $cash$ is no longer statistically significant, whereas that on the interaction between the crisis indicator and cash ($cash \times d$) is larger in magnitude than the estimate obtained without instrumental variables. However, given that the sum of the coefficients on $cash$ and $cash \times d$ is not significantly different from zero, we cannot conclude that during the financial crisis higher cash holdings were associated with higher investment intensity.

In column (3), we present CRC-IV-CUH estimates for the specification in equation (1), in which both the observed measures and unobserved firm-specific characteristics are allowed to affect investment differently before and during the financial crisis. For comparability purposes, we use the same instruments as in column (2), i.e., cash reserves lagged 18 quarters. According to the Kleibergen-Paap LM test statistics, we reject the null hypothesis of underidentification, hence the instruments can be considered to be adequate. Looking at the coefficient estimates, it is worth noting that a statistically significant differential impact of cash on investment ($cash \times d$) no longer obtains. Furthermore, given that the sum of the coefficients on $cash$ and $cash \times d$ is not significantly different from zero, we cannot conclude that during the financial crisis firms with high cash reserves invested more than firms with low cash holdings, when controlling for the effect of unobserved firm characteristics on investment separately during the pre-crisis and the crisis period. Note that if cash reserves were correlated with unobserved firm-specific characteristics and the effect of the latter on investment changed with the onset of the crisis, omitting the term $\delta_i d_t^f$ in equation (1) would imply that the coefficient on $cash \times d$ is inconsistently estimated. This rationalizes the fact that the coefficient on the interaction term between cash and the crisis indicator is statistically significant when imposing the restriction that unobserved firm characteristics have a constant effect on investment throughout the sample period (columns (1)–(2)).

In Table 5, we extend our analysis by studying the role of leverage in investment decisions. Also in this case we focus on the baseline sample period, 2006:Q3–2010:Q2, with the financial crisis starting in 2008:Q3. One should bear in mind that our measure of short-term debt refers to debt maturing within one year. The hypothesis we seek to test is whether firms with different degrees of short-term indebtedness displayed different investment intensities during the financial crisis.

[4] Formal tests also indicate that this instrument and the instruments used in the sequel when considering specifications with short-term debt and net short-term debt are strictly exogenous (Wooldridge, 2010). Namely, when adding the instrument forwarded one period into the specification in (1) and estimating it with instrumental variables, the corresponding coefficient estimate is not significantly different from zero. Results are available from the authors upon request.

[TABLE 5 ABOUT HERE]

Column (1) reports the CRC estimates. The positive fixed effects estimate of the short-term debt coefficient in the pre-crisis period is statistically significant at the 1% level, but relatively low in magnitude. The interaction term between the financial crisis dummy and short-term debt ($st\_debt \times d$) is instead negative, larger in absolute value than that on st_debt, and significant at the 0.1% level. Moreover, as evidenced by the F-test on the hypothesis $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$, during the financial crisis highly leveraged firms appear to have reduced their capital expenditures by more than unleveraged ones. Also according to this specification, a higher Tobin's Q is accompanied by a higher investment intensity.

The results based on the CRC-IV estimates are shown in column (2). We use as instruments cash reserves lagged 20 quarters and the interaction of cash reserves lagged 22 quarters with the crisis indicator. The Kleibergen-Paap LM underidentification test rejects the null hypothesis at 8% level. According to the CRC-IV estimates, the relationship between investment and short-term debt during the financial crisis is no longer statistically significant. The positive association between short-term debt and investment in the pre-crisis period, on the other hand, continues to hold (the corresponding coefficient is still significant at the 10% level).

Column (3) presents the CRC-IV-CUH estimates. The same instruments as in column (2) are used. According to the Kleibergen-Paap LM test, the model is correctly identified. In this case, the coefficients on neither st_debt nor $st\_debt \times d$ are statistically significant (the corresponding t-statistics are equal to 0.60 and to -0.43, respectively). This and the p-value of the F-test on the sum suggest that, when controlling for the effect of unobserved firm characteristics on investment separately during the pre-crisis and the crisis period, no significant relationship between investment intensity and the level of short-term debt obtains. The coefficient on Tobin's Q, instead, is positive and highly significant, as in column (2).

Lastly, in Table 6, we focus on the sensitivity of investment to net short-term debt, which represents net short-term indebtedness. The baseline sample period is again used (2006:Q3–2010:Q2), with the financial crisis starting in 2008:Q3.

[TABLE 6 ABOUT HERE]

According to the CRC estimates, the coefficient on q is positive and highly significant, while that on $q \times d$ is negative and also significant at the 0.1% level, even though lower in magnitude. The coefficient on net_st_debt is equal to 0.78 and highly significant, meaning that investment was higher for firms with high net short-term debt in the pre-crisis sample. At the same time, the

coefficient on $net\_st\_debt \times d$ is highly significant and negative, equal to -0.94. However, the sum of the coefficients on net_st_debt and $net\_st\_debt \times d$ is not significantly different from zero, suggesting that during the financial crisis there were no significant differences in the investment intensities of firms with different levels of net short-term debt.

Column (2) presents the CRC-IV estimates. We use as instruments cash reserves lagged 24 quarters. According to the Kleibergen-Paap LM test, the null hypothesis of underidentification is strongly rejected. The coefficient on Tobin's Q continues to be positive and highly significant. Moreover, the negative estimate on $net\_st\_debt \times d$ is significant at the 10% level. However, all the other coefficients are not significant at conventional levels.

Lastly, column (3) focuses on the CRC-IV-CUH estimates. The same instruments as in column (2) are used. Also in this case the Kleibergen-Paap LM test statistics indicates that underidentification is not an issue. The coefficient on q is positive and significantly different from zero, whereas the one on $q \times d$ is insignificant. Yet, two differences emerge with respect to column (2). First, the coefficient on $net\_st\_debt \times d$ becomes larger in absolute value. Second, the sum of the coefficients on net_st_debt and $net\_st\_debt \times d$, equal to -6.81, becomes statistically significant at the 10% level. That is, a 10 percentage point increase in net short-term debt relative to total assets would have reduced quarterly investment intensity during the financial crisis by 0.68%. Relative to the average investment intensity of 1.1% over the whole sample period, this is a considerable marginal effect. In sum, the estimates in column (3) suggest that investment during the crisis declined more strongly for firms with high net short-term debt than for companies with low net short-term debt.

To further gauge the economic significance of the results, let us relate the coefficient estimates to the average changes in the two observed explanatory variables, Tobin's Q and net short-term debt. The average Tobin's Q in the crisis period was 0.33 lower that in the pre-crisis period. Multiplying this difference with the marginal effect of Tobin's Q on investment during the crisis period (0.41 + 0.047) yields a predicted change of -0.15 percentage points. Net short-term debt, on the other hand, increased on average by 0.0111 between the pre-crisis and the crisis period. Thus, given that the marginal effect of net short-term debt on investment during the crisis is equal to -6.81, the ceteris paribus response of investment to the change in net short-term debt amounts to -0.076. That is, the predicted change in investment due to the average variations in Tobin's Q and net short-term debt is -0.23 percentage points, which is nearly 70 per cent of the average fall in investment of 0.33 percentage points. The remaining 30 per cent of the decrease is captured by the variation in unobserved heterogeneity at the firm level, time dummies and the residuals. Therefore, our results suggest that net-short term debt accounted for approximately one third of the variation in investment explained by the two regressors.

[TABLE 7 ABOUT HERE]

In order to investigate whether these findings are sensitive to the instruments chosen, in Table 7 we present additional results on the sensitivity of investment to net short-term debt. We focus on the model in (1). To ease comparison, column (1) reports results relative to a specification in which we use as instruments cash reserves lagged 24 quarters, as in Table 6. The remaining columns refer to specifications with different sets of instruments. In all cases, the null hypothesis of underidentification is strongly rejected based on the Kleibergen-Paap LM test, providing evidence in support of the validity of the chosen instruments.

In columns (2), (3) and (4), the coefficient on net_st_debt is never significant at conventional levels. The coefficient on $net\_st\_debt \times d$ is instead significant at the 10% level in column (4), even though the sum of the coefficients on net_st_debt and $net\_st\_debt \times d$ turns out to be insignificant. Conversely, in columns (2) and (3), the sum of the coefficients on net_st_debt and $net\_st\_debt \times d$ is statistically different from zero at the 10% level, pointing to a negative effect of short-term debt net of cash reserves on investment during the financial crisis.

To summarise, focusing on the baseline sample period 2006:Q3–2010:Q2, we find that neither cash holdings nor short-term debt individually had a statistically significant effect on corporate investment. However, short-term debt net of cash reserves negatively affected capital expenditures during the financial crisis. Furthermore, our control variable of observable investment opportunities, Tobin's Q, correlates strongly with investment, no matter the specification and estimation method used.

4.4 The sovereign debt crisis

In this section we extend the crisis sample to 2012:Q2, in order to include the sovereign debt crisis period. That is, the crisis dummy takes the value one during the financial and sovereign debt crises (2008:Q3–2012:Q2) and is zero otherwise (2006:Q3–2008:Q2). This longer crisis period allows us to examine whether the results presented above apply not only to the financial crisis but also to the sovereign debt crisis.

Table 8 focuses on cash holdings. Overall, results are similar to those in Table 4. More in particular, the coefficient on q is always positive and significant, while the one on $q \times d$ is significantly different from zero only in column (1). In addition, the coefficient on $cash$ is significant only according to the CRC estimates. Differently from Table 4, the coefficient on $cash \times d$ is never significant, no matter the estimator and the model used. Moreover, although the point estimate on $cash \times d$ in column (3) is positive and large in magnitude, it cannot be judged to be significantly

different from zero at conventional levels. The instruments can be considered valid, given that the Kleibergen-Paap LM test statistics rejects the null hypothesis of underidentification at the 10% level both in column (2) and in column (3). In sum, when the analysis is extended to the entire 2006:Q3–2012:Q2 sample, the finding that cash reserves were not, even in the crisis period, a significant determinant of investment continues to hold. The possibility that cash holdings exerted an influence on investment only during the sovereign debt crisis, which we cannot yet rule out, is considered later in this section.

[TABLE 8 ABOUT HERE]

Similar conclusions can be drawn when looking at Table 9, which focuses on short-term debt over the entire 2006:Q3–2012:Q2 sample. The estimates in column (1) are little changed with respect to the corresponding ones in Table 5. In column (2), instead, the point estimates are slightly different from those in Table 5. Moreover, the coefficient on st_debt is significant at the 5% level, while in Table 5 the corresponding coefficient is significant at the 10% level. Also the coefficient estimates in column (3) are somewhat different from those in Table 5. However, as in Table 5, neither the coefficients on st_debt and $st\_debt \times d$ nor their sum are statistically significant. To sum up, we conclude that short-term debt did not exert an influence on investment either in the pre-crisis or in the crisis period, even when the latter is extended to 2012.

[TABLE 9 ABOUT HERE]

Table 10 reports the estimates for net short-term debt, which in Table 6 was found to have affected investment negatively during the financial crisis. In column (1), the coefficients are close to those displayed in Table 6. In particular, the coefficient on net_st_debt is positive, while the one on $net\_st\_debt \times d$ is negative and larger in absolute value than the former. Moreover, both are significantly different from zero. Column (2) displays estimates for q and $q \times d$ that are similar to those in Table 6. The coefficient on $net\_st\_debt \times d$ instead is no longer significantly different from zero at the 10% level. Other differences emerge when examining column (3). Namely, neither the coefficients on net_st_debt and $net\_st\_debt \times d$ nor their sum are statistically different from zero. This is in contrast with Table 6, where the coefficient on $net\_st\_debt \times d$ was negative, large in absolute value and statistically significant. These results suggest that short-term debt net of liquidity negatively affected corporate investment only during the financial crisis. Still, in what follows, we examine carefully whether net short-term debt had any effect on investment during the sovereign debt crisis by treating it as a separate crisis period.

[TABLE 10 ABOUT HERE]

More specifically, to further investigate the influence of firms' financial positions on their capital expenditures during the sovereign debt crisis, we add in equations (1) and (5) interaction terms with a sovereign debt crisis indicator that takes the value one during the sovereign debt crisis period and is zero otherwise. Thus, differently from the specifications considered in Tables 8, 9 and 10 above, we consider two sets of interaction terms, one accounting for the effect of the financial crisis and the other designed to capture the impact of the sovereign debt crisis. We wish to test whether financial factors influenced investment differently during the sovereign debt crisis than during the financial crisis.

Therefore, the model in (1) with the additional set of interaction terms becomes:

$$\begin{aligned} investment_{it} &= c_i + \delta_{1i} d_t^f + \delta_{2i} d_t^s + \beta_{1i}^f f_{it} + \beta_{2i}^f f_{it} d_t^f + \beta_{3i}^f f_{it} d_t^s \\ &+ \beta_{1i}^q q_{it} + \beta_{2i}^q q_{it} d_t^f + \beta_{3i}^q q_{it} d_t^s + u_{it}, \end{aligned} \tag{6}$$

where the dummy variable d_t^f is equal to one during the financial crisis (2008:Q3–2010:Q2), while d_t^s is equal to one during the sovereign debt crisis (2010:Q3–2012:Q2), and zero otherwise. Similarly, additional interaction terms are added to the alternative model in (5).

Note that in this specification, firm fixed effects, the financial variable of interest and Tobin's Q are interacted with the sovereign debt indicator as well as with financial crisis one. That is, the coefficients on both the observed and the unobserved explanatory variables may change as we move from the pre-crisis period to the financial crisis and from the financial crisis to the sovereign debt crisis. It is worth pointing out that estimating the model in equation (6) should deliver the same point estimates for the pre-crisis and the financial crisis period as the specification in (1). Any differences between the coefficient estimates reported below and the corresponding ones in Tables 4–6 stem from the composition of the sample, due to data availability, and the instruments employed being different.

Results are given in Table 11 for cash reserves, while Table 12 refers to short-term debt and Table 13 to net short-term debt. In Table 11, although the coefficients (on q, $q \times d^f$, $cash$ and $cash \times d^f$) capturing conditional dependencies during the pre-crisis and the financial crisis differ slightly from those in Table 4, one can draw the same conclusions as above. In particular, the CRC-IV-CUH estimates suggests that in neither the pre-crisis nor the financial crisis period was there a dependence between investment and cash holdings. If instead one's inferences were based on the CRC-IV estimates, one could claim that cash reserves exerted a positive differential effect on capital expenditures during the financial crisis (as the point estimate on $cash \times d^f$ is almost significant at

the 10% level). As to the sovereign debt crisis, none of the specifications suggest that there was a positive relationship between investment and cash holdings during this crisis period. In other words, our conclusion about cash reserves not being a significant determinant of investment during the financial crisis also applies to the sovereign debt crisis. Moreover, the results in Table 11 show that the statistically insignificant coefficient on the interaction term between the crisis indicator and cash reserves in Table 8, where the two crisis periods are pooled together, is not driven by the financial crisis period.

[TABLE 11 ABOUT HERE]

Analogously, the estimates in Table 12 pertaining to the pre-crisis and the financial crisis period are similar to the corresponding ones in Table 5. Namely, in columns (2) and (3), no evidence emerges suggesting that short-term debt was a significant determinant of investment between 2006:Q3 and 2010:Q2. What is more, the statistically significant differential effect of short-term debt during the sovereign debt crisis (the coefficient on $st\_debt \times d^s$) in column (1) no longer obtains when employing instrumental variables. This and the F-tests on the sums of the coefficients suggest that short-term debt exerted no significant influence on capital expenditure not only during the financial crisis but also during the sovereign debt crisis. In other words, the effect of short-term debt on investment does not appear to have changed when the financial crisis turned into a sovereign debt crisis.

[TABLE 12 ABOUT HERE]

Also in Table 13, the coefficient estimates for the pre-crisis and the financial crisis do not differ markedly from the corresponding ones in the specification examining the period until 2010:Q2, in Table 6. This shows that the results obtained using the baseline sample period are robust to the variation in the sample of firms resulting from employing additional instruments and prolonging the sample period. As to the differential impact of net short-term debt on investment during the sovereign debt crisis, one notices that in column (3) a statistically significant effect (at the 10% level) obtains also during this latter crisis period. Even though the coefficient on $net\_st\_debt \times d^s$ is smaller in absolute value than that on $net\_st\_debt \times d^f$, they are not significantly different from each other (an F-test of equality yields a p-value of 0.31). Thus, we can conclude that the negative differential effect of short-term debt net of cash reserves on investment was of a similar magnitude during the sovereign debt crisis as during the financial crisis. However, the overall effect of net_st_debt on investment is only significant for the financial crisis, as can be seen from the p-values of the F-tests

on the sums. The fact that we found no differential effect of net short-term debt when pooling the two crisis periods together (Table 10) could be due not allowing the impact of unobserved firm-specific characteristics to change when entering the sovereign debt crisis period.

[TABLE 13 ABOUT HERE]

4.5 Alternative definitions of the financial crisis

In this section we conduct a series of robustness tests. The aim is to assess the sensitivity of the results to a different dating of the financial crisis. In particular, we use two alternative definitions of the financial crisis period: i) 2007:Q3–2010:Q2; ii) 2007:Q3–2008:Q2. In the first case, the financial crisis is simply defined to have started a year earlier than in the previously considered baseline sample split. In the second case, it is additionally supposed that the financial crisis ended in 2008:Q2. Dating the onset of the financial crisis to 2007:Q3 is motivated by the evolution of the three-month Euribor-OIS spread in Figure 9, which climbed to over 60 basis points already in summer 2007, due to the subprime crisis in the US.

In what follows, we present results from employing the alternative definitions of the financial crisis period for each of our three variables of interest. First, we consider the sample period in which the financial crisis spans the period 2007:Q3–2010:Q2. Table 14 reports results for cash holdings, Table 15 for short-term debt and Table 16 for net short-term debt.

[TABLE 14 ABOUT HERE]

[TABLE 15 ABOUT HERE]

[TABLE 16 ABOUT HERE]

In Table 14, the estimates are little changed from those in Table 4. The coefficient on q in column (3) is an exception, not being statistically significant, unlike the corresponding estimate in Table 4. This may be due to the fact that the sample size in the pre-crisis period is too small (and the number of regressors too large), reducing the power of the t-test. However, the sum of the coefficients q and $q \times d$ is highly significantly different from zero (an F-test yields a p-value smaller than 10^{-5}). Another difference with respect to Table 4 is the coefficient on $cash \times d$ in column (2), which in Table 14 is not statistically significant. Similarly, the sum of $cash$ and $cash \times d$ is not significantly different from zero (p-value = 0.20). That is, the results in Table 14, based on the first alternative definition of the financial crisis, provide even less evidence about any conditional dependence between cash reserves and investment than the CRC-IV-CUH estimates.

Also the results for short-term debt in Table 15 are similar to those obtained using the baseline sample period, in Table 5. However, as in the specification with cash reserves, the coefficient on q is not significant in column (3), unlike when employing the baseline sample split. Nevertheless, the sum of the coefficients q and $q \times d$ is highly significant (p-value $< 10^{-6}$). No evidence emerges though suggesting that short-term debt exerted an influence on investment either during the pre-crisis or the crisis period (the sum of the coefficients on st_debt and $st\_debt \times d$ is not significantly different from zero in columns (2) and (3)).

Table 16 focuses on net short-term debt. Also for this variable, no stark differences emerge with respect to the baseline sample split, in Table 6. As in Tables 14 and 15, the coefficient on q, capturing any effect on investment during the four-quarter pre-crisis period, is not significantly different from zero according to the CRC-IV-CUH estimates. However, there is strong evidence of a positive conditional dependence between Tobin's Q and investment during the crisis period. As to net short-term debt, the coefficient capturing its differential impact on investment during the financial crisis is statistically significant (at 6% level), as in Table 6. However, differently from when using the baseline sample period, the sum of the coefficients on net_st_debt and $net\_st\_debt \times d$ is not significantly different from zero (p-value = 0.24). This suggests the negative effect of net short-term debt on investment emerged rather during the more acute phase of the financial crisis, starting in 2008:Q3, than in the preceding year.

As a further check, we consider the third sample in Figure 10, which covers the shorter period 2006:Q3–2008:Q2, with the financial crisis starting in 2007:Q3. Note that with respect to the baseline 2006:Q3–2010:Q2 sample, the number of observations essentially halves. This sample split is also used by Duchin, Ozbas and Sensoy (2010), who argue it allows one to identify the effect of a negative shock to the supply of external finance given that in 2007:Q3–2008:Q2 the crisis was mainly a financial phenomenon. The results reported in Tables 17, 18 and 19 refer to cash holdings, short-term debt and net short-term debt, respectively.

[TABLE 17 ABOUT HERE]

[TABLE 18 ABOUT HERE]

[TABLE 19 ABOUT HERE]

Most of the coefficient estimates in the three tables are statistically insignificant at conventional levels. As in Tables 14–16, also the coefficient on Tobin's Q is not significantly different from zero when the CRC-IV-CUH specification is considered. However, in Tables 17 and 19 the sum of the

coefficients on q and $q \times d$ is significant (at 1% and 2% level, respectively). As to our variables of interest – cash reserves, short-term debt and net short-term debt – and their interactions with the crisis indicator, neither the CRC-IV nor the CRC-IV-CUH delivers any statistically significant estimates with two exceptions. The coefficient estimate of $st\_debt \times d$ obtained using the CRC-IV-CUH (Table 18) and that of net_st_debt delivered by the CRC-IV (Table 19) are both significant at the 10% level. The former result, however, no longer obtains when employing the CRC-IV-CUH, suggesting that it stems from not allowing the effect of unobserved firm-specific characteristics on investment to change. The significance of the latter finding, on the other hand, is undermined by the fact that the sum of the coefficient on st_debt and $st\_debt \times d$ is not significantly different from zero (p-value = 0.17). In sum, the results suggest that firms' financial positions did not exert a significant influence on investment during the first phase of the financial crisis, 2007:Q3–2008:Q2. However, these findings have to be treated cautiously, as the analysis is based on only two years of quarterly data. In other words, the fact that we do not find statistically significant coefficients may reflect the small sample size of both the pre-crisis and crisis periods.

4.6 Different sample composition

In this section we examine the robustness of our findings to considering only the core euro-area countries and the UK, which we expect to have been affected by the financial crisis differently than the peripheral countries. In addition, in a second step, we exclude in turn the smallest and the largest listed companies – as the effect of financial resources on investment is potentially very different in these two groups – and assess how our estimates change as the sample composition is altered in this way. Throughout we consider the baseline timing, 2006:Q3–2010:Q2, with the financial crisis starting in 2008:Q3. We do not consider the sovereign debt crisis period for the reason that above we found significant effects only during the financial crisis.

We first restrict our attention to the core euro-area countries – Austria, Belgium, France, Germany, the Netherlands – and the United Kingdom, accounting for nearly 70 per cent of the firms in the whole sample. Table 20 refers to cash holdings, Table 21 to short-term debt and Table 22 to net short-term debt.

[TABLE 20 ABOUT HERE]

[TABLE 21 ABOUT HERE]

[TABLE 22 ABOUT HERE]

Compared to the results for the whole sample in Table 4, the estimates in Table 20 are similar in magnitude and statistical significance. There is a difference, though, between the two in the coefficient on $cash \times d$ in column (2). In particular, the estimate obtained by excluding the peripheral countries is not statistically significant. That is, cash reserves cannot be judged to have exerted a positive differential impact on investment even when employing the CRC-IV specification. Moreover, as in Table 4, the sum of the coefficients on $cash$ and $cash \times d$ when considering the CRC-IV estimates is not significantly different from zero.

Similarly, when comparing the estimates in Table 21 with those in Table 5, no marked differences emerge. However, unlike when employing the full sample, a statistically insignificant coefficient on st_debt obtains when the CRC-IV is employed. Also according to the CRC-IV-CUH estimates, there is no evidence of any conditional dependence between short-term indebtedness and investment. This and the other similarities between the results in Tables 5 and 21 suggest that our results on short-term debt are not driven by firms in the peripheral countries.

Table 22 reports the results for net short-term debt. Again, the estimates are little changed relative to the full sample. In particular, all the coefficients have the same sign and are close in magnitude to those in Table 6. Examining the statistical significance of the estimates, one observes that the coefficient on net_st_debt is no longer significant at the 10% level when employing the CRC-IV-CUH. However, the sum of the coefficients on net_st_debt and $net\_st\_debt \times d$ remains significantly different from zero at the 10% level. This suggests that the conditional dependence between short-term debt net of cash reserves and investment is not attributable only to firms in the peripheral countries.

Lastly, we present the results obtained when dropping in turn the smallest and the largest firms in our sample. We carry out this exercise only for net short-term debt, which we have found to have influenced investment when employing the full sample. Table 23 shows the results from excluding the companies in the lowest 20 percentiles of the total asset distribution in 2006:Q2. It is worth noting that, according to the CRC-IV-CUH estimates, net short-term debt exerted a quantitatively similar effect on investment than in the full sample. Moreover, the sum of the coefficients on net_st_debt and $net\_st\_debt \times d$ is marginally more significant than in Table 6.

The results from excluding the firms in the highest 20 percentiles of the total asset distribution instead are presented in Table 24. Also in this case we obtain results similar to Table 6. However, differently from when using full sample, the sum of the coefficients on net_st_debt and $net\_st\_debt \times d$ is not significant at the 10% level (according to the CRC-IV-CUH estimates). In other words, net short-term debt does not appear to have influenced investment during the financial crisis. Taken together, Tables 23 and 24 indicate that the negative conditional dependence between short-term debt

net of cash reserves and investment during the financial crisis is present to less extent among the smallest than the largest firms in our sample.

[TABLE 23 ABOUT HERE]

[TABLE 24 ABOUT HERE]

Let us conclude this section with a brief summary of our findings. On the one hand, our main result – net short-term debt having influenced investment during the financial crisis – also obtains when we restrict our attention to firms located in the core euro-area countries (Austria, Belgium, France, Germany, and the Netherlands) and the United Kingdom. On the other hand, we find less evidence of a negative effect of short-term debt net of cash holdings on investment in 2008:Q3–2010:Q2 among the smallest than the largest firms in our sample. However, it is worth pointing out that the smallest listed firms in our sample are relatively large in size, as we have excluded companies with a market capitalization of less than 40 million euros as of June 30, 2006. Moreover, this result could reflect the possibility that the largest firms may have faced more difficulties in refinancing their higher stock of maturing debt during the financial crisis than firms whose quantity of debt to be refinanced was smaller.

5 CONCLUSION

In this paper, we have examined whether there was a conditional dependence between corporate investment and firms' financial positions and how it changed with the onset of the financial crisis and when moving from the financial crisis to the sovereign debt crisis period. We have employed a panel of listed firms in the euro area and the United Kingdom, economies which experienced steep falls in aggregate investment. The main hypothesis we have investigated is whether financial resources were a significant determinant of investment during the financial crisis, but not prior to its onset. Following the previous literature, we have focused on short-term liquidity and indebtedness, as they can be expected to influence the investment decisions of firms which cannot entirely fund their capital expenditures by raising external funds.

We have utilised an econometric specification which belongs to the family of correlated random coefficient panel data models (Murtazashvili and Wooldridge, 2008). Given that we have let not only the observed independent variables but also the unobserved heterogeneity at the firm level to interact with a crisis indicator, the conditional dependencies between investment and all the explanatory variables are allowed to change when moving from the pre-crisis to the crisis period. In order to address

the possible endogeneity issues arising from changes in cash holdings and short-term debt being correlated with unobserved variations in investment opportunities, we have instrumented firms' financial resources with their lagged values, choosing the lag lengths to ensure that the instruments pre-date our sample period.

Our analysis has yielded the following results. First, we have found that to attain plausible identification it is necessary to allow unobserved firm-level heterogeneity of investment to change with the onset of the financial crisis. In other words, assuming that the unobserved firm-specific component of investment remained constant throughout the sample period appears to induce biased coefficient estimates of the financial variables of our interest. Second, our results suggest that neither cash reserves nor short-term debt were significant determinants of investment over our sample period. Moreover, no evidence has been found that the effect of these two variables on investment was different before and after the onset of the financial crisis. However, we have found that investment depended negatively on short-term debt net of cash reserves during the financial crisis, while there was no such negative conditional dependence in the pre-crisis period. Also, no significant relationship between net short-term debt and investment has been detected during the sovereign debt crisis.

Our results, pointing to a negligible role played by cash holdings and short-term debt, considered individually, in accounting for investment dynamics, further qualify the existing results in the literature. Namely, our findings suggest that during the financial crisis neither short-term liquidity nor indebtedness ceteris paribus affected firms' ability to invest. Rather, we find that investment declined particularly markedly for firms with high levels of short-term debt net of their cash holdings, or conversely for firms with low cash reserves relative to the level of their short-term indebtedness. Given that net short-term liquidity measures a firm's capability to repay all short-term obligations if it was called to do so at once, our results support the hypothesis that firms were either unwilling or unable to roll over their short-term liabilities in the midst of the financial crisis, which in turn constrained their investment decisions.

In our analysis, we have been able to identify the parameters of interest by interacting firm-level heterogeneity with a crisis indicator. In terms of future research, a possible strand of investigation is to adopt a fully nonparametric framework allowing to capture unobserved heterogeneity in an even more flexible fashion than traditional models with additive individual unobserved components.

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Table 1: Distribution of firms by country

Country	Number of firms
Austria	66
Belgium	112
Cyprus	56
Estonia	14
Finland	125
France	705
Germany	654
Greece	227
Ireland	93
Italy	236
Latvia	25
Lithuania	28
Luxembourg	50
Malta	16
Netherlands	145
Portugal	46
Slovakia	32
Slovenia	25
Spain	123
United Kingdom	1419
Total	4197

Table 2: Descriptive statistics

Variable	N. obs.	Mean	St. Dev.	Min	Max
Capital expenditure / total assets (%)	37193	1.128	1.244	-0.436	8.462
Cash reserves / total assets	43778	0.141	0.158	0.001	0.890
Short-term debt / total assets	37612	0.083	0.088	0.000	0.512
Net short-term debt / total assets	37389	-0.0304	0.157	-0.713	0.441
Tobin's Q	30809	1.341	0.674	0.029	9.608
Market capitalization (EUR millions)	35472	2682	8812	40.01	124251

Notes. This table presents summary statistics for the main variables used in the empirical analysis. The statistics are calculated over the sample period 2006:Q3–2012:Q2 and refer to values obtained for adjusted data. Abbreviations: N. obs., number of observations; St. Dev., standard deviation; Max, maximum; Min, minimum.

Figure 1: Average investment and Tobin's Q: 2006:Q3–2012:Q2

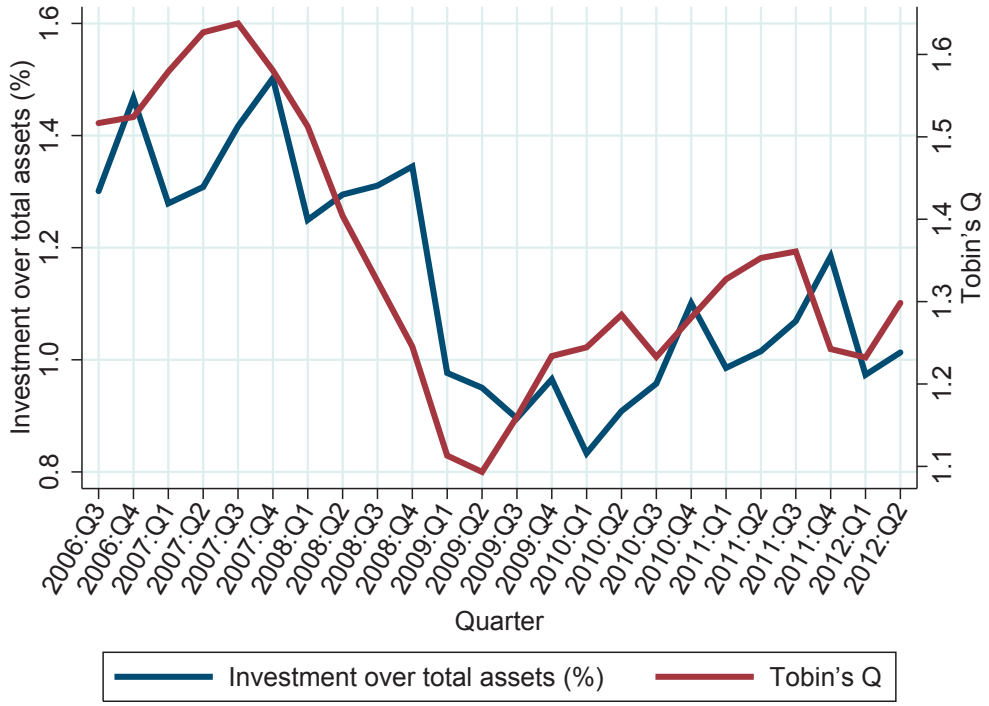

Figure 2: Average cash reserves and short-term debt: 2006:Q3–2012:Q2

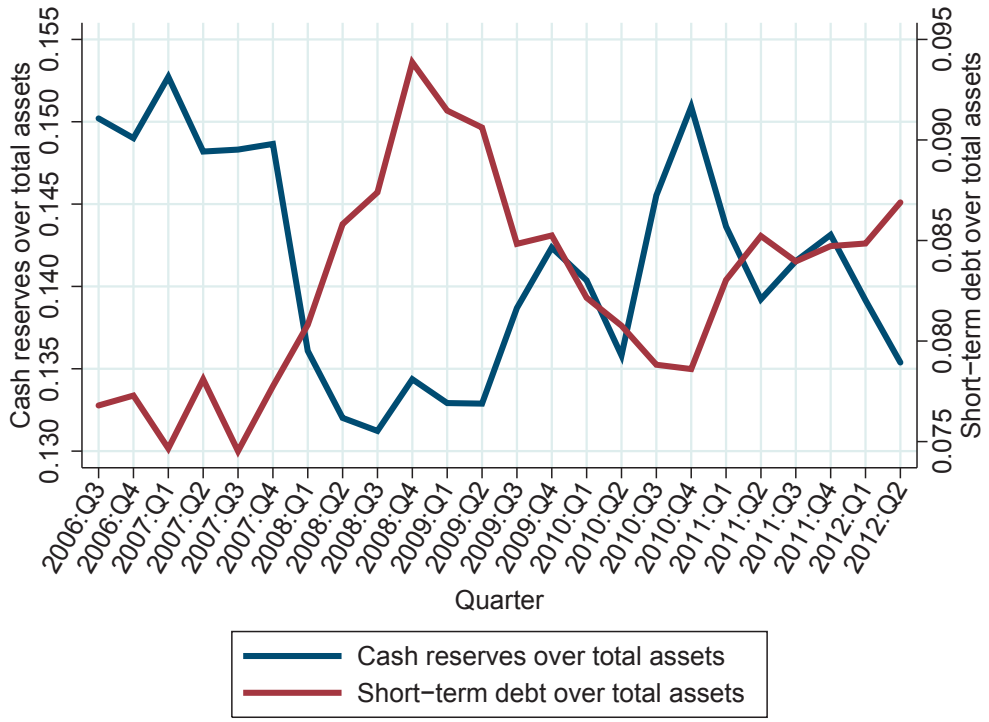

Figure 3: Average net short-term debt: 2006:Q3–2012:Q2

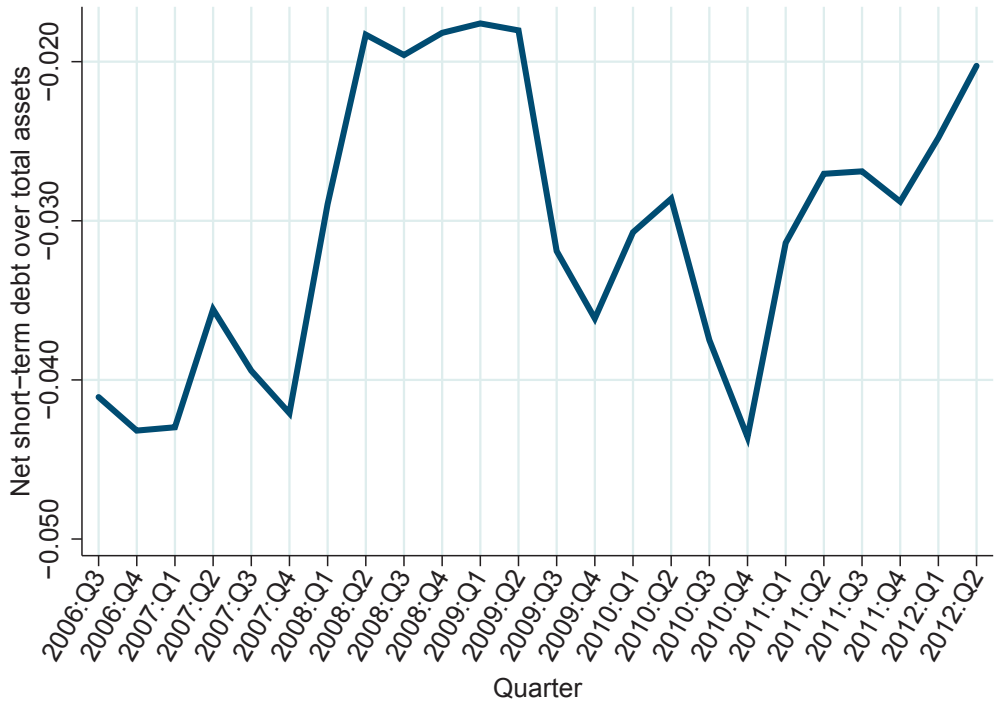

Figure 4: Median with 25th and 75th percentiles: 2006:Q3–2012:Q2

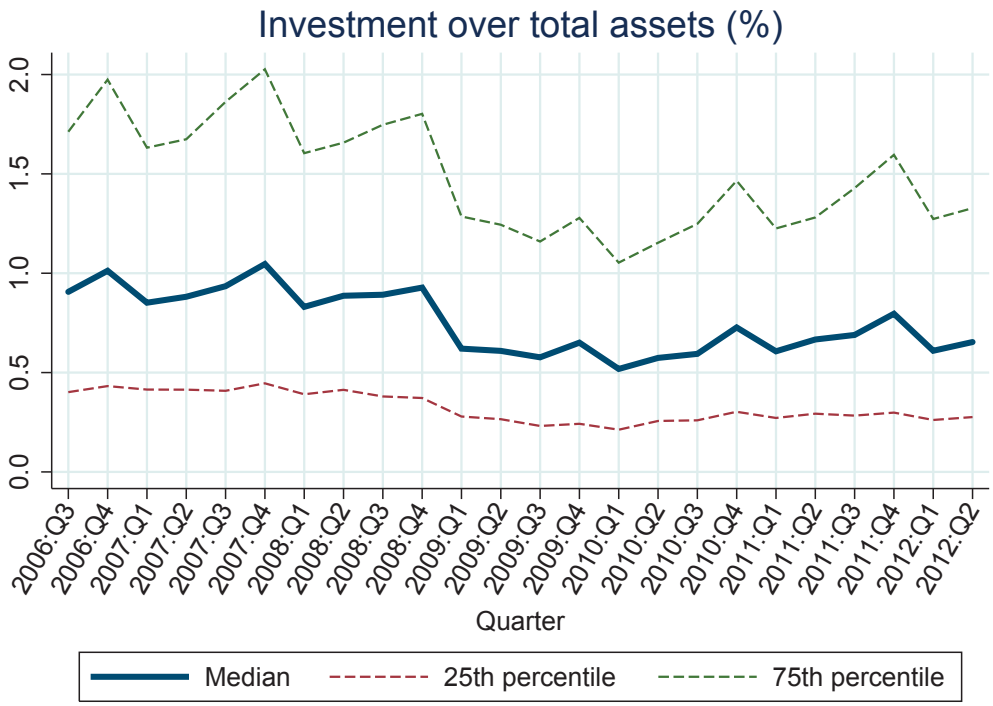

Figure 5: Median with 25th and 75th percentiles: 2006:Q3–2012:Q2

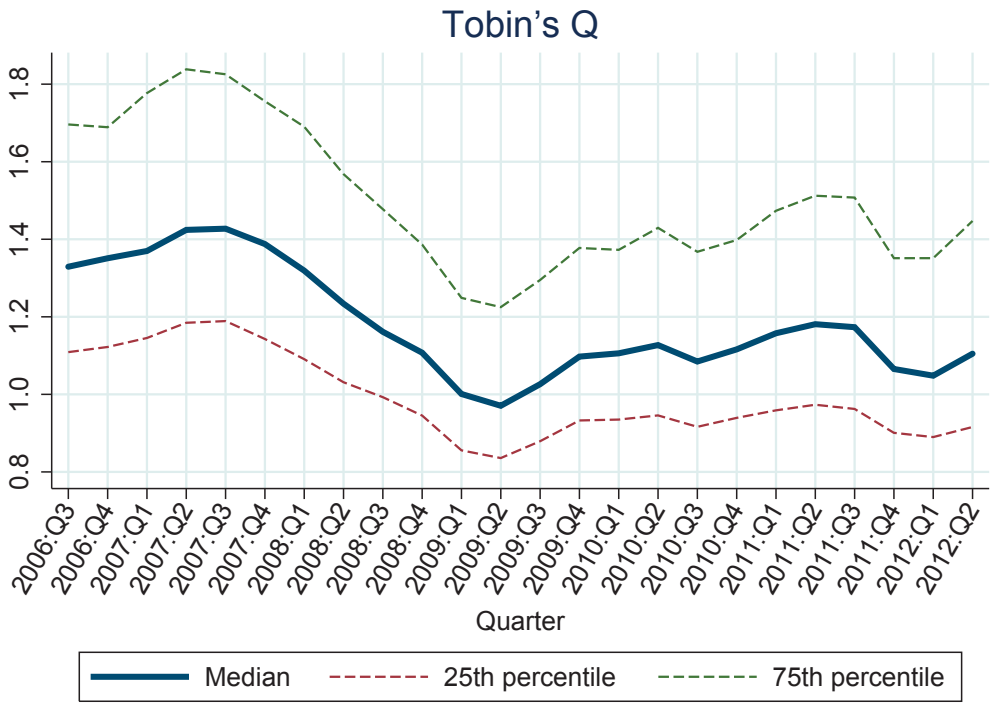

Figure 6: Median with 25th and 75th percentiles: 2006:Q3–2012:Q2

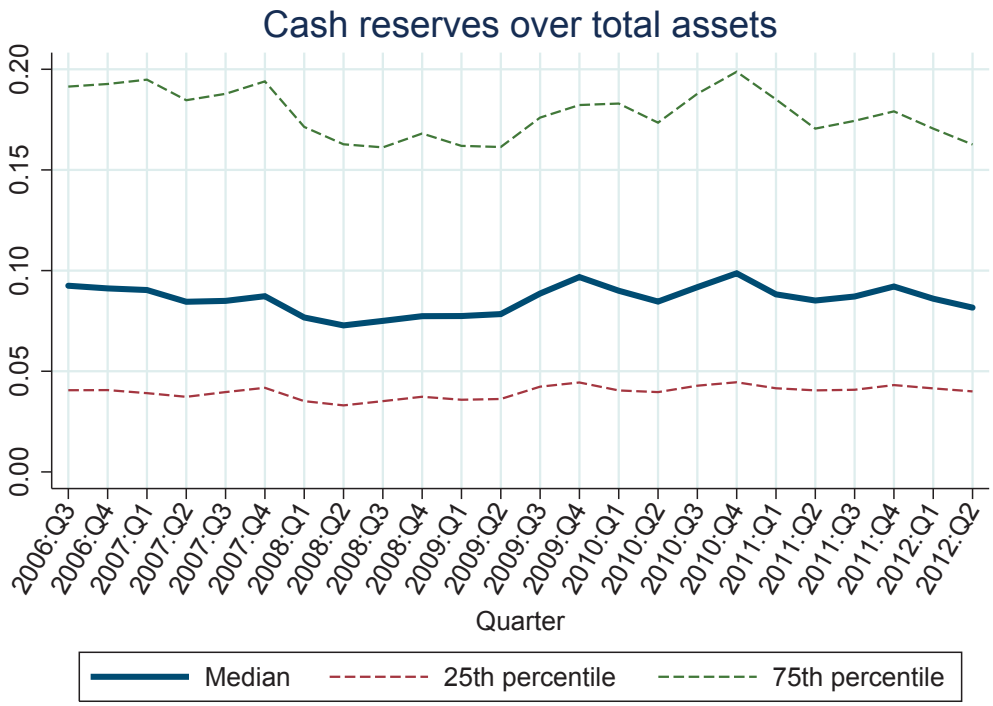

Figure 7: Median with 25th and 75th percentiles: 2006:Q3–2012:Q2

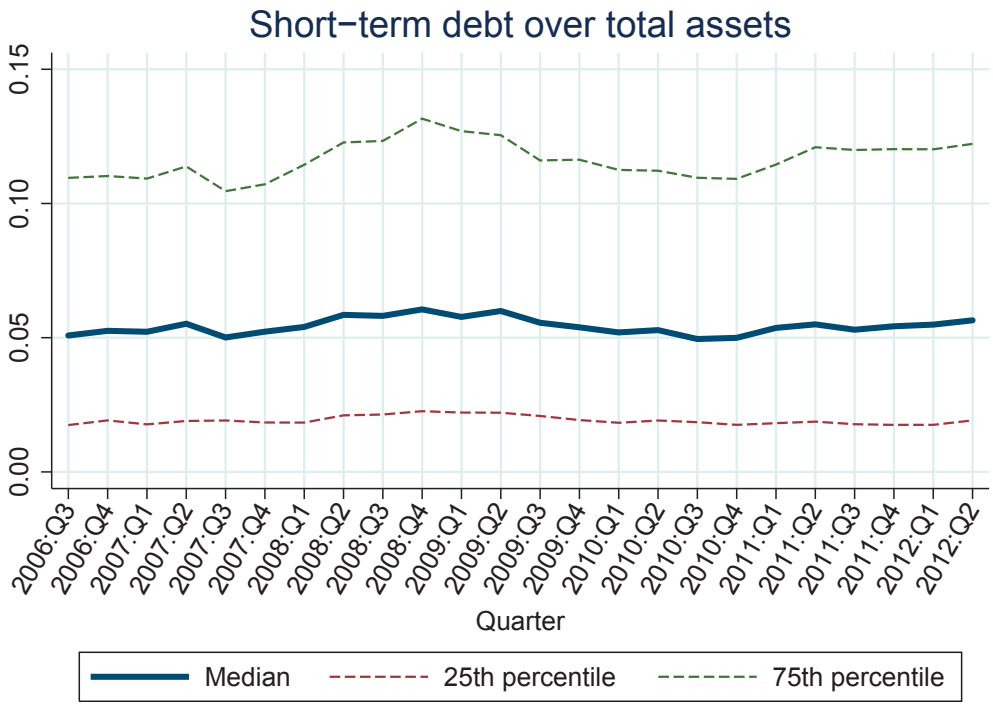

Figure 8: Median with 25th and 75th percentiles: 2006:Q3–2012:Q2

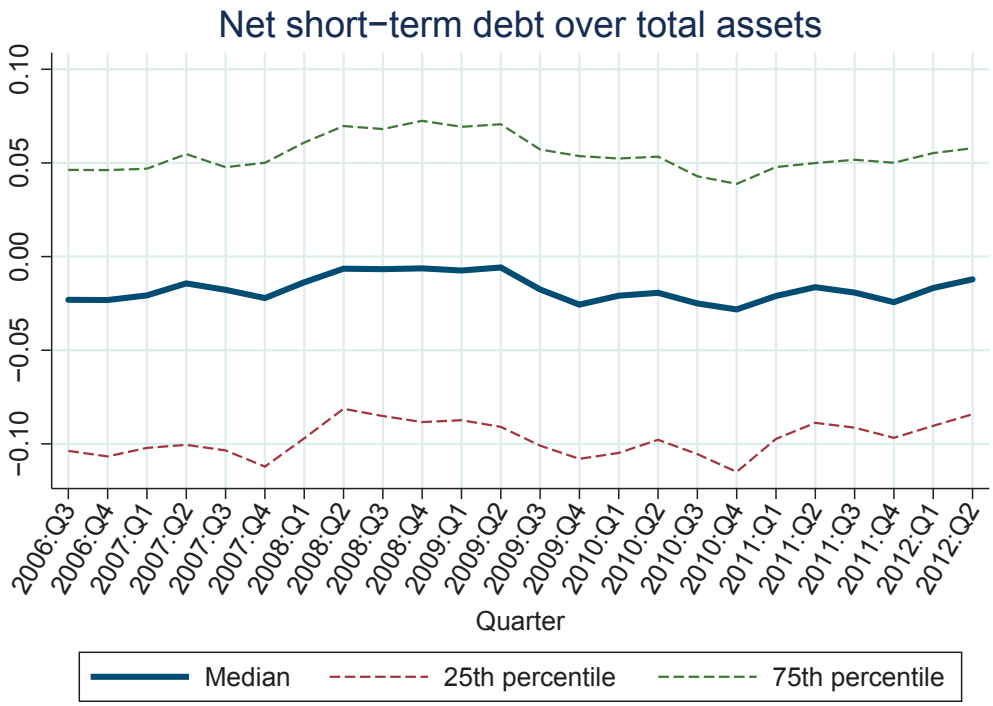

Table 3: Investment before and after the crisis: average investment and mean-comparison t-tests

	Before crisis	Financial crisis	difference (before vs. financial)	Sovereign debt crisis	difference (financial vs. sovereign)
Panel A: Cash reserves and average investment					
Low cash reserves	1.446	1.020	0.426	1.046	-0.026
			(13.22)		(-0.963)
Medium cash reserves	1.320	0.987	0.333	0.972	0.015
			(11.51)		(0.583)
High cash reserves	1.283	0.989	0.294	0.997	-0.008
			(8.833)		(-0.275)
Panel B: Short-term debt and average investment					
Low ST debt	1.278	0.984	0.294	0.953	0.031
			(9.131)		(1.085)
Medium ST debt	1.383	1.026	0.356	1.025	0.001
			(10.81)		(0.047)
High ST debt	1.477	1.047	0.431	1.037	0.010
			(12.03)		(0.341)
Panel C: Net short-term debt and average investment					
Low net ST debt	1.332	1.030	0.302	0.979	0.051
			(8.759)		(1.709)
Medium net ST debt	1.275	0.923	0.352	0.933	-0.010
			(12.02)		(-0.408)
High net ST debt	1.523	1.095	0.427	1.093	0.002
			(11.57)		(0.062)

Note: "Before crisis" refers to the period 2006:Q3–2008:Q2. "Financial crisis" refers to the period 2008:Q3–2010:Q2, while "Sovereign debt crisis" to the period 2010:Q3–2012:Q2. Low, medium and high indicate the first, second, and third terciles of cash reserves, short-term debt and net short-term debt as of 2006:Q2. In parentheses, t-tests on the equality of means in different periods. The null hypothesis is that the two means are equal. Variances in the groups are not assumed to be equal to each other.

Figure 9: Euribor-OIS spread

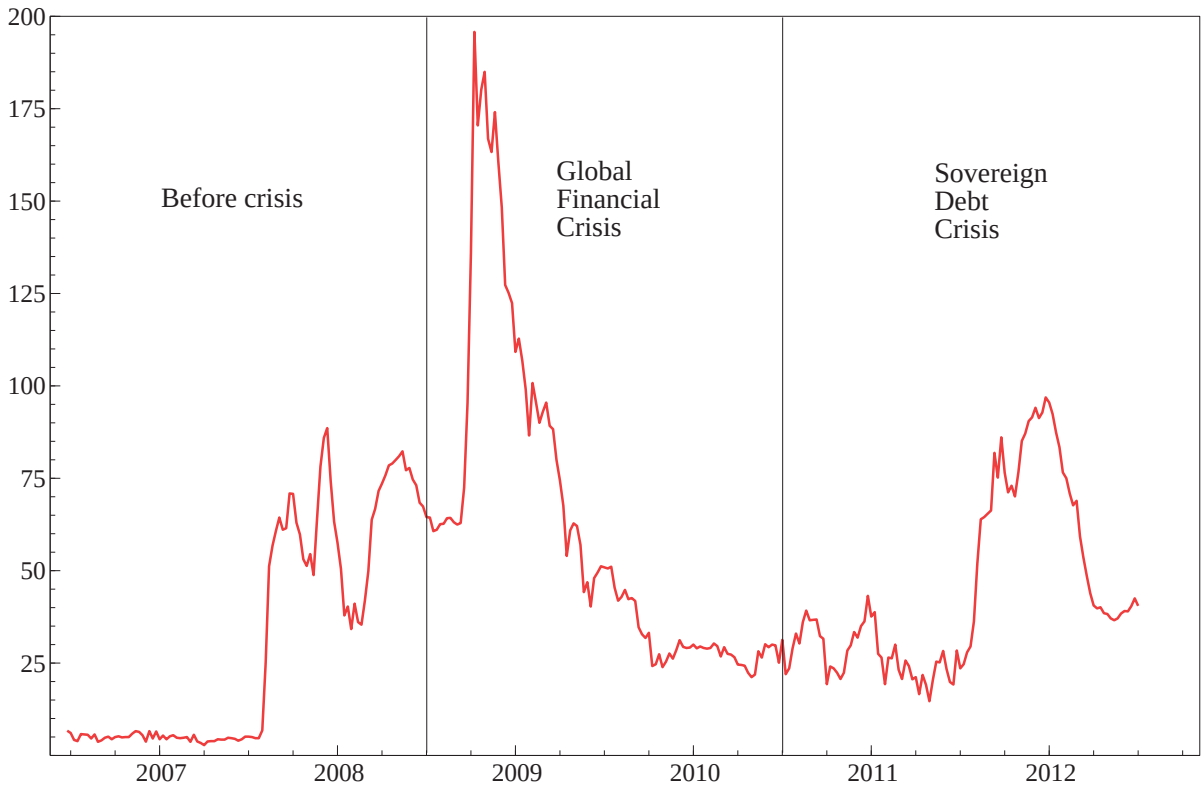

Figure 10: Different samples used for estimation

	1st SAMPLE		2nd SAMPLE		3rd SAMPLE		4th SAMPLE
	2006:Q3		2006:Q3		2006:Q3		2006:Q3
	2006:Q4		2006:Q4		2006:Q4		2006:Q4
	2007:Q1		2007:Q1		2007:Q1		2007:Q1
	2007:Q2		2007:Q2		2007:Q2		2007:Q2
PRE-CRISIS	2007:Q3		2007:Q3		2007:Q3		2007:Q3
	2007:Q4		2007:Q4		2007:Q4		2007:Q4
	2008:Q1		2008:Q1		2008:Q1		2008:Q1
	2008:Q2		2008:Q2		2008:Q2		2008:Q2
	2008:Q3		2008:Q3		2008:Q3		2008:Q3
	2008:Q4		2008:Q4		2008:Q4		2008:Q4
	2009:Q1		2009:Q1		2009:Q1		2009:Q1
FINANCIAL	2009:Q2		2009:Q2		2009:Q2		2009:Q2
CRISIS	2009:Q3		2009:Q3		2009:Q3		2009:Q3
	2009:Q4		2009:Q4		2009:Q4		2009:Q4
	2010:Q1		2010:Q1		2010:Q1		2010:Q1
	2010:Q2		2010:Q2		2010:Q2		2010:Q2
	2010:Q3		2010:Q3		2010:Q3		2010:Q3
	2010:Q4		2010:Q4		2010:Q4		2010:Q4
SOVEREIGN	2011:Q1		2011:Q1		2011:Q1		2011:Q1
DEBT	2011:Q2		2011:Q2		2011:Q2		2011:Q2
CRISIS	2011:Q3		2011:Q3		2011:Q3		2011:Q3
	2011:Q4		2011:Q4		2011:Q4		2011:Q4
	2012:Q1		2012:Q1		2012:Q1		2012:Q1
	2012:Q2		2012:Q2		2012:Q2		2012:Q2

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.410***	0.423***	0.249**
	(8.25)	(5.55)	(2.69)
$q \times d$	-0.178***	-0.130	0.0622
	(-7.21)	(-1.73)	(0.50)
$cash$	-1.218***	4.639	2.425
	(-5.64)	(1.17)	(0.60)
$cash \times d$	0.483**	1.901*	0.578
	(2.67)	(2.13)	(0.12)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.000431	0.166	0.404
N	16910	12134	12134
Kleibergen-Paap LM stat.		7.494	6.721
p-value (Chi-sq(1))		0.00619	0.00953

t statistics, based on robust standard errors clustered in the firm level, in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Estimates of the sensitivity of investment to cash reserves. Full sample. Pre-crisis: 2006:Q3–2008:Q2, crisis: 2008:Q3–2010:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and cash reserves. Excluded instruments: $cash_{t-18}$ and $cash_{t-18} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.371***	0.487***	0.301**
	(7.57)	(3.54)	(2.68)
$q \times d$	-0.0710**	-0.0927	-0.00345
	(-3.12)	(-0.42)	(-0.03)
st_debt	0.827**	12.37	4.743
	(3.26)	(1.92)	(0.60)
$st\_debt \times d$	-1.628***	3.685	-4.077
	(-6.14)	(0.31)	(-0.43)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.000200	0.188	0.837
N	15652	10278	10278
Kleibergen-Paap LM stat.		2.956	9.067
p-value (Chi-sq(1))		0.0856	0.00260

t statistics, based on robust standard errors clustered in the firm level, in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Estimates of the sensitivity of investment to short-term debt. Full sample. Pre-crisis: 2006:Q3–2008:Q2, crisis: 2008:Q3–2010:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and short-term debt. Excluded instruments: $cash_{t-20}$ and $cash_{t-22} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.415***	0.505***	0.411**
	(7.89)	(6.30)	(2.89)
$q \times d$	-0.169***	-0.0907	0.0470
	(-8.46)	(-1.38)	(0.25)
net_st_debt	0.781***	2.975	5.610
	(4.22)	(1.45)	(1.80)
$net\_st\_debt \times d$	-0.941***	-1.384	-12.42*
	(-5.34)	(-1.84)	(-2.51)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.355	0.541	0.0802
N	15683	9615	9615
Kleibergen-Paap LM stat.		8.314	5.617
p-value (Chi-sq(1))		0.00393	0.0178

t statistics, based on robust standard errors clustered in the firm level, in parentheses

$^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Table 6: Estimates of the sensitivity of investment to net short-term debt. Full sample. Pre-crisis: 2006:Q3–2008:Q2, crisis: 2008:Q3–2010:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and net short-term debt. Excluded instruments: $cash_{t-24}$ and $cash_{t-24} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1)	(2)	(3)	(4)
	CRC-IV-CUH	CRC-IV-CUH	CRC-IV-CUH	CRC-IV-CUH
q	0.411**	0.458*	0.399*	0.472*
	(2.89)	(1.99)	(2.33)	(2.43)
$q \times d$	0.0470	-0.00602	0.0777	0.153
	(0.25)	(-0.03)	(0.40)	(0.54)
net_st_debt	5.610	13.31	8.709	10.62
	(1.80)	(1.21)	(1.13)	(1.25)
$net\_st\_debt \times d$	-12.42*	-19.95	-14.36	-17.87
	(-2.51)	(-1.52)	(-1.49)	(-1.70)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.0802	0.0941	0.1023	0.2428
N	9615	10172	9480	5701
Kleibergen-Paap LM stat.	5.617	4.081	4.475	3.960
p-value (Chi-sq(1))	0.0178	0.0434	0.0344	0.0466
Instruments	$cash_{t-24}$	$cash_{t-20}$	$cash_{t-20}$	$net\_st\_debt_{t-25}$
	$cash_{t-24} \times d_t$	$cash_{t-24} \times d_t$	$net\_st\_debt_{t-18} \times d_t$	$cash_{t-24} \times d_t$

t statistics, based on robust standard errors clustered in the firm level, in parentheses. $^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Table 7: Estimates of the sensitivity of investment to net short-term debt (different instruments used). Full sample. Pre-crisis: 2006:Q3–2008:Q2, crisis: 2008:Q3–2010:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and net short-term debt. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.401***	0.463***	0.355**
	(8.37)	(6.54)	(2.62)
$q \times d$	-0.158***	-0.0793	-0.0302
	(-6.84)	(-1.32)	(-0.19)
$cash$	-0.969***	-2.138	-8.034
	(-4.56)	(-0.54)	(-1.50)
$cash \times d$	0.221	1.021	12.30
	(1.19)	(1.20)	(1.56)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.0000273	0.811	0.468
N	26592	16396	16396
Kleibergen-Paap LM stat.		3.540	3.119
p-value (Chi-sq(1))		0.0599	0.0774

t statistics, based on robust standard errors clustered in the firm level, in parentheses

$^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Table 8: Estimates of the sensitivity of investment to cash reserves. Full sample. Pre-crisis: 2006:Q3–2008:Q2, crisis: 2008:Q3–2012:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and cash reserves. Excluded instruments: $cash_{t-24} \times (1 - d_t)$ and $cash_{t-28} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.363***	0.533*	0.288**
	(7.52)	(2.51)	(2.62)
$q \times d$	-0.0637**	0.127	0.221
	(-3.11)	(1.29)	(1.40)
st_debt	0.925***	16.35*	0.900
	(3.46)	(2.40)	(0.20)
$st\_debt \times d$	-1.840***	-1.328	7.615
	(-6.71)	(-0.11)	(0.86)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.00000028	0.300	0.302
N	24459	15160	15160
Kleibergen-Paap LM stat.		2.395	4.313
p-value (Chi-sq(1))		0.122	0.0378

t statistics, based on robust standard errors clustered in the firm level, in parentheses

$^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Table 9: Estimates of the sensitivity of investment to short-term debt. Full sample. Pre-crisis: 2006:Q3–2008:Q2, crisis: 2008:Q3–2012:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and short-term debt. Excluded instruments: $cash_{t-20} \times (1 - d_t)$ and $cash_{t-30} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.418***	0.605***	0.648*
	(7.84)	(7.35)	(2.35)
$q \times d$	-0.165***	-0.0194	-0.178
	(-8.58)	(-0.21)	(-0.64)
net_st_debt	0.632***	4.395	5.425
	(3.51)	(1.23)	(0.66)
$net\_st\_debt \times d$	-0.857***	-0.112	-0.551
	(-4.90)	(-0.07)	(-0.06)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.111	0.371	0.250
N	24502	12933	12933
Kleibergen-Paap LM stat.		5.267	4.444
p-value (Chi-sq(1))		0.0217	0.0350

t statistics, based on robust standard errors clustered in the firm level, in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: Estimates of the sensitivity of investment to net short-term debt. Full sample. Pre-crisis: 2006:Q3–2008:Q2, crisis: 2008:Q3–2012:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and net short-term debt. Excluded instruments: $cash_{t-30} \times (1 - d_t)$ and $cash_{t-30} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.404***	0.505***	0.351*
	(8.29)	(6.31)	(2.42)
$q \times d^f$	-0.155***	-0.105	-0.00788
	(-6.48)	(-1.11)	(-0.04)
$q \times d^s$	-0.157***	-0.139	-0.0821
	(-5.49)	(-1.82)	(-0.41)
$cash$	-0.961***	2.265	6.527
	(-4.49)	(0.75)	(0.85)
$cash \times d^f$	0.295	1.019	-0.247
	(1.61)	(1.63)	(-0.03)
$cash \times d^s$	0.119	1.319	-8.465
	(0.51)	(1.46)	(-0.97)
p-value on $\mathbb{E}[\beta^f_{1i} + \beta^f_{2i}] = 0$	0.000438	0.321	0.209
p-value on $\mathbb{E}[\beta^f_{1i} + \beta^f_{3i}] = 0$	0.000102	0.324	0.705
N	26592	13551	13551
Kleibergen-Paap LM stat.		13.78	5.978
p-value (Chi-sq(1))		0.000206	0.0145

t statistics, based on robust standard errors clustered in the firm level, in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Estimates of the sensitivity of investment to cash reserves. Full sample. Pre-crisis: 2006:Q3–2008:Q2, financial crisis: 2008:Q3–2010:Q2, sovereign debt crisis: 2010:Q3–2012:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and cash reserves. Excluded instruments: $cash_{t-18} \times (1 - d^f_t - d^s_t)$, $cash_{t-18} \times d^f_t$ and $cash_{t-30} \times d^s_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.363***	0.672***	0.359**
	(7.48)	(3.90)	(2.88)
$q \times d^f$	-0.0645**	0.0315	0.0366
	(-2.90)	(0.28)	(0.23)
$q \times d^s$	-0.0609*	0.0481	-0.104
	(-2.55)	(0.49)	(-0.57)
st_debt	0.937***	15.84	10.36
	(3.50)	(1.60)	(1.26)
$st\_debt \times d^f$	-1.609***	0.137	-13.00
	(-6.02)	(0.06)	(-1.26)
$st\_debt \times d^s$	-2.145***	4.617	-14.26
	(-6.52)	(1.05)	(-1.29)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.000328	0.142	0.644
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{3i}^f] = 0$	0.0000003	0.118	0.579
N	24459	12497	12497
Kleibergen-Paap LM stat.		4.934	3.175
p-value (Chi-sq(1))		0.0263	0.0748

t statistics, based on robust standard errors clustered in the firm level, in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12: Estimates of the sensitivity of investment to short-term debt. Full sample. Pre-crisis: 2006:Q3–2008:Q2, financial crisis: 2008:Q3–2010:Q2, sovereign debt crisis: 2010:Q3–2012:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and short-term debt. Excluded instruments: $cash_{t-25} \times (1 - d_t^f - d_t^s)$, $st\_debt_{t-20} \times d_t^f$ and $net\_st\_debt_{t-30} \times d_t^s$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.422***	0.501***	0.411**
	(7.87)	(6.44)	(2.89)
$q \times d^f$	-0.151***	-0.139	0.0470
	(-7.69)	(-1.29)	(0.25)
$q \times d^s$	-0.177***	-0.194	-0.109
	(-7.92)	(-1.71)	(-0.60)
net_st_debt	0.636***	-0.224	5.610
	(3.53)	(-0.06)	(1.80)
$net\_st\_debt \times d^f$	-0.786***	-2.653	-12.42*
	(-4.53)	(-1.95)	(-2.51)
$net\_st\_debt \times d^s$	-0.957***	-2.269	-7.482
	(-4.41)	(-1.10)	(-1.71)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.296	0.578	0.0802
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{3i}^f] = 0$	0.0804	0.672	0.505
N	24502	13665	13665
Kleibergen-Paap LM stat.		2.082	5.617
p-value (Chi-sq(1))		0.149	0.0178

t statistics, based on robust standard errors clustered in the firm level, in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 13: Estimates of the sensitivity of investment to net short-term debt. Full sample. Pre-crisis: 2006:Q3–2008:Q2, financial crisis: 2008:Q3–2010:Q2, sovereign debt crisis: 2010:Q3–2012:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and net short-term debt. Excluded instruments: $cash_{t-24} \times (1 - d_t^f - d_t^s)$, $cash_{t-24} \times d_t^f$ and $net\_st\_debt_{t-30} \times d_t^s$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.545***	0.440***	0.146
	(10.76)	(4.98)	(1.07)
$q \times d$	-0.0598**	-0.0809	0.249
	(-2.90)	(-1.10)	(1.57)
$cash$	-1.235***	5.116	3.670
	(-5.21)	(1.24)	(0.49)
$cash \times d$	0.295	1.570	-1.747
	(1.55)	(1.34)	(-0.21)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.0000109	0.197	0.612
N	16910	11891	11891
Kleibergen-Paap LM stat.		5.632	5.530
p-value (Chi-sq(1))		0.0176	0.0187

t statistics, based on robust standard errors clustered in the firm level, in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 14: Estimates of the sensitivity of investment to cash reserves. Full sample. Pre-crisis: 2006:Q3–2007:Q2, crisis: 2007:Q3–2010:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and cash reserves. Excluded instruments: $cash_{t-21} \times (1 - d_t)$ and $cash_{t-18} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.503***	0.514***	0.540
	(9.05)	(5.47)	(1.52)
$q \times d$	0.00520	-0.0900	-0.0385
	(0.27)	(-1.47)	(-0.10)
st_debt	0.803**	8.332	-13.92
	(2.58)	(1.72)	(-1.17)
$st\_debt \times d$	-1.223***	-1.226	14.25
	(-4.12)	(-0.82)	(1.17)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.0365	0.179	0.909
N	15652	9639	9639
Kleibergen-Paap LM stat.		8.723	15.16
p-value (Chi-sq(1))		0.00314	0.0000987

t statistics, based on robust standard errors clustered in the firm level, in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 15: Estimates of the sensitivity of investment to short-term debt. Full sample. Pre-crisis: 2006:Q3–2007:Q2, crisis: 2007:Q3–2010:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and short-term debt. Excluded instruments: $st\_debt_{t-20} \times (1 - d_t)$ and $cash_{t-22} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.561***	0.536***	0.0422
	(10.30)	(6.05)	(0.20)
$q \times d$	-0.0584***	-0.108	0.537*
	(-3.47)	(-1.82)	(2.28)
net_st_debt	0.805***	2.627	6.388
	(3.92)	(1.33)	(1.51)
$net\_st\_debt \times d$	-0.644***	-1.007	-12.88
	(-3.44)	(-1.03)	(-1.94)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.344	0.549	0.242
N	15683	9615	9615
Kleibergen-Paap LM stat.		7.399	3.042
p-value (Chi-sq(1))		0.00652	0.0811

t statistics, based on robust standard errors clustered in the firm level, in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 16: Estimates of the sensitivity of investment to net short-term debt. Full sample. Pre-crisis: 2006:Q3–2007:Q2, crisis: 2007:Q3–2010:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and net short-term debt. Excluded instruments: $cash_{t-24}$ and $cash_{t-24} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.274***	0.239*	0.223
	(4.35)	(2.42)	(1.59)
$q \times d$	-0.0141	0.0475	0.214
	(-0.70)	(1.06)	(0.98)
$cash$	-0.805*	3.218	1.161
	(-2.57)	(0.45)	(0.21)
$cash \times d$	0.274	-0.247	-1.722
	(1.43)	(-0.22)	(-0.18)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.0719	0.719	0.916
N	7777	5323	5323
Kleibergen-Paap LM stat.		2.687	6.646
p-value (Chi-sq(1))		0.101	0.00994

t statistics, based on robust standard errors clustered in the firm level, in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 17: Estimates of the sensitivity of investment to cash reserves. Full sample. Pre-crisis: 2006:Q3–2007:Q2, crisis: 2007:Q3–2008:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and cash reserves. Excluded instruments: $cash_{t-12}$ and $cash_{t-22} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.243***	0.287**	0.184
	(3.57)	(2.74)	(0.94)
$q \times d$	0.00644	-0.0421	-0.149
	(0.36)	(-1.18)	(-0.48)
st_debt	-0.0193	-3.124	8.308
	(-0.05)	(-0.45)	(0.90)
$st\_debt \times d$	-0.0184	4.472	-27.64
	(-0.06)	(1.16)	(-1.66)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.928	0.784	0.170
N	7239	5787	5787
Kleibergen-Paap LM stat.		11.49	5.196
p-value (Chi-sq(1))		0.000699	0.0226

t statistics, based on robust standard errors clustered in the firm level, in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 18: Estimates of the sensitivity of investment to short-term debt. Full sample. Pre-crisis: 2006:Q3–2007:Q2, crisis: 2007:Q3–2008:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and short-term debt. Excluded instruments: $cash_{t-10} \times (1 - d_t)$ and $cash_{t-11} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.260***	0.445**	0.0422
	(3.77)	(3.12)	(0.20)
$q \times d$	-0.000592	-0.0658	0.319
	(-0.04)	(-1.32)	(1.23)
net_st_debt	0.329	5.649	6.388
	(1.11)	(1.85)	(1.51)
$net\_st\_debt \times d$	-0.217	0.666	-4.670
	(-1.07)	(0.65)	(-0.90)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.711	0.0888	0.605
N	7253	4009	4009
Kleibergen-Paap LM stat.		9.264	6.161
p-value (Chi-sq(1))		0.00234	0.0131

t statistics, based on robust standard errors clustered in the firm level, in parentheses

$^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Table 19: Estimates of the sensitivity of investment to net short-term debt. Full sample. Pre-crisis: 2006:Q3–2007:Q2, crisis: 2007:Q3–2008:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and net short-term debt. Excluded instruments: $cash_{t-24}$ and $cash_{t-24} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.461***	0.425***	0.225*
	(8.14)	(4.67)	(2.10)
$q \times d$	-0.166***	-0.0794	0.0560
	(-5.61)	(-0.88)	(0.40)
$cash$	-1.155***	1.774	-1.364
	(-5.11)	(0.42)	(-0.39)
$cash \times d$	0.561**	1.135	2.729
	(3.00)	(1.27)	(0.63)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.00604	0.558	0.697
N	12779	9586	9586
Kleibergen-Paap LM stat.		3.891	4.909
p-value (Chi-sq(1))		0.0485	0.0267

t statistics, based on robust standard errors clustered in the firm level, in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 20: Estimates of the sensitivity of investment to cash reserves. Sample: Core countries (Austria, Belgium, France, Germany, Netherlands, UK). Pre-crisis: 2006:Q3–2008:Q2, crisis: 2008:Q3–2010:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and cash reserves. Excluded instruments: $cash_{t-18}$ and $cash_{t-18} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.443***	0.494**	0.307**
	(7.32)	(3.15)	(2.65)
$q \times d$	-0.0545	-0.120	-0.000435
	(-1.95)	(-0.31)	(-0.00)
st_debt	0.823**	7.130	1.566
	(2.76)	(0.59)	(0.25)
$st\_debt \times d$	-1.527***	7.087	-1.460
	(-4.44)	(0.32)	(-0.19)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.00484	0.313	0.974
N	11651	8067	8067
Kleibergen-Paap LM stat.		1.186	11.39
p-value (Chi-sq(1))		0.276	0.000740

t statistics, based on robust standard errors clustered in the firm level, in parentheses

$^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Table 21: Estimates of the sensitivity of investment to short-term debt. Sample: Core countries (Austria, Belgium, France, Germany, Netherlands, UK). Pre-crisis: 2006:Q3–2008:Q2, crisis: 2008:Q3–2010:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and short-term debt. Excluded instruments: $cash_{t-20}$ and $cash_{t-22} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.494***	0.488***	0.380*
	(8.37)	(4.97)	(2.39)
$q \times d$	-0.145***	-0.0546	0.0318
	(-6.14)	(-0.67)	(0.17)
net_st_debt	0.772***	2.629	4.937
	(4.02)	(1.48)	(1.51)
$net\_st\_debt \times d$	-0.922***	-1.078	-9.043*
	(-4.56)	(-1.38)	(-2.20)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.437	0.492	0.103
N	11690	7526	7526
Kleibergen-Paap LM stat.		9.045	7.009
p-value (Chi-sq(1))		0.00263	0.00811

t statistics, based on robust standard errors clustered in the firm level, in parentheses

$^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Table 22: Estimates of the sensitivity of investment to net short-term debt. Sample: Core countries (Austria, Belgium, France, Germany, Netherlands, UK). Pre-crisis: 2006:Q3–2008:Q2, crisis: 2008:Q3–2010:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and net short-term debt. Excluded instruments: $cash_{t-24}$ and $cash_{t-24} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.423***	0.547***	0.487**
	(7.14)	(7.29)	(2.73)
$q \times d$	-0.168***	-0.134**	-0.0285
	(-8.60)	(-3.26)	(-0.13)
net_st_debt	0.790***	4.420	8.197
	(4.13)	(1.32)	(1.75)
$net\_st\_debt \times d$	-0.963***	-1.473	-13.93*
	(-5.25)	(-1.75)	(-2.49)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.305	0.468	0.0644
N	14403	9002	9002
Kleibergen-Paap LM stat.		4.340	6.450
p-value (Chi-sq(1))		0.0372	0.0111

t statistics, based on robust standard errors clustered in the firm level, in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 23: Estimates of the sensitivity of investment to net short-term debt. Sample: Large and medium companies (all firms except those in the bottom 20 percentile of total assets in 2006:Q2). Pre-crisis: 2006:Q3–2008:Q2, crisis: 2008:Q3–2010:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and net short-term debt. Excluded instruments: $cash_{t-24}$ and $cash_{t-24} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

	(1) CRC	(2) CRC-IV	(3) CRC-IV-CUH
q	0.411***	0.521***	0.355*
	(7.18)	(5.57)	(2.27)
$q \times d$	-0.173***	-0.105	0.145
	(-7.21)	(-1.35)	(0.65)
net_st_debt	0.760***	2.136	4.133
	(3.66)	(1.21)	(1.67)
$net\_st\_debt \times d$	-0.938***	-1.739*	-12.63
	(-4.81)	(-2.02)	(-1.93)
p-value on $\mathbb{E}[\beta_{1i}^f + \beta_{2i}^f] = 0$	0.362	0.865	0.159
N	11982	6603	6603
Kleibergen-Paap LM stat.		8.678	3.039
p-value (Chi-sq(1))		0.00322	0.0813

t statistics, based on robust standard errors clustered in the firm level, in parentheses

$^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Table 24: Estimates of the sensitivity of investment to net short-term debt. Sample: Medium and small companies (all firms except those in the top percentile of total assets in 2006:Q2). Pre-crisis: 2006:Q3–2008:Q2, crisis: 2008:Q3–2010:Q2

Notes to the table. CRC: Correlated random coefficients, IV: 2SLS Instrumental variables, CUH: Compound unobserved heterogeneity. Explanatory variables: Tobin's Q and net short-term debt. Excluded instruments: $cash_{t-24}$ and $cash_{t-24} \times d_t$. Estimates refer to the population averaged effects for each explanatory variable.

Venture Capitalists at Work: What are the Effects on the Firms they Finance?

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Abstract

Italian startups financed by venture capitalists (VCs) experience a faster growth in size and become more innovative compared with other startups. VC-backed firms also show a much larger increase in equity and a reduction in their leverage. This evidence is obtained by comparing a representative sample of firms financed by private VCs in the period 2004-2014 with a sample of firms rejected by VC at the very last stage of the screening process or in the due diligence phase. These firms narrowly lost the contest and *before VC financing* have very similar observable and unobservable characteristics to the VC backed firms; self-selection is specifically taken into account. The effects on firms' size and innovation are not exclusively explained by equity financing. The results hold when we restrict the comparison to firms in the control group that also increase their equity from investors other than VCs: this suggests that VC effects can also be linked to their managerial expertise and network connections. Finally, the results are exclusively driven by independent VC investors compared with captive VCc.

JEL classification: G21, G24, G32

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1 Introduction

Venture capital (VC) investors provide equity capital to early-stage, high growth potential startup companies that develop a new technology or a new business model in high-tech industries. Equity is an important source of finance for startup innovative companies that could find it difficult to obtain debt as banks normally require collateral they might lack of; additionally, debt financing involves the ability to service debt, while startup firms might not generate any cash flow for the initial years of activity. Venture capitalists aim at getting a return by selling their shares in the companies through a trade-sale or an Initial Public Offering (IPO). They usually expect important returns on some of their investments to offset the fact that a good amount of their projects will fail.[1] In order to increase the return of the investments, VC investors adopt an active form of financing: almost all of them sit on the board of directors and they provide entrepreneurs with advice and contacts.

VC investors might therefore have important effects on the firms they finance, whose performances are hence expected to be better than those of other similar firms that did not receive VC finance (Gompers and Lerner, 2001). This is not just because the equity capital they provide helps reducing the funding gap of high-tech startup firms, but also due to the fact that VC managerial and financial experience could be very useful in enhancing firms' grow perspectives. Finally they can also improve firms' performances through their network connections and a signaling effect on other financiers, specifically banks. On the other hand, following the VC intervention, important conflicts can arise in the governance of the firms, which could be harmful for their performances. First, the aims and strategies of VC investors could be very different from those of the entrepreneurs; specifically, most VC investors could have too a short-term investment perspective compared with that of the entrepreneurs, who can consider this feature detrimental for long-term firm performances. Although VC investors are committed to a company for a long haul, their primary aim is to find a good form of exit from the company.[2] Secondly, appropriability problems can arise as VC investors might just try to capture the innovative idea of the entrepreneurs and exploit it by themselves. The evaluation of VC effects is therefore an empirical question. As a matter of fact, some studies

[1] Shikhar Ghosh of Harvard Business School (HBS) found that three-quarters of US startups backed by venture capital failed to return the capital invested in them, let alone generate a positive return; the figure was calculated on a sample of 2,000 companies that received VC funding between 2004 and 2010. Entrepreneurs anonymous, The Economist, Sept 20th 2014.

[2] The US Small Business Administration website reports that on average the exit happens 4 to 6 years after an initial investment; in Italy, AIFI, the Italian Association of Private Equity and Venture Capital, estimates an average holding period of 5 years.

have found no or weak beneficial effects of VC investors on firms' results.

The aim of this paper is to evaluate the private VC contributions on Italian startups they finance. We focus on Italy where the VC market is still very underdeveloped compared with other European countries and the US (Figure 1). The evaluation of private VC activity is very important in our country where a public support has been suggested in order to provide a kick off to the expansion of the private VC market: with this purpose, some VC funds have been created, partially funded with public money.[3]

The most important challenge in this type of analysis is finding an adequate identification strategy so that a VC treatment effect is detectable, while selection effect is controlled for. Firms that apply for VC funding may be different: the decision to apply may be related to the quality of the new idea and the consequent determination to exploit it. Moreover, VC investors could be smart enough to select the best startup high-tech companies. In other words, there could exist some firm unobservable features (unobservable to the econometrician) that both affect the firm long-term growth prospects and its probability to be financed by a VC. VC treatment could therefore be endogenous. In this case, the effect found when VC companies are compared with other startups, which have not been financed by VC, could be just the selection effect or a mix of selection and treatment effects.

The empirical literature on this topic, reviewed in Section 2, struggles more or less fiercely with this selection problem. Many papers use propensity score matching to obtain a sample of control firms that are similar to those financed but with regard to just some observable features. Few papers rely on IV strategies that also attempt to control for unobservable characteristics. Most of the papers focus on few output indicators. The evidence of important VC effects is stronger in the US experience than in Europe. The most frequent results are that VC investors tend to largely increase the size and the survivorship-rate of the firms they finance. Effects on other firms' characteristics, such as profitability, productivity, innovation, and, namely, financial structure and governance are sometimes documented, though less frequently analyzed, specifically altogether, due to the difficulty in gathering data.

One contribution of this paper is that we control for the selection effect by comparing VC firms

[3]The Fondo Italiano di Investimento SGR runs 2 VC funds of funds with a target funding of more than 200 million, partly covered by Cassa Depositi e Prestiti, a state-owned company; since 2012 to 2016 they invested more than 100 million in private Italian VC funds, whose size was around 400 million at the end of 2016. Invitalia Venture SGR, a subsidiary of a public agency, runs another fund with a target funding of 100 million, which should be reached also with the contribution of private investors: this is a fund that directly co-invests in innovative start-ups with other private operators. Their effect on the size of the Italian venture capital market is expected to be remarkable when considering that early-stage investments in Italy in the whole period 2012-2016 were a bit more than 400 million.

with similar firms that have requested a VC financing, but were not able to get it by a *narrow* margin (late-stage discarded firms). First, considering in the control sample only firms that demand a VC intervention excludes self-selection bias and is an important control for firm *unobservable* features, mainly the desire and determination to grow, and therefore of firm growth perspectives. Secondly, since VC investment is not random, we select our control group by considering only firms that have been discarded *at the very last stage* of the screening process or in due diligence. This strategy is very similar to that applied by Greenstone, Hornbeck and Moretti (2010) in a very different framework.[4] The rationale is that by including in the control sample only the late-stage discarded firms we enhance the similarity with the sample of VC financed firms. The reason for which the deal has not been completed is likely not the quality of the project, but more reasonably the inability to find an agreement on the valuation of the idea, the lack of funds or of coordinated interest by different investors as deals are sometimes syndicated. The selection process has been very strict and meticulous: only 6 per cent of the sample of the initial applicants for VC funding are included in the control sample.

The similarity between financed firms and those of the control group supports our identification strategy. We verify that, *before VC financing*, the firms in the control group are very similar to VC backed firms as for almost all the observable characteristics available in our data, included the average credit score, a sort of proxy catching-up the whole risk and quality of the firm measured using balance sheets indicators. On this respect, we use many more variables than previous studies. Finally, the longitudinal nature of our data allows us to estimate a diff-in-diff model where we control for all unobservable firms' characteristics before VC financing. All in all, the differences that we find between treated and control sample firms *after* VC financing can hence be considered as a good measure of the VC treatment effect.

A second contribution of this paper is that we initally consider the population of the firms financed by private VC investors in Italy in the period 2004-2014 (293 startups), as reported in the Venture Capital Monitor by AIFI, the Italian Association of private equity and venture capital investors.[5] The AIFI dataset is one of the best representation of private VC investments in Italy; the dataset is not proprietary and can be used by other scholars to replicate the analysys: this

[4]The authors want to estimate the plant opening's spillover in the US and need to identify a county that is identical, in the determinants of incumbent plants' TFP, to that where the plant decided to locate. To this purpose, they use a ranking reporting the winner county as well as the one or two runner-up counties (i.e., the "losers") that have survived a long selection process, but *narrowly* lost the competition.

[5]The analysis excludes corporate VC, i.e. VC investments made by non-financial corporations, and public VC that are not reported in the Venture Capital Monitor by AIFI.

is not frequent in VC studies often based on proprietary data (Kaplan and Lerner, 2016). After the merge with the Cerved dataset, from which we get firm balance sheets data, and imposing the essential condition that firms have data the year before VC financing, the number of VC backed firms decreases to 101. This sample is still representative of the initial population of VC backed firms according to industries and geographical areas.

Thirdly, unlike other empirical papers, we consider the VC effects on many different firm outputs: in detail, we evaluate the effects of VC investors on firm size, sales, profitability, credit score, financial structure, survivorship and innovation. We are specifically interested in the effects on firms' financial structure and loan terms in order to test whether VC investment creates a signaling effect for other investors, above all banks (Hellmann, Lindsey and Puri, 2008). Finally, we focus on understanding the main channels through which VC investors have a positive impact on the firms they finance by disentangling the pure financing effect, for equity provision, from the one due to VC management and network connections.

As a brief preview of the results, we find that VC investors have a fast and extended positive effect on the size of the firm: during the 4 years after VC financing, total assets increase on average by almost 800,000 euro more than that of firms that do not receive any VC finance (more than half of the average total assets before financing/rejection). Results on assets are confirmed by labour costs, mainly through an increase in the number of employees. A larger rise in labour costs with a similar trend in sales explains the worse profitability of VC-backed firms and the deterioration of their credit score: both these effects tend to disappear after 4 years from VC financing, when sales increases more for VC-backed firms, though with a large dispersion that makes not significant the difference with the control sample. We also uncover important effects of VC investors on innovation activity that develop 2/3 years after financing: both the probability and the number of patent applications increase more for VC-backed firms. No differences are detected for the survivorship rates.

As expected, equity increases much more for VC-backed firms (452,000 euro more with an average value of equity before financing of almost 400,000 euro); leverage consequently decreases. As for bank loans, we detect a larger shortening in debt maturity and a higher increase in the cost of debt for VC-backed firms, which are likely to be correlated with the worsening in their credit score. The effects on firms' size and innovation persist when the control sample is reduced to consider only rejected applicants that increased their capital. This means that VC positive effects on size and innovation are not only explained by equity financing: their managerial experience and networking

connections play also an important role. Finally, the positive effects on size and innovation are exclusively driven by independent VC investors with respect to captive VC; the injection of equity of the former is much larger.

The plan of this paper is as follows. Section 2 reviews the empirical literature on this topic, while Section 3 explains our research desing based on the VC selection process of start-ups. Section 4 describes the data used and presents some descriptive statistics and Section 5 shows the main empirical strategy followed in the analysis. In Section 6 the results obtained when comparing VC treated firms with late-stage discarded firms are presented. In Section 7 some robustness and extensions of the analysis are considered, while Section 8 discusses the results and concludes.

2 Literature review

The empirical literature most related with this paper analyzes US companies. Most of the papers are aware of the selection problem, though only a few tackle it in a very comprehensive way by controlling for unobservable firm characteristics before VC financing. Helmann and Puri use a sample of Silicon Valley startups and do not control for other selection problems; they find that the startups receiving VC financing were faster in reaching the market with their products (Hellmann and Puri, 2000) and that venture capitalists also play an important role in the firm's organization, frequently replacing the founder with an outside CEO (Hellmann and Puri, 2002). Kortum and Lerner (2000) analyze the impact of VC on patents and they control for unobserved factors using a policy shift that freed pension funds to invest in VC in 1979 in the US; they find that increases in VC activity in an industry are associated with significantly higher patenting rates.

More recently, Puri and Zarutskie (2012) use a longitudinal dataset of private companies and match VC backed firms with others non VC backed firms using only size, sector, geographical area and age in the year that the VC financed firm receives the first round of VC; they find that VC financed firms achieve larger scale, but are not more profitable; default rates are also lower among VC backed firms. Chemmanur, Krishnan and Nandy (2011), using a very similar dataset but also different empirical strategies to control for unobservable firms' characteristics, find that VC backed firms have higher survivorship rate and total factor productivity, the main output they focus on. One of the most appealing studies as for the attempt to control for the selection problem is Kerr, Lerner and Schoar (2014). The authors compare firms financed by early stage investors (business angels in their case) with those that have been discarded with a level of score just below a threshold and that are hence very similar, in some observable and unobservable characteristics, to the firms

that have been financed; they find that firms receiving financing by business angels have improved survival, exits, employment, patenting, Web traffic, and further equity financing.[6] Another study (Samila and Sorenson, 2011) points out some macroeconomic effects of an increase in the supply of venture capital, even when instrumented, in terms of firm starts, employment, and aggregate income.

Regarding Europe, the results about VC effects are weaker. Bottazzi and Da Rin (2002) develop a unique hand-collected data set recording the companies that went public on Euro.nm market from its inception in 1996 to December 2000[7]; they argue they consider only startups companies to reduce the bias in the comparison, similarly to what Hellmann and Puri (2000) did in the same period in the US. They find European venture capital to have a limited effect on firms' ability to grow, create jobs and raise equity capital; these results hold after matching firms using few observable characteristics. Weak results of VC on innovation are also found in Popov and Roosenboom (2012) who follow an approach similar to Kortum and Lerner (2000): they work with data on 21 European countries and 10 industries during the period 1991-2005 and use, as an exogenous variation of VC, data on fund-raising and on the structure of private equity funds in each country.[8][9] They find that VC investments seem to have an effect only in the sub-sample of high-VC countries and in countries with lower barriers to entrepreneurship, with a tax and regulatory environment that welcome venture capital investments, and with lower taxes on capital gains.

A couple of recent papers, mainly based on matching procedures and on the VICO dastaset[10], find that independent VC have effects on sales growth and on exit performances of financed firms, while no effects are detected for government-managed VC (Grilli and Murtinu, 2014; Cumming, Grilli and Murtinu, 2017). On a similar line of research, Bottazzi, Da Rin and Hellmann (2008), analyzing *only* VC firms, using a hand-collected sample of European venture capital deals[11], find

[6]Another interesting paper regards China between 1998 and 2007: Guo and Jiang (2013) use a a propensity score matching and also instrumental variable estimations based on the number of IPO in the stock market. They find that VC backed firms outperform non-VC backed in terms of profitability, labour productivity, sales growth, and R&D investments.

[7]Euro.nm was the result of the alliance of Europe's new stock markets for innovative companies in high-growth industries along the lines of America's Nasdaq.

[8]Their idea is that independent funds have to invest within a relatively short time window compared with captive funds that do not have a limited lifespan and do not raise capital from outside investors other than the single owner of the private equity fund (e.g. a bank or insurance company). Therefore, increased flows in venture capital translate into investments in companies at a faster pace when a country has a higher fraction of independent as opposed to captive VC funds.

[9]They are able to replicate Kortum and Lerner (2000) results for the US in the same period; however, they also show that, even in the US, in a more recent period, VC had a comparably weak impact on innovation.

[10]More than 8,000 European high-tech firms, of which less than 10 per cent are VC backed.

[11]They analyze 1652 companies financed in 17 European countries by 119 venture capitalists between 1998-2001.

that investors' activism is more widespread among independent than captive VC (bank-, corporate- or government owned) and is positively related to the success of portfolio companies which is measured with a successful VC exit, either through an IPO or an acquisition. However, they do not look at specific different outputs of financed companies and they do not compare VC backed firms with others.

As for Italy, some empirical papers use a dataset built by the Politecnico of Milan, based on a sample of high-tech startups followed between 1993 and 2003, of which around 10 per cent were VC backed.[12] One of the most interesting result is obtained in Bertoni, Colombo and Grilli (2011): after controlling for selection of the unobservable variables with a panel fixed effect estimation, this study finds that VC financing spurs firm growth.

3 Selection process among venture capitalists and research design

How do VC investors decide whether or not to finance an innovative startup?

A typical flow chart is reported in Figure 2. VC investors receive thousands of requests of financing each year. Normally the entrepreneurs send a copy of their business plan or an executive summary. Most of them (50 per cent) are rejected after an initial and rapid evaluation of the papers. A share of startups of around 20 per cent reach the phase of a deeper evaluation. At this stage VC investors meet the team and conduct a broad analysis of the data; the startup team is invited to give a short presentation, which is followed by a question-and-answer session. They also analyse the business plan, the way the idea can be protected, the team experience in the market and its commitment in terms of time and funds devoted to the development of the idea, commercial and/or industrial partnerships. For the most promising ideas, VC investors also start to think about the structure of the operation, i.e. the terms of VC entrance and exit and the valuation of the firm. The most promising companies arising the greatest interest (around 10 per cent) enter a costly due diligence process during which the structure of the operation is finalised. Eventually, only 2-3 per cent of the ideas are financed.

There are many reasons why a deal is not reached during the screening or in due diligence. Most of them arise quickly in the process and are related to the quality of the firm, i.e. an inadequate business plan, an idea that is not developed enough, poor quality and/or low commitment of the management team. Some of the reasons are not related to the quality of the idea, but arise from VC preferences for some industries, in which they are specialized, or for the envisaged size of the

[12] The same dataset is included in the VICO dataset at the European level, mentioned in the previous paragraph.

business that could often be considered too small or too large.

Some other reasons might arise later in the process and are mostly related to the lacking agreement on the terms of entrance and exit of the VC fund in the firm and its evaluation, or to the difficulties in finding co-investors in the deal, or the absence of an envisaged way out. Trust is also quite important: early-stage investors take on significant risks as there are often many unknown factors. VC must be confident that the management team will be able to adapt to new conditions without losing focus. VC investors can hence change their mind about a startup also in the final stage of screening or even in due diligence. Moreover, trust is a matter of chemistry, not necessarily connected with the quality of the business. It could be that some startups are rejected by a VC for lacking of trust, but the overall idea is good.

Our research design is based on singling out the *late-stage rejected business* in the idea that at this stage the reasons for which the deal has not been concluded might be those mentioned in the previous paragraph and are less likely to be related to the quality of the idea or of the management. All in all, we try to select the best projects among those that have been rejected.

We are able to build this control sample as we have information on a sub-sample of startups rejected at the different steps of the screening or during the due diligence process. We asked all the VC members of the AIFI to share with us confidential information about the companies that applied for venture capital and their subsequent evaluations. Five of them, which account for one fourth of all the investments undertaken in the period 2004-2014, gave us the information we need. We thus know the tax code of more than 4000 companies that applied for this source of financing during the period 2006-2014, the year in which the screening process occurred, and the stage of the process when the applicant has been rejected. Albeit these VC use different ways of ranking firms, we were able to single out for each investor those businesses that were discarded *at the very last stage* of the screening process or in due diligence and with the highest grades.[13]

In conclusion, this research design allows us to identify the best applicants that were not able to get VC financing. We end up with 258 firms in the control group that account for almost 6 per cent of all VC applicants for which we have information, a percentage that is very similar to the difference between the share of firms reaching the last step of the evaluation and that of firms financed by VC (Figure 2).

[13]Some VC gave a summary grade to the applicant, others comment about the reasons not to undertake the investment. For some VC we choose discarded firms among those with the highest grades, for others the descriptions and comments given by the investors implied they were among the best of rejected firms.

4 Source of data and descriptive statistics

Aside from information on rejected startups among a sub-sample of VC applicants, the analysis is based on data coming from three other different sources. The first source of data is the annual survey Venture Capital Monitor by AIFI. We use the surveys between 2004 and 2014 to identify the universe of venture capital deals in the period (293 VC investments). For each deal we observe the name and the origin of the target firm, the name and the type of the investors, and, for most of the investments, some other details, such as the amount invested and the share of the firm acquired by VC. More specifically, about three-fourths of the target companies are private enterprises, 9 per cent are corporate spin offs and 15 per cent university spin offs. There are 82 different investors: many of them are however associated to only one deal, whereas the most active venture capital has invested in 17 different firms. As for deal terms, the amount invested is specified for more than 70 per cent of the investments: the average and the median value of the investments are 2.5 and 1 million of euro, with a range from 0.1 to 66 millions; 30 per cent of the deals are syndicated. Regarding the years of investments, prior the financial crises the trend in total number of deals was increasing, a pattern that has recovered starting from 2011.

Secondly, for every company in our study we gather information for the period 2000-2015 using the Cerved database that contains detailed annual balance sheets for all limited liability companies based in Italy. In the analysis we only focus on active firms with available information at least one year before the VC treatment. This condition reduces the number of ventures in our study to 101, but is crucial to evaluate the level and trends of the variables of interest since the year before the treatment. In order to evaluate the representativeness of this smaller sample of the initial population of VC-backed firms, in Table 1 we compare their industry and geographical distributions that turn out to be very similar, while firms in our sample tend to be slighlty more innovative when considering the probability and the number of patent applications.[14]

As mentioned, we focus on different firm characteristics, such as size, profitability, and financial structure. As for size, we present results on total assets, labor costs and sales; we are able to use the number and wages of employees by incrementing the Cerved database with data from INPS (the Italian retirement management agency). Our measures of profitability are EBITDA/Assets

[14]Industry and geographical area are available in the the Venture Capital Monitor, while patent applications are found in the Orbis database as explained in the final paragraph of this section. The status of limited liability company, determined by the use of the Cerved database for the balance sheet data, is likely to have low impact on the representativeness of our sample as the innovative start-ups included in the register since the 2012 Law, which has created them and given them important fiscal beneftis, need to have this legal form.

and ROE, whereas for financial structure we focus on book value of equity, total financial debts, and leverage, which is defined as the ratio between financial debts and the sum of equity and total financial debts. Moreover, in order to capture the relationship with banks, we also consider the ratio between bank debt and total financial debts, the ratio between short term bank debt and total bank debt, and the cost of loans.

Our group of VC-backed firms is therefore composed by 101 ventures financed over the period 2004-2014 for which we have balance-sheet information in the year before the treatment. Table 2 provides summary statistics on these VC-backed firms: 58 per cent of them are located in the North of Italy, whereas 24 per cent operate in the Center and 19 per cent in the South. About 70 per cent of these companies operate in sectors with high-growth potential, that is ICT, telecommunication, engineering, and pharmaceuticals, 17 per cent of them work either in the energy sector or in manufacturing, whereas 14 per cent in other services. As expected, these firms are young (5 years on average), small, as the size dummy, which reflects different accounting variables such as assets and labour costs and whose range is between 1 and 4, is on average equal to 1.1, and have a large incidence (71 per cent) of intangible assets on total fixed assets (tangible and intangible assets). They are also not profitable and, much less expected, their leverage is high (96.6 per cent), tough three quarters of their bank loans have a maturity shorter than 1 year. According to the score provided by Cerved, they are quite risky firms. The score in Cerved is particularly important as it captures the intrinsic quality of a company: the average rating for the treated firms is 6.5 out of 9, where higher values mean higher risk.[15]

Finally, as a measure of innovation we collect patent applications from the European Patent Register, which is kept by the European Patent Office, such as reported in the Orbis database. We focus on patent applications, rather than grants, to conform with most of the empirical literature about innovation. Using this dataset, we augment the Cerved dataset on balance sheets with information about the total number of patent applications at the European Patent Office by each firm in every year.[16]

[15] Cerved calculates the Z-score on the basis of different balance-sheet indicators and assigns firms in different 9 risk classes, from safe (1-4), to vulnerable (5-6) and risky (7-9).

[16] As in three out of four sources of data, firms' identifiers are names rather than fiscal codes, we double check that merges with the Cerved dataset are correct using the Business Register kept by the Italian Chambers of Commerce ($https://telemaco.infocamere.it.$).

5 Empirical strategy

To assess whether firms that benefitted from VC financing afterward outperform those that did not receive VC funding is a challenging task, as mentioned in the Introduction. In order to identify the impact of VC financing, recipient and non-recipient firms should differ only for the assignment of the funds. This assumption is not easily testable and could be affected by two sources of bias that we need to address in order to correctly identify the impact of VC financing.

The first source of bias comes from firms' self-selection. Enterprises that apply for VC funding can be different from those that do not. The decision to apply may be related to the quality of the new idea and the willingness to economically exploit it, or to other unobservable characteristics of the firms that are correlated with the firm performance. In these circumstances, comparing the results of recipients with those of non-recipient firms that do not apply for VC funds might produce biased estimates of the effects of the VC financing.

The second source of bias is due to the non-random assignment of VC. Recipient firms might be inherently different from those that applied, but were not financed. VC investors could select the best high-tech startups, and unobservable firm features might affect both the firm probability to be financed by a VC and its long-term growth prospects. Again, this type of problem induces a bias in the estimation of the effect of the financing to the extent that firm characteristics for which we are not able to control for are correlated with the firm performance and differ between recipient and non-recipient firms. To deal with these issues, we use an identification strategy based on a careful selection of the control group and diff-in-diffs estimation method.

The availability of the information on rejected applicant firms allows us to fully control for the first source of bias, i.e. self-selection. We use rejected applicants as the set of firms from which we choose the control group for financed firms. Since both groups of firms self-select among the applicants they cannot differ in this respect; hence self-selection bias does not occur.

Our strategy tries to control as much as possible also for the second source of bias. As carefully explained in Section 3, we exploit the multi-step screening process of VC investors and the grades they assign to the applicants to build a control sample of firms that were rejected in the final stages of the screening process or in due diligence.

To evaluate the validity of our identification strategy, we carefully verify whether VC backed firms and those in the control group are very similar before VC financing in terms of a larger set of observable characteristics than that used in previous studies. We consider indicators of size, profitability, financial structure, innovation and some other variables including a synthetic measure

of the risk of corporate failure (Z-score calculated by Cerved), which is very useful as it is an index of the overall quality of the firm, able to catch-up some unobservable firm characteristics such as for example the ability of the firms' management team. The results are very clear-cut. Even without imposing any matching, there are no statistically significant differences between VC-backed and late stage rejected firms (Table 3), but for the initial age of the firm that we hence include in our estimations as control.

Finally, in order to control for any residual differences in unobservable firm characteristics between financed and rejected firms *before* VC financing, we exploit the longitudinal nature of our data and use the diff-in-diffs (DID) estimation method. Using the DID, the effect of the VC financing is estimated by the change in the difference of the output between recipient and non-recipient firms before and after the VC investment.

Formally,

$$DID = [E(Y^1_{it*+x}) - E(Y^0_{it*+x})] - [E(Y^1_{it*-1}) - E(Y^0_{it*-1})] \tag{1}$$

where E is the average value, Y_i is the outcome variable of the firm i, t* is the year of VC financing, x are the number of years after VC financing (1 to 4 years) and the top index 1(0) refers to the VC-backed firms (control firms).

The DID method is strongly dependent on the parallel trend assumption, i.e. is based on the assumption that without the VC financing the outcome variables of the two groups would have followed the same time paths. Therefore, we carefully verify this hypothesis by testing the similarity of outcome variable trends in our samples before the treatment. The results are plotted in Figures 3 and 4: they indicate very similar trends before the VC financing for the main outcome variables analyzed in the paper. These graphs are also very useful because they show graphically the effects of VC financing on selected firms' outputs.

In detail, our baseline model is:

$$y_{it} = \beta_1 * post_t + \beta_2 * VC_i + \beta_3 * post_t * VC_i + \beta_4 * dyears + \beta_5 * f_i + const + \epsilon_{it} \tag{2}$$

where y_{it} are the outcome variables (assets, sales, labor costs, etc.), i is an index for firms, t refers to different years, VC_i is a dummy equal to 1 for firms that are financed by VC investors, $dyears$ are year dummies to control for different economic cycles and f_i stands for the firm fixed effect to control for unobservable firm characteristics that are fixed over time; in this equation $beta_4$ and $beta_5$ are vectors of coefficients. Standard errors are clustered at firm level to take into account

the correlation among the observations of the same firm.

As for the term $post_t$, first we run a DID estimation collapsing the various $post_t$ terms in a single dummy *post* to capture the overall effect of VC financing since the year of financing/rejection over the 4 years afterwords. Then we run 5 different DID estimations with the variable $post_t$ $(t = 0, ..., 4)$ defined as dummies taking values 1 the year of financing/rejection or one of the 4 years afterwords, 0 the year *before* financing/rejection and missing otherwise: in this way we study the effects of VC year by year. In other words the dummy $post_t$ is equal 1 in the year when we want to evaluate the VC effect on the firm, 0 in the year before financing/rejection and missing otherwise.[17] The parameter of interest is $beta_3$, that of the interaction term $post_t * VC_i$, which is reported in the tables.

One potential drawback of DID estimates is that they could be biased if the outcome variable of VC financed and VC non-financed firms have different trends. Apparently, from the figures this does not emerge. In any case, we control also for potential differences in time trends by interacting some pre-financing control variables, such as the initial age of the firm at financing/rejection, geographical area and sector dummies, with the post financing dummies $post_t$, in the idea that firms in different steps of life-cycle, belonging to different sectors or geographic areas could be subject to different time trends. In a less parsimonous specification of the previous estimation we hence include also the following control variables, where all coefficients stand for vectors of coefficients:

$$\beta_6 * init.age_i + \beta_7 * init.age_i * post_t + \beta_8 * sec_i + \beta_9 * sec_i * post_t + \beta_{10} * area_i + \beta_{11} * area_i * post_t \quad (3)$$

6 Results of the effects of VC financing

In this section we present the results concerning VC effects on firm's size, activity, innovation and financial structure. From Figures 3 and 4, in which we include graphs for selected variables that show some changes between VC backed and non-VC backed firms, the evidence is that after the VC intervention we observe a much stronger increase in total assets and labour costs over the entire period of the analysis. There is also a positive effect on firm sales, though only after 4 years from VC financing. We also observe a negative trend in the firm profitability (EBITDA/total assets) for VC backed firms, which also vanishes after 4 years since the VC financing, consistently with the

[17] In order to avoid Betrand, Duflo and Mullainathan (2004) criticism, the estimations by years include the period -1 and separately each single year in the post financing period, thus only two periods are included in each estimation: -1 and 0; -1 and 1; -1 and 2; -1 and 3; -1 and 4. Alternatively we present also the results of the estimations over the whole post financing period taking the average of each variables between 0 and 4 over the post period.

surge in sales. The figures also show that VC backed firms tend to have a much higher equity[18], more innovation activity and lower survival rate.

We then verify the previous graphical evidence in a multivariate econometric setup. In Tables 4 to 6 we report the results for the coefficient $beta_3$ of DID estimations (equation 2). We run the estimations with no controls and with all controls, including initial age, area and sector and their interactions with the term $post_t$. As the results of the two specifications are similar, we report in the tables only those obtained with all controls. Most of the graphical evidence is confirmed. In the tables we show first the effect on the whole period since VC financing and then the one for each single year.

First, we find that VC investors have a rapid and extended effect on firms' size: during the 4 years after the VC financing, total assets increase on average by 780,000 euro more for VC backed firms than for firms not receiving any VC financing (Table 4) a bit more than half of the average total assets of companies before financing. This is the average effect on firm size over the 4 years after the VC financing; from the interaction dummies, which capture the trends year by year, we elicit that the effect on firm size is increasing over time: after 4 years from VC financing the increase in assets is almost 2 million of euro more than for the control group. The gradual increase in firm size is confirmed by the rise in labor costs: on average roughly a rise of 157,000 euro more for VC backed firms with respect to an average amount of labor costs before VC financing equal to 280,000. Furthermore, the last two columns show that the increase in labor costs is due almost exclusively to a rise in the number of employees (increasing by 2 units more for VC backed firms), while the difference in the increase of monthly wage is positive but not significant.

As for sales, the effect of VC is increasingly positive, though never significant due to the large heterogeneity in the results which reflects in high standard errors. This could be a consequence of projects financed by VC that frequently take more time to reach the commercialization phase, i.e. projects that are in an earlier stage of their life-cycle and hence riskier. As a consequence of the gradual upsurge in sales, the operating profitability (EBITDA/assets) of firms that got VC financing, which was initially much worse than that of control group, improved; after 4 years from financing the difference between VC backed firms and control sample is no longer significant (Table 5. Moreover, there are almost no differences in the return on equity (ROE) of the two groups of firms. Nonetheless, the strongest negative trends in operating profitability for VC-backed firms is

[18]Rejected applicants do not get any equity financing from VC operators, but they might get equity from other investors. Indeed, investors in the capital of innovative start-ups, like friends, small entrepreneurs and corporates, have benefitted from fiscal incentives introduced with a Law passed in 2012.

likely to explain their worse rating, measured by an increase in the Z-score index by 0.6 points more than that of non-VC backed firms (the average score before financing is 6.5); consistently with the improvement in operating profitability, this difference vanishes after 4 years.

We then focus on firm financial structure indicators that are seldom analyzed in previous studies (Table 6). We find a remarkable stronger increase in equity for VC-backed firms: 452,000 euro higher than for the control group, more than double the average equity of firms before financing. The increase in equity becomes more and more wider, suggesting a multi-stage process of financing. This considerably reduces more the leverage of VC-backed firms (64 percentage points of additional reduction compared with a leverage before financing of VC-backed firms of 96.6 per cent). Overall VC-backed firms have a much more capitalized and hence stronger financial structure after VC financing. It is worth noticing that the additional increase in total assets for VC-backed company is much larger (almost twice as much) than that in equity: there is therefore a multiplicative effect induced by VC activity; we will deepen more thoroughly this issue in the next section.

Financial debts of VC financed firms also increase more than for the control sample, though the high variance of the results makes the difference not significant. Interestingly, VC-backed firms tend to have a shorter debt maturity than firms in the control sample (an increase of 10.6 percentage points more in the short term debt share compared with an average of 75 per cent before financing) and pay a higher interest rate on their financial debt (an increase of 7 percentage points more than for the control sample, compared with an average cost of funds of 4.5 per cent before the treatment). These worse conditions on bank loans might be explained by the deterioration in operating profitabiliy and credit score; this seems specifically true for the cost of funds for which the differences tend to disappear after 3 years since VC financing when the differences in score also vanish.

We finally deepen the evaluation on innovation activity and survival rates using the DID estimations (Table 5). When considering a dummy equal to 1 for firms that applied for a patent, the estimations show that the effect of VC financing on the whole period is positive, but not statistically significant. However, the increase in the cumulated number of patent applications is much larger for VC backed firms: a rise of 0.25 more patent applications than for the control sample, almost twice as much as the average number of patent applications before financing/rejection. When analysed over time, the effects on firms' innovation develop clearly 3-4 years after financing; this is expected as it takes time to strengthen an idea to the point of asking for a patent: after 4 years of financing, VC-backed firms show a much higher increase in patent applications (1.6 more)

compared with the control sample. We have reported in the table the results obtained with linear estimations that allow us to use the same controls as for the other output indicators, including the firm fixed effect; we also verify the evidence regarding innovation with non-linear estimations such as probability and negative binomial models. Finally, we do not detect any significant difference in the firm survivorship rate after three years of VC financing or rejection.

7 Robustness and extensions of the results

7.1 Comparison with firms in the control sample that increased their equity

In this subsection we show the results of some estimations regarding a control sample of late-rejected firms that also increased equity thanks to investors different from venture capitalists. The main intent of this exercise is to evaluate whether the VC effects on firms' size and innovation are exclusively connected with equity financing or there are some effects linked to their managerial expertise or networking connection. Results are reported in Tables 7 to 9 and refer to a control sample of 163 firms compared with an initial initial control sample made of 258 firms.

The evidence is that even restricting the control sample in this way, the effects of VC financing on firm size and innovation are very similar to those presented in the previous section; this is also true for the results concerning the worsening of profitability and credit score (Tables 7 and 8). It seems therefore that the VC effects on firms' growth and innovation are related to the general activity of venture capitalists, and not only to the fact that they offset a funding gap with equity financing.

It is however important to underline the fact that even restricting the control sample to rejected firms that also got some equity financing from outside investors, the increase in equity for VC-backed firms is much stronger, similarly to what we have shown in the previous section (an increase in equity of 448,000 more for VC-backed firms; table 9). It is therefore possible that some rejected firms get equity from other investors, but the amount they gather is so tiny that the previous conclusion appears not well grounded.

We therefore further restrict the sample to rejected firms that rise equity and for which this increase is higher than a certain threshold (the 1st quartile of the distribution of the increase in equity). In this case the rise in equity for VC-backed firms is not significantly different than the one observed in this much smaller control sample (122 firms), while all previous results on the size, innovation and activity of firms financed by VC investors are confirmed.[19]

[19] To preserve space results are not reported; they are available upon request.

The overall take of this extension of the analysis is hence that VC effects on firms' size and innovation of the firms they finance are not only mechanically linked to their equity financing.

7.2 Captive and independent venture capitalists

Another important issue is whether there are differences in the effects of the firms that have been financed by captive VC (bank-, financial or insurance company-owned in our sample) and independent VC investors. Captive VC do not raise capital from outside investors other than the single owner of the private equity fund and they could have specific indications, from the single owner, about the investment policy to adopt. Independent VC investors gather funds from the market and they are freer to chose the companies in which to invest. In our sample of 101 startups, 42 have been financed by captive VC and the remaining 59 by independent VC.

In order to test the differential effects of the two categories of VC, we split the crucial interaction term - post*VC - in the equation 2 using two dummies for VC: the first referring to captive VC and the second to independent VC. For each period, we report the coefficients of two interaction terms - post*VC-captive and post*VC-independent - measuring the effect of each specific group of VC after their financing.[20]

In Table 10 the evidence is that the growth in total assets for the whole period after VC financing is stronger, compared with the control group, only for independent investors. Similar results hold for labors costs and the number of employees that increase more, compared with the control group, only for VC-backed firms financed by independent operators. All in all, the positive effect of VC on the size of firms arise only when financing is obtained by independent investors. Similarly, for innovation activity in Table 11 the evidence is that the positive effect on the number of patent applications after 3 years is entirely driven by indipendent VC investors, while some effects on the probability of patent applications are detectable also for captive VC investors.

The previous findings are strictly connected to what we observe in the financial structure of the firms. Equity increases much more for VC backed firms than for firms in the control sample, but only when they are financed by independent VC (Table 12). When the firm is financed by a captive VC, its equity has the same path as for the firms in the control group one year after financing, suggesting that the injection of capital is much smaller and limited in time. Conseguently only firms financed by independent VC investors show a much stronger reduction in leverage compared with the one observed in the control group.

[20]The dummy VC has been similarly split in two dummies.

On the contrary, there are no remarkable difference as for operating profitability and credit score that are worse for all VC-backed firms, regardless of the type of VC investors (Table 11). However, the worsening of credit score and operating profitability has different effects on banking loan terms: as for firms financed by independent VC, interest rates increase much more than for the control group (almost 10 percentage points more), while for firms financed by captive VC we observe a much stronger increase in the share of short-term bank loans (16 percentage points more; Table 12).

All in all, independent and captive VC investors appear to be characterized by very different investment attitudes. Italian independent VC show greater activism in line with what has been found in other European countries (Bottazzi et al., 2008; Grilli and Murtinu, 2014; Cumming et al., 2017). They invest important amount of capital in the firms held in their portfolio that consequently grow faster and innovate more. On the contrary, captive VC invest less money in startups that are hence gathering an amount of equity similar to those obtained by firms in the control sample; for these investors we detect no effect in term of faster growh of the firms and much weaker effects as for innovation.

8 Discussion of results and conclusions

In this paper we use a novel strategy to tackle the selection problem influencing all the evaluation exercises of VC activity. On the one hand, we get rid of firms self-selection by considering in the control sample firms that have also looked for VC finance. On the other hand, we deal with the selection made by VC investors considering only late-stage discarded firms in the idea that firms that narrowly lost the contest were more similar to financed firms. This strategy is very similar to the one used by Greenstone et al. (2010) when tackling a very different empirical issue.

Although starting with the whole population of firms financed by private VC investors in Italy in the period 2004-2014, as reported in the Venture Capital Monitor by AIFI, when we impose the essential condition that firms have a balance sheet one year before VC financing, we end up with a sample of firms equal to one third of the universe; though we assess the representativeness of our sample in terms of geographical areas and sectors, it is true that the results can be generalized only with caution.

The evidence is that VC investors are able to accelerate the growth of the firms they finance and help their innovation activity. These firms show a larger increase in size (total assets, labor costs, no. of employees) and they innovate more (in term of the probability and number of patent

applications) compared with very similar firms in the control sample. This is not just a mechanical effect of the injection of equity capital. First, we notice that the larger increase in assets for VC-backed firms is by far greater than the wider rise in their equity. Secondly, we repeat the exercise by considering only firms in the control sample that also increase equity thanks to other investors (family, friends, corporate, etc) and the results still hold. The positive effects of VC investors in terms of firms' growth and innovation are hence likely to be connected also with their managerial expertise or network connections.

In general, an unexpected result is that all the innovative startups analyzed have a high leverage in the year before VC financing or rejection. This is actually in line with was has been discovered in the US by Robb and Robinson (2012), who find that new firms, even the home-based ones, analyzed for the period 2004-2007 rely heavily on external debt sources, such as bank financing: when summing up all forms of debt, it accounts for more than 50 per cent of the total capital of the firm. Similar recent evidence is found for Italy (Bonaccorsi di Patti and Nigro, 2017). Still, we focus in this paper on innovative startups, which are riskier and with a high share of intangible assets, for which bank lending is not the more appropriate source of finance. Consistently, Brown, Fazzari and Petersen (2009) find that for the US high-tech listed firms the share of new net debt issues on total net finance is very low, less than 2 per cent and that of net equity is higher (29 per cent); corresponding figures for Italian high-tech listed firms were reversed for the period 1998-2006 (Magri, 2014). In this paper, the evidence for a more recent period (2004-2014) is indeed that for VC-backed firms the wider increase in equity also mirrors in a stronger financial structure after VC financing: their leverage hence decreases much more than for firms in the control sample.

As for the effects on other sources of finance different from equity, we find that financial debts increase more for VC-backed firms though there is large heterogeneity: the differences are hence not significant. It is likely that the higher banks' selectivity after the 2008 financial crisis had an impact on these results given that VC-backed firms are quite risky firms. Due to the very innovative nature of their ideas, which delays the commercialization of products and services, and the upsurge in labor costs, their operating profitabiliy is much worse than that of non treated firms. This mirrors in a worsening in credit score for VC-backed firms that is likely to be the culprit of the larger increase in interest rates and in the share of short-term bank loans that we observe for them.

Finally, the positive VC effects on faster growth and innovation are exclusively driven by independent VC investors. Firms financed by captive VC investors (bank-, financial or insurance company-owned in our sample) have the same growth in size, equity and patent applications that those in

the control sample. This evidence is line with some recent literature that shows more activism and results for independent VC investors (Grilli and Murtinu, 2014; Cumming et al., 2017; Bottazzi et al., 2008). Specifically, independent VC investors finance their firms in subsequent stages and this is likely to help them as it takes time to reach the point where a patent could be asked for. To support firms' innovative ideas and their profitability and growth, a longer period of time and patience is likely to be required (Mazzuccato, 2013).

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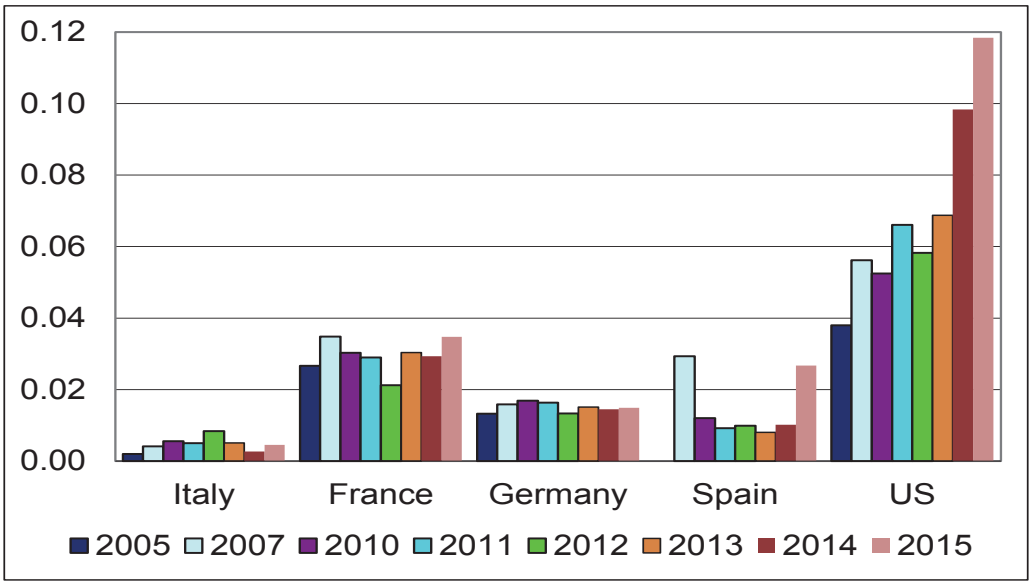
Tables and figures

Figure 1: Venture capital investments as a percentage of GDP



Source: AIFI for Italy, AFIC for France, EVCA-BVKA for Germany, ASCRI for Spain and NVCA for the United States.

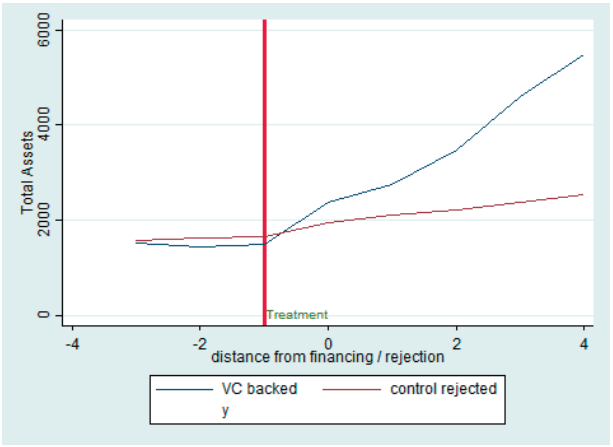
Figure 2: Selection process among venture capitalists

Table 1: Comparision between samples of VC-backed firms

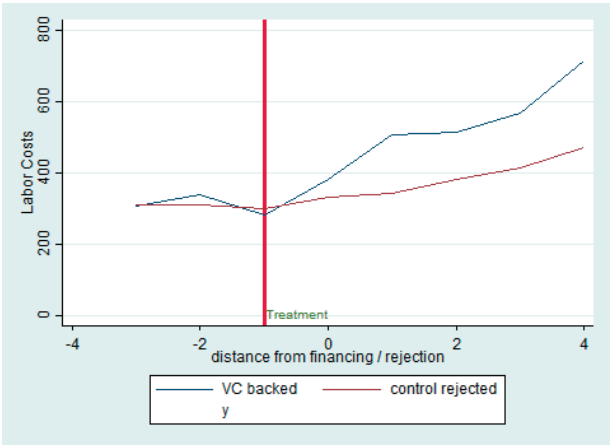
Percentage values, frequency, and numbers

	Our sample	VC population		Our sample	VC population
Sector			**Geographical area**		
Business services	3	1	North-west	40	49
Clean tech	7	6	North-east	18	13
Construction	2	2	Center	24	20
Consumer goods	3	2	South-islands	19	17
Financial services	2	2	**Innovation**		
Food and beverages	1	2	Probability patent application	0.3	0.2
Health care and social services	5	5	No. patent applications	0.12	0.08
ICT	36	37			
Industrial products	9	9			
Leisure	1	1			
Media and communications	7	7			
Nanotech	2	1			
Other professional and social services	6	6			
Pharmaceutical and biopharmaceuticals	11	13			
Transportation	1	1			
Utilities	2	3			
Web and mobile applications	3	2			
Total	100	100	Total	100	100
N	101	293		101	293

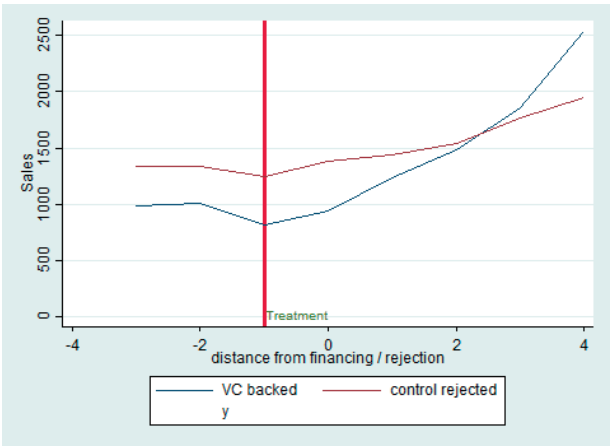
Figure 3: Trends in some output variables: late stage rejected control sample



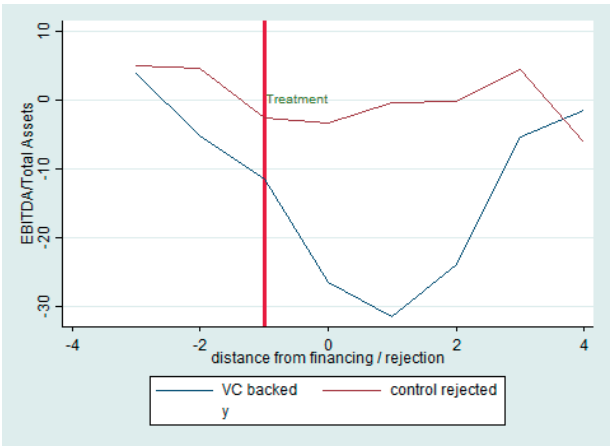
(a) Total Assets



(b) Labor Costs

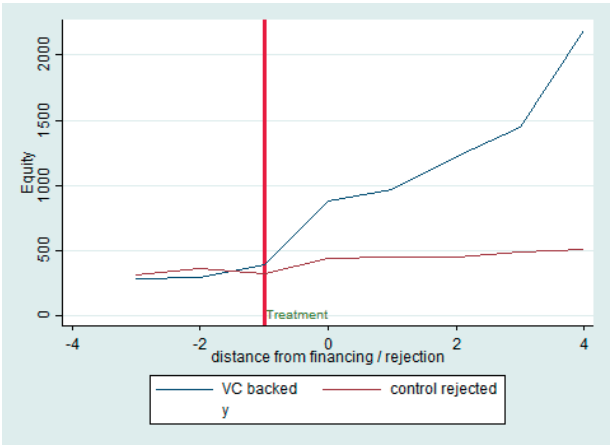


(c) Sales

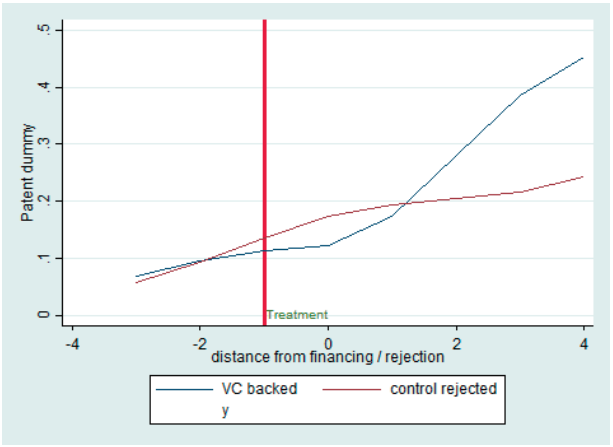


(d) Profitability

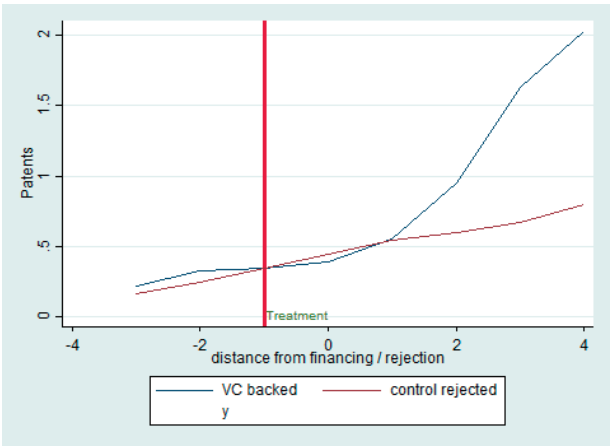
Figure 4: Trends in some output variables: late stage rejected control sample



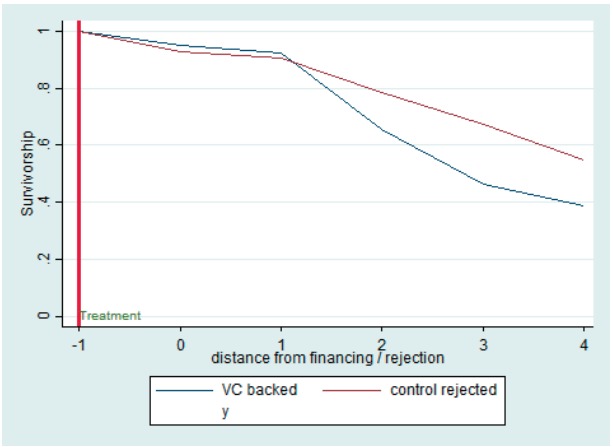
(a) Equity



(b) Patent-dummy



(c) Number of patent applications



(d) Survivorship

Table 2: Summary statistics for venture-backed firms

Summary Statistics VC				
Area			**Size**	
North-west	40	40%	Total Assets (*1000 euro)	1506
North-east	18	18%	Size dummy	1.1
Center	24	24%	Labor costs (*1000 euro)	281
South-islands	19	19%	Sales (*1000 euro)	814
Year of Financing			**Profitability**	
2004	3	3%	EBITDA/Assets %	-11.5
2005	3	3%	ROE %	-59.1
2006	6	6%	**Financial structure**	
2007	8	8%	Leverage %	96.6
2008	6	6%	Short-term bank debt/Bank debt %	75.2
2009	4	4%	Equity/Assets %	20.2
2010	7	7%	Financial costs/Financial debts %	4.5
2011	19	19%	**Innovation**	
2012	6	6%	Probability patent application	0.12
2013	17	17%	No. patent applications	0.35
2014	22	22%	**Other characteristics**	
Sector %			Age (years)	4.9
Manufacturing	8	8%	Intangible assets/Tangible+Intangible assets %	71.3
Energy	9	9%	Rating	6.5
IT	39	39%		
Telecomunication	5	5%		
Engineering	6	6%		
Pharmaceutics	20	20%		
Other services	14	14%		
N	101			

The statistics for area, sector, size, profitability, financial structure and other characteristics are calculated in the year before treatment.

Table 3: Balancing properties between treated and control groups

	VC-backed(1)	Late stage rejected (2)	t test (2)-(1)
Size			
Total Assets(*1000 euro)	1506	1648	0.44
Labor Costs(*1000 euro)	281	298	0.20
Sales(*1000 euro)	814	1242	1.42
Profitability			
EBITDA/Assets %	-11.5	-2.5	1.62
ROE %	-59.1	-63.2	-0.06
Financial Structure			
Leverage %	96.6	58.5	-1.68
Financial debts(*1000 euro)	544	576	0.20
Equity(*1000 euro)	393	324	-0.60
Bank debts/Financial debts %	57.5	60.2	0.48
Short-term bank debts/Bank debts %	75.2	79.4	0.83
Financial Costs/Financial debts %	4.5	6.3	1.06
Innovation			
Probability of patent applications	0.12	0.14	0.42
No. patent applications	0.35	0.34	-0.037
Other characteristiscs			
Age	4.9	7.5	2.5
Rating	6.5	6.2	-1.46
N	101	258	

Table 4: Effects of venture capitalists on firms' size and activity indicators

Diff-in-diff estimations (coefficient $beta_3$ is reported) - different post-treatment periods

Post-treatment periods	Assets (*1000 euro)	Labor costs (*1000 euro)	Sales (*1000 euro)	Employees number	Monthly wage euro
average post-treatment	780.4	157.3	126	2.0	189.6
	(378.2)**	(42.5)***	(163.3)	(1.2)*	(191)
t* (year of financing)	607.2	89.9	-29.8	4.2	157.7
	(333.4)*	(26.0)***	(132.1)	(1.6)***	(180.2)
t*+1	727.5	210.1	132.4	1.8	427.9
	(358.6)**	(45.0)***	(145.3)	(1.2)	(208.8)**
t*+2	1330.9	237	336	1.3	639.9
	(517.9)**	(59.4)***	(212.0)	(1.8)	(506.4)
t*+3	1720.2	193.5	343.7	0.0	145.5
	(715.5)**	(77.4)**	(359.6)	(2.0)	(642.1)
t*+4	1981.2	253.9	570.2	3.9	-309.4
	(971.1)**	(106.4)**	(525.7)	(3.0)	(684.2)
N. observation max	694	694	694	446	446
N. observation min	539	539	539	310	310
mean of variables at t*-1	1506	281	814	10.9	2354

All the specifications include the following controls: firm fixed effects, year dummies, age at t*-1, age at t*-1*post, industry, industry*post, area, area*post. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; standard errors are clustered at firm level. The means of variables at t*-1 refer to the sample of venture-backed firms.

Table 5: Effects of venture capitalists on firms' profitability, innovation and survivorship

Diff-in-diff estimations (coefficient $beta_3$ is reported) - different post-treatment periods

Post-treatment periods	EBITDA/Assets %	ROE %	Rating index	Patents dummy	Patents numbers	Survival rate
average post-treatment	-23.8	23.2	0.6	0.04	0.25	-0.008
	(6.4)***	(69.3)	(0.2)***	(0.04)	(0.14)*	(0.75)
t* (year of financing)	-20.5	108.2	0.5	-0.04	-0.06	
	(6.0)***	(90.5)	(0.2)**	(0.02)*	(0.07)	
t*+1	-24.1	56.3	0.6	-0.01	0.07	
	(7.9)***	(89.4)	(0.2)***	(0.04)	(0.12)	
t*+2	-22.9	-201.8	0.6	0.09	0.35	
	(11.6)**	(249.7)	(0.3)**	(0.06)	(0.18)*	
t*+3	-16.3	241.8	0.8	0.19	1.1	
	(6.2)***	(127.6)*	(0.5)	(0.07)**	(0.31)***	
t*+4	3.8	-6.8	0.10	0.21	1.6	
	(8.1)	(39.5)	(0.5)	(0.09)**	(0.43)***	
N. observation max	692	640	649	694	694	293
N. observation min	538	490	492	539	539	
mean of variables at t*-1	-11.5	-59.1	6.5	0.12	0.3	1

All the specifications include the following controls: firm fixed effects, year dummies, age at t*-1, age at t*-1*post, industry, industry*post, area, area*post. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; standard errors are clustered at firm level. The means of variables at t*-1 refer to the sample of venture-backed firms. Patents number is the cumulative number of patent applications in the period considered. Survival rate is the rate of survival after 3 years since financing/rejection, considering only firm financed until the year 2012; the mean at t*-1 is 1 per cent as all firms are alive at that time.

Table 6: Effects of venture capitalists on firms' financial structure

Diff-in-diff estimations (coefficient $beta_3$ is reported) - different post-treatment periods

Post-treatment periods	Leverage %	Fin. Debts (*1000 euro)	Equity (*1000 euro)	Bank/Fin.Debts %	Bank short/Bank %	Interest rate %
average post-treatment	-64.5	165.1	452.1	-5.6	10.6	7.1
	(38.9)*	(167.8)	(200.6)**	(5.1)	(5.4)*	(2.8)**
t* (year of financing)	-41.2	53.7	418.4	0.14	5.7	5.9
	(40.9)	(156)	(115.2)***	(4.5)	(5.4)	(2.8)**
t*+1	-88.1	179.4	439.7	-5.4	7.4	7.0
	(41.9)**	(170.6)	(196.5)**	(6.0)	(7.0)	(3.6)*
t*+2	-113.3	218.6	766.7	-9.7	17.3	7.5
	(53.9)**	(274.8)	(244.0)***	(9.2)*	(9.2)	(4.8)
t*+3	-53.7	572.7	801.4	-8.9	23.5	4.1
	(34.4)	(341.9)*	(350.2)**	(9.0)	(10.2)**	(3.4)
t*+4	-61.3	127.3	1197.4	-15.2	30.7	2.3
	(42.7)	(322.3)	(628.4)*	(11.9)	(11.8)***	(2.6)
N. observation max	618	629	694	527	425	526
N. observation min	468	483	539	413	334	413
mean of variables at t*-1	96.6	544	393	57.5	75.2	4.5

All the specifications include the following controls: firm fixed effects, year dummies, age at t*-1, age at t*-1*post, industry, industry*post, area, area*post. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; standard errors are clustered at firm level. The means of variables at t*-1 refer to the sample of venture-backed firms. Leverage is financial debts/(financial debts + equity); bank stands for bank loans; bank short are bank loans with maturity shorter than 1 year. Interest rate is financial costs on financial debts.

Table 7: Effects of venture capitalists on firms' size and activity indicators

Diff-in-diff estimations (coefficient $beta_3$ is reported) - different post-treatment periods
Specifications with a control sample of firms that increase their capital

Post-treatment periods	Assets (*1000 euro)	Labor costs (*1000 euro)	Sales (*1000 euro)	Employees number	Monthly wage euro
average post-treatment	965.7	147.2	206.7	1.5	192.3
	(418.3)**	(46.1)***	(184.2)	(1.2)*	(242.1)
t* (year of financing)	755.6	74.2	-31.9	3.3	206.4
	(391.7)*	(23.2)***	(145.8)	(1.5)**	(200.9)
t*+1	931.2	205.8	192.5	2.0	392.6
	(396.8)**	(44.4)***	(164.9)	(1.3)	(221.8)*
t*+2	1617.6	223.8	347.8	-0.7	619.4
	(503.7)***	(63.7)***	(223.5)	(2.7)	(613.6)
t*+3	1930.6	170.2	381.0	-1.4	-136.9
	(771.6)**	(92.2)*	(402.5)	(2.1)	(620.9)
t*+4	2453.5	265.5	895.8	4.2	-470.2
	(1042.4)**	(122.2)**	(574.6)	(3.5)	(661.5)
N. observation max	522	522	522	330	330
N. observation min	395	395	395	227	227
mean of variables at t*-1	1506	281	814	10.9	2354

All the specifications include the following controls: firm fixed effects, year dummies, age at t*-1, age at t*-1*post, industry, industry*post, area, area*post. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; standard errors are clustered at firm level. The means of variables at t*-1 refer to the sample of venture-backed firms

Table 8: Effects of venture capitalists on firms' profitability, innovation and survivorship

Diff-in-diff estimations (coefficient $beta_3$ is reported) - different post-treatment periods
Specifications with a control sample of firms that increase their capital

Post-treatment periods	EBITDA/Assets %	ROE %	Rating index	Patents dummy	Patents numbers	Survival rate
average post-treatment	-24.4	11.3	0.7	0.05	0.26	-0.08
	(6.5)***	(78.8)	(0.2)***	(0.02)	(0.16)*	(0.079)
t* (year of financing)	-21.0	79.3	0.5	-0.03	-0.05	
	(6.2)***	(111.7)	(0.2)**	(0.03)	(0.07)	
t*+1	-25.2	143.0	0.6	0.00	0.09	
	(8.1)***	(160.8)	(0.3)**	(0.04)	(0.13)	
t*+2	-23.4	-184.9	0.7	0.10	0.3	
	(10.7)**	(305.9)	(0.3)**	(0.06)	(0.18)*	
t*+3	-17.5	279.9	0.8	0.20	1.1	
	(5.9)***	(145.5)*	(0.5)	(0.08)**	(0.3)***	
t*+4	6.0	-8.9	0.0	0.21	1.5	
	(9.4)	(47.2)	(0.5)	(0.09)**	(0.5)***	
N. observation max	520	473	482	522	522	208
N. observation min	394	349	353	395	395	
mean of variables at t*-1	-11.5	-59.1	6.5	0.12	0.3	1

All the specifications include the following controls: firm fixed effects, year dummies, age at t*-1, age at t*-1*post, industry, industry*post, area, area*post. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; standard errors are clustered at firm level. The means of variables at t*-1 refer to the sample of venture-backed firms. Patents number is the cumulative number of patent applications in the period considered. Survival rate is the rate of survival after 3 years since financing/rejection, considering only firm financed until the year 2012; the mean at t*-1 is 1 per cent as all firms are alive at that time.

Table 9: Effects of venture capitalists on firms' financial structure

Diff-in-diff estimations (coefficient $beta_3$ is reported) - different post-treatment periods
Specifications with a control sample of firms that increase their capital

Post-treatment periods	Leverage %	Fin. Debts (*1000 euro)	Equity (*1000 euro)	Bank/Fin.Debts %	Bank short/Bank %	Interest rate %
average post-treatment	-63.6	223.0	447.9	-7.9	9.6	7.3
	(40.4)	(187.1)	(215.6)**	(5.4)	(5.9)	(2.9)**
t* (year of financing)	-36.5	118.7	415.2	-1.0	7.2	6.6
	(41.6)	(177.9)	(126.8)***	(5.2)	(5.9)	(3.0)**
t*+1	-83.8	219.1	450.6	-9.9	5.5	5.7
	(41.9)**	(194.5)	(212.5)**	(6.0)	(7.7)	(3.4)*
t*+2	-123.5	297.8	786.1	-12.8	14.5	8.1
	(55.8)**	(270.3)	(255.7)***	(9.5)	(11.0)	(5.0)
t*+3	-63.3	584.8	825.1	-8.8	18.6	5.4
	(41.5)	(374.9)	(361.6)**	(9.2)	(12.3)	(3.8)
t*+4	-64.7	9.4	1317.2	-11.7	24.0	3.3
	(51.4)	(377.3)	(641.1)**	(12.2)	(13.4)*	(2.3)
N. observation max	468	478	522	401	321	400
N. observation min	347	361	395	313	248	313
mean of variables at t*-1	96.6	543	393	57.5	75.2	4.5

All the specifications include the following controls: firm fixed effects, year dummies, age at t*-1, age at t*-1*post, industry, industry*post, area, area*post. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; standard errors are clustered at firm level. The means of variables at t*-1 refer to the sample of venture-backed firms. Leverage is financial debts/(financial debts + equity); bank stands for bank loans; bank short are bank loans with maturity shorter than 1 year. Interest rate is financial costs on financial debts.

Table 10: Effects of venture capitalists on firms' size and activity indicators

Diff-in-diff estimations (coefficient $beta_3$ is reported) - different post-treatment periods
Specifications that split between independent and captive venture capitalists

Post-treatment periods	Assets (*1000 euro)	Labor costs (*1000 euro)	Sales (*1000 euro)	Employees number	Monthly wage euro
average post-treatment independent	698.4**	210.5***	151.4	5.4***	182.1
average post-treatment captive	897.1	81.6	89.8	-1.1	196.5
t* (year of financing) independent	378.4*	93.3***	-25.0	5.7***	253.2
t* (year of financing) captive	933.0	85.1**	-36.5	2.8	69.0
t*+1 independent	707.0**	263.1***	115.9	3.5***	634.2**
t*+1 captive	756.2	135.6**	155.6	-0.0	198.7
t*+2 independent	1213.8***	320.1***	304.7	4.2*	219.1
t*+2 captive	1500.8	116.1	381.4	-2.6	1230.2
t*+3 independent	1699.3***	334.5***	512.0	6.2***	646.5
t*+3 captive	1750.2	-9.0	102.0	-7.2***	-430.8
t*+4 independent	1779.9*	381.3***	687.0	9.7***	232.3
t*+4 captive	2300.4	51.9	384.9	-10.6***	-1694.9**
N. observation max	694	694	694	446	446
N. observation min	539	539	539	310	310
mean of variables at t*-1	1506	281	814	10.9	2354

All the specifications include the following controls: firm fixed effects, year dummies, age at t*-1, age at t*-1*post, industry, industry*post, area, area*post. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; standard errors are clustered at firm level and are not reported to preserve space. The means of variables at t*-1 refer to the sample of venture-backed firms

Table 11: Effects of venture capitalists on firms' profitability, innovation and survivorship

Diff-in-diff estimations (coefficient $beta_3$ is reported) - different post-treatment periods
Specifications with a control sample of firms that increase their capital

Post-treatment periods	EBITDA/Assets %	ROE %	Rating index	Patents dummy	Patents numbers	Survival rate
average post-treatment independent	-28.4***	30.3	0.6**	0.02	0.33*	0.03
average post-treatment captive	-17.4**	11.2	0.7***	0.06	0.14	-0.06
t* (year of financing) independent	-21.6***	109.1	0.5*	-0.03	-0.01	
t* (year of financing) captive	-18.9*	106.5	0.5*	-0.05*	-0.12**	
t*+1 independent	-26.9**	135.0	0.6*	-0.03	0.07	
t*+1 captive	-20.2*	-81.6	0.7*	0.02	0.07	
t*+2 independent	-40.6**	-450.5	0.7*	0.05	0.42	
t*+2 captive	3.0	231.9	0.6	0.14	0.26	
t*+3 independent	-22.3**	-217.1	0.5	0.17*	1.5***	
t*+3 captive	-7.3	-277.7*	1.2**	0.21*	0.5	
t*+4 independent	3.7	39.0	-0.4	0.20*	2.0***	
t*+4 captive	4.0	-95.4	0.9	0.22	0.9	
N. observation max	692	640	649	694	694	293
N. observation min	538	490	492	539	539	
mean of variables at t*-1	-11.5	-59.1	6.5	0.12	0.3	1

All the specifications include the following controls: firm fixed effects, year dummies, age at t*-1, age at t*-1*post, industry, industry*post, area, area*post. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; standard errors are clustered at firm level and are not reported to preserve space. The means of variables at t*-1 refer to the sample of venture-backed firms. Patents number is the cumulative number of patent applications in the period considered. Survival rate is the rate of survival after 3 years since financing/rejection, considering only firm financed until the year 2012; the mean at t*-1 is 1 per cent as all firms are alive at that time.

Table 12: Effects of venture capitalists on firms' financial structure

Diff-in-diff estimations (coefficient $beta_3$ is reported) - different post-treatment periods
Specifications that split between independent and captive venture capitalists

Post-treatment periods	Leverage %	Fin. Debts (*1000 euro)	Equity (*1000 euro)	Bank/Fin.Debts %	Bank short/Bank %	Interest rate %
average post-treatment independent	-61.8**	-63.5	582.5**	-9.8	5.6	9.7**
average post-treatment captive	-68.0	462.7	266.3	-0.5	16.1**	3.8
t* (year of financing) independent	-43.8	-162.5	493.3***	-5.0	3.0	7.8**
t* (year of financing) captive	-37.7	335.2	311.7**	6.7	8.6	3.6
t*+1 independent	-73.9**	-22.8	667.4**	0.0	2.6	7.9
t*+1 captive	-110.3	480.2	120.1	-1.0	13.7*	5.7
t*+2 independent	-67.1**	-154.7	977.1***	-12.4	13.3	1.6
t*+2 captive	-182	763.6	460.9*	5.9	24.2*	15.7
t*+3 independent	-76.9*	149.2	1068.7*	-16.6	20.9	4.6
t*+3 captive	-19.1	1189.6*	417.6	1.3	27.2**	3.3
t*+4 independent	-84.9*	-108.2	1413.7**	-17.6	27.5**	3.2
t*+4 captive	-28.2	463.5	854.4	-11.7	37.3**	1.0
N. observation max	618	629	694	527	425	526
N. observation min	468	483	539	413	334	413
mean of variables at t*-1	96.6	543	393	57.5	75.2	4.5

All the specifications include the following controls: firm fixed effects, year dummies, age at t*-1, age at t*-1*post, industry, industry*post, area, area*post. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; standard errors are clustered at firm level and are not reported to preserve space. The means of variables at t*-1 refer to the sample of venture-backed firms. Leverage is financial debts/(financial debts + equity); bank stands for bank loans; bank short are bank loans with maturity shorter than 1 year. Interest rate is financial costs on financial debts.

PUBLIC GUARANTEES ON LOANS TO SMES: AN RDD EVALUATION

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THE SHADOW BANKING SYSTEM IN THE EURO AREA

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THE ROLE OF PRIVATE CAPITAL IN IMPLEMENTING ITALIAN INFRASTRUCTURE

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1. Introduction

Alongside the traditional model of the annual fund allocation in public budgets, the issue of infrastructure financing is now being addressed by governments through alternative financial models, consisting of different forms of public-private partnerships (PPPs). They can transfer all or part of the costs of infrastructure and related services to actual users; or, in the case of the so-called "cold works", directly used by the Public Administration (PA)[1], assure the classification of the assets involved in the PPP contract as non-government assets by carefully allocating project risks between the involved parties, thereby spreading the impact on government deficit – and possibly indirectly on debt – over the duration of the contract.

More specifically, in infrastructure implementation the term PPP refers to all forms of cooperation between public and private sectors aimed at design, construction, financing, operation and maintenance of public works[2]. Under specific circumstances, PPP operations can be realized by project financing (PF), which is a structured financing technique for a specific economic unit, based on a transaction in which the lender considers *i*) the cash

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The views expressed in this paper are those of the authors alone and do not necessarily reflect those of their respective Institutions. The analysis has been made on the basis of existing legislation up to October 23th, 2015, and contracts available as of December 20th, 2010.

[1] The private contractor directly supplies services to the PA, which pays the prices (availability payments). For example, in the case of prisons, hospitals, social housing and public offices.

[2] See art. 3, paragraph 15-*ter*, of the Legislative Decree 163, 12 April 2006 – Public Procurement Code (PPC). The present analysis focuses on the implementation of public works through concession contracts, which in Italy represent the most significant mode of PPP use, both in terms of number and value. It is worth mentioning that in our country the traditional procurement is the other main typology of public works contracts, where the private contractor is in charge of the design and construction of a project, without any involvement in its subsequent operation.

flows and the earnings of the project as security for the repayment of debt; *ii*) and the assets of the economic unit as collateral[3].

This paper analyzes the use of PPP contracts for implementing infrastructure in Italy, identifies critical issues and proposes some possible corrective measures, paying particular attention to regulatory profiles[4]. The survey is organized as follows: the second section analyzes the main features and functions of PPP contracts; the third section provides a brief description of the Italian regulations, focusing on the consistency of PPP operations in Italy and analyzing their characteristics; the fourth section identifies the main Italian regulatory weaknesses and identifies some corrective measures; and the final section summarizes the significant findings.

2. Potential benefits and risks in PPP use

The economic literature[5] indicates that, compared to the traditional public procurement (in which the construction and operation of works are separate), PPP contracts present potential advantages, but also possible risks. The potential benefits are tied to the ability to appropriately allocate the different risks between the parties involved in the transaction and to overcome the problems arising from conflicts of interests, asymmetric information or incomplete contracts individually related to the construction and operation of the work. Instead, the risks largely depend on the possibility that PPPs are used to circumvent the indebtedness limits imposed on public authorities and that these kind of operations can weaken competition as well as incentives for efficiency, given that the subsequent management of the infrastructure is entrusted to the private contractor (generally, a company set up *ad hoc*: the special purpose vehicle – SP) for long periods of time.

a) *Potential benefits*. The advantages tend to be relevant in the case of large infrastructures, whose construction and subsequent operation are intrinsically interrelated and are characterized by a certain degree of uncertainty. In fact, in these cases, it is preferable that the effects of the decisions are borne by the SP (and its participants acting as residual claimants), thereby encouraging the adoption of efficient behavior, for example with respect to the containment of the work timetable and construction costs. Similarly, a reduction of the construction costs can lead to an increase in costs during the operation phase, and vice versa. In such cases, the bundling of construction and operation forces the contractor in charge of construction to evaluate all the consequences of his choices, including those related to the next phase.

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3 See Nevitt (1987). For the definitions and the differences between PPP and PF see, among others, UTFP (2009); Cori (2009). It should be noted that, in listing PPP contracts, the art. 3, paragraph 15-*ter*, of the PPC mistakenly includes the award of public works through project financing *ex* art. 153 of the PPC, related to the various procedures for awarding a public works concession contract, thereby confusing contract types and awarding procedures and improperly using the term "project financing".

4 With the expression "regulatory profiles" we refer not only to the legislative framework but, more generally, to the adoption and dissemination of best practices, especially with regard to the inclusion of appropriate contract terms.

5 See, among others, Nevitt (1987); Esty (2003); Iossa (2008); Iossa and Martimort (2008).

The economic literature and financial reports[6] also indicate that the advantages of PPPs are usually more marked where the quality of services to be provided is more easily specifiable *ex ante* and verifiable *ex post*. Thus, SP revenues will depend in part on the quality of services resulting from the implemented work, not merely by the work's construction itself. Similarly, it makes little sense to use PPPs for cold works – the operation of which does not directly determine market revenues – where it is provided that SP revenues derive from a fixed payment, independent of the quality of services related to the work itself.

Another crucial aspect is the possibility of appropriately allocating and reallocating the various risks between the parties involved in the project. In fact, the construction and operation of an infrastructure, especially when large, imply high and heterogeneous risks: not only technical and market risks, normally faced by any private enterprise, but also administrative and regulatory risks, related to possible changes defined by the PA or to more general political choices (e.g., in terms of transport policy), which can impact the propensity to use a particular work. There are also microeconomic (partially linked to the efficient construction and operation of the work) and macroeconomic (related to the overall trends of the economy) market risks. For optimal allocation each risk should be borne by the party that can most efficiently and cost-effectively control or handle it, having the technical and managerial skills to minimize the economic impact of adverse events.

Identifying the party best able to handle some of the risks is fairly straightforward. For example, the PA should generally bear risks arising from changes in the regulatory framework, that may impact negatively on the profitability of the project; on the other hand, companies are better able to manage (and prevent) technical risks related to the construction of the work. In other cases the allocation of risks is less clear: for example, the market risk could be borne by both the PA (which may have better information on the amount and variability of demand, in addition to having tools to influence it) and private contractors (who would have stronger incentives to provide a better quality of services). In general, the PA should bear the macroeconomic market risks, while private contractors should bear those risks related to the microeconomic behavior of the same SP.

b) *Possible risks*. The appropriate risk allocation between private contractors and PA is also essential to prevent the risk that PPP contracts are used in order to circumvent the indebtedness limits imposed on public bodies. Eurostat clarified the criteria to use in this regard in February 2004. The analysis of the actual transfer of risks on private contractors should be carried out distinguishing between three main categories of risks: *i*) those associated with the design and construction of work (related to events such as delays in implementation, cost overruns, technical problems and substandard works); *ii*) those related to the availability of the service (for example, substandard service or production capacity); *iii*) those arising from the variability in the level of demand. The assets involved in a PPP contract can be considered as non-government assets only if the private sector bears the risks associated with construction and those associated with either availability or demand[7].

[6] See, e.g., Iossa and Russo (2008).

[7] If the analysis based on the three above-mentioned risk categories does not provide unequivocal conclusions, other aspects can be taken into account, such as the agreements on the allocation of work

Regardless of the mentioned statistical and accounting criteria, which are crucial for the monitoring of public accounts, the careful identification of significant risks and their nature is essential for their best allocation. To identify and to adequately redistribute these risks are complex, costly and time consuming operations. Therefore, PPP use is usually beneficial only for large-scale projects able to justify these high transaction costs. It is also necessary to take into account the fact that the regulatory risk should be not only allocated to the PA, but also specified and restricted by providing regulatory systems with sufficient impartiality (e.g., establishing independent and specialized authorities). Moreover, considering the complexity of PPP operations, it is necessary that contracting authorities have an adequate expertise to manage them, in order to avoid being "captured" by the private sector, especially in the case of small administrations.

The bundling of construction and operation of the work inherent in PPP could also weaken competition and disincentive efficiency, given that the subsequent management of the infrastructure is entrusted to the participants of the SP for long periods of time. Competition may be damaged not only in the use of the specified single infrastructure, but also with respect to possible competition between this and other new public works, the construction of which may be successively assumed: in fact, the need to guarantee returns to the SP of a given infrastructure on a sufficiently long time horizon could affect investment plans in the future.

Overall, PPPs are very useful tools when used appropriately. Transaction costs of PPP use are high and they generally appear justifiable only in the case of large projects and/or with the aim of allowing an optimal repackaging of the various risks. In addition, the appropriate risk allocation between private contractors and PA is essential to prevent the risk that PPP contracts are used in order to circumvent the indebtedness limits imposed on public bodies. Moreover, the possible constraints that may arise from PPPs to the competitive structure of the markets are also relevant: they should be used in cases where the bundling of construction and operation provides inherent advantages and the system should ensure healthy competition during the selection of the private contractor.

3. The Italian experience

Over the last years all the major European countries have sought to foster PPP for implementing infrastructure projects[8]. PPP contracts (in the form of the Private Finance Initiative – PFI) were first applied and have reached their maximum diffusion in the United Kingdom, especially in relation to very complex works. The case of Spain is also

ownership when the contract expires, and the presence of guarantees from the public authority (see the Eurostat decision of 11 February 2004, "Treatment of Public Private Partnerships" 2004, News Release No. 18, February 11).

[8] For a detailed analysis of the European experience see Giorgiantonio and Giovanniello (2011), Cori, Giorgiantonio and Paradisi (2011) and the references therein. It should be explained that, in Europe, the concession to build and operate – the main instrument for implementing PPP operations in Italy – does not exhaust the alternatives that could be used for implementing infrastructure with this financing method. In fact, the European practice knows many other formulas, among which we highlight – in particular – the English private finance initiative (PFI) and the German *Vorfinanzierungs Modell*, that represent public contracts for the design and execution of public works, or for the design, execution and operation of public works.

important: in recent years, this country has experienced a significant increase in PPP use, becoming the second largest market in the EU after the UK. Moreover, the use of PPPs has been repeatedly recommended by the European Commission itself, which has emphasized the involvement of the private sector in implementing public works in order to exploit its financial resources and to use its know-how and design capabilities[9]. In February 2014, the Commission adopted a specific directive on awarding concession contracts (23/2014/EU).

In Italy PPP use has been encouraged since the mid-90s, through the adoption of specific legislation aimed at facilitating the awarding of concession contracts for public works[10]. Especially through modifications in procedural aspects, over the last fifteen years PPP regulations have been amended several times to broaden its scope and encourage the submission of proposals by private contractors[11].

The regulatory framework outlined by the afore-mentioned amendments involves the following awarding procedures: *a*) the traditional procedure for awarding concession contracts for public works, in which the process moves from the administration that, with respect to works included in the triennial programming, publishes a contract notice announcing the intention to award a concession, after which the proceedings will continue in the manner typical of the open or restricted procedure[12]; *b*) alternatively, for public works included in the triennial programming, two other optional procedures based on a feasibility study (FS) prepared by the contracting authority, consisting of *i*) a simplified single awarding procedure on the FS[13], *ii*) a dual awarding procedure in which the first phase is aimed at identifying the promoter and granting him the *diritto di prelazione*[14] in the next step, while the second allows the award of the concession for public works[15]; *c*) a

9 See European Commission (2004), (2005a), (2005b) and (2009).

10 See art. 37-*bis* – 37-*novies* of the Law 109, 11 February 1994 (so-called *Merloni* Law), introduced by the Law 415, 11 November1998 (so-called *Merloni-ter* Law), after substituted by the art. 153-160 of the PPC. As noted above (see note No. 2), the wording of the *Merloni* Law, and after of the Code, which refers to project financing, is not entirely appropriate, since it seems to identify project financing with the special procedures for awarding concession contracts for public works provided by these articles. In fact, these contracts are not necessarily funded through project financing.

11 See, among the main interventions, *i*) Legislative Decree 190, 20 August 2002; *i*) Law 166, 1st August 2002; *iii*) Legislative Decree 113, 31 July 2007; *iv*) Legislative Decree 152, 11 September 2008; *v*) Law Decree 70, 13 May 2011, converted by Law 106, 12 July 2011; *vi*) Law 183, 12 November 2011; *vii*) Law Decree 201, 6 December 2011, converted by Law 214, 22 December 2011; *viii*) Law Decree 1, 24 January 2012, converted by Law 27, 24 March 2012; *ix*) Law Decree 179, 18 October 2012, converted by Law 221, 17 December 2012; *x*) Law Decree 69, 21 June 2013, converted by Law 98, 9 August 2013; *xi*) Law Decree 133, 12 September 2014, converted by Law 164, 11 November 2014. Nevertheless the numerous regulatory changes have been not accompanied by indications about the way to properly implement these rules and to monitor their proper use and the advantages both for contracting authorities and for users, with increasing administrative and legal risks, already very high in our country. For the regulatory changes that characterized PPP use in Italy see Giorgiantonio and Giovanniello (2011); Marasco, Piacenza and Tranquilli (2015).

12 See art. 144 of the PPC.

13 See art. 153, paragraphs 1-14, of the PPC.

14 I.e., the right to adapt his offer to that judged the most economically advantageous and thus win the award.

15 See art. 153, paragraph 15, PPC.

procedure in case of inaction on the part of the contracting authority[16]; *d*) for additional works not included in the triennial programming, a procedure based on a preliminary project prepared by the private contractor (the promoter), which – if determined to be in the public interest – is placed at the base of a subsequent awarding procedure, where the promoter has the *diritto di prelazione*[17].

The numerous above-mentioned reforms can be seen to match with a positive trend in PPP use. According to information collected by the National Project Financing Observatory[18], between 2002 and 2012, the total number of PPP projects has increased from 183 to 740, their value from 1.2 to 4.6 billion euros (from 0.5 to 4.7 percent in terms of the total number of projects for public works and from 5.4 to 20.8 per cent in terms of the total value). More recently, this positive trend has significantly slowed, especially in terms of value, presumably in connection with the long term effects of the financial crisis: in 2014 the total number of PPP projects was 242, for a total value of 1.5 billion euros (equal to 1.4 percent of the total number of projects for public works and to 5.2 per cent in terms of the total value).

Nevertheless, even in the pre-crisis scenario, PPP use was still limited in Italy compared to other European countries. Between 1990 and 2009, in fact, 1,340 PPP contracts were been signed in Europe, representing 253,745 million euros. For the period 1990-2009, the UK accounted for 67 percent of the total contract number (53 per cent of the total value); Spain for 10 percent (12 percent of the total value); France and Germany for 6 and 5 percent respectively (corresponding to 5 and 4 percent of the total value); and Italy for only 2 percent of the total contract number (3 percent of the total value)[19].

Moreover, with few exceptions (mainly concerning transportation and hospitals), Italian projects are relatively small in size: in the period between 2002 and 2014, the average value of PPP projects was 14.5 million euros, while in the UK it was 136.1 million euros (Fig. 1). Over 95 percent of projects (excluding those with unreported amounts), do

[16] I.e., if the contract authority does not publish the contract notice after the approval of the annual list of public works: see art. 153, paragraph 16, of the PPC.

[17] See art. 153, paragraph 19, of the PPC. It is worth noting that this last procedure significantly increases the scope of the controversial *diritto di prelazione* for the promoter, already reintroduced in the two-phase procedure by the Legislative Decree 152, 17 September 2008. This tool, already criticized by the European Commission because of its possible infringement on the equal treatment principle given the different position attributed to the promoter (see Case C-412/04), may contribute to discouraging the participation of operators from other European countries, who are unfamiliar with this mechanism and thus limit their investment in Italy. More specifically, the *diritto di prelazione* for the promoter could create imbalances that result in anticompetition mechanisms. For these issues, see Iossa and Russo (2008); Giorgiantonio and Giovanniello (2011); Cori and Giorgiantonio (2013).

[18] The Observatory represents the main information base relating to Italian PPP operations. The available data are still quite limited, and stop once contracts have been awarded. In fact, the Observatory does not collect data on the signing of contracts, their financial closing or questions related to the maintenance and operation phases.

[19] See Kappeler and Nemoz (2010). They consider projects based on a long-term, risk sharing contract between public and private parties, which includes the bundling of design, construction, operation and/or asset maintenance, together with a major component of private finance. Payments are made over the life of the PPP contract by the public sector to the private partner and are linked to the level and quality of services actually delivered. The database does not include smaller projects with a capital value of less than 5 million euros.

not exceed 50 million euros; projects under 5 million prevail, representing more than 75 percent of the total.

During the period 2002-2014, local public services were the dominant sectors in PPP operations (Fig. 2): apart from a few large projects in the transportation (highways, subways: 1 percent of PPP project number, but 52 percent in terms of value) and hospital sectors, most of the works covered local investment for car parks (8 percent of the total project number; 4 percent in terms of value), sports facilities (15 per cent of PPP project number; 3 percent of their value), cemeteries (12 percent of PPP project number; 3 percent of their value). Generally, PPP operations are related to less complex interventions, for which cash flows are easily predictable and market risks are presumably limited.

Figure 1

Average value of PPP projects in Italy
(million euros)

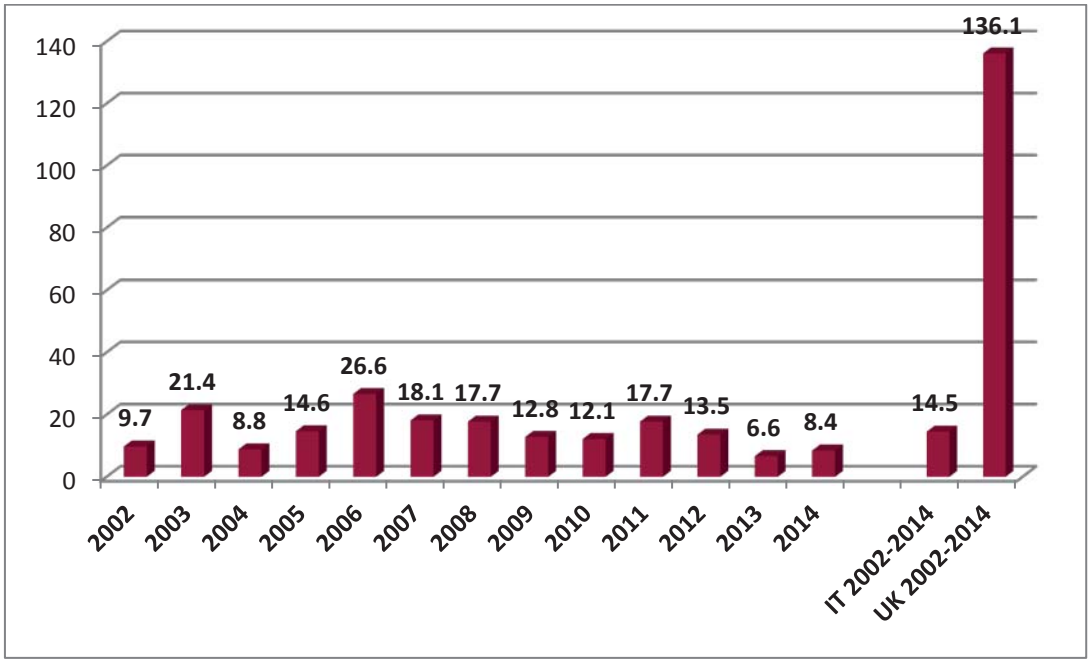
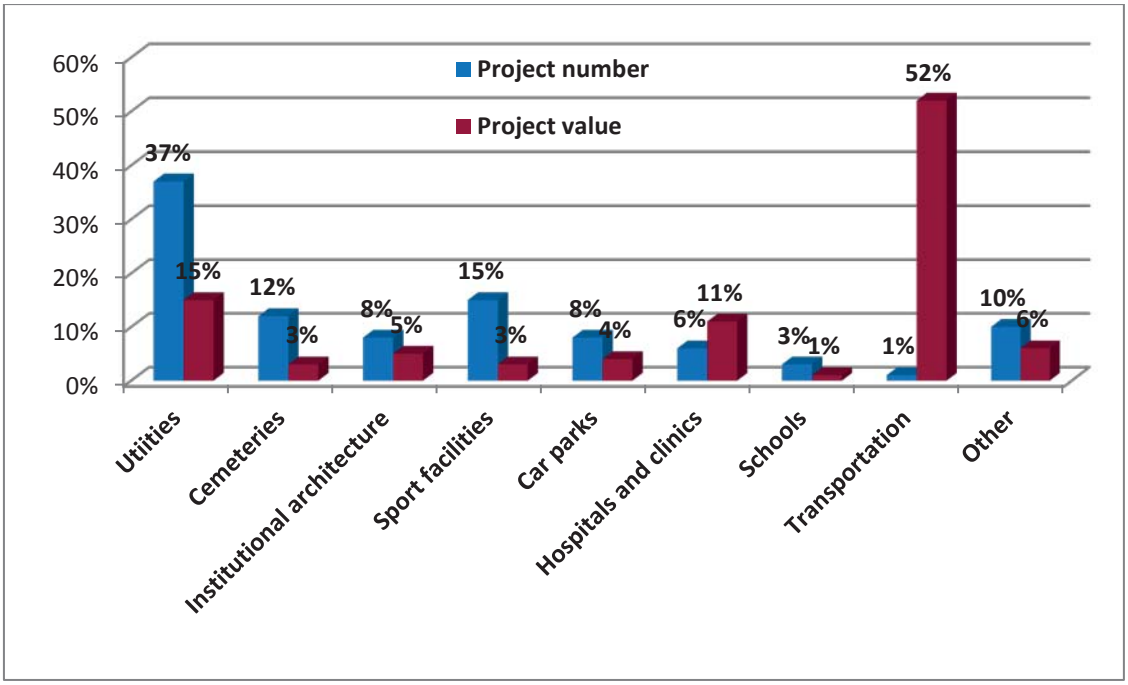


Figure 2

PPP dominant sectors in Italy
(2002-2014)



With regards to geographic distribution, the majority of projects and their value are concentrated in the north of the country, particularly in the north-west (25 and 31 percent of the total, respectively). The north-east, which represents 17 percent of the market as project number and 27 percent in terms of value, shows an average project value that is higher than the national average (23.5 against 14.5 million euros). The south and the islands, particularly Campania, are characterized by a high project number, with a share of 40 percent of the total, and an average project value much lower than the national average (9.2 million euros against 14.5). PPPs are most broadly used in Lombardy: projects represent 15 percent of the national total number and 22 per cent in terms of value.

Finally, data show a high project mortality: in the period 2002-2014, only 48 percent of PPP contracts were awarded. The distribution of the awarded contracts seems to reward higher value projects: the ratio of procedures for awarding PPP contracts and awarded contracts is equal to 85 percent where the works have a capital value between 5 and 50 million euros and 87 percent for those with a greater capital value; for the works with a capital value of less than one million euros, on the other hand, the ratio is equal to 44 percent.

In summary, the relatively small size of the projects, the dominant sectors and the types of the works (often less-complex or cold works with availability payments inadequately tied to the quality of services provided) indicate that PPP use is still limited compared to other European countries and not always consistent with its main objectives and potential benefits. There is a risk that PPP operations are used not to realize a complex repackaging of risks (which is too expensive for interventions of small capital value) and to strengthen private contractor incentives in order to reduce costs and improve the quality of public works (through the bundling of construction and operation), but with the purpose of obtaining construction costs fronted by the private contractor against the assumption of future expenditure commitments by the PA, with the aim of circumventing indebtedness limits imposed on public authorities[20].

4. Some policy implications

At least in part, some of the above-mentioned problems relating to PPP use for implementing infrastructure could be mitigated by the introduction of appropriate regulatory measures at the legislative level and, more generally, through the adoption of standard contracts and the diffusion of best practices.

First, the system could benefit from a rationalization and simplification of existing legislation, which has become increasingly complex as a result of the numerous reforms – often coming quickly on the heels of one another and not always mutually consistent – that have led to a strong instability of the already very complex regulatory framework, that causes difficulties and uncertainties both for national and foreign operators. The criteria provided by the recent draft law for the transposition of the new European directives on

[20] See MEF (2015).

public contracts, including the so-called Concession Directive (Directive 2014/23/EU) seems to move in this direction[21].

As part of this rationalization and on the basis of the experience of other European countries (such as the United Kingdom and Spain), improvements could arise from the adoption of specific measures aimed at: *i*) rationalizing PPP use; *ii*) guaranteeing an adequate preparation of contracts; *iii*) ensuring the bankability of operations; *iv*) improving information transparency and accessibility.

4.1. Rationalize PPP use

Unlike in other European countries (e.g., the United Kingdom and Spain)[22], Italian contracting authorities until now have awarded PPP contracts in the absence of adequate preliminary assessments about the advantages of using PPPs rather than traditional procurement (Value for Money analysis)[23]. More generally, the preparation of technical documents to support the decision-making processes of the PA – in particular the FS – is inadequate[24].

It is worth mentioning that despite the progress resulting from the Presidential Decree 207 of 5 October 2010 (Public Procurement Code Implementing Regulations)[25],

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21 See the draft law AC 3194-A "Delegation to the Government for the implementation of Directives 2014/23/EU, 2014/24/EU and 2014/25/EU of the European Parliament and of the Council of 26 February 2014 on awarding of concession contracts, public procurement and procurement by entities operating in the water, energy, transport and postal services sectors, as well as to revise the current legal framework for public contracts". In particular, it provides for the recognition and the rationalization of the existing regulatory framework in the areas of public procurement and concession contracts, in order to achieve a drastic reduction of the relevant legislative regulatory and administrative provisions, and a greater level of certainty of interpretation and simplification of procedures (art. 1, paragraph 1, lett. *b*) and *d*)), and the simplification of PPP contracts (art. 1, paragraph 1, lett. *rr*)).

22 The UK has long developed the methodology of the Public Sector Comparator to determine the advantages of using PPP contracts rather than traditional procurement. In Spain, the new law on public procurement (*Ley de contratos del Sector Público*, October 30th, 2007, enacted in April 31st, 2008), which laid down specific rules for the award of PPP contracts for particularly complex projects (*contratos de collaboraciòn entre el sector pùblico y el sector privado*), has expressly required a preliminary cost-benefit assessment, aimed at establishing the existence of a positive assessment regarding the advantages and disadvantages of using this type of contracts over others (*Evaluación Previa*). A similar provision was adopted in France with the Law 2008-735, of July 28th, 2008, which amended *ordonnance* 2004-559, of June 17th, 2004, that had introduced the *contrat de partenariat.* For further details see Giorgiantonio and Giovanniello (2011).

23 The term Value for Money (VfM) indicates the achievement of pursued objectives through an optimum use of the available resources (see, among others, EPEC – PPP Task Force, 2011). In recent years different methodologies to assess the requirement of VfM have been developed. In the English evaluation models the estimated VfM is based on the construction of the aforementioned Public Sector Comparator, an instrument based on the financial enhancement of the risks transferred to the private sector (see HM Treasury, 2006; Martiniello and Samoggia, 2008).

24 See Amatucci and Vecchi (2009).

25 The art. 14, paragraph 2, letter. *d*), of Presidential Decree 207 of 5 October 2010, which essentially incorporates the indications arising from the the decision of the Supervisory Authority for Public Procurement of 14 January 2009, n. 1 (see AVCP, 2009), provides that if the feasibility study is related to a competitive dialogue or a project financing procedure, respectively, under art. 58 and 153 of the PPC, technical and economic documents have to be included: *i*) the verification of the possibility of

which has prescribed a minimum content of the FS – including the verification of the possibility of the project implementation by a PPP contract rather than a traditional procurement – this Decree has provided for neither a Value for Money analysis nor a risk analysis. Therefore, there is still the need to establish a common methodology for the Value for Money assessment of infrastructure projects to be implemented through PPP contracts. This methodology should be systematically applied as a preliminary evaluation to investment decisions and then diversified depending on the complexity and value of the projects[26].

In order to rationalize PPP use, a significant step forward has been realized in terms of coordination between the different decision levels of the public sector involved in the decision-making process prior to the awarding of the contract. In response to a repeatedly expressed need on the part of sector operators[27], it has been provided that, in the procedures for awarding PPP contracts, the FS (or the preliminary project, in the case in which the awarding procedure is based on this latter document) is subjected to a mandatory preliminary approval by each administration involved (*conferenza preliminare di servizi*)[28]. Thus, the authorities that protect specific interests (such as environmental, landscape-territorial, historical, artistic, health and public safety) cannot express a negative opinion about the project or ask for changes in the original project that would modify the business plan after the private contractor has been selected. In this way, the regulatory and administrative risks related to project approval are significantly reduced[29].

The effectiveness of this provision would be further strengthened by measures aimed at improving the level of specialized technical skills, planning capacity and project management capability: these are generally lacking in Italian contracting authorities (especially local ones)[30]. In this last regard, improvements might derive from the creation of specialized public bodies – for example, within the Ministry for Infrastructure or the National Anti-Corruption Authority (ANAC), which since June 2014 has assumed the functions of the Supervisory Authority for Public Procurement (AVCP)[31] – or the strengthening of existing structures (in particular, the Italian PPP Task Force – UTFP). In addition to diffusing best practices, these structures may contribute to the harmonization of standards, increasing the degree of certainty of interpretation in a highly complex regulatory context. The implementation of these bodies would also contribute to reducing the costs that each contracting authority would incur to obtain the necessary skills.

implementation by a concession contract rather than a traditional procurement; *ii*) the analysis of financial feasibility (costs and revenues) in relation to the construction phase and, in the case of concession contracts, the operation phase; *iii*) the analysis of the economic and social feasibility (cost-benefit analysis); *iv*) the scheme of tariff system, in the case of concession contracts; *v*) the essential elements of the draft contract.

26 See Nicolai (2015); NUVAL (2014).

27 See ABI (2007); AVCP (2009).

28 See art. 14-*bis*, paragraph 1-*bis*, of the Law 241 of 7 August 1990, paragraph added by the art. 3 of the Law Decree 83 of 22 June2012, converted by the Law 134 of 7 August 2012.

29 It is worth mentioning that these risks do not exist in the traditional procedure for awarding PPP contracts, in which the process moves from the administration: see art. 14-*bis*, paragraph 5, of the Law 241 of 7 August 1990.

30 See Amatucci and Vecchi (2009); Marasco, Piacenza and Tranquilli (2015).

31 See art. 19 of the Law Decree 90 of 24 June 2014, converted by the Law 114 of 11 August 2014.

4.2. Guarantee an adequate preparation of contracts

In Italy, unlike other European countries, the regulatory effort was mainly focused on PPP procedural aspects, devoting limited attention to other relevant aspects, especially with regard to the contract terms for regulating the relationships between the various parties involved in these operations[32]. With the exception of the hospital sector[33], there is also only limited use in Italy of soft law instruments (such as guidelines and standard documents), which can clarify the complex regulatory framework and guide operators (in particular contracting authorities) in the preparation of contracts. On the contrary, the recent Directive for awarding concession contracts explicitly mentions the need for soft codification instruments[34].

The relevance of this approach is also documented by our analysis[35], that show – in particular – the limited attention given to the preparation of concession contracts for public works, which should be the natural place to not only regulate the relationships between the involved parties, but also achieve the optimal risk allocation in PPP operations. More specifically, we have examined 61 concession contracts for public works submitted to the UTFP for monitoring the compliance of Italian PPP contracts on Eurostat criteria[36]. Despite the small number[37], the contracts submitted to the UTFP represent a sample sufficiently diversified by type[38] and capital value[39] of the work, which has made it possible to develop a single evaluation grid, that detects the presence and regulation of

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32 See also Marasco, Piacenza and Tranquilli (2015).

33 In the hospital sector, see the concession contract standard models drafted by Finlombarda (Finlombarda, 2007) and the Italian PPP Unit (UTFP, 2008). More recently, general guidelines for the preparation of concession contracts for public works have been drafted (see Ance, 2014). In other European countries the use of soft law is much more pronounced. In particular, in the UK – to facilitate PPP use – the Government provided detailed but non-binding circulars, showing best practices, contract terms and technical aspects (guides, practice notes, recommendations). See Giorgiantonio and Giovanniello (2011).

34 See art. 45. As mentioned, the draft law for the transposition of the new European Directives on public contracts provides the enhancement of soft codification tools, attributing the competence of their adoption to the ANAC (art. 1, paragraph 1, lett. *t*)).

35 See Cori, Giorgiantonio and Paradisi (2011).

36 These contracts were submitted to the UTFP according with the provisions of the art. 44, paragraph 1-*bis*, of the Law Decree 248 of 31 December 2007, converted by the Law 31 of 28 February 2008, and the Circular of the Italian Presidency of the Council of Ministers of 27 March 2009 for the implementation of these legislative provisions. They are related to public works destined for the direct use of the PA, generally in the public service sectors (cold works): it is more difficult in these cases to determine when the risk of work operation is actually transferred to private contractors.

37 The sample represents about 6 percent of the concession contracts for public works awarded between January 2002 and June 2009 (about 10 percent in terms of value). The subset of analyzed contracts related to hospital sector (19 contracts, for a total capital value of 2,122 million euros) accounts for 41 percent of the total number of contracts awarded in the sector between January 2002 and June 2009 (71 percent in terms of value).

38 The contracts have been divided in 7 different sectors: *i*) hospitals (19 contracts); *ii*) kindergartens (6); *iii*) institutional architecture (7); *iv*) sport facilities (9); *v*) cemeteries (7); *vi*) car parks (8); *vii*) energy and gas (5).

39 Regarding the capital value, there are very low value projects (below 5 million euros: 22 contracts), low value (between 5 and 15 million: 16 contracts), medium value (15 to 40 million: 8 contracts), high value (between 40 and 100 million: 6 contracts) and very high value (100 million or more: 9 contracts).

some aspects particularly relevant on the basis of economic analysis and international best practices. More specifically, we have analyzed:

a) the contract standardization (by sector);

b) the transparency of risk allocation[40];

c) and, whether this allocation has been made according to economic efficiency criteria.

From this last point of view, we have taken into consideration:

i) the presence of "incentives" for the private contractor: reward mechanisms (bonuses and deductions) and penalty systems for cases of breach of contract (especially mechanisms for applying penalties in the operation phase);

ii) the regulation of business plan rebalancing[41];

iii) the contracting authority's control of the operation phase (e.g., presence and adequacy of performance specifications aimed at regulating the provision of all services defined by the concession contract[42]; procedures for exercising supervision powers over the execution of the concession by the contracting authority).

For each above-mentioned aspect, numerical scores (based on a scale of 1 to 8) have been allocated to the various sectors, rating their compliance on economic analysis indicators and international best practices[43].

The results of our analysis, summarized in table 1, show that no sector has a fully satisfactory average score and only two sectors (hospitals and kindergartens) achieve a sufficient one. The main problems are related to the provision of penalties and reward mechanisms, as well as business plan rebalancing. In fact, inadequate penalties are generally provided for cases of breach of contract[44], while reward mechanisms for the private contractor are never provided. Also the regulation of business plan rebalancing is inadequate, given that in many cases it simply refers to legislative provisions.

Furthermore, contract standardization is insufficient: with the exception of hospitals (the only sector for which standard contract models have been drafted) and kindergartens, in each sector there is a significant lack of homogeneity of the contracts in terms of both structure and contents.

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40 Even the provision of guarantees beyond those required by law is assessed as revealing element of risk-taking by the involved parties. In particular, we have considered the presence of guarantees additional to those prescribed by law in the operation phase: in fact, the majority of the examined contracts have been signed prior to the enactment of the Legislative Decree 152 of 11 September 2008, which introduced guarantees related to the proper fulfillment of obligations provided in the contract operation phase (see art. 153, paragraph 13, of the PPC), was enacted.

41 As prescribed by the art. 143, paragraph 7, of the PPC.

42 Even through the provision of quality and quantity specific standards, diversified for each service.

43 The score 5 is equal to sufficient: see Cori, Giorgiantonio and Paradisi (2011) for more details on numerical scores.

44 In some cases penalties during the operation phase are not included.

The regulation of operation scores better, though still insufficient. It is regulated in great detail in hospital and kindergarten contracts, while it is still insufficiently regulated for institutional architecture, sport facilities and car park projects.

Risk allocation is the best-regulated aspect: it is particularly clear for kindergartens, energy and gas projects, and to a lesser extent for cemeteries and car parks; it is difficult to identify in the remaining sectors (institutional architecture, in particular).

The results of our analysis and the experience of countries in which PPP use appears more developed support the need to foster an adequate PPP contract standardization process in Italy diversified by sector. It could be specifically provided through the implementation of the principles contained in the draft law for the transposition of the new European directives on public contracts, which already attributes to the ANAC functions of "supporting best practices development" through the adoption of standard contracts[45]. This process should be aimed, in particular, at ensuring:

i) the provision of more appropriate reward mechanisms and penalties in cases of breach of contract by private contractors, especially during the operation phase;

ii) the introduction of clauses related to the sharing of financing documents (included reimbursement, compensation and rebalance mechanisms between private contractors and financial institutions) by the contracting authorities;

iii) the appropriate attention to business plan quantitative elements;

iv) the strengthening of the supervisory activity of contracting authorities during the various phases of contracts.

[45] See the afore-mentioned art. 1, paragraph 1, lett. *t*).

Table 1

Analysis of contracts: summary

SECTORS	Aspects of the analysis					Average score (sector)
	Contract standardization	Transparency of risk allocation	Penalties and reward mechanisms	Business plan rebalancing	Regulation of operation phase	
Hospitals	6	4	4	4	7	5
Kindergartens	5	7	4	3	7	5,2
Institutional architecture	2	3	2	3	3	2,6
Sport facilities	3	4	3	3	3	3,2
Cemeteries	4	5	3	4	5	4,2
Car parks	3	5	3	3	3	3,4
Energy and gas	2	7	4	4	3	4
Average score (aspect)	3,6	5	3,3	3,4	4,4	-

Source: Cori, Giorgiantonio and Paradisi (2011).

4.3. Ensure the bankability of operations

The measures provided in the Italian legal system to protect lenders do not seem sufficient to effectively ensure the bankability of PPP projects, especially where they are financed by PF[46]. This is one of the causes – along with others such as the inadequate preparation of PPP contracts – which has so far led to considerable stretches of time between the awarding of the concession contract for public works and its financial closing[47]. In recent years there have been several regulatory interventions aimed at

[46] The importance of ensuring the bankability of PPP projects is now also underlined by Italian regulations: the art. 50, paragraph 1, lett. *a*), of the Law Decree 1 of 24 January 2012, converted by the Law 27 of 24 March 2012, n. 27, provides that in the procedures for awarding concession contracts for public works, contract notices, draft contracts and business plans have to be prepared in order to ensure adequate levels of project bankability.

[47] For example, in the hospital sector, the time needed to reach the financial closing of contracts averages two years (more precisely, 23.2 months). See Finlombarda (2011); ANCE (2013).

facilitating an early involvement of credit institutions in the procedures for awarding concession contracts.

In particular, the Public Procurement Code now enables contracting authorities: *i*) to hold prior to the deadline for submission of tenders a consultation with the economic operators invited to tender, in order to verify the absence of problems related to the project bankability and according to the results of the consultation allowing for modifications of bid documents and the extension of the deadline for submission of tenders; *ii*) to specify in the contract notice that tenders have to be accompanied by a declaration of interest to finance the PPP operation on the basis of the draft contract and business plan on which the awarding procedure is based, signed by one or more financial institutions[48]; *iii*) to specify in the contract notice that the contract will be terminated if the necessary funding for the project is not raised within a reasonable period, set in the same contract notice and not exceeding twenty-four months from the approval of the final project[49].

These provisions, albeit relevant for a more careful preparation of tenders in terms of bankability, do not address certain substantive issues, which are also linked to a more appropriate lender involvement in financing PPP operations[50]. In particular, in terms of certainty of financial resources for implementing projects, the importance of modifying the discipline of the Italian *asseverazione* of the business plan by a credit institution has been repeatedly emphasized[51]. The rationale behind the *asseverazione* is to verify the validity of the elements that make up the business plan[52] and responds to the logic (unexceptionable in theory) to attest, in the interest of the public sector, the ability to carry out the public work with private capital. However, in practice the *asseverazione* does not seem to be perceived as a signal of the "quality" of the project and could often be translated into a simple (and not insignificant) increase of costs for the private contractor, without appreciable effects on PA. In fact, on the one hand, the contracting authority has to independently evaluate the feasibility of the intervention, its profitability and ability to generate positive cash flows[53]; on the other hand, there is no obligation for the Italian *asseverante* to provide the necessary funds and to ensure the availability of such funds even in the absence of lenders interested in the project[54]. Instead, in order to reduce moral hazard and adverse selection problems, the law should provide that the Italian *asseverante*

48 See paragraph 3-*ter* of the art. 144 of the PPC, introduced by the art. 19 of the Law Decree 69 of 21 June 2013, converted by the Law 98 of 9 August 2013.

49 See paragraph 3-*ter* of the art. 144 of the PPC, introduced by the art. 19 of the Law Decree 69 of 21 June 2013, converted by the Law 98 of 9 August 2013. It also provides that, in case of contract termination, the private contractor will not be entitled to any cost reimbursement, including those relating to the final design.

50 It in this regard the recently introduced possibility for the contracting authority to ask for a declaration of interest to finance the PPP operation does not appear decisive, given that this declaration does not represent a constraint to its effective financing.

51 See, e.g., UTFP (2010).

52 See art. 96, paragraphs 4 and 5, of the Presidential Decree 207 of 5 October 2010.

53 See AVCP Decision No. 14 of 5 July 2001.

54 See AVCP Decision No. 34 of 12 July 2000.

assumes the role of arranger, reducing the chances of failure during the search for funding[55].

Moreover, other regulatory aspects – crucial for lenders and related to the contract execution phase – have not been affected by the latest reform, as in the case of step-in right[56] which lets lenders replace the private contractor in some specific cases (such as breach of contract). However, the involvement of donors is allowed only if the dealer is in a situation of full-blown default so serious that it requires reporting by the PA for termination. In contrast, a so-called dynamic step-in right – which allows for the substitution of the private contractor who is not efficiently operating according to the efficiency indices established in the financial contract – would place more emphasis on efficiency parameters laid out in the contract. This would encourage lenders to enter in the process of drafting the contract with the contracting authorities for the inclusion of terms consistent with their needs[57].

4.4. Improve information transparency and accessibility

As previously mentioned, the information available related to PPP projects stop once contracts have been awarded, because the National Project Financing Observatory does not collect data on the signing of contracts, their financial closing or questions related to the operation phase. In this respect, the Circular of the Italian Presidency of the Council of Ministers of 27 March 2009, which provides for the submission of concession contracts involving the so-called cold works to the UTFP for monitoring PPP operations, does not seem to have fully addressed this issue. In fact, many contracting authorities have not fulfilled this obligation; in any case, even if the information collected thusly were complete, it would represent only a part of PPP operations since it excludes the so-called warm works.

Firstly, it would be appropriate to introducing a systematic monitoring of PPP operations at the central level, in order to also collect data as well on the signing of contracts, their financial closing and work operation phase[58]. This would not only provide a complete picture of the operations that have reached the operation phase, but also ensure the continuous monitoring of the operating performance of private contractors to verify their capability to be compliant on public interest during the entire contract duration.

Moreover, it would also be desirable to expand information related to PPP operations that contracting authorities have to require of private contractors. This could be accompanied by a strengthening of PA control in all contract phases, thereby ensuring better coordination between central and local levels, in order to establish a process of communication between the various government levels aimed at identifying and disseminating best practices in the sector.

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55 See Sambri (2007); Iossa and Legros (2004).

56 See art. 159 of the PPC.

57 See UTFP (2005); Montella (2005).

58 Also the recent European Directive 2014/23/EU on awarding concession contracts contains relevant provisions on work maintenance and operation phase, providing – among other things – the creation of monitoring and control systems.

5. Conclusions

Despite significant progress, the Italian regulations still have limitations that do not permit the most appropriate use of PPPs.

First, the system could benefit from a rationalization and simplification of existing legislation, which has become increasingly complex over the years as a result of the numerous reforms. The appropriate implementation of criteria provided by the recent draft law for the transposition of the new European directives on public contracts should help to solve this problem.

As part of this rationalization and on the basis of the experience of other European countries (such as the United Kingdom and Spain), improvements would arise from the adoption of specific measures aimed at:

i) a rationalization of PPP use, in particular strengthening the concept of "value for money" in evaluating infrastructure projects;

ii) an appropriate standardization of contract terms to facilitate a clear and efficient risk allocation[59], in particular through the adoption and diffusion of soft law instruments;

iii) the provision of more adequate safeguards to ensure the bankability of the projects, especially through the strengthening of step-in right mechanisms;

iv) and, the introduction of a systematic monitoring of PPP operations, in order to increase information transparency and to ensure the continuous monitoring of the operating performance of private contractors to verify their capability to be compliant on public interest during the entire contract duration.

[59] In particular, *i*) allowing for the necessary adjustments to the changes occurring in the process of granting; *ii*) conditioning the revenues of the private contractor to the quality of services provided; *iii*) facilitating the actual passing of the risks related to the availability of the service and those arising from the variability in the level of demand on the private contractor.

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INVESTMENT AND INVESTMENT FINANCING IN ITALY: TWENTY YEARS OF MACRO EVIDENCE

Claire Giordano, Marco Marinucci and Andrea Silvestrini*

Abstract

We analyse the developments of investment and investment financing in Italy since 1995, based on data from national accounts and the flow of funds. The exceptional fall in investment after the global financial crisis in 2007 concerned all institutional sectors and asset categories. However, appropriately deflated data highlight the more intense fall of household capital expenditure. Consistently, on the asset side, construction was one of the most hard-hit capital goods; ICT and intangible investment instead weathered the double recession better. Next, a correlation analysis suggests that long-term liabilities (long-term loans, long-term debt securities, shares and other equity) can be used to gauge trends in the financing of investment, at least when considering non-financial corporations and households. Focusing on investment financing, we moreover show that the eruption of the crisis caused a major contraction in the availability of external finance for these institutional sectors. Long-term loans to non-financial corporations became more important, crowding out their short-term counterparts. Also the weight of debt securities increased significantly, especially after 2008.

Keywords: Gross fixed capital formation; investment financing; national accounts; financial accounts; heat maps

JEL Classification: E22; G01; G31; G32

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1 Introduction

Following the outbreak of the global financial crisis, the euro area experienced a large fall in gross fixed capital formation, both in 2008-09 and during the sovereign debt crisis. This drop was dramatic in the countries more exposed to tensions in government bond markets. In Italy, in particular, total real investment has suffered a loss of around 30 per cent since 2007, the pre-crisis peak, reverting to its lowest levels since the mid-1990s. Weak investment also remained a key drag on GDP growth in 2014, although more recent quarterly data on capital accumulation point to a slight increase in 2015 relative to 2014.

The depressed growth of investment is in contrast with the substantially muted aggregate financing costs, which stem from the low interest rate environment, resulting from the strongly expansionary stance of monetary policy in the euro area. In this context, one scenario is that investment demand will remain too low to absorb financial savings, inducing a persistent state of an excess supply of funds in capital markets. On the other hand, there are concerns that there may be a shortage in the availability of funding for long-term investment, mainly because of unintended effects of the still ongoing overhaul of financial regulation.

All these issues raise several concerns and make it necessary to ground policy responses on sound data and analysis. It is thus crucial to identify a set of key quantitative indicators – based on data that are of good quality, timely and comparable across countries – to monitor developments in investment and in the financing of investment. The need of having more data on investment and the way in which it is financed has been recently emphasised by international organizations and public authorities alike. The purpose of this paper is to meet this demand focusing on macroeconomic data.

In the first part of the analysis we describe the main trends in investment expenditure in Italy based on a selected set of indicators, drawn from official data. Regarding Italian gross fixed capital formation official data, two issues potentially stand out. The first

concerns the fact that institutional sector accounts are expressed at current prices, when indeed price movements of investment goods can be non-negligible, affecting medium-term trends. This leads to the need for assessing suitable deflators for institutional sector accounts. In the paper we tackle this problem by providing constant-price series obtained by deflating the nominal investment expenditure of each institutional sector with deflators retrieved from the Italian National Institute of Statistics (Istat) capital accounts disaggregated by economic activity. The second issue concerns the lack of publicly available data broken down by both institutional sector and asset type, with the exception of the general government. In this respect, we combine information coming from the institutional sector disaggregation with the asset type breakdown, using capital expenditure data disaggregated by industry. More in particular, for non-financial and financial corporations, we first rely on data on capital expenditure by economic activity in order to obtain a disaggregation by asset. Then, we use asset-specific investment deflators which allow us to obtain constant-price series disaggregated both by institutional sector and by asset type.

In the second part of the paper, we examine investment financing. We focus on those financial liabilities that are usually associated with investment activities ("long-term liabilities"), which include long-term loans, long-term debt securities as well as shares and other equity. We show that long-term liabilities can be used to gauge trends in the long-term financing of investments, at least when considering non-financial corporations and households. As a consequence, we argue that the use of long-term liabilities as a proxy of long-term investment financing may not be such a restrictive assumption. Then, we investigate the pattern of the different components of total liabilities, focusing on the most relevant sectors involved in investment activity, namely non-financial corporations and households.

The rest of the paper proceeds as follows. Section 2 describes the developments in

gross fixed capital formation in Italy since 1995, based on yearly national accounts.[1] We first focus on total investment, broken down by institutional sector. We then analyse investment in different asset types, crossing the information, where possible, with the previous breakdown. Relying on financial accounts, Section 3 first examines the link between investment and long-term liabilities of the main investor sectors in Italy. Then, we move on to explain the evolution over time of the most important funding instruments. Finally, Section 4 draws some conclusions, pointing out Italy's main data challenges and suggesting possible future research items.

2 Developments in investment

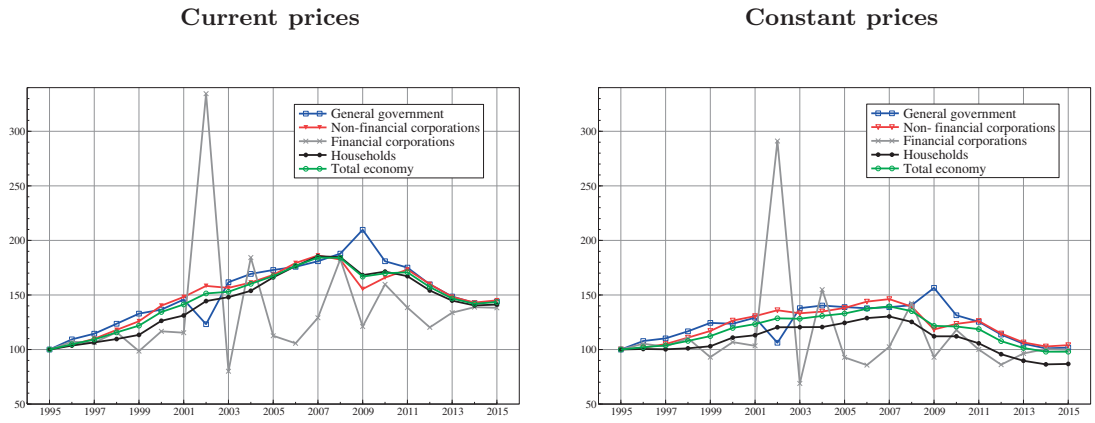
Since 1995, the first year for which national accounts data are currently available according to the SNA2008/ESA2010 standards, and until the outbreak of the global financial crisis in 2007, total investment expenditure in Italy was set on a markedly upward trend, nearly doubling at current prices and increasing by approximately 40 per cent in real terms (Figure 1). The decline thereafter was particularly sharp both in a historical perspective and with respect to the other largest euro-area countries (Figure A.1 in the Appendix): the downturn was approximately 23 per cent in nominal terms and 30 per cent at constant prices. As a result, real gross fixed capital formation in Italy is currently at its lowest levels since the mid-1990s.

Moreover, the total investment rate of the Italian economy, measured as the ratio of total investment to GDP at constant prices using chain-linked values, fell from levels comparable to those recorded in France and Germany in the first half of the 2000s (over 21 per cent) to its lowest level in twenty years (under 17 per cent), implying a large investment loss both relative to the country's 2000-07 average and to its pre-crisis peak. Italy's non-construction investment rate recorded similar negative trends. Both rates are

[1] This section is based on national accounts released in March 2016 by the Italian National Institute of Statistics (Istat).

depicted in Figure A.2 in the Appendix, in comparison with those recorded in France, Germany and Spain.

Figure 1: Total gross fixed capital formation: trends by institutional sector
(indices 1995=100)



Source: Istat for current price series and authors' calculations based on Istat data for constant price series.

The following analysis attempts to evaluate whether these trends were broad-based across institutional sectors and across asset types or if, on the contrary, they were concentrated in certain institutional sectors or driven by specific capital goods.

2.1 Trends by institutional sector

The accumulation trends at current prices in Italy are largely similar across institutional sectors (Figure 1, left-hand side panel), thereby implying broadly stable shares of total investment in the medium term and few composition effects (Table 1). Non-financial corporations account for nearly a half of total investment expenditure in Italy, followed by households (more than a third). Less than a fifth of capital spending can be attributed to general government and only a negligible share (under 2 per cent) is made by financial corporations.

Table 1: Total gross fixed capital formation: breakdown by institutional sector (1)

(percentage shares computed on current price series)

	General government (2)	Non-financial corporations (3)	Financial corporations (4)	Households (5)
1995–1999	14.4	49.5	1.6	34.5
2000–2007	13.7	50.2	1.6	34.5
2008–2015	14.4	48.8	1.5	35.4

Source: Istat. Notes to the table:

(1) Shares are always computed on current-price series since chain-linked volumes do not preserve additivity.

(2) General government comprises central, regional and local government and social security funds.

(3) Non-financial corporations include all private and public corporate enterprises that produce goods or provide non-financial services to the market.

(4) Financial corporations comprise both financial and insurance firms.

(5) Households include "consumer" households, as well as "producer" households (i.e., household firms with up to five employees) and non-profit institutions serving households (NPISHs).

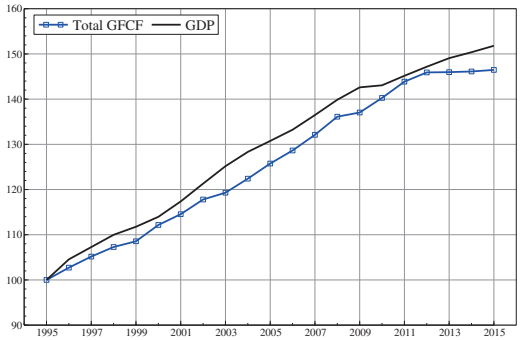
The pronounced expansion in nominal gross capital formation until 2007 was of comparable magnitude across the three largest institutional sectors, although general government saw a significant drop in its expenditure in 2002 (again Figure 1, left-hand side panel). The decline since 2007 has been similar for both non-financial corporations and households, whereas general government capital accumulation rose sharply in 2009, owing to the counter-cyclical fiscal policies enacted in response to the crisis, before rapidly falling to its lowest levels since the early 2000s. Financial corporations' investment expenditure shows more pronounced fluctuations, with an exceptional hike recorded in 2002; since the turn of the new millennium it remained on average more subdued than the rest of the economy.

However, in the medium term, investment series at current prices may be biased by price movements (e.g., see Karabarbounis and Neiman, 2014, which document the global

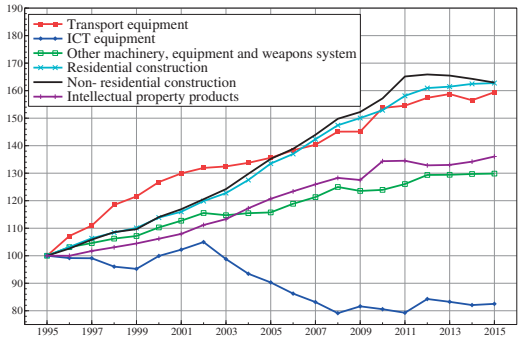
decline in investment prices relative to consumer goods' prices). Moreover, the potential bias may be of a different magnitude over time and across assets. In particular, as seen in Figure 2 (left-hand side panel), the total investment price deflator in Italy increased until 2011, and stabilised thereafter. Relative total investment prices (i.e., the total investment deflator relative to the GDP deflator) have instead marginally declined over the whole period.

Figure 2: GDP and investment deflators by asset type
(indices 1995=100)

GDP and GFCF deflators



GFCF deflators by asset type



Source: Istat.

An appreciable variance in price movements shows up across assets: construction investment prices have grown faster than non-construction investment prices (with the exception of transport equipment), whereas ICT prices declined by approximately one fourth after 2002 (Figure 2, right-hand side panel). Indeed, as discussed for example by Kolev (2013), assets such as machinery have shorter economic lives than construction and therefore the stock of such assets is renewed over shorter periods. Moreover, the technologies used in the construction and production of machinery branches differ substantially in their capital/labour ratios: typically, construction is more labour-intensive and reports slower

productivity growth. As a result, price indices for construction tend to grow faster than those for machinery. The decline in ICT prices is instead due to the vast improvements in this type of technology over the years. The prices of all assets have broadly stabilised in the most recent recessionary years, with the exception of those of intangible goods, which also in 2014 were set on an upward trend.

In the right-hand side panel of Figure 1, we therefore also provide constant-price series, obtained by deflating the nominal expenditure of each institutional sector with deflators taken from Istat data on capital accounts disaggregated by economic activity. In particular, we deflated total general government investment expenditure with the "public administration, defence, education, human health and social work activities" investment deflator, in turn computed as the ratio between the current and constant-price Istat series. For financial corporations' investment we employed the "financial and insurance activities" investment deflator, for households the "real estate activities" deflator (owing to the fact that most of households' investment expenditure is in residential dwellings) and for non-financial corporations the deflator computed for the total economy net of the previously mentioned industries. Correlations between growth rates in total investment of each institutional sector at current prices and those in total investment of the selected corresponding economic branches, again at current prices, are satisfactory. In particular, they are over 0.9 in the case of non-financial corporations and households, and over 0.7 for financial corporations in the overall period under study. The correlation is instead smaller for general government (0.5).[2] Moreover, correlations in levels are even more satisfactory (greater than 0.9 for all institutional sectors except financial corporations, for which it is equal to 0.6).

In real terms the pre-2007 investment expansion is more moderate for all institutional

[2] As an alternative, for this latter sector, we also attempted to employ the deflator computed only for "public administration and defence", thereby netting out health and education (which in part are private services), but the correlation is even lower (0.4); hence, we preferred to use the deflator previously described.

sectors than in nominal terms, as to be expected (Figure 1; right-hand side panel). Yet the pace of real household investment growth turns out to be significantly more contained than that of general government and non-financial corporations. The fall in investment after the global financial crisis was also slightly more marked for households (34 per cent). This shows that whereas, net of price effects, the 2015 levels of investment expenditure of all institutional sectors are found to be broadly comparable to the (low) values recorded in the mid-1990s, household investment reverted to its lowest levels in the past twenty years.

Furthermore, both the household and non-financial corporation investment rates, computed in real terms, decreased by around 2 percentage points of GDP after 2007, against a fall of half that magnitude of the general government investment rate (Figure A.3 in the Appendix). However, whereas the general government and non-financial corporation rates in the most recent years were broadly comparable to those recorded in 1995, respectively at 2 and 8 per cent, the household rate was over one percentage point lower, standing at less than 6 per cent.

In conclusion, although all institutional sectors shared an expansionary phase in the 1995–2007 period and experienced a sharp decline thereafter, household investment was less buoyant in the first phase and the hardest-hit in the second. Given this sector's non-negligible weight in the total economy, accounting for approximately a third of total capital accumulation, the household sector thereby dampened aggregate investment developments in Italy. For an analysis of the role of economic branches of activity in explaining Italy's non-construction investment trends see Busetti, Giordano and Zevi (2016). In particular, during the recent double recessionary phase, private non-financial services are found to be the main driver of the sharp investment downturn.

2.2 Trends by asset type

Moving to total gross capital formation by asset type, construction investment represents just over half of total accumulation in Italy (Table 2), which is similar to the share observed in the other largest euro-area countries. Italy's construction quota is then more or less equally divided between residential and non-residential buildings, with some reallocation in favour of the former occurring as of 2008.[3] Non-construction investment mainly comprises accumulation in "other" machinery, equipment and weapons systems, followed by expenditure in intangibles, which constitutes a slightly lower share relative to that recorded in France and Germany (Busetti, Giordano and Zevi, 2016).

Table 2: Total gross fixed capital formation: composition by asset type (1) (2)
(percentage shares computed on current price series; the sum of tangible non-construction investment, investment in intellectual property rights and investment in infrastructure is equal to total investment, net of rounding-up discrepancies)

	Tangible non-construction investment					Construction investment (3)		
	Transport equipment	ICT equipment	Other machinery, equipment and weapons systems	Total	Intellectual property products	Residential dwellings	Other buildings and structures	Total
1995–1999	6.9	4.3	25.7	36.9	12.0	25.3	25.4	50.7
2000–2007	7.2	4.1	24.6	35.9	11.8	24.8	27.3	52.1
2008–2015	5.3	3.7	24.1	33.1	13.7	27.7	25.3	53.0

Source: Istat. Notes to the table:

(1) Owing to their negligible share, cultivated biological resources are not shown.

(2) Shares are always computed on current-price series since chain-linked volumes do not preserve additivity.

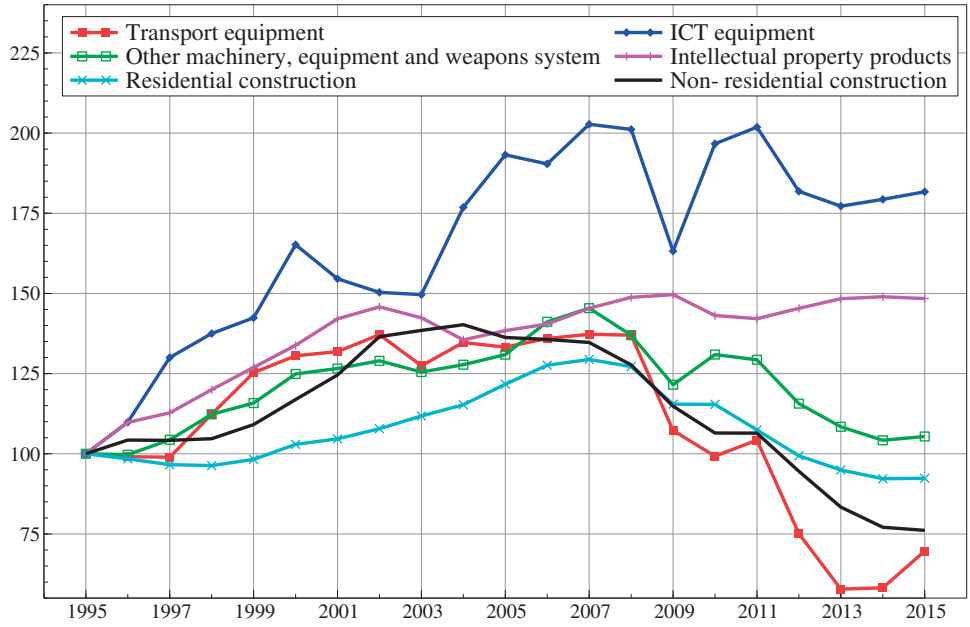
(3) Construction investment includes the cost of ownership transfers.

Istat provides both current-price and chain-linked series for gross fixed capital formation disaggregated by asset type; for the sake of brevity we only show the latter in Figure

[3] According to ESA 2010, infrastructure is placed in the category "other buildings and structures", or non-residential investment, but there are no separate official statistics on infrastructure.

3.[4]

Figure 3: Total gross fixed capital formation: trends by asset type (1)
(indices 1995=100; chain-linked volumes)



Source: Istat. Notes:

(1) Owing to their negligible share, cultivated biological resources are not shown.

As of the mid-1990s capital spending at constant prices in both information and communication technologies (ICT) and in intangibles grew at a much faster rate than more traditional investment items, albeit with the former displaying a temporary setback in the early 2000s after the burst of the dot-com bubble. Transport equipment stands out as being the most volatile component (also confirmed in Table 3), but on the whole it registered similar developments to those of the other capital goods.

[4]Percentage shares, as in Tables 1 and 2, are instead always computed on current-price series since chain-linked volumes do not preserve additivity.

Table 3: GFCF volatility by asset relative to GDP volatility

GFCF asset type	Relative volatility
Transport equipment	5.3
ICT equipment	4.9
Other machinery, equipment and weapons systems	2.8
Intellectual property products	1.8
Residential dwellings	2.1
Other buildings and structures	2.9

Notes to the table: Standard deviation of yearly growth rates of chain-linked volumes, 1996-2014. Source: Authors' calculations on Istat data.

The decline in investment after the outbreak of the global financial crisis was broad-based across assets, yet with ICT and intangible investment faring better than other capital goods, similarly to what occurred in the other main euro-area countries. With the exception of transport equipment, which holds a fairly modest share, construction expenditure was the worst affected during the recent recession years, with residential dwellings declining by roughly 30 per cent as of 2007 and other buildings and structures by over 40 per cent. Currently, gross fixed capital formation in both transport and construction is well below its (low) levels of the mid-1990s. This evidence is consistent with the previously documented sharp downturn in household capital expenditure, which, as we will later explain, is mainly composed of housing investment.

The post-2007 trends are also confirmed by the observed fall in the investment rates of all asset types, the only exception being the broad stability displayed by intangible goods as a share of GDP (data not shown). The decline in the total construction investment rate was the sharpest recorded across all capital goods, reflecting in particular the drop in the investment rate for the non-residential component.

2.3 Trends by institutional sector and by asset type

In the case of Italy's national accounts, the challenge is to combine both the institutional sector disaggregation with the asset type breakdown for investment data, as this cross-classification is not publicly available for all sectors. A useful source leading in this direction is the general government's accounts, available at current prices and, at the time of writing, for the period 2000–14, which allow us to disaggregate general government capital expenditure (net of sales) by asset type. Gross fixed capital formation data disaggregated by institutional sector and by asset type are currently not disseminated, with the mentioned exception of data referring to the general government.

Total general government gross fixed capital formation from the general government's accounts coincides (at current prices) with that described in Figure 1 (left-hand side). Investment in infrastructure (i.e., in buildings and civil engineering works) accounts for over half of total general government spending in Italy (Table 4).[5] The share of intangible expenses (in particular software and R&D) is high (just under a quarter) and is nearly double that of "other" machinery, equipment and weapons.

[5]The breakdown by asset type is slightly different to that provided in Table 2. In particular, it is not possible to distinguish between residential dwellings and non-residential buildings (schools, hospitals, etc.).

Table 4: General government gross fixed capital formation: composition by asset type

(percentage shares computed on current price series; the sum of tangible non-construction investment, investment in intellectual property rights and investment in infrastructure is equal to total investment)

	Tangible non-construction investment					Investment in infrastructure		
	Transport equipment	ICT equipment	Other machinery, equipment and weapons systems (1)	Total	Intellectual property products	Residential and non-resid. buildings (2)	Civil engineering works (3)	Total
2000–2007	2.5	3.9	14.4	20.8	22.4	23.2	33.4	56.6
2008–2014	2.7	4.6	12.6	19.8	23.3	23.0	33.7	56.7

Source: Istat. Notes to the table:

(1) Net of sales.

(2) Includes the cost of ownership transfers; net of sales.

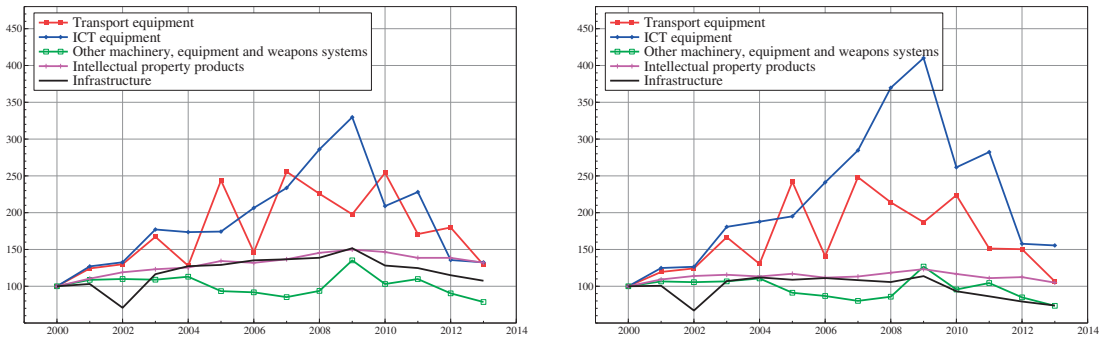
(3) Includes transport infrastructures (roads, railways, bridges, etc.), pipelines, communication and electricity lines and other civil engineering works.

In the years prior to the global financial crisis the general government investment in ICT showed the fastest growth, followed by transport equipment, a highly volatile component also in this sector's expenditure (Figure 4, left-hand side panel and Figure A.4 in the Appendix). Investment in all assets except transport reached its highest point in 2009, thus explaining the peak in aggregate general government expenditure in that year (see Figure 1) in order to counter the deep recession. The overall pre-2009 expansion, in current prices, for infrastructure, intangibles and "other" machinery, equipment and weapons systems ranged between 40 and 60 per cent; building construction was partially dampened by the sharp fall recorded in 2002 due to exceptional sales. The post-2009 contraction, linked also to fiscal consolidation, was again broad-based across products; however, intangible and civil engineering investment were less affected than other assets, such as buildings and "other" machinery, equipment and weapons systems (in particular, investment in weapons systems contracted markedly after 2009). Sales of buildings only increased in 2012 and 2013 relative to the previous years, pointing to lower new invest-

ment rather than disinvestment as the main reason for the developments seen in building construction expenditure.

Figure 4: General government fixed capital formation: trends by asset type
(indices 2000=100)

Current prices (1) **Constant prices (2)**



Source: Istat for current price series and authors' calculations based on Istat data for constant price series. Notes:

(1) It was not possible to construct a separate deflator for the two components of infrastructure; therefore, total public infrastructure is shown in the two panels of this Figure. Figure A.4 in the Appendix provides the complete breakdown of the current-price series.

(2) The time series are constructed until 2013 as investment disaggregated by asset and by economic activity, employed to deflate the current-price series, is currently available only until 2013.

In order to remove the effect of price changes, we also proceeded to deflate the official general government current-price series with the asset-specific investment deflator of the "public administration, defence, education, human health and social work activities";[6] the resulting constant-price series are shown on the right-hand side panel of Figure 4.[7] In real terms, the pre-2009 expansion in ICT was even more pronounced than in nominal terms, owing to a marked decline in its prices (as already seen in Figure 2); its downturn thereafter was instead comparable to that valued at current prices. The nominal developments for

[6] It was not possible however to construct a separate deflator for the two components of infrastructure.

[7] A general issue with crossing data breakdowns by asset and by industry is that we cannot account for second-hand markets for capital goods, which may be important for example for dwellings and machinery equipment.

the other asset categories in general government investment expenditure were broadly confirmed by the corresponding developments in volume terms.

As anticipated, other than for general government, there are no official published disaggregated data by institutional sector and asset type in Italy. Some rough indications may however again be deduced from the data on capital expenditure by economic activity. Households' investment is mainly made up of residential dwellings, although not entirely, as unincorporated enterprises of households and NPISHs are also included in the population; indeed developments in our estimated constant-price household expenditure series in Figure 1 are very similar to those in residential construction of the total economy portrayed in Figure 4.

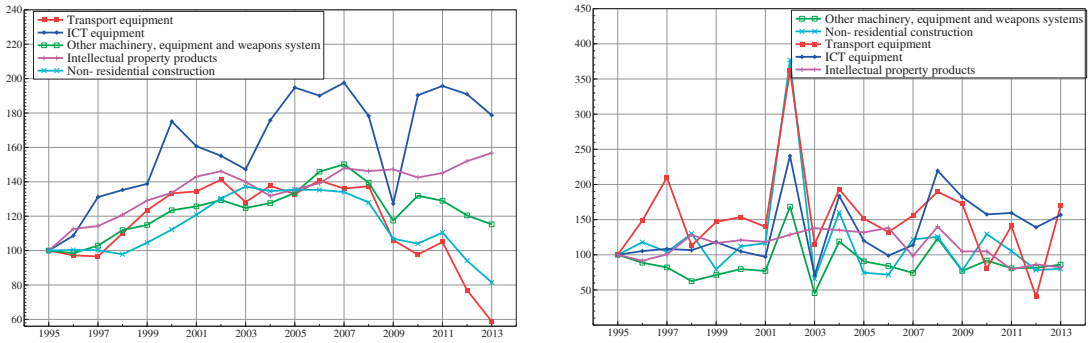
A breakdown by asset type is only warranted for non-financial and financial corporations, which we provide at constant prices. In particular, for financial corporations we rescaled the current-price series of investment by asset of the financial and insurance sector so that they added up to the financial corporations' total current-price expenditure.[8] Subsequently, we deflated each asset by the asset-specific investment deflator of the financial and insurance sector. For non-financial corporations we adopted the same procedure, employing information on investment by asset of the total economy net of the public, financial and real estate sectors, respectively.

The expansion in ICT and other intangible expenditure of non-financial corporations before the crisis and the greater resilience of their investments in these goods during the recent recessionary years (Figure 5, left-hand side panel) led to the developments seen at the aggregate level in Figure 3. Moreover, the current low levels in total-economy non-residential construction and transport equipment are in large part due to developments in non-financial corporations' investment activity.

[8]Since residential investment accrues entirely to the real estate industry in the capital expenditure by economic sector breakdown, we cannot provide any information on financial and non-financial corporations' investment in residential dwellings, which however should represent only a small share of corporations' total capital spending.

Figure 5: Corporations' fixed capital formation: trends by asset type
(indices 1995=100; chain-linked volumes) (1) (2)

Non-financial corporations **Financial corporations**



Source: based on Istat data. Notes:

(1) Series constructed until 2013, as investment disaggregated by economic activity and by asset type is currently available only until this year.

(2) Note that the two scales are not comparable.

Turning to financial corporations' expenditure (Figure 5, right-hand side panel) the co-movement across capital goods is relatively high, since they all have a pronounced cyclical nature, with transport equipment once again displaying the highest volatility. In particular, the exceptional rise in financial corporations' expenditure in 2002 was broad-based, yet mainly driven by non-residential construction and transport equipment. In 2013, the last year for which disaggregated data are presently available, only ICT and transport equipment investment stood at higher levels than their 1995 values.

3 Developments in financing

The previous section described the trends in gross fixed capital formation across institutional sectors and asset categories. The analysis is now complemented by looking at the main developments in investment financing based on information gathered from financial accounts. Financial accounts are computed at market values (or at their best approximation):[9] stock variations are therefore not only due to transactions but also to "other changes". By "other changes" (OCs), we mean all the changes in the stock that are not determined by flows. An example of OCs are price revaluations (in the case of securities and shares), write-offs, and write-downs (in the case of bank loans). For further details, see Banca d'Italia (2003).

3.1 Exploring the link between investment and investment financing

Before moving on to discuss the main developments in investment financing, it is worth pointing out an important *caveat*: one of the problems faced with in analysing the link between investment and financing concerns the fungible nature of finance. In fact, there is not a direct link between liability flows and investment. As a consequence, financial accounts' data can be regarded only as a proxy of finance directed to investment, in that institutional sectors may employ these financial resources for other additional purposes.

In this context, the financial liabilities that generally speaking are associated with investment activity (also referred to as "long-term liabilities") include long-term loans, long-term debt securities, shares and other equity (in financial accounts, according to the SNA2008/ESA2010, long-term instruments are those with an original maturity of more than one year).

In order to gauge a link between investment and the financial instruments just defined,

[9]The market value rule does not apply to assets that are not traded on a secondary market (bank deposits and loans, other accounts receivable/payable of the economy) and that are normally included at face value (Banca d'Italia 2003; 2014).

we examine whether there are any common patterns between the long-term financing provided by institutional sectors and investment carried out by non-financial corporations, financial corporations, general government and households, as already described in Section 2. To facilitate the inspection of the cross-correlation structure between long-term liabilities and investment, we make use of a matrix heat map. A heat map is a graphical representation of a data matrix in which the individual values contained in the cells are represented as colours. For more explanations and some examples on the use of heat maps in statistics we refer to Wilkinson and Friendly (2009).

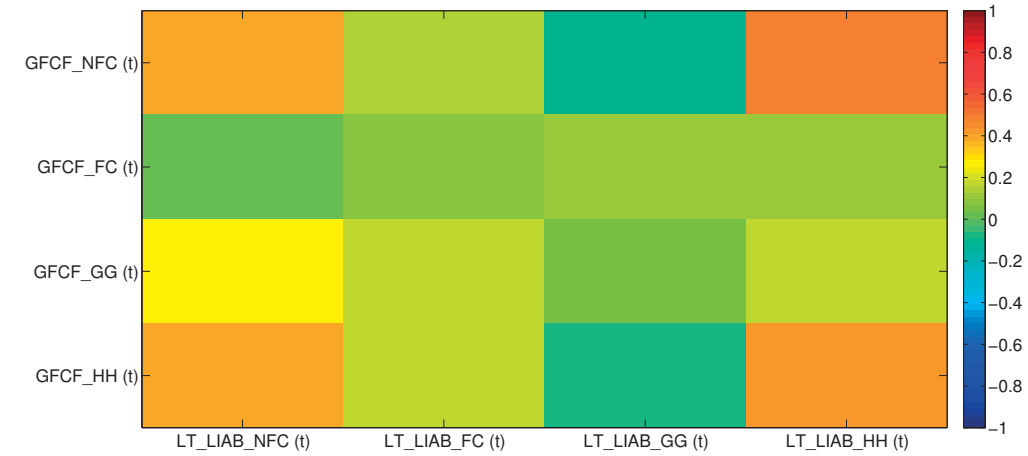
Figure 6 examines the cross-correlation coefficients between the growth rates of long-term liabilities flows and those of gross fixed capital formation. Both investment and long-term liabilities data are disaggregated by institutional sector. We use long-term liability flows because they capture the variation of financial resources reflecting decisions by economic agents, rather than other changes in volume, which are not due to transactions between institutional units.

Panel (a) of Figure 6 displays a cross-correlation coefficient matrix heat map. The cross-correlation function with zero time lag ($\tau = 0$) between growth rates of investment expenditure and long-term investment financing is defined as:

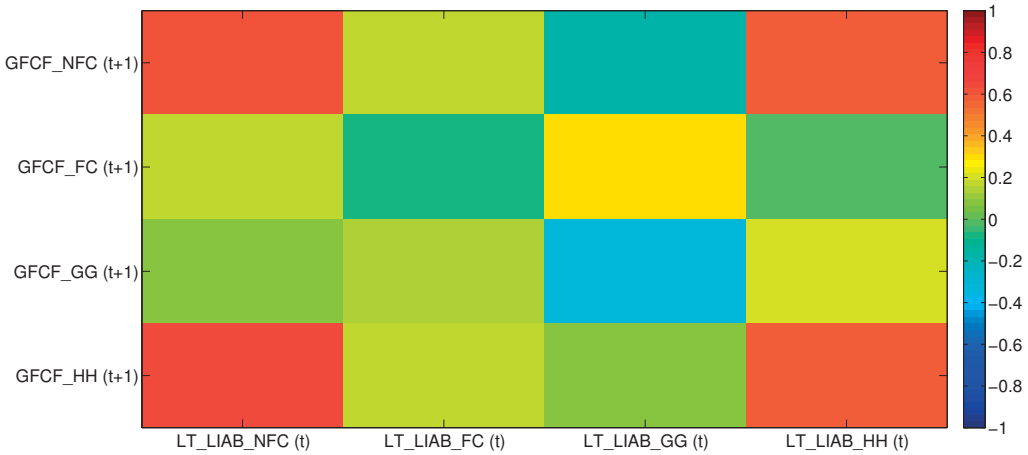
$$R_{i,j}(\tau = 0) = \frac{\sum_t (GFCF_{i,t} - \mu_{GFCF_i}) \times (LT\_LIAB_{j,t} - \mu_{LT\_LIAB_j})}{\sqrt{\sum_t (GFCF_{i,t} - \mu_{GFCF_i})^2 \times \sum_t (LT\_LIAB_{j,t} - \mu_{LT\_LIAB_j})^2}}, \quad (1)$$

where GFCF is the growth rate of investment, LT_LIAB is the growth rate of long-term financial liabilities flows, i and j refer to the institutional sectors and $t = 1996, \ldots, 2014$. For instance, GFCF_NFC indicates the growth rate of non-financial corporations' gross fixed capital formation. By the same token, LT_LIAB_NFC represents the growth rate of non-financial corporations' liability flows. The colour map ranges from blue (for negative correlation coefficients) to red (for positive correlation coefficients).

Figure 6: Cross-correlation coefficient matrix heat maps of investment and flows of long-term liabilities growth rates



(a) Cross-correlation between the growth rate of long-term liability flows at time t and the investment growth rate (GFCF) at time t



(b) Cross-correlation between the growth rate of long-term liability flows at time t and the investment growth rate (GFCF) at time $t+1$

Source: Authors' calculations on Istat and Banca d'Italia data. Notes: graphic visualization of the cross-correlation coefficient matrix heat map of investment growth rates (GFCF) and long-term liability flows growth rates (LT_LIAB). Both investment and long-term liabilities data are disaggregated by institutional sector. In the axis labels, NFC stands for "Non-financial corporations", FC for "Financial corporations", GG for "General government", HH for "Households".

The main diagonal of the matrix heat map in panel (a) refers to the cross-correlation

coefficients between growth rates of investment and long-term financial liabilities flows when considering the same institutional sector ($i = j$). Out-of-diagonal cells of the matrix are instead associated with cross-correlation coefficients between growth rates of gross fixed capital formation and long-term financing of different institutional sectors ($i \neq j$).

There is evidence of low cross-correlation between LT_LIAB_FC and investment disaggregated by institutional sector (second column), while the cross-correlation is very close to zero or even negative between LT_LIAB_GG and investment items (third column). Specifically, a negative correlation exists between LT_LIAB_GG and GFCF_NFC as well as between LT_LIAB_GG and GFCF_HH (light blue boxes on the heat map). This is not surprising given that the general government sector often finances the shortage of current income to cover current expenditures by increasing indebtedness.

At the same time, there is higher cross-correlation when we look at the first and fourth column (non-financial corporations' and households' long-term liabilities): more in particular, when focusing on the cross-correlation between LT_LIAB_NFC and GFCF_NFC, LT_LIAB_NFC and GFCF_HH, LT_LIAB_HH and GFCF_NFC as well as LT_LIAB_HH and GFCF_HH, the corresponding coefficients range up to 0.40.

It is also possible to provide a more general definition of first-order cross-correlation coefficient function by modifying equation (1) in order to introduce a one-year lag between GFCF and LT_LIAB,[10] namely:

$$R_{i,j}(\tau = 1) = \frac{\sum_t (GFCF_{i,t+1} - \mu_{GFCF_i}) \times (LT\_LIAB_{j,t} - \mu_{LT\_LIAB_j})}{\sqrt{\sum_t (GFCF_{i,t} - \mu_{GFCF_i})^2 \times \sum_t (LT\_LIAB_{j,t} - \mu_{LT\_LIAB_j})^2}}. \quad (2)$$

Equation (2) measures the degree of cross-correlation between the two time series at lag one: conceptually, it is indeed reasonable to conjecture that the availability of long-term finance leads investment expenditure of one or more years.

Consistently with this way of reasoning, panel (b) of Figure 6 presents the same cross-correlation coefficient matrix heat map between growth rates of investment and one-year-

[10] See for instance to El-Gohary and McNames (2008).

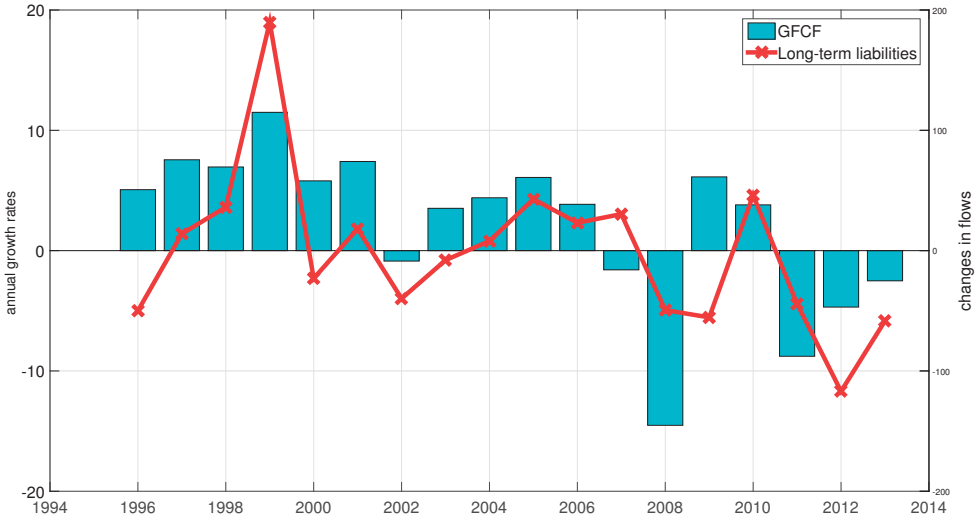
lagged long-term financial liabilities flows. On balance, there is evidence that the first-order cross-correlation coefficients are most of the times higher than contemporaneous cross-correlation coefficients. In particular, it is interesting to note that the first-order cross-correlation between LT_LIAB_NFC at time t and GFCF_NFC at time $t+1$ reaches 0.60 (red cell in the first column, on the main diagonal), a value that is considered large. At the same time, the first-order cross-correlation between LT_LIAB_HH at time t and GFCF_HH at time $t+1$ attains the sizable value of 0.58.

The strong cross-correlation between growth rates of investment and one-year-lagged long-term financial liabilities flows of non-financial corporations and households is due to the fact that these two institutional sectors are closely interrelated. On the one hand, an increase in long-term financial resources of households may induce higher propensity of firms to construct dwellings, with a beneficial impact on the building sector. On the other hand, firms increase their long-term financial resources in order to raise their investment activity. This higher propensity to invest may spill over to the rest of the economy, especially to smaller firms (which are included within the household sector) and to households, which in turn may be driven to increase their investment as well.

In short, the growth rate in non-financial corporations' investment is positively and significantly correlated to the lagged growth rate in the same sector's long-term liability flows (more graphical evidence is provided in Figure 7). As descriptive as it may be, this result suggests that notions of long-term liabilities can be used to gauge trends in the long-term financing of investments, at least when considering the non-financial corporations and the household institutional sectors. As a consequence, the use of long-term liabilities as a proxy of long-term investment financing may not be such a restrictive assumption.

Figure 7: Non-financial corporations' investment and long-term liabilities: a comparison of growth rates of investment and those of long-term liability flows

(annual growth rates computed on current-price series and considered at year $t+1$, left-hand scale; growth rates of liability flows computed in millions of euros and considered at year t, right-hand scale)

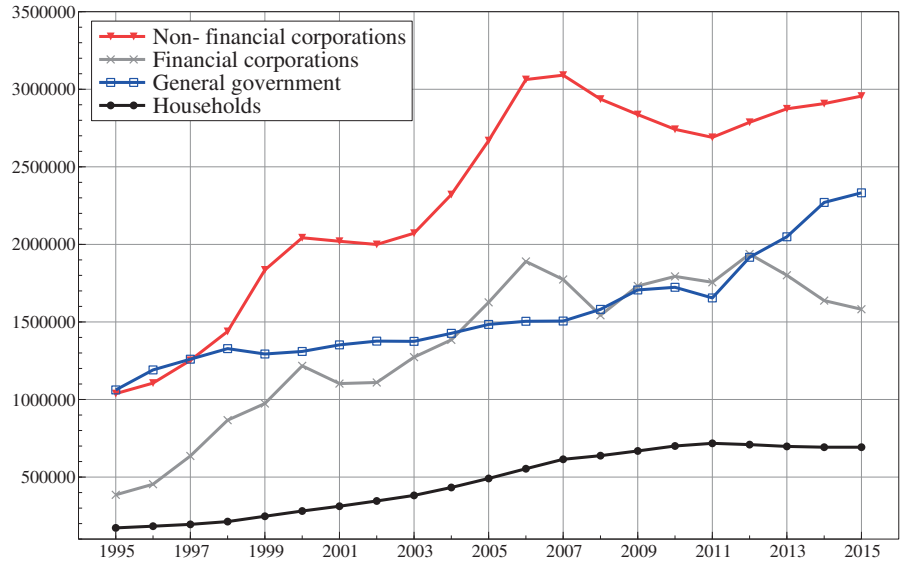


Source: based on Istat and Banca d'Italia data.

3.2 Financing trends by institutional sector

Looking at developments in long-term liabilities in Italy during the 1995–2015 period (Figure 8), we can observe an upward trend for all sectors. This "financial deepening" was interrupted by the three major shocks of the last two decades, i.e., the dot-com bubble in the early 2000s, the global financial crisis in 2007-2009 and the more recent sovereign debt crisis of the euro area.

Figure 8: Long-term liabilities: trends by institutional sector
(millions of euros, market value)



Source: Banca d'Italia.

We now move on to analyse the different components of total liabilities for each institutional sector. As already shown in the previous subsection, the most relevant sectors involved in investment activity are non-financial corporations and households, which we focus on here.

Concerning non-financial corporations, information on total liabilities is given both on their composition (Table 5) and on how that composition changes over time (Figure 9). Equity represents the largest component, accounting for nearly one half of total liabilities. Short and long-term loans amount to more than 30 per cent of total liabilities, a weight that is quite high, especially compared to other countries such as France and, to a lesser extent, Germany.[11] The weight of debt is confirmed also by the relatively high level of leverage, although the latter has been edging down in recent years (Figure A.5 in the Appendix).

[11] See Table A1 in the Appendix, which shows the share of bank loans in non-financial corporations' total debt in the four largest euro-area countries.

Table 5: Non-financial corporations' total liabilities: composition by financial instrument

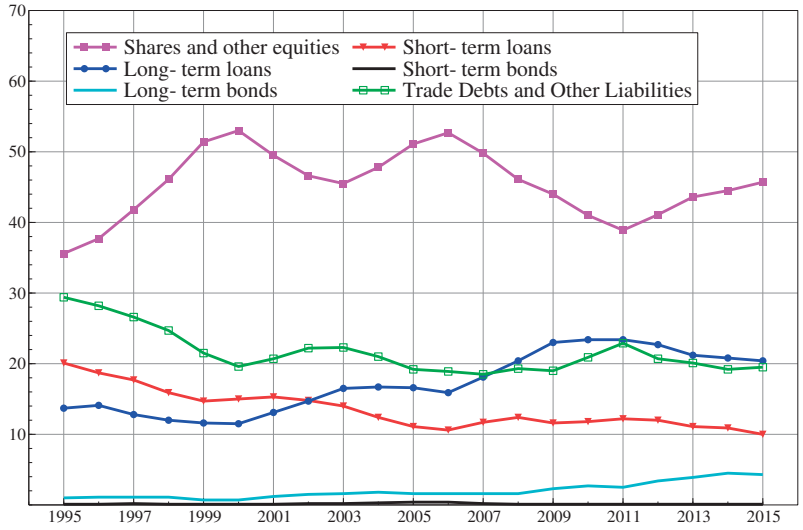
(percentage shares on current prices, market value)

	Shares and other equities	Short-term loans	Long-term loans	Short-term bonds	Long-term bonds	Trade debts and other liabilities
1995–1999	42.5	17.4	12.9	0.1	1.0	26.1
2000–2007	49.6	12.9	15.6	0.2	1.5	20.2
2008–2015	42.9	11.3	22.3	0.1	3.0	20.3

Source: Banca d'Italia.

Figure 9: Non-financial corporations' total liabilities: trends by financial instrument

(percentage shares on current prices, market value)



Source: Banca d'Italia.

It is important to note that for non-financial corporations the main driver of trends in long-term liabilities is the "other changes" component, which includes price changes and other factors unrelated to flows (Figure A.6 in the Appendix). This mainly reflects the incidence of "shares and other equity" among firms' liabilities.

A further look at the composition of total liabilities leads to some interesting insights. First, as shown in Table 5, there has been an increasing share of long-term loans, which crowded out the short-term counterparts. Such evidence is even more clear-cut when considering the share of long-term loans over total loans (which rose from 40 to 66 per cent in the 1995–2015 period) as well as the increasing "catching up" between firms' leverage and the long-term component of leverage, which is defined as the ratio of the sum of long-term bonds and long-term loans to total financial liabilities (Figure A.5 in the Appendix).

This rising trend in the incidence of long-term loans on the liability side of non-financial corporations' balance sheets can be accounted for by several factors, hinging both on banks (supply side) and on firms (demand side). Some of the structural factors that have likely had an impact on firms' financing choices since 1995 are as follows. Rules limiting banks' maturity transformation became less stringent in 1993 following the introduction of the Consolidated Law on Banking (*Testo Unico Bancario*), and were removed entirely around 2006. Since the mid-1990s, the persistent fall in the inflation rate reduced the uncertainty in banks' cash-flow management, hence the need to resort to short-term loans (Banca d'Italia, 2005). Focusing on the more recent period, after the peak of the global financial crisis, firms may have been interested in lengthening the maturity of their liabilities (Banca d'Italia, 2012; International Monetary Fund, 2013). Moreover, in recent years, the strong tensions in euro-area government bond markets may have pushed firms towards long-term funding in order to avoid liquidity constraints from potential credit rationing.[12]

[12]For an account of the relative incidence of demand and supply factors in explaining the contraction in bank lending in Italy in recent years, see Del Giovane, Eramo and Nobili (2011).

Also the share of debt securities on total financial debt[13] has significantly increased over the years (from 3.1 per cent in 1995 to 12.3 per cent in 2014; Banca d'Italia, 2015b), in particular doubling after the outbreak of the global financial crisis, even though it still represents a very small share of total long-term liabilities. This evidence suggests that the contraction in bank lending that has occurred in Italy since 2008 encouraged corporations to diversify their sources of finance. Data on individual firms reveal, however, that this larger recourse to bond markets was mainly on the part of medium and large firms, as smaller firms continued to rely mainly on bank lending.

In summary, for non-financial corporations, the increase of long-term loans and bond share, together with the stationary "Share and other equity" component, led to an overall increase of long-term instruments on total liabilities from 56.4 per cent during the 1995–1999 period to almost 68.2 per cent in 2008–2015.

Finally, households' investment financing coincides with long-term loans, currently representing nearly 70 per cent of total liabilities (Table 6), as households do not issue shares and bonds.[14] Long-term loans are mainly driven by transactions, because "other changes" normally play a negligible role for this kind of instrument.

Looking at the dynamics of long-term loans three phases stand out (Figure 10): sustained growth during the 2001–07 period; a slowdown starting in 2008, and a decline since 2011. The levelling off of Italian household debt since the global financial crisis mainly reflects the impact of the prolonged period of weakness of the domestic economy. As a ratio to disposable income, at the end of 2015 long-term loans stood at 62.9 per cent, a much lower level than the euro-area average (96.0 per cent; Banca d'Italia 2015a).

[13]Total financial debt corresponds to the sum of loans and debt securities. In particular, long-term debt securities almost coincide with the total in that short-term debt securities are negligible.

[14]Note that according to SNA2008/ESA2010 there is still no clear definition of unincorporated enterprises, which fall into the household category, implying that there may be differences between countries in the definition of this sub-sector. In the Italian case, they are defined as all enterprises with no more than five employees.

Table 6: Households' total liabilities: composition by financial instrument

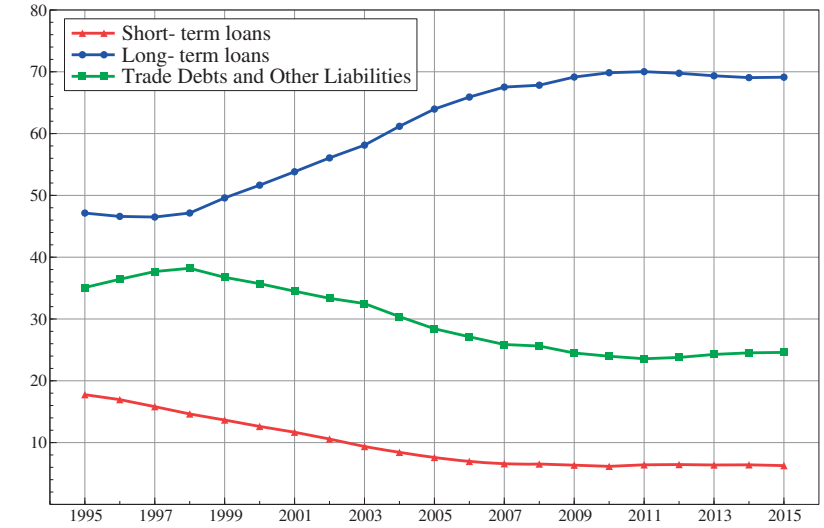
(percentage shares on current prices, market value)

	Short-term loans	Long-term loans	Trade debts and other liabilities
1995–1999	15.8	47.4	36.8
2000–2007	9.2	59.8	31.0
2008–2015	6.4	69.5	24.1

Source: Banca d'Italia.

Figure 10: Households' long-term liabilities: trends by financial instrument

(percentage shares on current prices, market value)



Source: Banca d'Italia.

It is worth remembering that long-term loans can be considered as a proxy of households' investment activity but it is not possible, at this stage, to distinguish across subsectors whose funding have different purposes. In other words, long-term loans related to households owning a dwelling usually correspond to residential investment, while this is not the case for unincorporated enterprises of households or NPISHs, which typically

request long-term funding to invest in their own economic activity. Therefore, even though the former households are the most representative subsector, we cannot say *a priori* how much they contribute to investment financing.

4 Conclusions and indications for complementary analysis

In this paper we have described the main trends in investment expenditure and long-term investment financing in Italy since 1995. We have only considered indicators at the macro level that are based on official economic or financial national accounts data (see Table A2 in the Appendix for an overview of the indicators we analysed). This choice was made in order to favour comparability with similar analyses produced by other countries, at the cost however of being constrained in terms of available information.

Medium-term gross fixed capital formation trends in Italy may be summarised along the following lines. The pre-2007 capital expansion was broad-based, both across institutional sectors and asset categories, although less marked for households; similarly, the exceptional downturn thereafter affected all sectors and components, yet to a different extent. In particular, focusing on the most recent period, the decline in general government and non-financial corporations' expenditure, cumulatively undertaking about two thirds of total investment in Italy, was sizable (approximately 25 per cent), yet slightly more contained than the concurrent drop in household investment spending. The total-economy investment rate in Italy currently stands at its lowest levels since data became available in the mid-1990s; current government and non-financial corporation investment rates are comparable only to those recorded in 1995; the household rate is even lower. From the asset side, in recent years construction investment, in both residential dwellings and non-residential buildings, which represents half of total expenditure, was the hardest-hit item, whereas ICT investment and the accumulation of intangible assets weathered the recent double-dip recession better. This fact entails some key policy implications given

that construction represents one of the Italian economy's most important items and plays a fundamental role for the recovery.

Regarding Italian gross fixed capital formation data, two issues stand out. The first concerns the fact that official institutional sector accounts are expressed at current prices, when in fact price movements of investment goods can be non-negligible and are differentiated across capital products, affecting medium-term trends. For example, the decline in ICT prices is a well-known stylised fact in many advanced economies, interrupted in Italy only by the global financial crisis. This leads to the need to assess suitable deflators for institutional sector accounts – an attempt that was made in this paper – to allow for an analysis of both nominal and real developments in institutional sector investment. The second issue concerns the lack of official and publicly available data broken down by both institutional sector and asset type (with the exception of general government accounts), which are useful to design policy incentives correctly. For instance, on the basis of our calculations, only some disaggregated trends were common to most sectors, such as the better-than-average performance of ICT investment or the large current investment gap in non-residential construction. Conversely, the recent drag on transport equipment mainly stemmed from the non-financial corporation sector. Finally, the breakdown by asset and by sector of economic activity, which we used to deflate the official current-price series, is only available with a sizable delay (up to 21 months) after the end of the reference year, therefore preventing timely analyses.

Our analysis of the main developments in investment financing in Italy drew on financial accounts' data, which provide information on stocks and flows of assets and liabilities classified by institutional sector and financial instrument, where the latter are also broken down by maturity at issue. As such, they can serve as a proxy for finance directed to investment projects, although institutional sectors may employ these financial resources for different purposes. A cross-correlation analysis however points to a satisfying statistical

relationship between gross fixed capital formation and long-term financial liabilities, at least for households and non-financial corporations.

The financial liabilities that are usually associated with investment activity (termed "long-term liabilities") since 1995 displayed an upward trend for all institutional sectors, which came to a halt after the outbreak of the global financial crisis. Focusing on the developments in long-term liabilities of the main investor sectors, a break in 2008 is particularly evident both for non-financial corporations and households. For non-financial corporations, the largest component of long-term liabilities is equity, which accounts for more than 40 percent of the total. Households' investment financing basically coincides with long-term loans, as even the micro enterprises included in this sector cannot issue shares and bonds.

A glance at the composition of the stock of total long-term liabilities provides further interesting insights. First, long-term loans to non-financial corporations have become increasingly important, crowding out the short-term counterparts. Second, in spite of the fact that the issuance of debt securities still represents only a small part of non-financial corporations' total long-term liabilities, its weight has increased significantly, especially after 2008, although we know from firm-level data that the greater recourse to bond markets almost exclusively involved large companies.

There are at least three challenges concerning Italy's investment financing data, which we leave for future research. As mentioned earlier, long-term liabilities taken from financial accounts are not necessarily directed to investment. Hence, it is not possible to identify unambiguously a direct link between financing and investment, based solely on these data. A finer matching of investment and investment financing data would be warranted, although difficult to attain, given data constraints. However, the use of long-term liabilities as a proxy of long-term investment financing may not be such a restrictive assumption after all, as we provide evidence that the growth rate in non-financial corporations' and

households' investment is positively and significantly correlated to the lagged change in the same sector's long-term liability flows, which is encouraging.

Secondly, another type of data that we did not use in this analysis and that could be particularly informative, also for conducting international comparisons, is survey-based information. Surveys such as the Bank Lending Survey (BLS) and the Survey on the access to finance of enterprises (SAFE) conducted by the European Central Bank, as well as the Investment Survey coordinated by the European Commission, provide important information on both bank lending (which is known to be a significant source of funding for investment, especially for small and medium-sized Italian firms) and corporate investment as well as its determinants. These surveys have the advantage of referring not only to banks and firms in one single European country, but to those of all euro-area or European Union countries. Moreover, they allow to explore issues related to both sides of the markets (demand and supply), including episodes of tightening in the supply of credit and credit rationing.

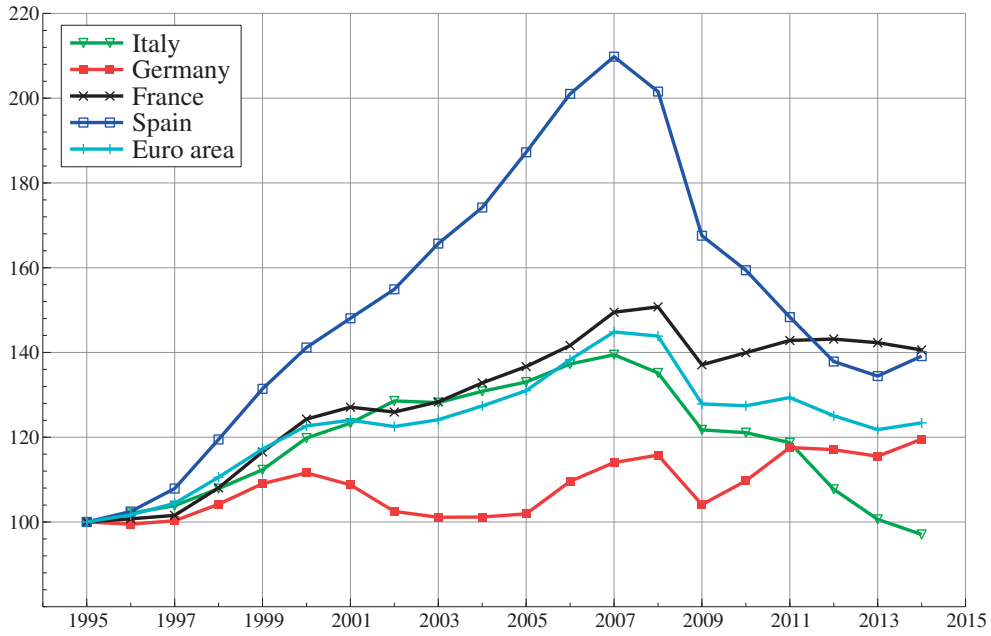
Finally, while data at the macro level give an accurate indication of the size and trend of the phenomena, they are not able to capture heterogeneity at the level of individual firms, households or financial instruments and markets. A case in point are the small and medium-sized enterprises (SMEs), for which the official national accounts data we have used in this paper do not offer any insights, including, in particular, on the existence of funding gaps.

In conclusion, in future research it may also be useful to investigate the availability of comparable survey and firm-level data at an international level, in order to complement official indicators at the macro level with qualitative, but often more timely, information and with more granular data.

Appendix A Additional figures and tables

Figure A.1: Total gross fixed capital formation in the four largest euro-area countries

(indices 1995=100; chain-linked volumes)

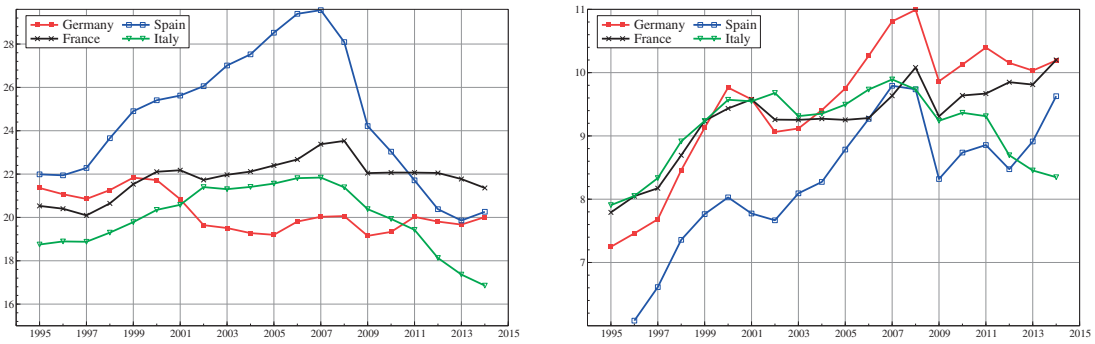


Sources: Istat and Eurostat.

Figure A.2: Total and non-construction gross investment rates in the four largest euro-area countries

(ratio of total investment to GDP at constant market prices, computed using chain-linked volumes)

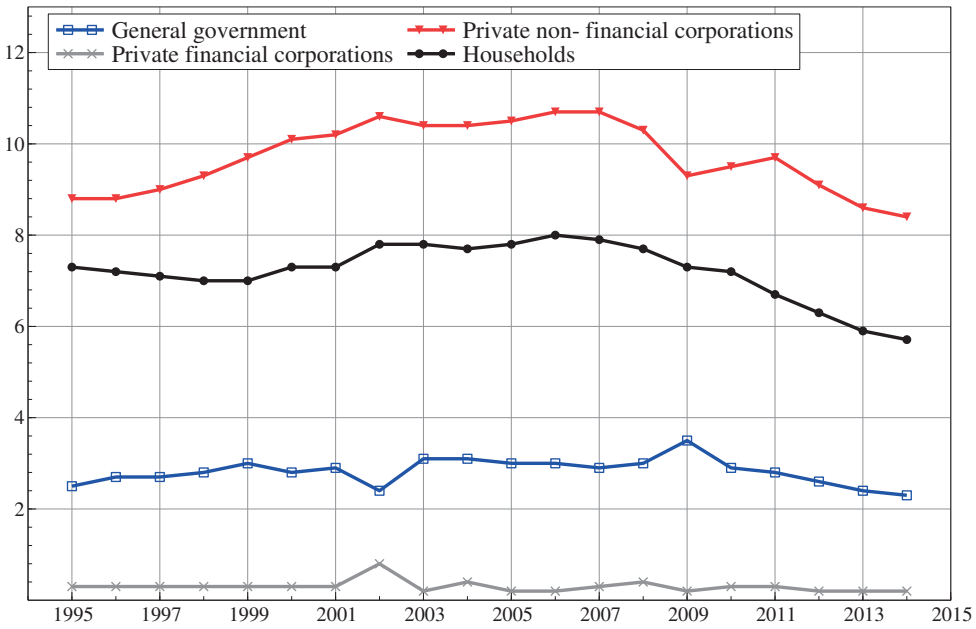
Total **Total net of construction**



Source: Busetti, Giordano and Zevi (2016).

Figure A.3: Total investment rates: trends by institutional sector

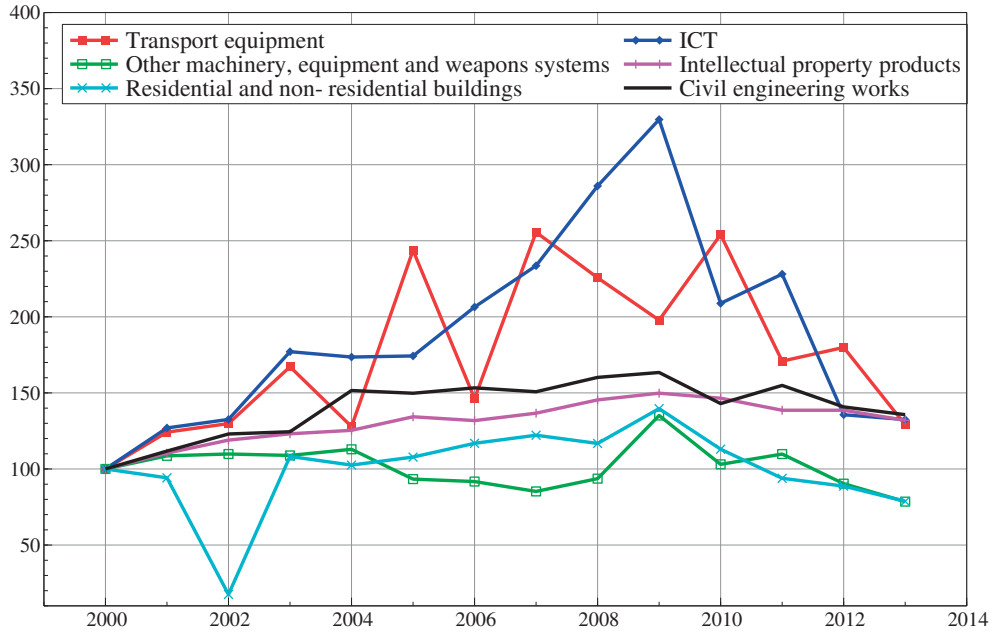
(ratio of total investment to GDP at constant market prices, computed using chain-linked volumes)



Source: based on Istat data.

Figure A.4: General government fixed capital formation: trends by asset type (detailed breakdown)

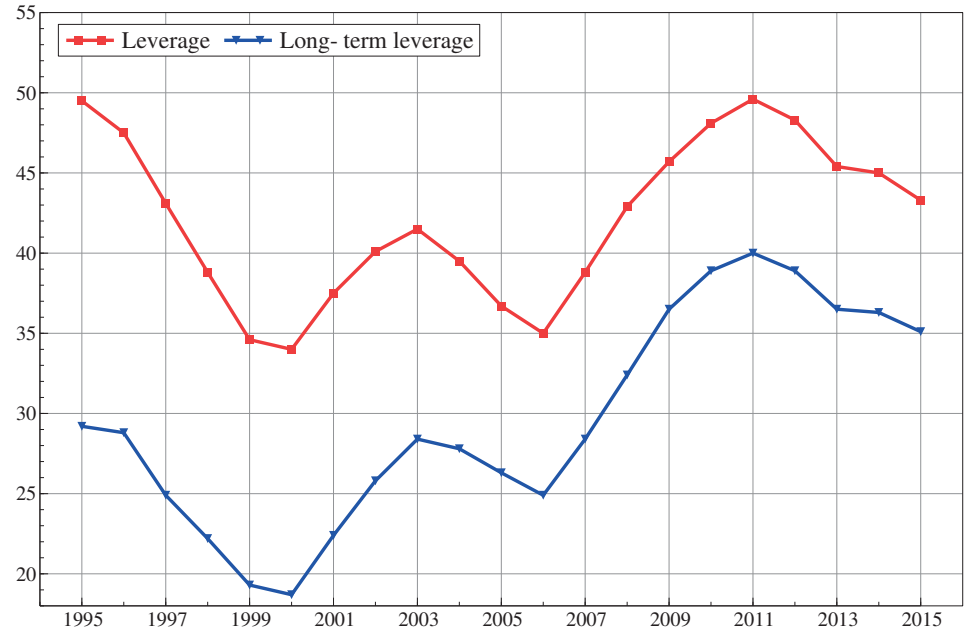
(current prices; indices 2000=100)



Source: based on Istat data.

Figure A.5: Non-financial firms' leverage: total and long-term component trends

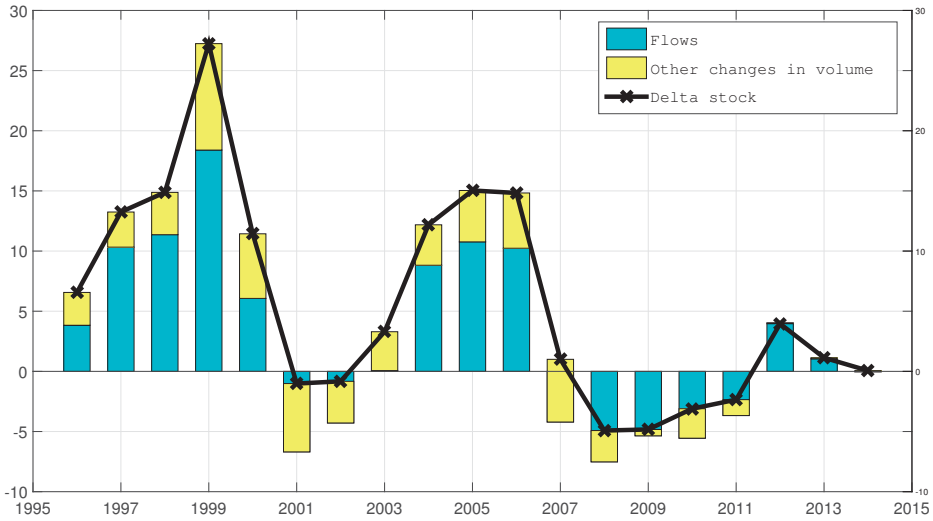
(ratio of bonds and loans to total financial liabilities; percentage shares)



Source: based on Banca d'Italia data.

Figure A.6: Non-financial corporations long-term liabilities: growth decomposition

(percentage changes)



Source: based on Banca d'Italia data.

Table A1: Percentage shares of Monetary Financial Institutions' loans in total non-financial corporations' debt

	DE	FR	IT	ES
Average Q1 2000 – Q2 2008	50.2	39.6	60.4	58.3
Average Q3 2008 – Q4 2012	46.9	39.2	62.2	59.6
Q4 2012 only	45.5	37.0	62.8	51.5

Source: ECB (2014).

Table A2: A summary of the indicators reviewed

Indicator	Definition and evaluation
1. Gross fixed capital formation (GFCF)	
a) GFCF by institutional sector	Current and constant prices (1)
b) Investment rate by institutional sector	Ratio of investment by institutional sector to GDP; current and constant prices (1)
c) GFCF by asset type	Current and constant prices (1)
d) GFCF by institutional sector and asset type	Current and constant prices (1)
2. Investment financing	
a) Long-term liabilities (long-term loans, long-term bonds, shares and other equity)	Market prices (except for assets for which there is no secondary market: these are included at face value)
b) Long-term liabilities by institutional sector	
c) Long-term liabilities by institutional sector and financial instrument	
d) General government's long term bonds by holders	

Notes to the table: (1) Constant prices are estimated by the authors.

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