



Cash Holdings of Listed Companies in the Eurozone: Evidence Pre- and Post-Crisis

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Abstract

The purpose of this study is to investigate whether the cash holdings of Eurozone public companies increase after the most recent financial crisis beginning in 2008, compared to the pre-crisis period. Different hypotheses are formulated involving cash holdings and their determinants using a sample of listed companies from 11 Euro-adhering countries by 2001. To test those hypotheses, we apply different panel and cross-section data methodologies. Contrary to the evidence provided by previous studies, our results show that, on average, firms do not significantly increase their cash holdings in the post-crisis period compared to the pre-crisis period. However, we provide evidence that the sensitivity of cash to cash flows increase in the post-crisis period for companies from the most affected countries (Spain, Ireland, and Portugal).

Keywords: Cash Holdings, Liquidity, Financial Crisis, EuroZone, Public Firms

1. Introduction

In 2007, the subprime credit crisis, which devastated the United States (U.S.) economy and hit the financial markets worldwide, triggered a shortage of funds in the European banking system. The opaque and overpriced financial products infected banks' balance sheets, spreading those effects over the world economy (European Commission, 2009). According to Campello et al. (2010), companies feel more financially constrained when accessing external financing, namely on credit terms and conditions in the post-crisis comparing to the pre-crisis period. In some Eurozone countries, such as Portugal, Greece, and Ireland, the decline in sovereign debt rating has raised the costs of accessing to external financing (Cameron, 2010). Consequently, that financial rationing environment led to the intervention and external assistance of three International Institutions: the International Monetary Fund (IMF), the European Central Bank (ECB) and the European Commission. Therefore, our main purpose is to analyze if cash holdings of Eurozone public companies increase after the most recent financial crisis that affected Europe between 2008 and 2011. Hence, we collected a sample of companies



established in 11 Euro-adhering countries by 2001.¹ This financial crisis affected the Eurozone countries in different ways and aspects. Consistent with this view, prior research (e.g., Belkin et al., 2012) point out that the most affected countries are Greece, Ireland, Portugal, and Spain. However, while Ireland and Spain experienced a banking crisis that has spread to the economic environment, in Greece and Portugal the financial crisis quickly became an economic crisis due to the weak and fragile economic institutions. On the other side of this discussion, we have the less affected countries by financial crisis. According to De Broeck e Guscina (2011), it can be considered Germany, Austria, and Finland as the less affected countries by the financial crisis.

Based on previous evidence, we predict that companies in the most affected countries are more prone to save more cash out of cash flows, which translates in augmented sensitivity of cash to cash flow (Almeida *et al.*, 2004). Also Opler *et al.* (1999) and Bates *et al.* (2009) predicted that firms that face higher cash flows volatility tend to increase cash holdings driven by the uncertainty of the economic environment as a way to maintain the operating and investment activities in the future, which is the case of most companies from the countries most affected by the crisis. However, previous studies provide evidence of a rising in liquidity in the post-financial crisis period, such as the case of U.S. listed companies (Pinkowitz *et al.*, 2016). According to Kahle and Stulz (2013), corporate liquidity increased sharply after the *Lehman Brothers Investment Bank* collapse. Consistent with this view, Akguc and Choi (2013) document that Eurozone companies increased their cash holdings still during the crisis period, unlike companies outside of Eurozone, which decreased their cash holdings. Pinkowitz *et al.* (2016) provide evidence that Eurozone companies (for a sample of 12 countries) increased substantially their liquidity in the post-crisis period (authors consider the crisis period between 2007 and 2008 and the post-crisis period 2009-2010). However, the behavior of cash holdings is explained by some determinants. Previous literature (e.g., Pinkowitz *et al.*, 2016) point out some of those determinants, such as growth opportunities, the volatility of future cash flows, and the cost of accessing to external financing; these determinants are intrinsically related to firms' characteristics.

In contrast to the evidence provided by Pinkowitz *et al.* (2016), our results suggest that, on average, firms do not increase significantly cash holdings in the post-crisis period comparing with the pre-crisis period. Nevertheless, our findings show evidence that the cash sensitivity to cash flows of firms from the most affected countries group² (Spain, Ireland, and Portugal) increase in the post-crisis period. As far as we know, this is the first study to provide evidence about the sensitivity of cash to cash flow for Eurozone listed companies, especially, companies from the most affected countries by the most recent financial crisis.

The remaining of this study is organized as follows. Section 2 provides a review of the related literature and outlines our research hypotheses. Section 3 describes the data and the methodology. Section 4 presents the empirical results. Section 5 summarizes our main conclusions.

2. Literature Review and Research Hypotheses

Prior empirical studies provide evidence that companies hold more corporate cash, on average, in the post-crisis period (e.g., Pinkowitz *et al.*, 2016; Akguc and Choi, 2013). Pinkowitz *et al.* (2016) examine the behavior of cash holdings in the pre- and post-crisis period using a sample of 45 different countries (U.S. companies and outside U.S.) and document an increase in abnormal cash holdings in Eurozone-based companies (using a sample of 12 countries). However, the magnitude of such increase was higher in the U.S. based companies, especially in the most profitable group. Akguc and Choi (2013) analyze the differences in cash holdings between private and public firms in 33 countries across Europe during 2002 e 2011. They included emerging and developed European countries and show evidence that Eurozone-based companies, on average, hold more cash during the financial crisis. A reasonable explanation of the rise in cash holdings of Eurozone companies are the changes in the monetary policies conducted by the ECB. On the other hand, authors document that outside Eurozone companies decreased their cash holdings. Hence, Akguc e Choi (2013) point out that

¹ The Euro-adhering countries included in the sample are: Austria, Belgium, Spain, Finland, France, Greece, Italy, the Netherlands, Portugal and the Republic of Ireland. Although Luxembourg joined the Euro in 1999, the small number of observations included in the sample led to their exclusion.

² Greece was excluded from the group of the most affected by the financial crisis because, at the time of this research, Greece was still under the financial intervention of the IMF, BCE and European Commission.



public companies tend to adjust faster their cash holdings in the presence of a cash deficit than when firms have a cash surplus. Authors also highlight that in countries with stronger shareholder protection rules - the so-called Common Law countries- firms are less prone to hold cash. This argument is corroborated by Ferreira and Vilela (2004), who examine cash holdings determinants of Eurozone listed companies during the 1987-2000 period. Authors document a 15% average of cash holdings (a percentage of total assets) at the end of the year 2000.

According to Miller e Orr (1966), Opler *et al.* (1999), Ozkan and Ozkan (2004) e Custódio *et al.* (2005), increasing liquidity prevents default and bankruptcy, save transaction costs when raising funds, finance operating and investment activities when external financing sources are not available or are too costly, among other benefits. On the other hand, Kim *et al.* (1998) argue that investing in liquid assets such as cash and marketable securities is costly and the firms forgo investment opportunities in more profitable assets. Authors also point out the tax incidence on liquid assets is higher than on fixed assets. Also the free cash flow hypothesis proposed by Jensen (1986) defends a reduction in cash holdings in order to discipline managers, thus decreasing agency problems between managers and stockholders caused, mainly, by information asymmetry.

Consistent with the evidence provided by Pinkowitz *et al.* (2016), it is expected that cash holdings increase with industry cash flow volatility, market-to-book ratio, debt issuance, and equity issuance, mainly after the crisis due to precaution reasons. On the contrary, cash holdings decrease with size, cash flows, net working capital, capital expenditures, leverage, dividends payout, and acquisitions. Overall, these findings corroborate the *precautionary motive* posit by Keynes (1936), that riskier firms and firms with higher growth opportunities should hold more cash. Based on previous evidence, we formulate our first hypothesis.

Hypothesis 1: *Cash holdings of Eurozone-based companies increase in the post-crisis period relative to the pre-crisis period.*

According to prior research (e.g., Pinkowitz *et al.*, 2016), one of the main consequences of a financial crisis is an increase in corporate cash, which corroborate the precautionary motive advanced by Keynes (1936). Moreover, previous literature (e.g., Arslan *et al.*, 2006; Pinkowitz *et al.*, 2016) provides evidence about an increase in cash flows volatility and higher restrictions when accessing external funds which drive firms to increase cash holdings to maintain current and future operating and investment activities.

Arslan *et al.* (2006) analyze the effects of a severe financial crisis which took place in Turkey in the early 2000s using a sample of listed Turkish companies between 1998 and 2002 (before and after the financial crisis); results document that more financially constrained firms display higher investment sensitivity to cash flow. Their findings provide evidence that companies use internal financing to support corporate investment. Duchin *et al.* (2010) uncover similar results but using a cross-industry sample of U.S. listed firms during the most recent financial crisis. Authors document a reduction of external financing sources, as well as an increase in investment sensitivity to internal financing associated with an increase in cash holdings. Also Kahle e Stulz (2013) show evidence of a strong increase in cash holdings between 1983 and 2010 for the U.S. market; which is even stronger after the Lehman Brothers collapse. Consistent with that, Akguc and Choi (2013) for the European market and Pinkowitz *et al.* (2016) for U.S. market find similar results: an increase in cash holdings in the most affected countries by the most recent financial crisis.

Campello *et al.* (2010) survey about 1050 chief financial officers (CFOs) in companies from U.S., Europe, and Asia to investigate corporate borrowing during the financial crisis. Almost 86 percent of CFOs of U.S. financially constrained firms answered that they had to forgo investment opportunities because of the credit crisis.

Taken together, most of the previous evidence is consistent with the precautionary motive (Keynes, 1936); it is expected that the firms from the most affected countries by the financial crisis face higher uncertainty about future cash flows, which in turn drives those firms to hold more cash, preserving current and future corporate investment. Hence, we expect those firms save more cash out of cash flows, which drives to an increase of cash-to-cash flow sensitivity proposed by Almeida *et al.*(2004). This argument leads us to formulate our second hypothesis.

Hypothesis 2: *The cash-to-cash flow sensitivity should increase in firms from the most affected countries in the post-crisis period.*



3. Data and Methodology

3.1 Sample Description

This study uses a longitudinal database covering the 2001-2015 period. We collect financial data from the World scope database and market data from the DataStream. Acquisitions, equity issuance and debt issuance are from Thomson Financials Securities Data Corporation (SDC). Total assets expressed in Euros are Consumer Price Index (CPI) adjusted considering Eurozone 2010 prices, provided by the World Bank.

The period of our sample was defined according to the pre-and post-crisis period. According to the European Commission (2009), Eurozone countries felt on average the first effects of the most recent financial crisis in 2008. Following previous studies (e.g., Akguc and Choi, 2013), we extend that crisis period until 2011. Therefore, we divide our sample into different sub periods, as follows: i) following Pinkowitz *et al.* (2016), we adopt a benchmark period between 2001 and 2003; ii) before crisis period covering 2005-2007, iii) after crisis period covering 2012-2014.

We include in the sample the Eurozone-adhering countries by 2001: Germany, Austria, Belgium, Spain, Finland, France, Greece, Italy, the Netherlands, Portugal and the Republic of Ireland. We required at least two years of observations before and after the crisis. Hence, we exclude all firms from Luxembourg because they don't meet those requirements (two years of observations before and after the crisis period).

Following previous studies (e.g., Pinkowitz *et al.*, 2016), we exclude financial firms (SIC codes between 6000 and 6999) and utilities (SIC codes between 4900 and 4949). We also exclude observations that exhibit negative values in fixed assets, current assets, total assets, inventories, long-term liabilities, current liabilities, depreciation, equity, sales, and other additional variables.

In order to reduce any bias generated by outliers, all variables are winsorized at the 1 percent level in each tail.

Our final sample is an unbalanced panel data of 9744 firm-year observations, related to 1133 different firms. Table 1 describes our sample by country, including the number of observations and firms.

Table 1-Sample Description by Country

Table 1 describes the number of firms ("No. Firms") and the total number observations ("No. Observations") per country during the 2001-2015 period for a sample of listed companies from Euro-adhering countries by 2001, excluding Luxembourg. We also exclude financial firms (SIC Code 6000-6999) and strictly regulated firms (SIC Code 4900-4949).

COUNTRY	NO. FIRMS	NO. OBSERVATIONS
Germany	516	4516
Austria	21	178
Belgium	37	318
Spain	80	893
Finland	24	207
France	264	2030
Greece	40	378
Ireland	27	234
Italy	96	767
The Netherlands	18	145
Portugal	10	78
TOTAL	1133	9744



3.2 Methodology and Variables

In order to test our research hypotheses, we conduct multivariate analysis using panel data methodologies. The identification and estimation of the panel data models require previous tests to identify the correct method. Hence, we performed a Hausman test³ to decide about the most appropriate model: random effects (RE) *versus* fixed-effects (FE). The rejection of the null hypothesis (RE) suggests the FE model as the most appropriate, which means there are unobservable individual effects that must be captured (e.g., management style, location, financing structure, industry, etc.).

We also address heteroskedasticity and serial correlation problems adopting clustering technique that provides robust standard errors (Cameron and Triverdi; 2009:233). We use single cluster (by firm or country) and double cluster (by firm/year or country/year).

Following previous studies (e.g., Opler *et al.*, 1999; Bates *et al.*, 2009; Akguc and Choi, 2013), our baseline model to test the changes in cash holdings is as follows:

$$Y_{i,t} = \alpha_i + \beta'Z_{i,t-s} + \lambda_k + \eta_j + \gamma_t + \varepsilon_{it} \quad (1)$$

Where the dependent variable $Y_{i,t}$ is cash and marketable securities scaled by total assets. α_i Is the intercept that captures the unobservable heterogeneity of the individual specific effects of each firm? $\beta'Z_{i,t-s}$ is a vector of control variables, which includes: *Capex* is the ratio of capital expenditures to total assets; *Cash Flow* is net income plus depreciation and amortization expenses scaled by total assets; *Market to book* is the market value of equity plus the book value of assets minus the book value of equity scaled by the book value of total assets; *Size* is the logarithm of total assets. *Net Working Capital* is working capital minus cash and marketable securities divided by total assets; *Leverage* is total debt divided by total assets; *Industry volatility* is the standard deviation of 2-digit industry cash flows; *Dividends payout* is a dummy variable equal to one if firm i pays dividends in a given year, and zero otherwise. *Acquisitions* is an indicator variable equal to one if firm i acquires another company in a given year, and zero otherwise. *Equity issuance* is an indicator variable equal to one if firm i issue equity in a given year, and zero otherwise. *Debt issuance* is an indicator variable equal to one if firm i issue debt in a given year, and zero otherwise. We also include a set of dummies to control for country (λ_k), industry⁴ (η_j), and year (γ_t) fixed effects.

Table 2 reports descriptive statistics for all the variables described above. We observe in Table 2 that cash holdings ratio is, on average, of 0.1704, and median is 0.1078.

In Table 3 we report Pearson correlation coefficients for all variables. We observe that cash holdings (measured by cash and marketable securities) are positively correlated with market to book ratio, industry volatility, and equity issuance dummy. However, cash is negatively correlated with size, cash flows, net working capital, capital expenditures (Capex), leverage, and Dividends Payout.

Table 2-Descriptive Statistics

Table 2 provides descriptive statistics for the period 2000-2015 for a sample of listed companies from Euro-adhering countries by 2001, excluding Luxembourg. We also exclude financial firms (SIC Code 6000-6999) and strictly regulated firms (SIC Code 4900-4949) and observations with anomalies in all variables described above. Our panel set includes 1133 different firms, which corresponds to 9744 firm-year observations. *Cash* is cash and marketable securities scaled by total assets. *Market to book* measured as the market value of equity plus the book value of assets minus the book value of equity scaled by the book value of total assets. *Size* is the logarithm of total assets. *CF* is the net income plus depreciation and amortization expenses scaled by total assets. *Net Working Capital* (NWC) is working capital minus cash

³ The null hypothesis of the Hausman test is that the unobservable heterogeneity term is uncorrelated with regressors. If the null hypothesis is not rejected, there will be random effects and the model is then estimated by Generalized Least Squares. If the null hypothesis is rejected the effects are considered fixed and the model is then estimated by FE.

⁴ Classification according to Fama and French (1997) for 12 Industry Portfolios.



and marketable securities divided by total assets. *Capex* is capital expenditures scaled by total assets. *Leverage* is total debt divided by total assets. *Industry volatility (Ind. Vol)* is the standard deviation of 2-digit industry cash flows. *N* is the number of observations. Statistics are: Mean, Median, Standard Deviation (SD) Minimum (Min) and Maximum (Max).

Variables	N	Mean	Median	SD	Min	Max.
<i>Cash</i>	9744	0.1704	0.1078	0.1818	0.0004	0.8617
<i>M/B</i>	9744	1.8181	1.3321	1.4984	0.4577	10.4901
<i>Size</i>	9744	6.9429	6.6659	1.9318	4.2165	10.2679
<i>CF</i>	9362	-0.0068	0.0359	0.2095	-1.0792	0.3758
<i>NWC</i>	9466	-0.5218	-0.4989	0.2060	-0.8762	-0.2416
<i>Capex</i>	9744	0.0445	0.0263	0.0657	-0.0914	2.3401
<i>Leverage</i>	9744	0.2111	0.1880	0.1716	0.0003	0.5037
<i>Ind. Vol</i>	9742	0.1883	0.2157	0.0699	0.0799	0.3086

Table 3-Pearson Correlation Matrix

Table 3 reports the correlation matrix for the full period 2000-2015 period for a sample of listed companies from Euro-adhering countries by 2001, excluding Luxembourg. We also exclude financial firms (SIC Code 6000-6999) and strictly regulated firms (SIC Code 4900-4949) and observations with anomalies in all variables described above. Our panel set includes 1133 different firms, which corresponds to 9744 firm-year observations. *Cash* is cash and marketable securities scaled by total assets. *Market to book* measured as the market value of equity plus the book value of assets minus the book value of equity scaled by the book value of total assets. *Size* is the logarithm of total assets. *CF* is the net income plus depreciation and amortization expenses scaled by total assets. *Net Working Capital (NWC)* is working capital minus cash and marketable securities divided by total assets. *Capex* is capital expenditures scaled by total assets. *Leverage* is total debt divided by total assets. *Industry volatility (Ind. Vol)* is the standard deviation of 2-digit industry cash flows. *Acquisitions* is an indicator variable equal to one if firm *i* acquires another company in a given year, and zero otherwise. *Dividends payout* is a dummy variable equal to one if firm *i* pays dividends in a given year, and zeros otherwise. *Equity issuance* is a dummy variable equal to one if firm *i* issues equity in a given year, and zero otherwise. *Debt issuance* is a dummy variable equal to one if firm *i* issues debt in a given year, and zero otherwise. * indicates significance at least at the 10% level.



	<i>Cash</i>	<i>M/B</i>	<i>SIZE</i>	<i>CF</i>	<i>NWC</i>	<i>Capex</i>	<i>Leverage</i>	<i>Ind. Vol</i>	<i>Dividends Payout</i>	<i>Acquisitions</i>	<i>Equity Issuance</i>	<i>Debt Issuance</i>
<i>Cash</i>	1.0000											
<i>M/B</i>	0.2696*	1.0000										
<i>SIZE</i>	-0.2337*	-0.2480*	1.0000									
<i>CF</i>	-0.1410*	-0.2935*	0.3047*	1.0000								
<i>NWC</i>	-0.5306*	-0.2526*	0.2339*	0.2407*	1.0000							
<i>Capex</i>	-0.1200*	-0.0218	0.1002*	0.0461*	0.1478*	1.0000						
<i>Leverage</i>	-0.4077*	-0.1659*	0.3345*	-0.0315*	0.1799*	0.1083*	1.0000					
<i>Ind. Vol</i>	0.2409*	0.2477*	-0.3641*	-0.1922*	-0.1475*	-0.0768*	-0.2428*	1.0000				
<i>Dividends Payout</i>	-0.1170*	-0.0805*	0.4098*	0.0974*	0.1360*	0.0222*	0.1704*	-0.1880*	1.0000			
<i>Acquisitions</i>	0.0094	-0.0320*	0.0775*	0.0301*	-0.0145	-0.0173	0.0099	0.0092	0.0144	1.0000		
<i>Equity Issuance</i>	0.1496*	0.1392*	-0.0520*	-0.1339*	-0.0848*	-0.0034	-0.0626*	0.1205*	-0.0431*	0.0354*	1.0000	
<i>Debt Issuance</i>	0.0063	-0.0135	-0.0266*	0.0001	-0.0120	-0.0153	-0.0155	0.0133	-0.0306*	-0.0004	-0.0066	1.0000

4. Empirical Analysis

4.1 Univariate Analysis

This section provides a unilateral analysis of cash holdings behavior across the 2001-2015 period. Panel A, Table 4, reports three indicators of cash holdings per year: i) Mean of variable Cash (measured as cash and marketable securities scaled by total assets); ii) Median of variable Cash; iii) *Asset-Weighted Cash* (proposed by Pinkowitz *et al.*, 2016), measured as the aggregate cash scaled by aggregated total assets of all firms in the sample. As we can observe in Panel A, mean (median) of variable Cash is 13.88 (7.77) percent in 2001, and in 2015, the mean (median) is 17.16 (10.67) percent. However, mean (median) highest value was in 2008 (2011) of 20.56 (11.87) percent. The *Asset-weighted Cash* is higher in the post-crisis period than before.

These results are slightly lower than the ones uncovered by Pinkowitz *et al.* (2016). As an example, in 2010, mean (median) of U.S. firms is 21.48 (14.30) percent, and for Eurozone firms, mean (median) is 16.95 (11.51) percent.

Panel B of Table 4 displays the three indicators described as before by subperiod: i) benchmark period (2001-2003); ii) pre-crisis period (2005-2007), iii) post-crisis period (2012-2014). As we can observe in Panel B, the mean and median of cash holdings are higher in the pre-crisis period relative to the post-crisis period, and the opposite is true for the asset-weighted cash measure.



Table 4-Cash ratios by Year and Subperiod

Panel A reports Mean and Median of Cash variable and of Asset-Weighted Cash during the 2001-2015 period for a sample of listed companies from Euro-adhering countries by 2001, excluding Luxembourg. Cash is measured as cash and marketable securities scaled by total assets. Asset-Weighted Cash is measured as aggregate cash scaled by aggregated total assets of all firms in the sample. We exclude financial firms (SIC Code 6000-6999) and strictly regulated firms (SIC Code 4900-4949). Our panel set includes 1133 different firms, which corresponds to 9744 firm-year observations. Panel B presents the same indicators described as before, by subperiod: i) a benchmark period (2001-2003); ii) pre-crisis period (2005-2007), iii) post-crisis period (2012-2014).

Panel A: Cash Ratios by Year

Year	N	Mean Cash	Median Cash	Asset-Weighted Cash
2001	178	13.88%	7.77%	7.08%
2002	226	15.23%	9.75%	7.96%
2003	266	13.03%	8.82%	7.70%
2004	282	12.49%	7.67%	5.39%
2005	336	13.84%	9.83%	7.67%
2006	444	19.22%	11.16%	7.93%
2007	609	20.29%	11.54%	7.62%
2008	751	20.56%	11.76%	7.13%
2009	832	17.29%	10.06%	4.72%
2010	861	16.95%	11.51%	10.16%
2011	863	17.29%	11.87%	7.05%
2012	810	15.63%	10.58%	9.93%
2013	825	16.06%	10.41%	10.43%
2014	873	17.08%	11.50%	12.48%
2015	831	17.16%	10.67%	10.65%

Panel B: Cash Ratios by Subperiod

Year	N	Mean Cash	Median Cash	Asset-Weighted Cash
Benchmark Period	774	13.47%	8.60%	6.94%
Pre-Crisis	1804	20.14%	11.67%	7.49%
Post-Crisis	2529	16.77%	10.86%	11.21%

4.1.1 Cash Holdings across Eurozone Countries

Table 5 compares mean (Panel A) and median (Panel B) of the variable Cash from each country with the benchmark period. Panel A shows that Germany is the only country that presents cash holdings significantly higher than the Eurozone group (Euro N=11) across the sample period. Also, the group of less affected countries displays a similar behavior. Thus, besides Germany, also Austria and Finland (which compose the group of less affected countries), present higher cash holdings than the Eurozone, although most of the differences in means are not significant. These results are corroborated by the ones provided in Panel B.

On the other side, we observe in Panel A that, on average, cash holdings are significantly lower in Spain, Greece, Portugal and Italy than in the Eurozone (EURO N=11). This is also observed in the most affected group (Portugal, Spain and Ireland). This behavior is similar to the one displayed in Panel B. In this context, Greece and Portugal are the countries that present the lowest level of cash holdings, although mean and median values are not, on average, statistically significant.



Table 5-Cash Holdings by Country and Group of Countries

Panel A reports the mean and Panel B presents median of Cash variable during the 2001-2015 period for a sample of listed companies from Euro-adhering countries by 2001, excluding Luxembourg. Cash is measured as cash and marketable securities scaled by total assets. We exclude financial firms (SIC Code 6000-6999) and strictly regulated firms (SIC Code 4900-4949). Our panel set includes 1133 different firms, which corresponds to 9744 firm-year observations. Subperiods are: i) benchmark period (2001-2003); ii) pre-crisis period (2005-2007); iii) post-crisis period (2012-2014). DE means Germany. AT is Austria. BE is Belgium. ES means Spain. FI is Finland. FR is France. EL is Greece. IE is Ireland. IT is Italy. NL means The Netherlands. PT is Portugal. “More Affected” countries are Spain, Ireland, and Portugal. “Less Affected” countries are Germany, Austria, and Finland. Differences in means are tested using t- statistic test and differences in medians are tested using Wilcoxon rank sum test. *, **, *** (+, ++, +++) indicate if the mean (median in Panel B) is significantly smaller (larger) than in the Eurozone (Euro N=11) at the 1 percent level, 5 percent level, and 10 percent level, respectively.

Panel A-Mean of Cash holdings

Year	EURO N=11	DE	AT	BE	ES	FI	FR	EL	IE	IT	NL	PT	More Affected	Less Affected
2001	0.1388	0.1513	0.1980	0.1465	0.1185	0.3636 ⁺⁺	0.1716	0.0690	0.2065	0.1334	0.1067	-	0.1378	0.1581
2002	0.1523	0.1355	0.2201	0.1634	0.1049	0.2511 ⁺	0.1266	0.1086	0.1251	0.1218	0.0701	-	0.1092	0.1418
2003	0.1303	0.1364	0.1883	0.1945	0.0886*	0.2634 ⁺⁺	0.1152	0.1076	0.1157	0.1040	0.0677	0.0445	0.0920*	0.1424 ⁺⁺
2004	0.1249	0.1558 ⁺	0.0974	0.1935	0.1241	0.2511 ⁺	0.1213	0.0848*	0.1701	0.1162	0.1097	0.0412	0.1301	0.1570 ⁺⁺
2005	0.1384	0.2385 ⁺⁺⁺	0.2721	0.2294	0.1140 ^{**}	0.2314	0.1941	0.0626 ^{***}	0.1416	0.1220*	0.1391	0.0569	0.1180 ^{***}	0.233 ⁺⁺⁺
2006	0.1922	0.2457 ⁺⁺⁺	0.2721	0.2301	0.1038 ^{***}	0.2100	0.2116	0.0503 ^{***}	0.1230	0.1213 ^{**}	0.1481	0.0776	0.1065 ^{***}	0.2451 ⁺⁺⁺
2007	0.2029	0.2386 ⁺⁺⁺	0.2551	0.2491	0.1046 ^{***}	0.2013	0.2204	0.0734 ^{***}	0.2077	0.1156 ^{***}	0.1445	0.0472	0.1255 ^{***}	0.2376 ⁺⁺⁺
2008	0.2056	0.1893 ⁺⁺⁺	0.2101	0.2286 ⁺	0.0822 ^{***}	0.1666	0.1961 ⁺⁺	0.0821 ^{***}	0.2624 ⁺⁺	0.0982 ^{***}	0.1606	0.0398*	0.1216 ^{**}	0.1892 ⁺⁺⁺
2009	0.1729	0.1811 ⁺⁺	0.1955	0.2256 ⁺	0.1011 ^{***}	0.1555	0.1977 ⁺⁺⁺	0.0928 ^{**}	0.2564 ⁺⁺	0.0960 ^{***}	0.1590	0.0392 ^{**}	0.1319*	0.1806 ⁺⁺⁺
2010	0.1695	0.1972 ⁺⁺⁺	0.1782	0.2136	0.1015 ^{***}	0.1416	0.1854 ⁺⁺⁺	0.0761 ^{***}	0.2618 ⁺⁺	0.0904 ^{***}	0.1537	0.0610	0.1351*	0.1944 ⁺⁺⁺
2011	0.1729	0.1740 ⁺⁺⁺	0.1673	0.1890	0.1024 ^{**}	0.1530	0.1827 ⁺⁺⁺	0.0835 ^{***}	0.1707	0.0826 ^{***}	0.0810	0.0522*	0.1113 ^{**}	0.1729 ⁺⁺⁺
2012	0.1563	0.1746 ⁺⁺⁺	0.1847	0.2024	0.0999 ^{***}	0.1355	0.2041 ⁺⁺⁺	0.0858 ^{**}	0.1196	0.0978 ^{***}	0.0730	0.0634	0.0999 ^{***}	0.1733 ⁺⁺⁺
2013	0.1606	0.1809 ⁺	0.1636	0.2265 ⁺	0.1129 ^{***}	0.1462	0.2153 ⁺⁺⁺	0.0948 ^{**}	0.0900*	0.1102 ^{***}	0.1154	0.1201	0.1101 ^{***}	0.1785
2014	0.1708	0.1747	0.1899	0.2281 ⁺	0.1147 ^{***}	0.1165	0.2254 ⁺⁺⁺	0.0898 ^{**}	0.1182	0.1233 ^{**}	0.1062	0.1287	0.1164 ^{***}	0.1721
2015	0.1716	0.1766	0.1380	0.2603 ⁺⁺	0.1270 ^{**}	0.1199	0.2170 ⁺⁺⁺	0.1071*	0.1895	0.1391	0.0920	0.1409	0.1366 ^{**}	0.1719
Benchmark Period	0.1347	0.1408	0.2013 ⁺	0.17016	0.1037 ^{**}	0.2862 ⁺⁺⁺	0.1320	0.1039	0.1524	0.1139	0.0802	0.0445	0.1128*	0.1471 ⁺⁺
Pre-Crisis	0.2014	0.2410 ⁺⁺⁺	0.2644 ⁺	0.2378	0.1071 ^{***}	0.2111			0.1615	0.1190 ^{***}	0.1439	0.0598 ^{**}	0.1171 ^{***}	0.2406 ⁺⁺⁺
Post-Crisis	0.1677	0.1768 ⁺⁺⁺	0.1792	0.2196 ⁺⁺	0.1091 ^{***}	0.2110	0.0622 ^{***}	0.0901 ^{***}	0.1090 ^{**}	0.1107 ^{***}	0.0982 ^{**}	0.1056 ^{**}	0.1088 ^{***}	0.1747 ⁺⁺



Panel B: Median Cash holdings

Year	EURO N=11	DE	AT	BE	ES	FI	FR	EL	IE	IT	NL	PT	More Affected	Less Affected
2001	0.0777	0.0706*	0.2155	0.0796	0.1149	0.2705	0.1134 ⁺⁺	0.0690	0.1222	0.0997	0.0668	-	0.1149	0.0744
2002	0.0975	0.0662	0.1588	0.0983	0.1056	0.0640	0.0805	0.0921	0.0914	0.0816	0.0387	-	0.0990	0.0664
2003	0.0882	0.0754	0.1364	0.0993	0.0755	0.0802	0.0785	0.0788	0.0877	0.0899	0.0436	0.0445	0.0755	0.0777
2004	0.0767	0.1030	0.1048	0.1047	0.1221	0.0947	0.0874	0.0531 ^{**}	0.1133	0.0869	0.0806	0.0412	0.1221	0.1030
2005	0.0983	0.1471 ⁺⁺⁺	0.1021	0.1456	0.1026	0.2132	0.1217	0.0515 ^{***}	0.1104	0.1075	0.0810	0.0469	0.1078 ^{**}	0.1471 ⁺⁺⁺
2006	0.1116	0.1635 ⁺⁺⁺	0.1506	0.1155	0.0623 ^{***}	0.1564	0.1592 ⁺⁺	0.0308 ^{***}	0.1023	0.0757 [*]	0.0945	0.0389	0.0642 ^{***}	0.1632 ⁺⁺⁺
2007	0.1154	0.1463 ⁺⁺⁺	0.1161	0.1296	0.0707 ^{***}	0.1426	0.1544 ⁺⁺	0.0424 ^{***}	0.1223	0.0884 ^{**}	0.0980	0.0257 ^{**}	0.0698 ^{***}	0.1449 ⁺⁺⁺
2008	0.1176	0.1189 ⁺⁺⁺	0.1458	0.0841	0.0672 ^{***}	0.1041	0.1258 ⁺⁺⁺	0.0513 ^{***}	0.1436 ⁺⁺	0.0639 ^{***}	0.0695	0.0212 ^{***}	0.0724 ^{***}	0.1191 ⁺⁺⁺
2009	0.1006	0.1340 ⁺⁺⁺	0.1382	0.0816	0.0745 ^{***}	0.1441	0.1533 ⁺⁺⁺	0.0661 ^{***}	0.1851 ⁺⁺⁺	0.0649 ^{***}	0.1080	0.0349 ^{***}	0.0883 [*]	0.1356 ⁺⁺⁺
2010	0.1151	0.1366 ⁺⁺⁺	0.0962	0.0985	0.0672 ^{***}	0.1130	0.1353 ⁺⁺	0.0499 ^{***}	0.1416 ⁺⁺	0.0566 ^{***}	0.1141	0.0588 [*]	0.1022 [*]	0.136 ⁺⁺⁺
2011	0.1187	0.1162 ⁺⁺⁺	0.0976	0.0854	0.0656 ^{**}	0.1215	0.1356 ⁺⁺⁺	0.0405 ^{***}	0.1278	0.0607 ^{***}	0.0701	0.0318 ^{**}	0.0759 ^{**}	0.1162 ⁺⁺⁺
2012	0.1058	0.1164 ⁺⁺⁺	0.0987	0.1203	0.0861	0.0724	0.1311 ⁺⁺⁺	0.0539 ^{***}	0.1079	0.0683 ^{***}	0.0562	0.0556 [*]	0.0873 ^{**}	0.1154 ⁺⁺⁺
2013	0.1041	0.1245	0.1019	0.1327	0.1021	0.1054	0.1476 ⁺⁺⁺	0.0517 ^{***}	0.0585 [*]	0.0967 ^{**}	0.1307	0.0681	0.0943 ^{**}	0.1221
2014	0.1150	0.0949	0.1279	0.1144	0.1047	0.0871	0.1537 ⁺⁺⁺	0.0408 ^{***}	0.1192	0.1079	0.0834	0.0702	0.1047	0.0961
2015	0.1067	0.0988	0.1228	0.1164	0.1126	0.0948	0.1391 ⁺⁺⁺	0.0647 ^{**}	0.1352	0.1094	0.1008	0.0921	0.1131	0.0996
Benchmark Period	0.8600	0.0709	0.1606 ⁺	0.0958	0.0949	0.0678	0.0946	0.0788	0.0914	0.0872	0.0411	0.0445	0.0949	0.0735
Pre-Crisis	0.1167	0.1542 ⁺⁺⁺	0.1228	0.1285	0.0710 ^{***}	0.1542	0.1512 ⁺⁺⁺	0.0402 ^{***}	0.1104	0.0883 ^{**}	0.0909	0.0385 ^{***}	0.07892 ^{***}	0.1525 ⁺⁺⁺
Post-Crisis	0.1086	0.1137	0.1213	0.1146	0.0957 ^{***}	0.0928	0.1425 ⁺⁺⁺	0.0492 ^{***}	0.1079 [*]	0.0886 ^{***}	0.0834 [*]	0.0692 ^{***}	0.0943 ^{***}	0.1131

4.1.2 Analysis of the Determinants of Cash Holdings

Previous literature points out several determinants of cash holdings. Thus, we use the set of explanatory variables advanced in former studies (e.g., Bates et al., 2009; Pinkowitz et al., 2016), included in equation (1) in order to explain changes in cash holdings across the Eurozone countries. Hence, Table 6 provides means (Panel A) e medians (Panel B) of those variables for the Eurozone group (EURO N=11) and by each country. Moreover, we can observe in Table 6 the statistical significance of the differences in means and medians between Eurozone and each country, and also between Eurozone and the group more (less) affected.

Prior research documents a positive relation between cash holdings and market to book ratio (e.g., Opler et al., 1999). However, we observe that Austria hold more cash than the average countries of Eurozone, and displays a lower market to book ratio. On the other side, Spain holds less cash and displays a higher market to book ratio than the average countries of Eurozone. The variable size presents the expected behavior predicted by transactions motive, i.e., the larger the size of the company the smaller the cash reserves, (e.g., Opler et al., 1999).

On average, cash flow and net working capital display a negative mean (median) because they compete with cash (like predicted by the trade-off theory of Krauz and Litzenberger, 1973), which is corroborated by the results of the most affected group, that presents lower cash holdings than less affected countries, and higher cash flow and net working capital than the less affected group. According to the pecking order⁵ theory, capital expenditures (Capex) and leverage are negatively related to liquidity. According to that view, we observe that the most (less) affected group displays a higher (lower) leverage ratio than the Eurozone. On the contrary, Capital expenditures (Capex) are lower (higher) for the most (less) affected group. This univariate analysis is consistent with correlation analysis (section 3.2). However, a shortcoming of univariate (and correlation) analysis is that it does not allow differentiating causes from consequences. This issue will be addressed and discussed in the next section

⁵ Pecking Order is a capital structure theory. According to Myers and Majluf (1984), this theory argues that companies- should prefer, as a first option, to finance their investments through internal financing.



Table 6-Determinants of Cash Holdings: Mean and Median by Country

Panel A (Panel B) reports the mean (median) of the variables considered as determinants of cash holdings during the 2001-2015 period for a sample of listed companies from Euro-adhering countries by 2001, excluding Luxembourg. Cash is cash and marketable securities scaled by total assets. Market to book is measured as the market value of equity plus the book value of assets minus the book value of equity scaled by the book value of total assets. Size is the logarithm of total assets. CF is the net income plus depreciation and amortization expenses scaled by total assets. Net Working Capital (NWC) is working capital minus cash and marketable securities divided by total assets. Capex is capital expenditures scaled by total assets. Leverage is total debt divided by total assets. Industry volatility (Ind. Vol) is the standard deviation of 2-digit industry cash flows. We exclude financial firms (SIC Code 6000-6999) and strictly regulated firms (SIC Code 4900-4949). Our panel set includes 1133 different firms, which corresponds to 9744 firm-year observations. DE means Germany. AT is Austria. BE is Belgium. ES means Spain. FI is Finland. FR is France. EL is Greece. IE is Ireland. IT is Italy. NL means The Netherlands. PT is Portugal. “More Affected” countries are Spain, Ireland, and Portugal. “Less Affected” countries are Germany, Austria, and Finland. Differences in means are tested using t- statistic test and differences in medians are tested using Wilcoxon rank sum test. *, **, *** (+, ++, +++) indicate if the mean (median in Panel B) is significantly smaller (larger) than in the Eurozone (Euro N=11) at the 1 percent level, 5 percent level and 10 percent level, respectively.

Panel A-Mean of the Determinants of Cash Holdings

VARIABLES	EURO N=11	DE	AT	BE	ES	FI	FR	EL	IE	IT	NL	PT	More Affected	Less Affected
Cash	0.1704	0.1870+++	0.1952*	0.2191+++	0.1077***	0.1672	0.1978+++	0.0833***	0.1778	0.1083***	0.1195***	0.0795***	0.1195***	0.1864+++
M/B	1.8181	1.8757+++	1.3751***	2.0584+++	2.0067+++	1.7457	1.9025+++	1.2515***	1.6110**	1.5079***	1.5697**	1.2355***	1.8799	1.8520++
SIZE	6.9429	6.5735+++	7.8925+++	7.1928++	8.6658+++	7.7242+++	6.3481***	6.0608***	7.3303+++	7.8604+++	9.1646+++	8.7965+++	8.4149+++	6.6700***
CF	-0.0068	-0.0348+++	0.0106	-0.0252	0.0648+++	0.0477+++	-0.0039	0.0197**	-0.0042	0.0320+++	0.0107	0.0256	0.0492+++	-0.0295***
NWC	-0.5218	-0.5020+++	-0.5133+++	-0.5393	-0.4489+++	-0.5836	-0.5932***	-0.5100	-0.4365+++	-0.5550***	-0.4615+++	-0.4800*	-0.4484+++	-0.5060+++
CAPEX	0.0445	0.0476+++	0.0632+++	0.0414	0.0416	0.0436	0.0419**	0.0494	0.0361**	0.0354***	0.0374	0.0420	0.0406**	0.0480+++
Leverage	0.2111	0.1817+++	0.2616+++	0.2054	0.2989+++	0.2040	0.1906***	0.2801+++	0.1868**	0.2830+++	0.2176	0.3795+++	0.2824+++	0.1856***
Ind. Vol.	0.1704	0.1870+++	0.1952++	0.2191+++	0.1077***	0.1672*	0.1978+++	0.0833***	0.1778+++	0.1083	0.1195***	0.0795***	0.1195***	0.1864+++

Panel B: Median of the Determinants of Cash Holdings

VARIABLES	EURO N=11	DE	AT	BE	ES	FI	FR	EL	IE	IT	NL	PT	More Affected	Less Affected
Cash	0.1078	0.1178+++	0.1262	0.1049	0.0886***	0.1049	0.1336+++	0.0514***	0.1135	0.0769***	0.0902***	0.0472***	0.0903***	0.1176+++
M/B	1.3321	1.3558+++	1.1921***	1.5643+++	1.2984***	1.4190*	1.3915+++	1.0968***	1.2748**	1.2480***	1.2547	1.1057***	1.2807	1.3498++
SIZE	6.6659	6.3113***	7.8053+++	7.0233++	8.8689+++	8.3643+++	5.8967***	5.8995***	7.1377+++	7.9070+++	9.8446+++	8.7122+++	8.7738+++	6.3993***
CF	0.0359	0.0266***	0.0267	0.0172**	0.0423+++	0.0551+++	0.0418+++	0.0356	0.0395	0.0415++	0.0467	0.0317	0.0418+++	0.0281***
NWC	-0.4989	-0.4726+++	-0.4833	-0.5277	-0.3903+++	-0.5409***	-0.5870***	-0.4808	-0.3770+++	-0.5541***	-0.4317+++	-0.4658	-0.3954+++	-0.4772+++
Capex	0.0263	0.0290+++	0.0494+++	0.0237**	0.0309+++	0.0273	0.0191***	0.0217	0.0199***	0.0243*	0.0248	0.0241	0.0285++	0.0296+++
Leverage	0.1880	0.1418***	0.2489+++	0.1379	0.3147+++	0.1886	0.1559***	0.2775+++	0.1303***	0.2911+++	0.2265	0.4015+++	0.3065+++	0.1515***
Ind. Vol.	0.2157	0.2165+++	0.1935**	0.2178+++	0.1197***	0.2178	0.2178+++	0.1710***	0.1710***	0.1710***	0.1197***	0.1061***	0.1362***	0.2165+++

4.2 Multivariate Analysis

4.2.1 Determinants of Cash Holdings

The purpose of this section is to test the determinants of cash holdings by estimating equation (1). Table 7 displays the results using different estimation techniques. Models 1-4 were estimated using all samples, and models 5-8 were estimated



excluding Greece by the motives already explained. Therefore, excluding Greece is considered to be a robustness test. Moreover, we estimate different specifications of equation (1) to check the robustness of our baseline results. In model 1 (5), we clustered standard errors at firm- and year-level; in model 2 (6), we clustered standard errors at country- and year-level; in model 3 (7) we use fixed effects at firm-level, and in model 4 (8) we use fixed effects at country-level. Results across models are similar in sign and magnitude to the ones shown in the baseline model (model 1).

According to our predictions, the *Capex*, *net working capital*, and *leverage* display, on average, negative and significant coefficients, which is consistent with *pecking order theory* (Myers and Majluf, 1984). Those results are consistent with Pinkowitz *et al.* (2016) e Bates *et al.* (2009). However, and against our expectations, the variable *size* presents positive and not significant coefficients in all estimations. Also, the *book to market ratio* is positive but not significant, on average, across estimations. Contrary to the findings uncover by Pinkowitz *et al.* (2016), our coefficients' estimates of the cash flow variable are positive and statistically significant in models 3-4 and 7-8, which was estimated adopting FE method. Although this result is not consistent with *pecking order theory*, corroborates the results of Ferreira and Vilela (2004) for a sample of Eurozone listed companies.

Furthermore, *Dividends Payout* displays positive and significant estimates when we use fixed effects specification (by firm and country). This is consistent with the idea that less financially restricted firms pay more dividends. Also, the fact that coefficients are only significant for FE specifications suggests there are specific firms' characteristics that explain that behavior. Moreover, *Acquisitions* present positive and significant coefficients across estimations (only models 2 and 6 do not display significance). A reasonable explanation for these results is that firms can delay acquisitions payments or pay it by exchange of shares.

According to the evidence provided by Pinkowitz *et al.* (2016), the *equity issuance* is positively related with cash holdings. On the other hand, debt issuance displays negative and not significant coefficients, which does not correspond to our predictions. However, also Bates *et al.* (2009), after controlling for time effects, uncover negative coefficients for the debt issue variable.

Table 7-Determinants of Cash Holdings

Table 7 reports regression estimates of equation (1) using different specifications for a sample of listed companies from Euro-adhering countries by 2001, excluding Luxembourg, during the 2001-2015 period. The dependent variable is Cash (cash and marketable securities scaled by total assets). C is the intercept term. The independent variables are the following: Market to book (market value of equity plus the book value of assets minus the book value of equity scaled by the book value of total assets); Size (logarithm of total assets); CF (net income plus depreciation and amortization expenses scaled by total assets); Net Working Capital (NWC-working capital minus cash and marketable securities divided by total assets); Capex (capital expenditures scaled by total assets); Leverage (total debt divided by total assets). Industry volatility (Ind. Vol - is the standard deviation of 2-digit industry cash flows). Acquisitions is an indicator variable equal to one if firm *i* acquires another company in a given year, and zero otherwise. Equity issuance is a dummy variable equal to one if firm *i* issues equity in a given year, and zero otherwise. Debt issuance is a dummy variable equal to one if firm *i* issues debt in a given year, and zero otherwise. We exclude financial firms (SIC Code 6000-6999) and strictly regulated firms (SIC Code 4900-4949). Our panel set includes 1133 different firms, which corresponds to 9744 firm-year observations. Robust t Statistic in parentheses. In models 1 and 5 (2 and 6) standard errors are clustered by firm (country) and year. In models 3 and 7 (4 and 8) we estimate fixed-effects by firm (country). Models 1-4 were estimated using the all sample, and models 5-8 were estimated excluding Greece. OLS means Ordinary Least Squares and FE means Fixed Effects. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively.



Model	1 OLS (year, firm)	2 OLS (year, country)	3 FE (firm)	4 FE (country)	5 OLS (year, firm)	6 OLS (year, country)	7 FE (firm)	8 FE (country)
Dependent Variable	CASH							
C	-0.0255 (-1.04)	-0.0241 (-0.89)	-0.0408 (-1.08)	-0.0408 (-1.46)	-0.0330 (-1.28)	-0.0216 (-0.74)	-0.0439 (-1.13)	-0.0439 (-1.44)
M/B	0.0084** (1.99)	0.0089 (1.44)	0.0009 (0.38)	0.0009 (0.61)	0.0080* (1.89)	0.0081 (1.30)	0.0008 (0.32)	0.0008 (0.51)
SIZE	0.0019 (0.85)	0.0012 (0.25)	0.0043 (0.86)	0.0043 (1.06)	0.0021 (0.89)	0.0004 (0.08)	0.0045 (0.88)	0.0045 (1.04)
CF	0.0147 (0.64)	-0.0045 (-0.08)	0.0708*** (5.17)	0.0708*** (8.09)	0.0145 (0.62)	-0.0037 (-0.06)	0.0724*** (5.21)	0.0724*** (8.70)
NWC	-0.4091*** (-16.24)	-0.3876*** (-7.74)	-0.4577*** (-23.97)	-0.4577*** (-16.00)	-0.4190*** (-16.23)	-0.3956*** (-7.94)	-0.4680*** (-24.02)	-0.4680*** (-19.64)
Capex	-0.1013*** (-2.99)	-0.0832*** (-3.12)	-0.0717*** (-3.11)	-0.0717*** (-4.92)	-0.1125*** (-2.92)	-0.0863** (-2.60)	-0.0760*** (-2.69)	-0.0760*** (-3.60)
Leverage	-0.2904*** (-13.38)	-0.3184*** (-11.88)	-0.1842*** (-9.47)	-0.1842*** (-17.39)	-0.2801*** (-12.36)	-0.3054*** (-11.74)	-0.1832*** (-9.15)	-0.1832*** (-16.41)
Ind. Vol.	-0.0021 (-0.03)	0.0044 (0.10)			0.0103 (0.15)	0.0081 (0.18)		
Dividends Payout	-0.0003 (-0.04)	-0.0002 (-0.03)	0.0151*** (2.75)	0.0151* (2.01)	-0.0008 (-0.10)	-0.0007 (-0.09)	0.0154*** (2.70)	0.0154* (1.92)
Acquisitions	0.0156** (2.41)	0.0014 (0.16)	0.0107** (2.38)	0.0107* (2.05)	0.0183** (2.49)	0.0045 (0.44)	0.0126*** (2.65)	0.0126** (2.37)
Equity Issuance	0.0389*** (4.66)	0.0386*** (5.24)	0.0238*** (6.45)	0.0238*** (8.39)	0.0381*** (4.60)	0.0369*** (5.59)	0.0230*** (6.13)	0.0230*** (8.91)
Debt Issuance	-0.0070 (-0.82)	-0.0047 (-0.59)	-0.0016 (-0.38)	-0.0016 (-0.76)	-0.0089 (-0.97)	-0.0057 (-0.63)	-0.0016 (-0.36)	-0.0016 (-0.69)
R²	0.451	0.430	0.367	0.367	0.450	0.430	0.375	0.375

4.2.2 Evolution of Abnormal Cash Holdings

Per hypothesis 1, we predict that Eurozone listed firms hold more cash in the post-crisis period comparing to the pre-crisis period. To test this hypothesis, we follow Pinkowitz *et al.*(2016) and we measure cash holdings before and after the crisis with a benchmark period between 2001 and 2003. Hence, we estimate abnormal cash holdings as the difference between pre (post)-crisis period and the benchmark period. In order to estimate the cash holdings for the benchmark period (2001-2003), we estimate the following model by each year:

$$Y_i = \alpha_i + \beta'Z_{i,t-s} + \varepsilon_i \quad (2)$$

Where the dependent variable Y_i is cash and marketable securities scaled by total assets. α_i is the intercept that captures the unobservable heterogeneity of the individual specific effects of each firm. $\beta'Z_{i,t-s}$ is a vector of the determinants of cash holdings, as explained in the section above, which includes: *Capex* (measured as the ratio of capital expenditures scaled by total assets); *CF* (net income plus depreciation and amortization expenses scaled by total assets); *Market to book* (measured as the market value of equity plus the book value of assets minus the book value of equity scaled by the book value of total assets); *Size* (the logarithm of total assets); *Net Working Capital* (working capital minus



cash and marketable securities divided by total assets); *Leverage* (total debt divided by total assets); *Industry volatility* (the standard deviation of 2-digit industry cash flows); *Dividends payout* is a dummy variable equal to one if firm *i* pays dividends in a given year, and zero otherwise; *Acquisitions* is an indicator variable equal to one if firm *i* acquires another company in a given year, and zero otherwise; *Equity issuance* is an indicator variable equal to one if firm *i* issues equity in a given year, and zero otherwise; *Debt issuance* is an indicator variable equal to one if firm *i* issues debt in a given year, and zero otherwise.

Abnormal cash holdings are measured as the difference between pre (post)-crisis period and the estimated cash holdings for the benchmark period (2001-2003). Table 8 reports the results.

Table 8-Abnormal Cash Holdings

Table 8 provides the abnormal cash holdings, measured as the difference between pre (post)-crisis period and the estimated cash holdings for the benchmark period (2001-2003). Our sample covers the 2001-2015 period and is composed of listed companies from Euro-adhering countries by 2001. We exclude financial firms (SIC Code 6000-6999) and strictly regulated firms (SIC Code 4900-4949). Our panel set includes 1133 different firms, which corresponds to 9744 firm-year observations. Panel A reports the abnormal cash holdings by year. Differences in means are tested using t- statistic test. The results in bold are significantly different from zero at the 5 percent level. DE means Germany. AT is Austria. BE is Belgium. ES means Spain. FI is Finland. FR is France. EL is Greece. IE is Ireland. IT is Italy. NL means The Netherlands. PT is Portugal. “More Affected” countries are Spain, Ireland, and Portugal. “Less Affected” countries are Germany, Austria, and Finland. Panel B reports the abnormal cash holdings by subperiod. Subperiods are: i) benchmark period (2001-2003); ii) pre-crisis period (2005-2007); iii) post-crisis period (2012-2014). Panel C displays the differences (Post-Crisis minus Pre-Crisis) in abnormal cash holdings by subperiod. *, **, *** (+, ++, +++) indicate if the mean (of excess cash) is significantly smaller (larger) than the Eurozone (Euro N=11) at the 1 percent level, 5 percent level, and 10 percent level, respectively.

Panel A: Abnormal Cash Holdings by Year

Year	EURO N=11	DE	AT	BE	ES	FI	FR	EL	IE	IT	NL	PT	More Affected	Less Affected
2001	-0.0024	-0.0036	0.0177	-0.0437	0.0005	0.1429 ⁺⁺	-0.0066	-0.0593	-0.0025	0.0138	-0.0320	-0.0001	0.0013	
2002	-0.0168	-0.0132	0.0225	-0.0115	-0.0075	-0.0234	-0.0485*	-0.0449	-0.0021	-0.0005	0.0141	-0.0063	-0.0121	
2003	-0.0221	-0.0220	0.0376	0.0322	-0.0221	0.0441	-0.0552**	-0.0056	-0.0054	-0.0041	0.0018	-0.1190	-0.0213	-0.0173
2004	-0.0212	-0.0239	-0.0238	0.0106	0.0121	0.1100 ⁺⁺⁺	-0.0665****	-0.0411	0.0236	0.0012	0.0043	-0.0502	0.0121 ⁺⁺	-0.0190
2005	0.0020	0.0129	0.0347	0.0333	0.0016 ^{**}	0.0841 ⁺	-0.0257 ^{**}	-0.0281	0.0008	0.0058	-0.0147	-0.0066	0.0010	0.0172 ⁺⁺
2006	0.0033	0.0173 ⁺⁺	0.0099	0.0110	0.0004	0.0162	-0.0185 [*]	-0.0286	-0.0063	0.0025	0.0041	-0.0129	-0.0019	0.0170 ⁺⁺
2007	0.0151	0.0304⁺⁺⁺	0.0150	0.0239	0.0003	0.0019	0.0034	-0.0185	0.0098	0.0003	-0.0275	0.0071	0.0029	0.0284⁺⁺⁺
2008	0.0067	-0.0014	0.0106	0.0446	-0.0187	0.0304	0.0197	0.0075	0.0545	-0.0016	0.0660	0.0046	0.0004	0.0004
2009	0.0028	-0.0054 ⁺	0.0197	0.0070	0.0083	0.0123	0.0082	0.0229 ⁺⁺	0.0596	-0.0046	0.0288	-0.0023	0.0193	-0.0038
2010	0.0002	-0.0012	-0.0160	0.0139	0.0037	-0.0235	0.0003	0.0080 ⁺	0.0556	-0.0126	0.0219	-0.0060	0.0149	-0.0027
2011	-0.0100	-0.0087	-0.0745*	-0.0313	-0.0034	-0.0174	-0.0035	0.0071	-0.0422	-0.0170	-0.0292	0.0017	-0.0095	-0.0113
2012	-0.0095	-0.0084	-0.0316	-0.0269	-0.0026	-0.0252	-0.0054	0.0160	-0.0679	-0.0161	-0.0342	-0.0152	-0.0121	-0.0099
2013	0.0013	0.0049	-0.0211	-0.0229	0.0075	-0.0147	0.0021 ⁺⁺	0.0179 ⁺⁺	-0.0721	-0.0032	0.0185	0.0046	-0.0045	0.0030
2014	0.0078	0.0036	0.0301	-0.0253	-0.0018	-0.0303	0.0256	0.0116	-0.0482	0.0177	-0.0073	0.0159	-0.0067	0.0026
2015	0.0066	-0.0046 ^{**}	0.0117	-0.0076	0.0104	-0.0413 [*]	0.0257⁺⁺	0.0109	-0.0346	0.0296	-0.0196	0.0262	0.0063	-0.0064 ^{**}



Panel B: Abnormal Cash Holdings by Subperiods

Subperiod	EURO N=11	DE	AT	BE	ES	FI	FR	EL	IE	IT	NL	PT	More Affected	Less Affected
Benchmark Period	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre-Crisis	0.0079	0.0219⁺⁺⁺	0.0182	0.0218	0.0007	0.0256	-0.0112 ^{***}	-0.0250^{**}	0.0019	0.0023	-0.0127	-0.0030	0.0008	0.0220 ⁺⁺⁺
Post-Crisis	-0.0001	0.0001	-0.0079	-0.0250	0.0010	-0.0232	0.0081 ⁺	0.0152⁺⁺⁺	-0.0628	0.0000	-0.0087	0.0025	-0.0077	-0.0014

Panel C: Differences in Abnormal Cash Holdings by Subperiods

Subperiod	EURO N=11	DE	AT	BE	ES	FI	FR	EL	IE	IT	NL	PT	More Affected	Less Affected
Pre-Crisis	0.0079	0.0219⁺⁺⁺	0.0182	0.0218	0.0007	0.0256	-0.0112 ^{***}	-0.0250^{**}	0.0019	0.0023	-0.0127	-0.0030	0.0008	0.0220 ⁺⁺⁺
Post-Crisis	-0.0001	0.0001	-0.0079	-0.0250	0.0010	-0.0232	0.0081 ⁺	0.0152⁺⁺⁺	-0.0628	0.0000	-0.0087	0.0025	-0.0077	-0.0014
POST-PRE	-0.0080	-0.0219	-0.0260	-0.0468	0.0003	-0.0488	0.0193	0.0402	-0.0648	-0.0023	0.0040	0.0055	-0.0085	-0.0234

In Panel A, Table 8, we observe a continued decrease of abnormal cash holdings in Eurozone (EURO N=11) from 2001 until 2004, displaying a decrease of -2.12 percentage points. (p.p.) in 2004, starting to increase from 2005 to 2007 (1.51 p.p. in 2007). However, in 2008 abnormal cash holdings start to decrease until 2012, slightly increasing thereafter. Indeed, at the end of the financial crisis in 2011, cash holdings register a strong decrease of about -1 p.p.

Among Eurozone countries, Germany displays the highest difference of +1.5 p.p. in 2007 relative to the Eurozone. On the other side, France presents a continuous declining of abnormal cash reserves between 2002 and 2004, displaying the lowest value in 2004 (-6.65 p.p.). Moreover, abnormal cash reserves in France over the 2002-2004 period are lower than in the Eurozone. However, Ireland exhibits the lowest value of abnormal cash holdings at the end of 2012 (about -6.79 p.p.), which matches with the end of the financial crisis.

The less affected group displays a significant increase in abnormal cash holdings relative to the Eurozone between 2005-2007, showing in 2007 a difference of 2.84 p.p.. However, abnormal cash reserves start to decrease thereafter. On the other hand, the more affected group display displays, on average, lower values of abnormal cash holdings, showing only a major and significant difference in 2009.

The panel B provides abnormal cash holdings by subperiods, pre- and post-crisis, comparing to the estimated cash holdings for the benchmark period 2001-2003, and Panel C reports the differences between post- and pre-crisis. Our hypothesis 1 postulates that firms hold more cash in the post-crisis period relative to the pre-crisis period. However, the evidence provided in Panel B and in Panel C of Table 8 do not supports, on average, hypothesis 1; our results suggest a decrease of 0.8 p.p. in abnormal cash holdings between the pre-crisis period and the post-crisis period for the Eurozone (EURO N=11), but this difference is not significant.

Overall, these findings do not support hypothesis 1.

4.2.3 Cash-to-Cash Flow Sensitivity of the “Most Affected” Countries

The hypothesis 2 postulates that the sensitivity of cash to cash flow increases in the group of the most affected countries in the post-crisis period. We test the differences of cash sensitivity to cash flow between the most affected group (Spain, Ireland, and Portugal) with Eurozone cash average. Therefore, and following the intuition of Almeida *et al.* (2004), we modeled equation (3) applying the *difference-in-differences* technique aiming to analyze the differences between the group of the most affected countries by the financial crisis and the full sample. Thereby, to test hypothesis 2 we estimate several alternative specifications of equation (3):



$$\begin{aligned} \Delta CASH_{i,t} = & \\ & \alpha_i + \beta_1 CF_{i,t} + \beta_2 CF_{i,t} \times Most\ Affected_i + \beta_3 Most\ Affected_i \times Post_t + \beta_4 CF_{i,t} \times Most\ Affected_i \times Post_t + \\ & \beta_5 Most\ Affected_i + \beta_6 Post_t + \beta_7 CF_{i,t} \times Post_t + \beta_8 M/B_{i,t} + \beta_9 Size_{i,t} + \lambda_k + \eta_j + \gamma_t + \\ \varepsilon_{it} & \quad (3) \end{aligned}$$

Where the dependent variable $\Delta CASH$ is cash and marketable securities scaled by total assets. α_i is the intercept that captures the unobservable heterogeneity of the individual specific effects of each firm. $CF_{i,t}$ Is the net income plus depreciation and amortization expenses scaled by total assets? *Market to book* is measured as the market value of equity plus the book value of assets minus the book value of equity scaled by the book value of total assets. *Size* is the logarithm of total assets. In order to observe the differences in cash sensitivity to cash flow in the group of the most affected countries post-crisis, we include two binary variables: i) *Most Affected_i* is an indicator variable equal to one if a firm is established in a country of the most affected group (Spain, Ireland, and Portugal), and zero otherwise; ii) *Post* is an indicator variable equal to one in the subperiod 2012-2014, and zero otherwise. Our main variable of interest is the triple interaction $CF_{i,t} \times Most\ Affected_i \times Post_t$, which captures the change in cash-to-cash flow sensitivity for firms from the most affected countries in the post-crisis period. $\lambda_k, \eta_j, \gamma_t$ are a set of dummies to control for country, industry, and year, respectively. Table 9 reports the results.

As predicted by hypothesis 2, the coefficient of interest $\beta_4 (CF_{i,t} \times Most\ Affected_i \times Post_t)$ is positive and statistically significant. As we can observe in Table 9, the coefficients' estimates of our variable of interest are positive and significant in models 1, 2, and 3. Despite the lack of significance in models 4 and 5, the estimates of coefficients $\beta_1, \beta_2, \beta_4, \beta_7$ present jointly significance, as observed in the last two rows of Table 9 (except for model 5).

Taken together, these results suggest that cash sensitivity to cash flow increase in the post-crisis period for the group of firms from the most affected countries. This finding is consistent with previous literature, e.g, Almeida et. al. (2004) and Han and Qiu (2007), which predicts that more financially constrained firms save more cash out of cash flow to preserve current and future operations and investment activities. Overall, the results provided by Table 9 supports hypothesis 2.

Table 9-Cash-to-Cash Flow Sensitivity

Table 9 presents regression estimates of equation (3) using different specifications for a sample of listed companies from Euro-adhering countries by 2001, excluding Luxembourg, during the 2001-2015 period. We exclude financial firms (SIC Code 6000-6999) and strictly regulated firms (SIC Code 4900-4949). Our panel set includes 1133 different firms, which corresponds to 9744 firm-year observations. The dependent variable is Cash (cash and marketable securities scaled by total assets). C is the intercept term. The independent variables are the following: CF (net income plus depreciation and amortization expenses scaled by total assets); Market to book (market value of equity plus the book value of assets minus the book value of equity scaled by the book value of total assets); Size (logarithm of total assets). Most Affected is a dummy variable equal to one if a firm i is based in the group of the most affected countries (Spain, Ireland, and Portugal), and zero otherwise. Post is a dummy variable equal to one for the superperiod 2012-2014 (post-crisis subperiod), and zero otherwise. Robust t Statistic in parentheses. In model 2 (3) standard errors are clustered by firm (country) and year. In model 4 (5) we estimate fixed-effects by firm (country). OLS means Ordinary Least Squares and FE means Fixed Effects. The last two rows report the sum and the respectively p-value of the coefficients [$CF + CF \times Most\ Affected \times Post + CF \times Most\ Affected + CF \times Post$]. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively.



<i>Model</i>	<i>1 OLS</i>	<i>2 OLS (year, firm))</i>	<i>3 OLS (year, country)</i>	<i>4 FE (firm)</i>	<i>5 FE (country)</i>
<i>Dependent Variable</i>	CASH				
<i>C</i>	0.2124*** (26.46)	0.2124*** (9.52)	0.1458*** (7.76)	0.2825*** (6.12)	0.2825*** (10.19)
<i>CF</i>	-0.0128 (-1.19)	-0.0128 (-0.37)	-0.0193 (-0.90)	0.0464*** (2.88)	0.0464* (1.91)
<i>CF x More Affected</i>	-0.3123*** (-6.19)	-0.3123*** (-3.03)	-0.2885*** (-2.77)	-0.0777 (-0.83)	-0.0777 (-1.15)
<i>More Affected x Post</i>	-0.0212 (-1.64)	-0.0212* (-1.95)	-0.0207 (-1.01)	0.0120 (1.11)	0.0120 (0.70)
<i>CF x More Affected x Post</i>	0.3097*** (3.05)	0.3097** (2.05)	0.2914 (1.39)	0.0577 (0.39)	0.0577 (0.32)
<i>More Affected</i>	-0.0186*** (-2.74)	-0.0186 (-1.52)	-0.0236 (-0.91)		
<i>Post</i>	-0.0036 (-0.84)	-0.0036 (-0.75)	0.0029 (0.38)	-0.0384*** (-3.23)	-0.0384*** (-10.81)
<i>CF x Post</i>	0.0213 (1.12)	0.0213 (0.46)	0.0259 (0.63)	0.0344 (1.51)	0.0344*** (3.46)
<i>M/B</i>	0.0301*** (22.57)	0.0301*** (7.11)	0.0268*** (4.25)	0.0081*** (3.08)	0.0081*** (4.43)
<i>Size</i>	-0.0133*** (-13.14)	-0.0133*** (-5.32)	-0.0106*** (-4.88)	-0.0149** (-2.33)	-0.0149*** (-3.82)
<i>R²</i>	0.109	0.109	0.143	0.054	0.054
<i>CF + CF × Most Affected × Post + CF × Most Affected + CF × Post</i>	0.0059	0.0059	0.0095	0.0608	0.0608
<i>P-Value</i>	(0.0030)	(0.0025)	(0.0483)	(0.0865)	(0.1998)

5. Conclusions

In this study we test if Eurozone public companies hold more cash after the most recent financial crisis, beginning in 2008, compared to the pre-crisis period. Using a sample of Eurozone listed companies over 2001-2015, our final panel set includes 1133 firms, which corresponds to 9744 firm-year observations.

Contrary to previous literature (e.g., Akguc and Choi, 2013; Pinkowitz *et al.*, 2016), which provide evidence that cash holdings of companies based in the U.S. and Europe increase after the most recent financial crisis in the post-crisis period, our findings suggest that, on average, listed firms based in Eurozone countries do not hold more cash in the post-crisis period than in the pre-crisis period. On average, our results do not support our hypothesis 1. However, our findings show evidence that the sensitivity of cash to cash flow increase in the post-crisis period for firms from the most affected countries by the financial crisis (Spain, Ireland, and Portugal). Our results support hypothesis 2. This finding is consistent with the evidence provided by Almeida *et al.* (2004) and Han and Qiu (2007); more financially constrained firms save more cash out of cash flows to preserve current and future investment.

For the best of our knowledge, this is the first study to provide evidence about cash sensitivity to cash flow for Eurozone companies, especially, companies from the most affected countries by the most recent financial crisis.



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