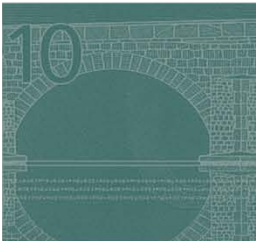
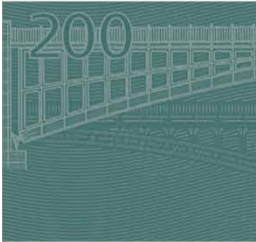




EUROPEAN CENTRAL BANK

EUROSYSTEM



COMPNET POLICY BRIEF NO 7

A MICRO-BASED LOOK AT THE EVOLUTION OF INVESTMENT OVER THE GREAT RECESSION

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CompNet The Competitiveness Research Network



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The objective of CompNet is to develop a more consistent analytical framework for assessing competitiveness, one which allows for a better correspondence between determinants and outcomes.

The research is carried out in three workstreams: 1) Aggregate Measures of Competitiveness; 2) Firm Level; 3) Global Value Chains. CompNet is chaired by Filippo di Mauro (ECB). The three workstreams are headed respectively by Chiara Osbat (ECB), Antoine Berthou (Banque de France) and João Amador (Banco de Portugal). Julia Fritz (ECB) is responsible for the CompNet Secretariat.

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ABSTRACT

Due to high heterogeneity at the firm level, aggregate indicators might deliver misleading information. A novel dataset containing firm-level data (CompNet) is used to complement previous analysis of weak investment over the Euro area. We find that the raise in credit constraints affected disproportionately low-productive firms, whereas low profitability hampered investment of the most productive firms.

INTRODUCTION

Widely used country-level indicators show that investment performance in the Euro area has been sluggish in recent years. The trend seems consistent across a variety of sources.¹ However, aggregate investment data alone do not provide clear patterns from which it is possible to infer the reasons behind such a weak investment performance. At a more disaggregate level, sectorial data reveal that investment has not only dropped in all countries, but also rather consistently across all sectors.² As a consequence, sectorial developments do not seem to be the only drivers of investment over the recent years.

Against this background, a more disaggregated analysis, considering firms split by productivity or firm size within a given sector, might help shedding some light on this issue. We use a novel dataset containing firm-based information, provided by the Competitiveness Research Network (CompNet).³ The standard motivation for the use of firm level information is that aggregate indicators alone, when interpreted as if they had been generated by the behaviour of a representative firm, may be misinterpreted.

The reason is that when heterogeneity is large at the firm level (as documented in Caves 1998, Bartelsman and Doms 2000), aggregate performance depends jointly on firm-level decisions (on factor inputs, innovation and technological capacity or export strategy) as well as on market environment (macro wage and price dynamics, structural framework conditions and financial market developments). In these circumstances, drivers of aggregate variables, such as investment must be evaluated with due knowledge of the underlying distribution across firms of the variable of interest.

The relevance of firm's heterogeneity can be appreciated in Annex 3, where among other trends, it is shown that in all countries and for most sectors prior to the crisis, the investment ratio⁴ of the top productive firms is larger than for least productive firms. Most importantly in this context, investment has not dropped equally across all firms operating in a given sector but mostly in low productive firms.

¹ See Annex 1 for a comparison of aggregate investment across different databases including our novel database, CompNet.

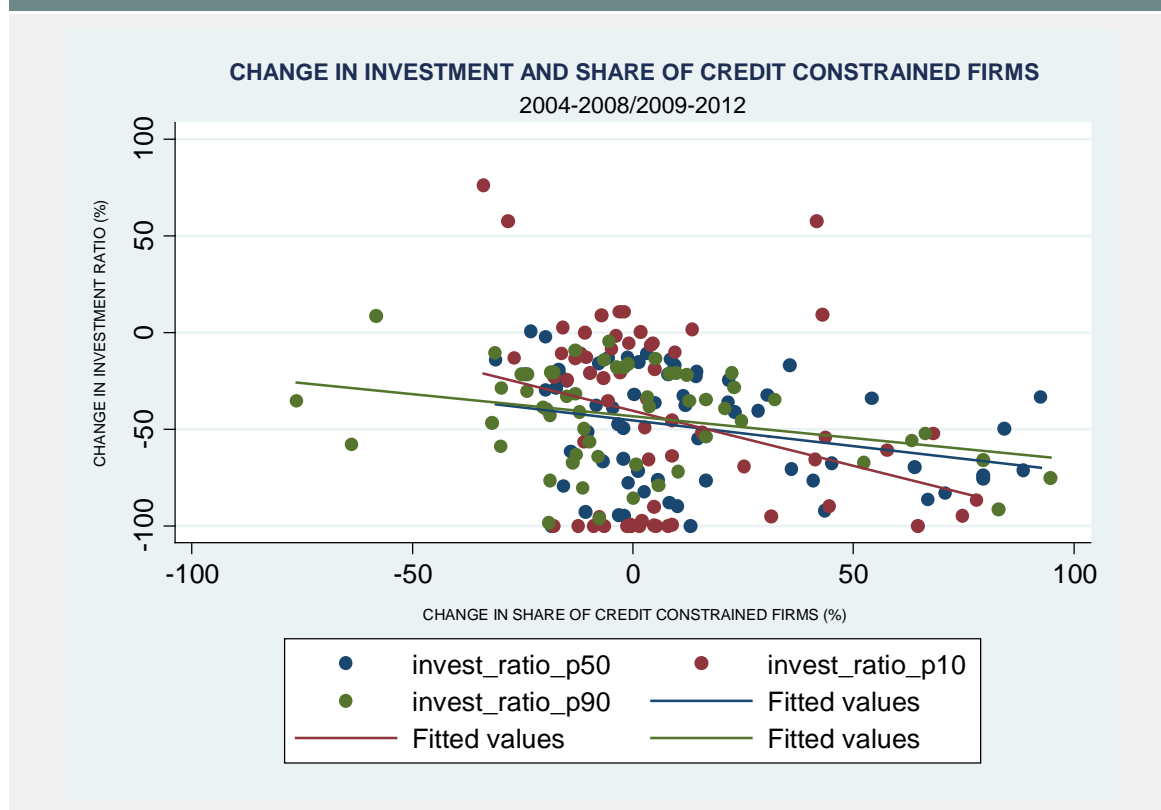
² Annex 2 develops the analysis at the sectorial level.

³ The micro-based database compiled by CompNet includes very rich information on several indicators of the financial position of firms, investment and return on assets among them, as well as the interaction with the firm's productivity and size, aggregated at the sector level. The data has been collected for 17 countries (13 Euro Area) and covers all private non-financial sectors over the period 1995-2012. For more information on the database, see Lopez-Garcia, di Mauro and the CompNet Task Force (2015).

⁴ Defined as the annual growth rate in the fixed assets net of depreciation.

That heterogeneity matters can also be seen by looking at the correlation between investment and the share of credit constrained firms. Figure 1 shows that **while investment appears to be negatively correlated with financial constraints in all firms, this is particularly the case for the least productive ones (red line), as compared to firms in the median productivity distribution (blue line) and most productive (green line).**

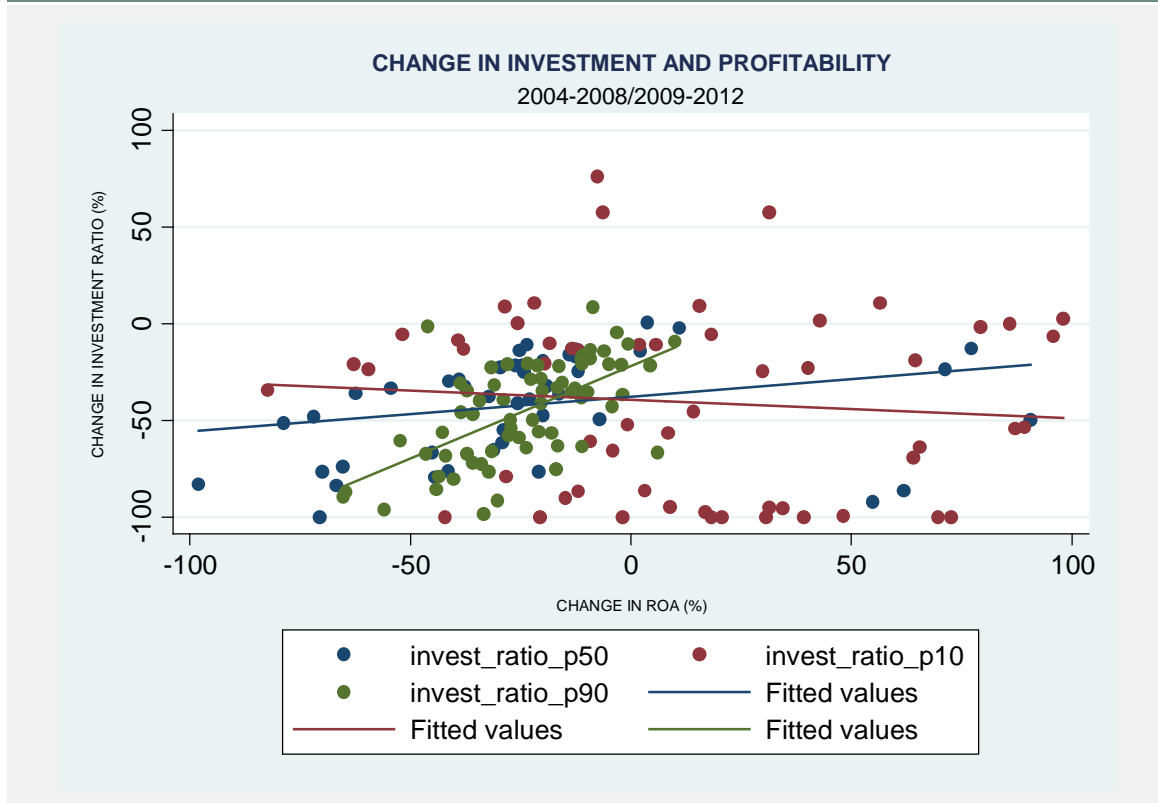
Figure 1 Change in investment and credit constraints between the pre-crisis (2004–2008) and the crisis period (2009–2012); bottom, median and top productive firms in each of the 9 macro-sectors. Firms with at least 1 employee.



Similarly, Figure 2 shows the (unconditional) correlation between the change in profitability – as proxied by the return on assets (ROA) and investment between the pre-crisis and the crisis period, again considering the least, median and most productive firms in a given macro-sector. The figure shows that the correlation between **profitability and investments is positive for firms placed in upper half of the productivity distribution (blue and green lines), with different magnitude. However, the correlation between profitability and investment is quite different for low productive firms (red line).**⁵

⁵ These are unconditional charts and therefore they should not be interpreted as showing causal relations.

Figure 2 Change in investment ratios and profitability between the pre-crisis (2004–2008) and the crisis period (2009–2012); bottom, median and top productive firms in each of the 9 macro-sectors. Firms with at least 1 employee.



Figures 1 and 2 together suggest that credit constraints hamper investment disproportionately more in low productive firms, while the most productive ones are more sensitive to changes in profitability. However, in order to assess the impact of both determinants on investment we need to control for other possible factors, which is what the next section does.

INVESTMENT, CREDIT CONSTRAINTS AND PROFITABILITY: DIFFERENCES ACROSS PRODUCTIVITY DISTRIBUTIONS

In this section, we explore possible differences in the factors associated to the observed drop of investment between high and low productivity firms. In particular, we are interested in determining whether financial constraints – measured by the share of credit constrained firms⁶ - and profitability - which is proxied by the return on assets -, played different roles for different categories of firms.

Given the differences in the developments of top and bottom productive firms exposed in the previous section, we perform a more accurate analysis considering average investment in the sector but also investment of the top and the bottom productive. We use data from 7 countries⁷, 9 one digit industries (from NACE rev.2) covering all non-financial private sectors, and 13 years (2000-2012).

We run a reduced form regression where the dependent variable is the y-o-y change in the sector investment ratio. Independent variables capture sector specific developments, external demand and, finally, access to credit conditions and profitability. Access to credit conditions is approximated by the Indicator of Credit Constraints (ICC) constructed at the firm level by CompNet using information on credit constraints from the ECB SAFE survey matched with balance sheet information of the sampled firms.⁸ To proxy profitability, we use the return on assets (ROA), measured as operating profits/loss over total assets.

We estimate equation (1) below in first differences, which, like the fixed-effect estimation, removes country and sector time-invariant effects by differencing adjacent observations. In order to allow for serial correlation of the error terms, we cluster residuals at the country-by-sector level.

The estimated model is as follows:

$$\begin{aligned} \Delta Inv_{cspt} = & \beta_1 \Delta EMP_{cst} + \beta_2 \Delta EXP_{ct} + \beta_3 \Delta CC_{cspt} + \beta_4 \Delta ROA_{cspt} \\ & + \beta_5 (\Delta ROA_{cspt} \times D_{crisis}) + \beta_6 (\Delta CC_{cspt} \times D_{crisis}) + u_{cspt} \end{aligned} \quad (1)$$

ΔInv_{cspt} refers to change in the investment ratio in country c, sector s, percentile p and time t/t-1; ΔEMP_{cst} refers to the change between t and t-1 of employment of sector s in country c and is the proxy for change in sector demand conditions; ΔEXP_{ct} refers to the change in aggregate exports of goods and

⁶ The CompNet Indicator of Credit Constraints (ICC) uses firms' financial conditions (e.g. leverage, profits, collateral or cash holdings) to assess whether the firm has high probability of being financially constrained. It is calibrated on a novel dataset available at ECB, matching the answers to the SAFE survey to firms' financial statements. See Lopez-Garcia, di Mauro and the CompNet Task Force (2015).

⁷ Countries with complete data for firms with at least 1 employee (that is, including small firms). They are: Belgium, Estonia, Germany, Italy, Lithuania, Slovenia and Spain.

⁸ Elasticities of each of the relevant items of the firm's balance sheet, as well as firm size, are estimated and then used to predict the probability that a given firm in the CompNet sample, with a certain financial position and size, will be credit constrained. The share of credit constrained firms in each sector is then computed as the share of firms with an indicator above a country-specific threshold. For more details refer to Lopez-Garcia, di Mauro and the CompNet Task Force (2015).

services of country c (data from National Accounts, Eurostat); ΔICC_{cspt} and ΔROA_{cspt} refer to the change in the share of credit constrained firms and the return on assets in country c , sector s , percentile p and time $t/t-1$. Variables D_{crisis} is a dummy variables taking value one after 2008. Finally, u_{cspt} represents the error term.⁹

Table 1 shows the results of our estimation exercise. We start by considering average investment in the sector (column 1). In normal times, credit constrains seems not to affect aggregate investment, which, instead, responds to profitability, and to a less extent to cyclical fluctuation of export. Moreover, the positive correlation between profitability and investment growth becomes stronger during the crisis.

Columns 2 and 3 consider the change of investment of bottom 10% productive firms in the sector and change of investment of top 10% productive firms.

The model estimated in column 2 reveals that the least productive firms in sectors with a high share of credit constrained firms have experienced lower than average investment growth. Unlike in our aggregate specification, the coefficient of the change in ROA is not significant for low productive firms.

The last specification (column 3), focuses on the most productive firms. Consistent with intuition, profitability and investment are positively and significantly correlated. Unlike with low productive ones, investment of firms in the 90th percentile of the productivity distribution is not significantly correlated with credit constrains.

⁹ It is important to keep in mind the purely descriptive nature of the following regressions, as in this setting it is virtually impossible to control for all the relevant variables. Therefore, all it can be said about the following relationships is whether our variables are found to be significantly correlated.

Table 1 Regression results. OLS regression in differences of investment ratio (growth rate of tangible assets). For each country, sector and year we have information on the distribution of the data, which allows us to look at the average, but also the top and bottom percentiles of the productivity distribution.

<i>VARIABLES</i>	(1) <i>change in aggregate investment</i>	(2) <i>change in investment bottom productive</i>	(3) <i>change in investment top productive</i>
change in credit constraint (CC)	0.2759 (0.2228)	-0.2284*** (0.0832)	-0.1248 (0.1744)
change in ROA	1.5290*** (0.2776)	-0.0638 (0.1239)	1.0381*** (0.1659)
change in CC x crisis	-0.0244 (0.3707)	0.1146 (0.1074)	0.2906 (0.2174)
change in ROA x crisis	0.6456* (0.3385)	0.0782 (0.1848)	0.2959 (0.2247)
change in sectorial employment	0.0000 (0.0000)	-0.0000 (0.0000)	0.0000 (0.0000)
change in aggregate export	0.0003*** (0.0001)	0.0002*** (0.0000)	0.0003*** (0.0001)
Constant	-0.0076*** (0.0014)	-0.0056*** (0.0018)	-0.0100*** (0.0019)
<i>Observations</i>	556	540	542
<i>R-squared</i>	0.4620	0.0514	0.2630
<i>r2_a</i>	0.456	0.0407	0.255

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

CONCLUSIONS

Using the novel micro-based CompNet database we are able to gain relevant insights with respect to standard macro analysis on drivers of investment. Our contribution is to highlight that least productive firms – as opposed to the most productive ones – appear to be affected by a different set of factors as their respective investment activity is concerned.

More specifically, according to our simple model, changes in investment growth rates are correlated with variation in profitability in top-productivity firms and with increase of credit constraints in the least productive ones.

As already emphasized, these regressions should not be interpreted as offering a causal interpretation, particularly because the chosen specifications are admittedly over simplistic and they are likely to omit several important controls.

The objective of this note is rather to show that standard aggregate indicators mask important heterogeneity at the firm level and therefore they can be seriously misleading. Thanks to CompNet data, we are able to disentangle these differences in terms of investment behaviour. Therefore, in addition to providing insights on the determinant of investment at the firm level, this note intends to promote a more extensive use of micro data.

APPENDIX I - COMPARISON WITH OTHER MICRO AND MACRO DATASOURCES

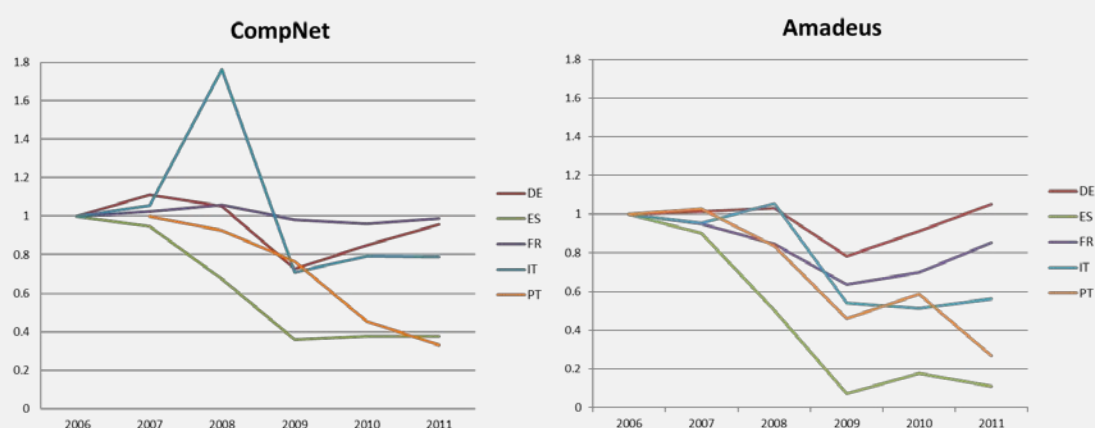
Figure A.1 shows the dynamics of investment across the selected countries between 2006 and 2012. The figure compares trends from two different types of sources. The first one (Panel A) is micro-based whereas the second one (Panel B) is aggregate (National Accounts, Eurostat). We show investment from two firm-level databases: CompNet and Amadeus. In both cases we track mean private investment, after pooling together firms with at least 20 employees.

Panel B shows, for the same countries and period, the evolution of the aggregate investment rate extracted from National Accounts and defined as gross fixed capital formation over value added of non-financial corporations.¹⁰

Overall, Figure 1 shows that investment dynamics across databases are rather similar, although the two micro-based datasets record a larger drop at the peak of the trade collapse in 2009 with respect to Eurostat.

Figure A1 Investment ratio, all firms with at least 20 employees. CompNet and Amadeus

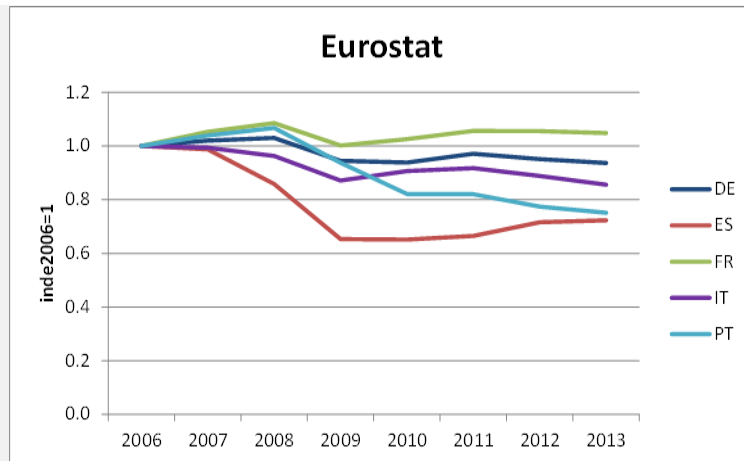
PANEL A: Firm-level data



Source: CompNet micro-based database, 20E sample, and Amadeus.

PANEL B: National Accounts

¹⁰ Note that aggregate investment is gross while the firm-level based indicator of investment is net of depreciation. The reference variable is also different across databases: capital stock in the firm-level case and aggregate value added in the case of Eurostat; hence the different magnitude of the drop. In any case, the dynamics shown by both sources of firm-level data are extremely similar.



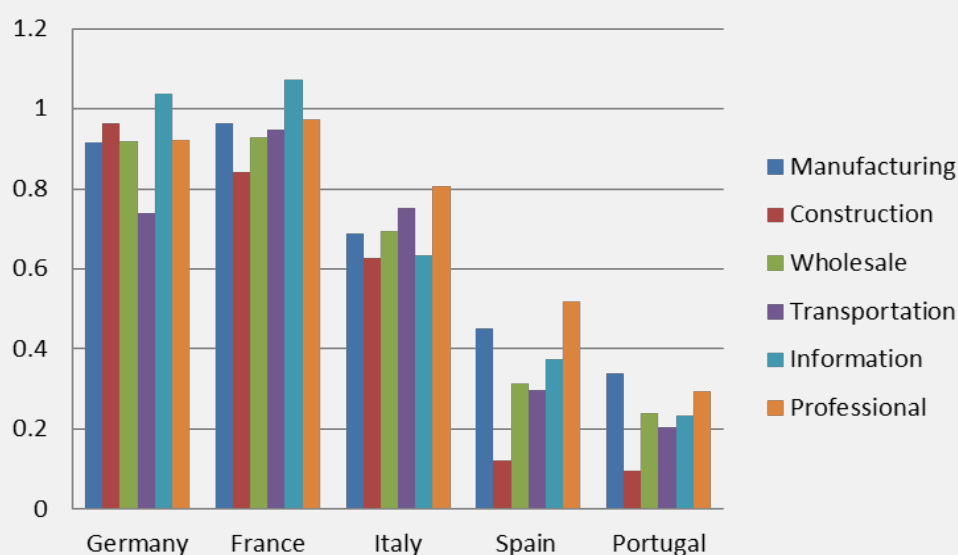
Source: Eurostat.

According to CompNet data, the largest cumulative drop in the investment ratio (from 2006 to 2012) took place in Spain and Portugal, amounting to -68% and -77% respectively. The contraction of the investment ratio was somewhat milder for Italy (-28%). On the other side of the spectrum, Germany and France's investment was in 2012 almost back at their 2006 level.

APPENDIX II - SECTORIAL ANALYSIS OF INVESTMENT

In order to investigate whether such aggregate developments are driven by any specific sector, Figure 2 shows the investment ratio in 2012, relative to the pre-crisis level (in 2006), in 6 macro-sectors of the economy¹¹ across the 5 European countries mentioned above: Germany, France (where investment has recovered the pre-crisis level), Italy (investment has recovered somehow but is still below the pre-crisis level) and Spain and Portugal (investment is still well below the pre-crisis level). The analysis is carried out with data from CompNet and refers to all firms with at least 20 employees operating in the selected sectors.¹²

Figure A2 Investment ratio by sector in 2012 relative to 2006 level; selected countries



Source: CompNet micro-based database, 20E sample.

Investment appears to have dropped for all countries and rather consistently across the sectors considered in Spain and Portugal (although to a larger extent in construction, as expected). Information and communications is the only sector featuring in 2012 a higher level than the one in 2006, although only in Germany and France. Figure 2 shows that the slow recovery of investment is not driven by any particular sector but it is rather a country story.

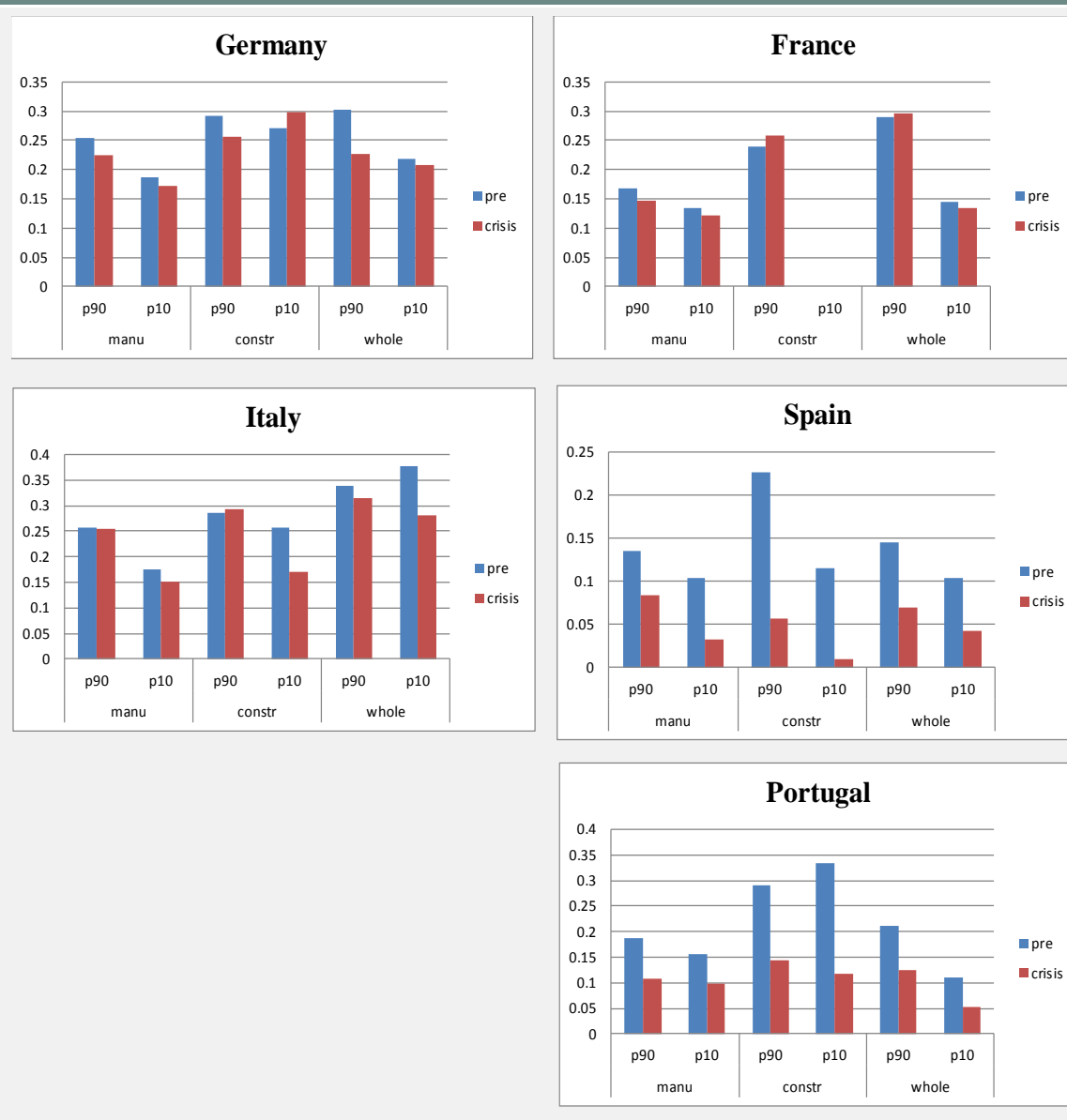
¹¹ Manufacturing, construction, wholesale and retail trade, transportation, information and communication and professional activities.

¹² Amadeus has an over-representation of manufacturing firms (see Annex 3). Hence it is preferable to carry out the sector analysis with CompNet data.

APPENDIX III - INVESTMENT DYNAMICS IN FIRMS AT DIFFERENT TAILS OF THE PRODUCTIVITY DISTRIBUTION

The novel CompNet dataset allows exploring how investment developments relates to relevant covariates, for instance firms' productivity (Figure A.3) and firms' size (Figure A.4).

Figure A.3 Investment rate, pre-crisis and crisis; top (p90) and bottom (p10) productive firms in each sector with at least 20 employees.¹³

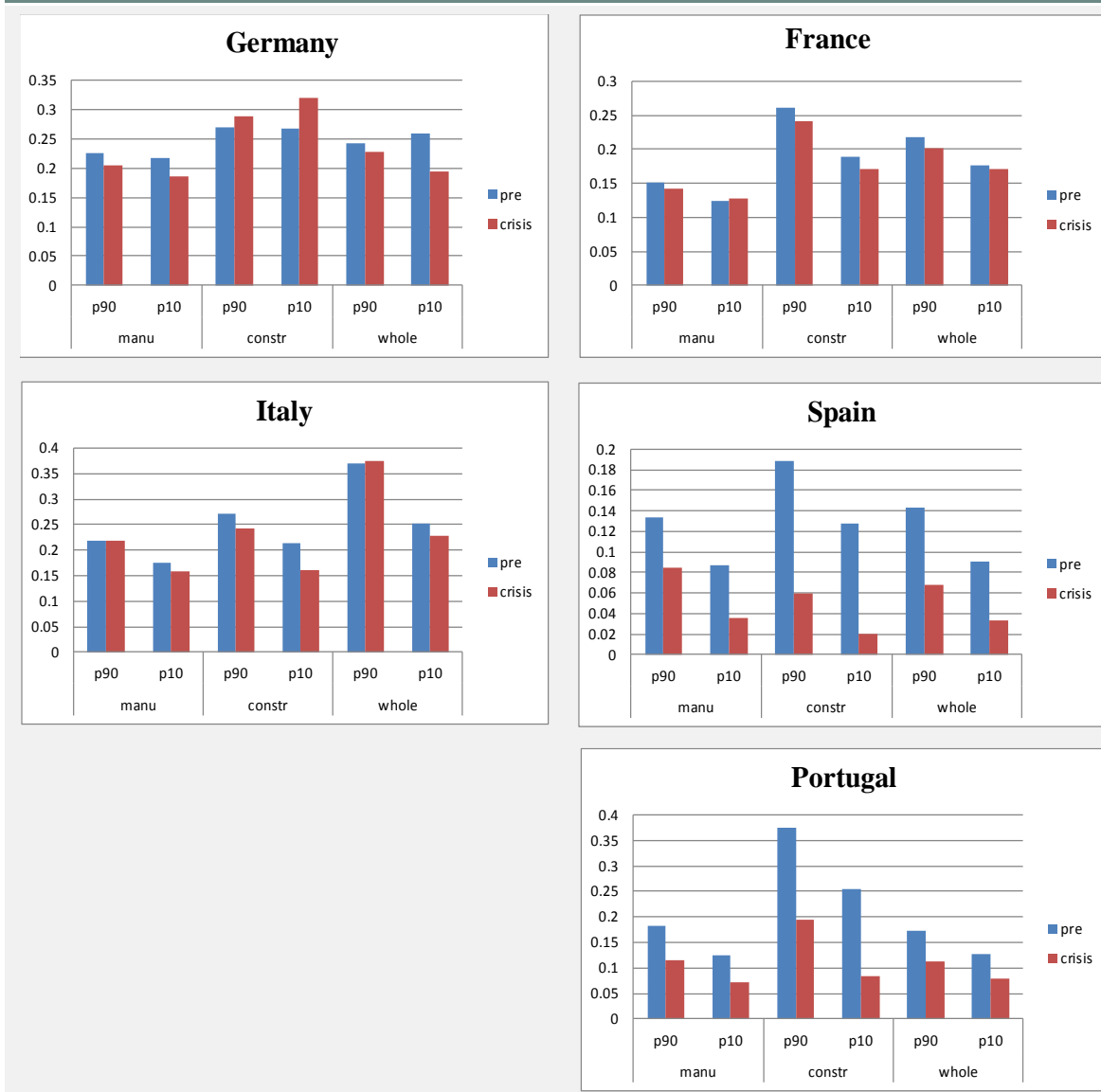


¹³ France has not reported data for the least productive firms (bottom 10%). We consider 3 sectors (manufacturing, construction and one service sector, namely wholesale and retail trade) and the 5 countries analysed previously. The chart shows the average investment rate of firms with at least 20 employees during the pre-crisis period (2004-2008) and the crisis period (2009-2012)

Starting with the interaction with productivity, the following findings are worth mentioning:

- 1) In all countries, prior to the crisis, the investment ratio of the top productive firms is larger than for least productive firms. There are only two exceptions: the wholesale and retail trade sector in Italy and the construction sector in Portugal. The case of Portugal could reflect the building up of inefficiencies during the housing boom, including widespread credit facility not necessarily linked to the productivity of the firm.
- 2) In Spain and Portugal the sharp drop in investment takes place for both most and least productive firms.

Figure A.4a Investment rate, pre-crisis and crisis; top (p90) and bottom (p10) firms in terms of firm size; firms with at least 20 employees.



The picture is rather similar if we split firms, within each macro-sector, by size rather than productivity, which confirm the well-known stylised fact that the largest firms are the most productive.

Finally, the next chart shows Figure A.4 but considering all firms with at least 1 employee. Note that the cross-country comparability of the sample of firms with at least 20 employees is much higher than the comparability of the sample including the smallest firms, particularly in the case of Germany. Besides, France does not provide information for firms with less than 20 employees.

Figure A.4b Investment rate, pre-crisis and crisis; top (p90) and bottom (p10) productive firms with at least 1 employee



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