

Transnational monetary institution and corporate cash holdings: Evidence from public and private firms in Europe¹

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Abstract

We examine how Eurozone membership impacts the cash holdings of public and private firms in Europe from 2002-2019, focusing on the effects of transnational monetary institutions on corporate liquidity decisions. Due to the removal of within-zone exchange risk and the resulting lower cash transaction demand in the single currency zone, we find that cash-to-asset ratios are lower in the Eurozone than in non-Eurozone countries. While public firms have greater liquidity than private firms across Europe, the difference in cash ratios is greater in the Eurozone, reflecting a market-based adjustment mechanism, which directly affects public firms more than private ones.

Keywords: Corporate cash balance, exchange risk, transnational monetary institution, Eurozone, private firms

JEL codes: G30, G32, G15, F30

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1. Introduction

Considering corporate cash balances in a cross-country setting requires an incorporation of transnational economic institutions beyond the determinants of corporate liquidity and risk management decisions in a single country setting. This is particularly true when one considers corporate cash balances in Europe. Europe has differing regimes of transnational economic institutions - the European Union (EU) with its own set of distinct governance and institutions beyond national institutions, vs. non-EU, and within EU, the Eurozone representing the European monetary union with a single currency. We focus on the differential effect of the transnational European monetary institution (i.e., the Eurozone) that formed a single currency block, with and without the EU. We argue that the single currency zone pertaining to the Eurozone vs. non-Eurozone influences transaction demand for cash, as well as the agency cost (or organizational slack of cash) in a unique way. Taking advantage of these distinctive monetary institutional environments in Europe, we examine corporate cash holding behaviors in Eurozone vs. non-Eurozone, and with additional investigation of different liquidity in public and private firms, in 33 European countries.

North (1990, 1991) provides a basic theoretical framework of new institutional economics by examining the effect of institutions and institutional changes on economic performance. In management literature, institutions or institutional changes enable or constraint corporate activities at both macro and micro levels (Campbell, 2004) and confer organizational legitimacy during conditions of complexity (Kostova and Zaheer, 1999). Internationally, Aguilera and Groggaard (2019), Moore, Brandl, and Dau (2019) and others recognize the institutional schisms between national and transnational institutions and their implications. Mundell (1961) develops a theory of optimum currency area, embodied in the Eurozone, a transnational monetary institution within the EU.

Amidst concerns over corporate liquidity, there is a growing literature on corporate cash holdings, but most empirical work focuses on cash holdings of listed public firms in the U.S. (e.g., Opler, Pinkowitz, Stulz and Williamson, 1999; Almeida, Campello and Weisbach, 2004; Bates, Kahle and Stulz, 2009). The study of

UK firms by Ozkan and Ozkan (2004) is also limited to cash holdings of public firms without examining the Eurozone issue.²

In most countries, private firms comprise a dominant share of the economy. Our tabulation of the European data for all firms other than those in finance and utilities from Standard & Poor's (S&P) Capital IQ indicates that private firms comprise 98% of all firms in numbers, 35% of total corporate assets, 35% of total sales, and 41% of after-tax corporate profits in 33 European countries in 2019.³ Studies on cash holdings of private firms are relatively few and for U.S. firms (e.g., Gao, et al. 2013; Farre-Mensa, 2017), showing higher cash holdings by public firms relative to private firms. Two studies on selective European sample show contradicting results: Mortal et al. (2020) report lower cash holdings by private firms due to higher borrowing cost, while Asimakopoulos et al. (2019) show private firms exhibit higher cash holdings than public firms; and neither compare corporate cash balances in Eurozone vs. non-Eurozone.

We use a unique dataset from S&P Capital IQ for 33 European countries for 18 years from 2002 to 2019 and estimate cash balance models for public listed firms and private unlisted firms with respect to the effects of the EU, the Euro, and the European financial crisis. We find that corporate cash ratios are lower in the Eurozone than in non-Eurozone countries. We attribute this difference to a lower transaction demand for cash stemming from the adoption of a single currency in the Eurozone. However, the difference in cash ratios between public and private firms is higher in the Eurozone than in non-Eurozone countries. This reflects a combination of two opposing factors. First, the precautionary cash demand is higher in the Eurozone due to the risk and pitfalls of conducting national economic adjustment without exchange rate as a policy instrument. Bodt, Lopez, and Schwienbacher (2013) show that the introduction of the Euro led to an increase in the systemic risk of banks in the Eurozone. If so, this can lead to an increase in precautionary demand for cash in that region.

Second, economic adjustments in the Eurozone primarily operate through the public market (i.e., public traded markets for interest rates, financial transfers, or asset prices), thus influencing publicly listed firms

² For instance, Dittmar, Mahrt-Smith and Servaes (2003), Ferreira and Vilela (2004), Pinkowitz, Stulz and Williamson (2006, 2013), Kalcheva and Lins (2007), and Iskandar-Datta and Jia (2012). Pinkowitz et al. (2012) have a section on the aggregate cash balances of U.S. private firms using the aggregate Federal Reserve flow of funds data but does not include firm-level results.

³ In the U.S., Asker, Farre-Mensa and Ljungqvist (2015) estimate that private firms accounted for about 69% of total private sector employment, 59% of total sales, and 49% of aggregate pre-tax profits in 2010.

more directly than private firms. Namely, the extent to which public firms have higher cash ratios than private firms is greater in the Eurozone than in non-Eurozone countries. The different channel in terms of traded public vs. non-traded private markets is related to McKinnon's (1963) criterion in terms of traded vs. non-traded goods and services in an optimum currency area (Mundell, 1961).

We further analyze the effects of the European financial crisis and show how the difference between public and private firms' cash holdings increases even more during the crisis period in Eurozone countries compared to non-Eurozone countries.

As a robustness test, we perform transition analysis. We consider two subsamples of firms that underwent a transition from private to public through an IPO, or from public to private by delisting. Consistent with the main results, we find that the cash ratios of pre-IPO firms increased by 2.6% (1.81%) after the IPO for firms in Eurozone (non-Eurozone), whereas average cash ratio of pre-delisting firms decreased by 0.76% (1.15%) for firms in Eurozone (non-Eurozone).

To address the concern over the endogeneity of being a public vs. private firm, we use a two-stage instrumental variable method, where the instruments include the number of years since a country applied for EU membership, the industry fraction of total sales by public firms, a dummy indicating whether a country is one of the original eleven core members of the Eurozone, as well as predetermined firm variables. The results confirm our baseline findings: firms in Eurozone countries hold less cash relative to asset and the difference in cash ratios between public and private firms is higher. A separate two-stage analysis based on the Heckman self-selection bias test adds to the robustness of the result.

To our knowledge, our paper is the first large-scale multi-country study that examines the impact of Eurozone membership on cash holdings of publicly and privately held companies. In Europe (with the possible exception of the U.K.), listed public firms do not have as much of a dispersed ownership structure as they do in the U.S., implying a smaller ownership-related agency problem in Europe than in the U.S.⁴

⁴ Barca and Becht (2001), for example, show that in Austria, Belgium, Germany, and Italy, a single blockholder or a linked group of investors hold more than 50% of voting stocks in about 50% of the listed non-financial firms. The percentage was 43.5% in the Netherlands, 34.5% in Spain, 34.9% in Sweden, and 20% in France. This suggests that the ownership-related agency problems of European public firms may be smaller than those of U.S. public firms. Since the agency problems provide one reason for public firms having higher cash ratios than private firms (e.g. Gao, et al. (2013)), it follows that the difference in cash ratios between public and private firms is smaller in Europe than in the U.S. given the higher precautionary demand for cash by private firms relative to public firms in both regions.

Using a large cross-country firm-level data in Europe, we demonstrate how the differences in transnational monetary institution (e.g., the Euro) influence cash holdings of public vs. private firms across Europe.

The rest of the paper proceeds as follows. In section 2, we briefly review the literature on cash holdings and develop our hypotheses. In section 3, we describe our sample construction and provide summary statistics. We discuss the main empirical results in Section 4 and further empirical analysis in Section 5. In Section 6 we conclude.

2. Literature and Empirical Hypotheses

In this section, we briefly discuss the literature on corporate cash holding and develop hypotheses concerning the cash holdings of firms in Eurozone vs. non-Eurozone, and of private vs. public firms.

2.1. Existing work on corporate cash holdings

Outside the perfect market world of Miller and Modigliani (1958), the case for corporate demand for cash depends, among other things, on the value of financial flexibility that cash balances help bring out, as well as how the firm is owned and operated. According to a survey of Chief Financial Officers (CFOs) by Graham and Harvey (2001), financial flexibility is at the top of the issues that influence corporate finance decisions. Denis (2011) provides an overview of the literature on financial flexibility and cash holdings. The implication for the present work is that public and private firms may have different cash ratios because they have different degrees of financial flexibility – private firms face more financial frictions than public firms do (Saunders and Steffen, 2011).⁵

With uncertainty in the firm's cash flow or sales growth, the firm's cash holdings depend on the availability of internal *precautionary* funds, and the firm's ability to obtain external funds. Thus, a firm with current or anticipated financial constraints will hold more cash to minimize an adverse effect in the future (Almeida, Campello and Weisbach, 2004; Faulkender and Wang, 2006). Firms also hold cash in response to

⁵ With market frictions, a firm's financing decisions are not separable from its investment decisions, and a decision to hold cash is related to a firm's investment and dividend decisions as well as its financial conditions. Kaplan and Zingales (1997) find that firms with less financial constraints exhibit greater investment sensitivities to cash flow than firms that are more financially constrained. Almeida, Campello and Weisbach (2011) also study the linkages between financing constraints and investments in situations in which firms expect costly financing. Since the availability of internal funds helps reduce financing constraints, there is a level of interdependence between investment and financing decisions, including cash management.

expected and unexpected changes in the firm's cash flows or growth opportunities (Opler, Pinkowitz, Stulz and Williamson, 1999; Bates, Kahle and Stulz, 2009). Ang and Smedema (2011) document that even financially unconstrained firms are more likely to build cash balances if they anticipate a future economic recession. Duchin, Ozbas and Sensoy (2010) argue that an excess cash reserve is beneficial, especially during the financial crisis, when funding for investments is tight.

Almeida et al. (2011) consider intertemporal links between financing constraints and investments. In their generic cash balance model with binding credit constraints, capital budgeting rules are biased towards a project that generates early cash flows, but the effects of future financial constraints are alleviated with the availability of internal funds. A prediction of their model is that, given the greater financial constraints, private firms attempt to minimize the impact of financial frictions by increasing cash holdings more than public firms. Thus, private firms have higher cash ratios than public firms because of their precautionary demand for cash and the desire not to fail on funding a good investment project.

Another motive for corporate cash holdings is *agency* considerations. Jensen (1986) argues that an entrenched manager tends to build cash reserves rather than pay them out to shareholders even when the firm has poor investment opportunities. However, holding large cash balances can be value-destroying because excess cash reserves tend to increase both agency problems and opportunity costs. Several papers examine corporate cash policy from the agency perspective (Harford, 1999; Dittmar and Mahr-Smith, 2007; and Harford, Mansi, and Maxwell, 2008). Harford et al. (2008) find that firms with poor governance spend cash quicker than those with better governance. Similarly, Dittmar, Mahr-Smith and Servaes (2003) show that firms in countries with more agency problems tend to hold more cash.⁶

Gao et al. (2013) use agency cost to explain their finding that private firms have lower cash ratios than public firms in the U.S. This result is also confirmed by Farre-Mensa (2017), but his explanation is based on the cost of disclosure by public firms. Since public firms cannot be selective in releasing firm-specific

⁶ One additional explanation for cash holdings is taxes. Foley, Hartzell, Titman and Twite (2007) argue that U.S. multinational firms hold a larger amount of cash than domestic firms because international cash reserves can assist in reducing overall corporate taxes. Parenthetically, Bates et al. (2009) attribute the recent increase in cash holdings by U.S. firms to changing firm characteristics. Subramaniam, Tang, Yue, and Zhou (2011) investigate whether firm structure affects cash holdings and find that diversified firms have significantly higher cash ratios than focused firms. Denis and Sibilkov (2011) show that when firms have high hedging needs (i.e., when the correlation between cash flows and investment opportunities is low), cash holdings allow constrained firms to invest more.

information, they face a “two-audiences problem” (Farre-Mensa, 2017): on one hand, more information reduces the firm’s cost of capital due to reduced information asymmetry; on the other hand, competitors can exploit information. Private firms can be selective in revealing confidential information to specific investors, hence reducing potential misvaluation concerns. Similarly, Mortal et al. (2020) use a Western European sample and show that private firms hold less cash than public firms, which they attribute to fact that private firms face higher borrowing cost compared to public firms. However, two studies (Hall et al., 2014; Asimakopoulos et al., 2019) report the opposite results that private firms hold more cash than public firms.

In sum, cash balance decisions of public firms depend, among other things, on the level and nature of market frictions and their impact on precautionary demand, as well as agency problems characterized by the governance and operational profile of the firm. In the next section, we develop hypotheses focusing on the impacts of international monetary institution, i.e., the Eurozone vs. non-Eurozone.

2.2. Hypotheses concerning Eurozone vs. non-Eurozone

The Eurozone, as transnational monetary institution, is an embodiment of an optimum currency area theory of Mundell (1961). With national currency with flexible exchange rates, firms are subject to exchange risk, along with the impacts of financial and operational hedging (e.g., Choi and Jiang, 2009; Bartram, Brown and Minton, 2010). Since the creation of the Euro is tantamount to the elimination of national currencies of member countries, we would expect a reduction in transaction demand for cash in the Eurozone due to the removal of the costs of currency conversions and risk management within the European monetary union (EMU). This leads to Hypothesis 1.

Hypothesis 1: Corporate cash ratios are lower in the Eurozone than in non-Eurozone countries.

As discussed in the previous section, one of the principal reasons why firms hold cash is to provide a precautionary cushion in the event of an unexpected adverse shock. Since external capital is costly relative to internal funds, given market frictions, firms may miss out on some projects that are value-enhancing (Myers

and Majluf, 1984) or may be forced to contract by selling assets at unfavorable prices to generate cash reserves. Firms with a particularly prohibitive cost of external financing may consider increasing their internal funds and cash reserves in order not to miss out on valuable investments (Denis and Sibilkov, 2011). Since frictions are costly for financially constrained firms, cash holdings are more valuable for them than for unconstrained firms (Faulkender and Wang, 2006; Pinkowitz, Stulz, and Williamson, 2006). Both reasons – financial frictions and precautionary demand – suggest that private firms, which have greater financial constraints, should have greater cash holdings relative to total assets than public firms.

On the other hand, private firms may have smaller agency problems hence lower cash ratios than public firms. Private firms have fewer shareholders and are often managed by owner-managers, garnering benefits of private controls and operational flexibility. When a firm goes public, its manager or inside owners will have to accept some degree of external controls, which may remove managerial and operational flexibility, although the firm may thereby gain easier access to capital (Pagano, Panetta and Zingales, 1998). Moreover, if a manager's interests are not totally aligned with those of the company's shareholders, agency problems may worsen (Jensen and Meckling, 1976) with potentially profound consequences if the firm faces financial hardships or when the market is in crisis. Private firms, in contrast, are subject to a lower level of shareholder monitoring or interference. Whether private firms have higher or lower cash ratios than public firms then depends on the trade-off between the effects of agency cost vs. the precautionary demand for cash due to financial frictions. To the extent that the agency cost (private firms have less agency costs than public firms) is a stronger factor than the effect of financial frictions (private firms have higher precautionary cash demand than public firms), private firms should hold less cash as a percentage of total assets than public firms.⁷ In Eurozone, a firm's precautionary cash demand may be higher than comparable firms outside Eurozone due to the difficulty of policy coordination in the Eurozone, i.e., the difficulty of conducting national economic adjustments without changes in exchange rate as a policy tool that influence interest rate, inflation as well as trade and real economy: "The euro had taken away two adjustment mechanisms [exchange rate and interest rate] and put nothing in their places" (Stiglitz, 2013, p276). In the face of a negative external

⁷ We are neutral on the effect of operational flexibility and private controls on cash holdings. While this could arguably enhance firm performance, there is also a possibility of private expropriation of firm resources. The net effect of these on cash holdings is unclear.

shock, currency devaluation could make the country competitive and help revive the economy. This inflexibility with monetary union is exasperated when there is no fiscal union, as is the case in Eurozone. This shortfall affects public firms directly compared to private firms because both national and zone-wide economic policy adjustments often operate through the market (e.g., interest rates, asset prices, financial transfers, bond purchases). Publicly traded firms are more directly influenced to these influences relative to private firms, which are not openly traded in the market. Therefore, the extent to which public firms have higher cash ratios than private firms should be larger in the Eurozone than in non-Eurozone countries.

***Hypothesis 2:** Private firms hold less cash as a percentage of total assets than public firms if the agency cost is a greater factor than the effect of financial frictions; conditional on that, the extent to which public firms have higher cash ratios than private firms is greater in the Eurozone than in non-Eurozone countries.*

We expect that the effects on cash holdings in and out of the Eurozone as delineated above would have been especially intense during the European financial crisis. Duchin, Ozbas and Sensoy (2010) document a significant decrease in corporate investments by U.S. firms following the global financial crisis and show that a decrease in investment is greater among financially constrained firms and firms with low cash reserves. In the Eurozone, the difficulty of conducting economic adjustment without exchange rate changes as a policy instrument is exacerbated by austerity programs adopted by (or forced upon) many EMU countries during the financial crisis. Bodt, Lopez and Schwiendbacher (2013) report an increase in the systemic risk of banks in the Eurozone after the adoption of the Euro. Given that the European financial crisis was more intense in the Eurozone compared to non-Eurozone, firms in Eurozone countries are likely to have more liquidity problems and hence lower cash ratios compared to firms in non-Eurozone countries during the European financial crisis.

***Hypothesis 3:** The effect of the European financial crisis on corporate cash holdings is greater in the Eurozone than in non-Eurozone countries.*

3. Data and Univariate analysis

This section describes how the sample is constructed from the raw data, presents descriptive characteristics of firm-specific variables, and discusses cash ratios and other variables for private versus public firms in a univariate context.

3.1. *Sample construction*

The main data source for this study is Standard and Poor's (S&P) Capital IQ (CIQ) database. CIQ provides firm-specific data for a large sample of publicly traded and privately held firms globally. Private firms in the CIQ are unlisted firms with audited statements, who may have prior issuance of public debt.⁸ To construct a usable dataset, we start with all the firms listed in the database from 45 European countries that have non-missing entries in their total assets from 2002 to 2019. We exclude firm-year observations with total assets accounting to less than \$1 million. As is customary in empirical corporate literature, financial institutions (SIC codes between 6000 and 6999) and regulated utilities companies (SIC codes between 4900 and 4949) are excluded. We require firms to have at least two years of non-missing data for key variables to be able to calculate growth rates. We exclude firm-year observations with inconsistent financial information such as negative assets, revenue or debt, as well as those with missing cash and cash equivalents variables. Finally, we require countries in the sample to have at least 100 firm-year observations.

One important feature of the Capital IQ database is that it classifies a firm as public or private based on the firm's latest status. To correctly classify the contemporaneous status of firms, we searched all corporate event dates and identified initial public offerings (IPOs) and delistings from the stock exchanges. We then reclassified the firm-year observations as public or private based on these key dates⁹. We also excluded firm year observations for 2,560 IPOs and 1,878 delistings to make sure we correctly accounted for differences in cash holdings between public and private firms. (We will examine the effects of status changes due to IPO and delisting in a separate robustness analysis later). After applying the screening as discussed above and adjusting firm status based on IPOs and delistings, the final sample includes 4,133,713 firm-year observations

⁸ U.S. private firms, in contrast, are not required to report their financial statements publicly unless they have issued public bonds or have more than 500 shareholders.

⁹ For example, if a firm did an IPO in 2012 and has financial information from 2002 to 2019, CIQ classifies this firm as public in all years. As a result of detailed event date checks, we corrected this designation error and reclassified the firm as private for 2002-2012 and as public for 2013-2019

(or 462,172 unique firms) in 33 countries. This consists of 4,066,303 private firm-year observations (or 458,293 unique private firms) and 67,410 public firm-year observations (or 5,943 unique public firms).¹⁰

Table 1 provides the number of firm-year observations for public vs. private firms by country, grouped them into developed Europe or emerging Europe following CIQ's classification. One striking result to note, in panel A, is that 98.4% of all observations represent private firms and only 1.6% represent public firms, indicating the dominance of private firms in an economy. Three countries with the most frequency of observations are Italy, France, and the U.K. As is typical in broad firm samples, areas of manufacturing, transportation, and business services, as well as wholesale and retail industries are well represented. Finance and utilities are excluded. The sample is representative of all 48 Fama-French industry (Fama and French, 1997) categories for both public and private firms.

[Insert table 1 about here]

3.2. Univariate analysis

Table 2 presents descriptive statistics for key firm-specific variables for all public and private firms in the “All Europe” raw sample (33 countries) in panel A. Detailed definitions of variables are provided in Appendix A1. For cross-country analysis, all monetary accounts are expressed in 2019 U.S. dollars using the consumer price indices from the U.S. Bureau of Labor Statistics. All continuous variables are winsorized – within each country and by private and public firms separately – at the bottom and top 1% levels to reduce the effect of outliers. Pairwise correlations in panel B show that public firms are significantly correlated with the dividend dummy (0.61) and the natural log of total assets (0.25). These findings are confirmed in the descriptive statistics of variables in panel A: 51.4% of all public firms pay dividends while only 0.3% of private firms pay dividends, for instance. As expected, public firms are much larger in total assets and sales revenues than private firms in the raw sample: public firms have a mean asset size of \$ 2,640.6 million compared to \$50.7 million for private firms. Public firms also have larger sales revenues than private firms (\$2058.1 million vs. \$54.6 million in means). Public firms are older than private firms (54 years old vs. 27). Average sales growth and operating cash flows as a percentage of total assets are also larger for public firms

¹⁰ Numbers do not exactly add up due to the firms that changed ownership status by IPOs and delistings. The effects of tracking firm ownership changes will be examined later in the paper.

than for private firms. However, private firms have bigger net working capital and acquisition expenses over total assets than public firms. Private firms have lower long-term debt and higher short-term debt compared to public firms. Later in the robustness analysis, we will examine the case of the matched public and private samples based on industry-size matching and propensity scores matching.

[Insert table 2 about here]

The key variable of interest is the ratio of cash and cash equivalents to total assets. Table 3 presents summary statistics for cash ratios by countries grouped by “developed” or “emerging Europe” in panel A and by their membership in the EU and Eurozone in panel B, both differentiated by public vs. private firms. In panel A, we make an observation that cash ratios are much greater for firms in the developed region than those in emerging Europe (13.98% for public firms and 11.43% for private firms in the developed countries, and 7.40% and 6.40%, respectively, in the emerging markets). These cash ratios generally reflect the level of development of the monetary sector in these regions. Interestingly, another observation shows the difference between the regions is greater for public firms than for private firms (6.58% for public firms vs. only 5.03% for private firms). Within a country or region, these numbers also indicate that the monetary sector is better developed in the (traded) public firm sector than in the (non-traded) private firm sector. These two aforementioned observations put together determine the difference between public and private firms to be larger and significant in developed Europe (2.55%) than in emerging Europe (1%), as observed in Panel B of Table 3. Panel B also shows that the volatility of cash ratios is greater for public firms than for private firms. We will examine the implications of this heterogeneous tradeoff between the mean and volatility of cash ratios for public versus private firms across regions in the context of multivariate analysis later.

[Insert table 3 about here]

In Panel B of Table 3, countries are grouped into five categories: EU member countries, Eurozone countries, non-EU Europe, non-Eurozone countries, and All Europe.¹¹ In classifying countries into these

¹¹ EU countries, and the year they joined the EU (or EC, as the EU was previously called), are: Austria (1995), Belgium (1952), Bulgaria (2007), Croatia (2013), Cyprus (2004), Czech Republic (2004), Denmark (1973), Estonia (2004), Finland (1995), France (1952), Germany (1952), Greece (1981), Hungary (2004), Ireland (1973), Italy (1952), Latvia (2004), Lithuania (2004), Luxembourg (1952), Malta (2004), the Netherlands (1952), Poland (2004), Portugal (1986), Romania (2007), Slovakia (2004), Slovenia (2004), Spain (1986), Sweden (1995), and the U.K. (1973). Countries in the Eurozone with the year they started using the Euro as their national currency are: Belgium, Germany, Ireland, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Portugal, and Finland (1999),

groups, we considered the year in which the country joined the EU or the Eurozone and used it in country classification. The univariate results in Panel B are similar to those obtained in Panel A: public firms have higher cash ratios than private firms in All Europe. The mean (median) cash ratios are 13.05% (7.82%) for public firms and 11.42% (5.41%) for private firms. The average differences in cash holdings, both in mean (1.63%) and median (2.41%), are statistically significant at the 1% percent level.¹² These results provide a tentative support of Hypothesis 1 (H1), that public firms have higher cash ratios than private firms. Cash ratio volatility is also slightly higher for public firms (7.48%) than for private firms (6.72%).

Panel B shows that corporate cash ratios are lower in the Eurozone than in non-Eurozone countries by 4.37% of assets, tentatively supporting Hypothesis 2 (H2). This is due to the reduction in transaction demand for cash with the elimination of national currencies in the Eurozone. The difference in cash ratios between public and private firms, however, is 2.24% in the Eurozone compared to -1.21% in non-Eurozone countries, tentatively supportive of Hypothesis 3. This is due to the increase in precautionary demand for cash in the Eurozone stemming from policy coordination risk, given the absence of exchange rate changes as a policy tool. We will revisit these issues in a multivariate context in the next section.

To identify whether there is a statistically significant time trend in average cash ratios, we also estimate a simple linear relationship between cash ratio and year. Using this method, Bates et al. (2009) show that the time trend is positive and statistically significant for cash holdings of U.S. public firms for 1980-2006. For our 33-country European sample for 2002-2019, the results are similar for public firms. The coefficient on the time trend is positive and highly significant (p-value below 0.01) in most sub-samples.¹³ Figure 1 shows the evolution of cash ratios over time graphically. Public firms have higher cash ratios than private firms every year in the sample for EU and Eurozone samples. However, in the non-Eurozone, cash holdings of private firms are higher than those of public firms after 2006. These results underscore time-

Greece (2001), Slovenia (2007), Cyprus (2008), Malta (2008), Slovakia (2009), Estonia (2011), and Latvia (2014). Non-EU European countries are Iceland, Norway, Switzerland, Croatia, Serbia, and Ukraine.

¹² When we adjust the mean cash holding by subtracting the industry median, the public firms still have 3.3% higher cash ratios than private firms, indicating that the difference in cash holdings is not driven by different industry distribution between public and private firms.

¹³ The annual increase in average cash ratios is larger for Eurozone private firms (0.3%, $R^2=95.8\%$) than for Eurozone public firms (0.12%, $R^2=75.1\%$). Outside the Eurozone, the coefficients remain positive and significant, and larger for private than for public firms. The trend in median cash holdings also follows a similar pattern as the mean cash holding. The overall evidence is consistent with a positive and significant time trend in cash ratios over the 2002-2019 period for both public and private firms in Europe.

variant heterogeneity in the behavior of cash holdings across different European groups influenced by the EU and the adoption of the Euro.

[Insert Figure 1 about here]

4. Main Empirical Results

In this section, we estimate the baseline cash balance model for a panel of firm data from 33 European countries classified under EU, Eurozone, non-EU Europe, and All Europe headings. After the estimation of the baseline cash balance model used in existing work, we examine the role of the Euro and the European financial crisis, and country risk and financial sector development. We then address such methodological issues as the matching sample, changing firm-year observations due to IPOs and delistings, and endogeneity of firm status.

4.1. The baseline model

We first estimate a baseline model of cash balances to assess Hypothesis 1 and 2 regarding the relative cash ratios of private vs. public firms in Eurozone and non-Eurozone countries in a multivariate setting. The baseline model is based on Opler et al. (1999) and Bates et al. (2009), however since the market-to-book ratio in their model is not available for private firms, we adapt the model to include sales growth instead following Michaely and Roberts (2011), and Asker et al. (2015).

The baseline model is as follows:

$$\begin{aligned}
 Cash_{it} = & \beta_0 + \beta_1 Public_i + \beta_2 EMU_i + \beta_3 (EMU * Public)_i + \beta_4 Ln(Total\ asset)_{it} + \\
 & \beta_5 (Cash\ flow)_{it} + \beta_6 (CF\ volatility)_{it} + \beta_7 (Sales\ growth)_{it} + \beta_8 (Leverage)_{it} + \beta_9 (NWC)_{it} + \\
 & \beta_{10} (Dividend)_{it} + \beta_{11} (PP\&E\ growth)_{it} + \beta_{12} (R\&D)_{it} + \beta_{13} Ln(Firm\ age)_{it} + \\
 & \beta_{14} Ln(Bus.\ segments)_{it} + year + industry + country + \varepsilon_{it} \quad (1)
 \end{aligned}$$

We estimate equation (1) using a pooled ordinary least square where standard errors are adjusted for clustering by country and year, allowing for serial correlation within clusters. The dependent variable is the cash ratio - the cash and cash equivalents scaled by total assets. For independent variables, *Public* is a dummy variable that takes a value of one for public firms and zero for private firms; *Ln(Total asset)* is the firm size

measured by the natural logarithm of total assets; *Cash flow* is the operating cash flow scaled by total assets; *CF volatility* is the standard deviation of cash flow for each firm for all available years; *Sales growth* is the growth rate of sales revenue from t-1 to t; *Leverage* is the total debt scaled by total assets; *NWC* is the net working capital calculated as (current assets - current liabilities – cash and cash equivalents) scaled by total assets; *Dividend* is a dummy variable which takes a value of one for dividend-paying firms and zero for non-paying ones; *PP&E growth* is the net growth in property, plant, and equipment; *R&D* is a dummy variable which takes a value of one if a firm has positive R&D and zero otherwise; *Ln(Firm age)* is the natural logarithm of firm age; and *Ln(Bus. segments)* is the natural logarithm of one plus the number of business segments in which the firm operates (we set it equal to one if the value is missing).

Table 4 presents baseline regressions comparing cash ratios of private and public firms in the Eurozone and non-Eurozone countries for 2002-2019, controlling for country, year, and industry. In columns 1, 2, and 3, the Eurozone dummy, which takes a value of one if a firm is in a Eurozone country, is negative and significant at the 1% level, implying that both public and private firms in the Eurozone have lower cash ratios than firms in non-Eurozone countries after controlling for various firm characteristics. This provides further support for Hypothesis 2 in a multivariate setting and confirms our earlier univariate results. This difference is wider for private firms as indicated by the positive and significant coefficient for the interaction between the Public dummy and the Eurozone dummy.

[Insert Table 4]

Estimation results in column 5 confirm Hypothesis 1 that public firms have higher cash ratios than private firms. Further insight is provided from the interaction terms between the public firm dummy and the Eurozone dummy, which are positive and statistically significant at the 1% level. Economically, the coefficient in column 1 (and column 3) indicates that public firms in Eurozone countries hold on average 6.8% (6.5%) more cash as a percentage of total assets than private firms respectively, while this difference is 5% (4.9%) in non-Eurozone countries. The higher cash holdings of public firms in the Eurozone compared to those in non-Eurozone countries are attributable to the netting of two opposing effects. On the one hand, the replacement of national currencies by a single currency, the Euro, should lower cash holdings due to lower transaction demand for cash. On the other hand, there is an adjustment policy risk, which may increase the

precautionary demand for cash in the Eurozone. In the Eurozone, the loss of exchange rate changes as an effective macroeconomic policy tool may strain the ability of national governments to address fiscal and trade deficits especially in weaker countries in the periphery. This - coupled with the possibility of financial transfers out of stronger core countries to help keep weaker members in monetary union and to help achieve the overall financial stability of the zone - signifies the adjustment policy risk in the Eurozone with a single currency but no fiscal union. The finding by Bodt, Lopez and Schwienbacher (2013) that the systemic risk of Eurozone banks increased since the adoption of the Euro is supportive of this notion.

Outside of the Eurozone, there is still some pressure to act towards achieving the objective of economic union within the EU (or through International Monetary Fund for non-EU countries), but this pressure is much weaker than in the Eurozone because of the availability of exchange rate policy as a macroeconomic policy tool.

The present empirical results reflect such risk differences in and out of the Eurozone. In addition, to the extent that the zone-wide transfers and adjustments take place through market mechanisms and through traded assets, it is likely that the precautionary demand for cash due to Euro-related adjustment policy risk is felt more by public firms in the “traded” sector than by private firms in the “non-traded sector”. It follows that cash ratios are greater for public than for private firms for 2002-2019, and this difference is greater in the Eurozone than in non-Eurozone Europe, supporting Hypothesis 3.

One might raise the concern here that the U.K. is similar to the U.S., rather than Continental European countries, in terms of its dispersed share ownership structure as well as a general emphasis on shareholder value. For instance, Barca and Becht (2001) show that less than 3% of publicly listed companies in the U.K. have shareholders with majority control. Continental Europe, in contrast, has much higher concentrated ownership. In countries like Austria, Belgium, Germany, and Italy, a single blockholder or a connected group of investors holds more than 50% of voting stocks in about 50% of the listed non-financial firms.¹⁴ In contrast, U.K. firms, account for 14.8% of total observations. To mitigate the concern that the basic results reported on cash holdings of public vs. private firms in Europe might be driven by the U.K. firms, we ran the baseline

¹⁴ The percentage of voting stocks controlled by blockholders was 43.5% in the Netherlands, 34.5% in Spain, 34.9% in Sweden, and 20% in France.

cash model by excluding the U.K. Unreported results show that both the Public dummy and the interaction between Public and Eurozone dummy are still positive and statistically significant at 1% level, confirming the results in the baseline model in Table 4.

Economically, comparing our results with Gao et al. (2013) in the context of U.S. firms, we observe that the cash ratios of public vs. private firms in Europe are similar and of greater magnitude. These results are consistent with the findings of Farre-Mensa (2017) and Mortal et al. (2020). As Gao et al. (2013) argue, this is indicative of the market conditions where the extra precautionary motive for holding cash by private firms over public firms is not as strong as the extra cost of agency conflicts in public firms relative to private firms. The smaller gap between public and private firms for Europe can be attributed to lower agency costs in European public firms compared to U.S. ones: The lower agency costs of European firms may be related to a more concentrated ownership structure as well as less emphasis on shareholder interests in Europe (except the U.K.) compared to the U.S.

The coefficients of control variables are generally significant in all samples and consistent with those reported in the static tradeoff model of cash holdings of Opler, Pinkowitz, Stulz and Williamson (1999) and Pinkowitz, Stulz and Williamson (2013).¹⁵ Adjusted R² scores are also consistent with those of existing work on the determinants of corporate cash (21% to 21.9%).

For further robustness, we investigated if country risk or financial sector development might influence corporate cash holdings. Country risk can affect the overall risk environments and hence corporate cash holdings. The state of financial market development in a country might also influence asset liquidity and the extent to which firms may want to keep their assets as cash. As a proxy for country risk, we use the S&P sovereign bond risk ratings, obtained from various public reports including the S&P's "RatingsDirect" sovereign rating report until 2013 and Trading Economics website after 2013. As a proxy for financial market development, we use the ratio of total market capitalization of listed companies to GDP, obtained

¹⁵ On the one hand, firms with higher sales growth, riskier cash flows (i.e., higher cash flow volatility), and firms with positive R&D expenses per asset have higher cash ratios. On the other hand, larger and older firms *ceteris paribus* hold less cash relative to total assets. In addition, firms with higher leverage and higher net working capital and firms that operate in more business segments, have lower cash ratios.

from the World Bank database. The untabulated results show that our baseline results do not change after controlling for macro factors.

We consider the robustness of the present results as well as gaining some new ground, by modifying model specifications to address a variety of issues pertaining to the baseline cash model after we present Eurozone-related results.

4.2. The effect of adopting the Euro: diff-in-diff model

One potential concern is whether the results on corporate cash holdings obtained above are driven by Eurozone entry decisions by countries. To address this concern, we estimate a difference-in-difference model to examine changes in corporate cash holdings before and after the introduction of the Euro. Specifically, a diff-in-diff model is estimated where the first difference is between the Eurozone and non-Eurozone countries before the Euro was introduced, and the second difference is between Eurozone and non-Eurozone countries after the Euro was introduced in 1999. In effect, we net out the change in corporate cash holdings in non-euro countries from the cash change in core-Euro countries before and after the introduction of Euro. We use 11 core-Euro countries as of 1999 for Eurozone in our estimation. For this analysis, we obtained firm-specific data for the period from 1990 to 2019 from S&P's Compustat Global database. Cash ratios in core-Eurozone countries are about 3% lower than non-Eurozone countries after 1999, which is consistent with the ratios in our main sample.

Estimation results are presented in Table 5. The coefficient of the interaction term between core-Euro and Post-1999 is negative and statistically significant at the 1% level, indicating that cash holdings decreased in core-Euro countries after the introduction of Euro. This finding lends further support to our results presented in Table 4 that firms in the Eurozone have lower cash ratios than firms in non-Eurozone countries, reinforcing Hypothesis 2.

[Insert Table 5 about here]

4.3 The European financial crisis

To examine whether cash holdings of firms have been affected by the European financial crisis in and out of the Eurozone, we include a crisis dummy, which takes a value of one in the years 2008, 2009 or 2010 and zero otherwise. We also interact the crisis dummy with Eurozone and Public dummies. Following Mian

et al. (2014), we restrict our data to a period from 2003 to 2015, marking 5 years before and 5 years after the financial crisis period. The results are presented in Table 6, with the Public dummy remaining positive and significant in all specifications. The larger negative coefficient estimates in the Eurozone sample in column 1 (-1.2%) compared to the non-Eurozone sample in column 2 (-0.6%), along with the negative interaction term between Eurozone dummy and crisis dummy indicate that firms in Eurozone members hold less cash than firms in non-Eurozone countries during the financial crisis, providing support for Hypothesis 3. This result is consistent with our earlier discussion about the coordination issues and absence of a monetary policy within Eurozone.

[Insert table 6 about here]

4.4. Endogeneity of firm status

We now consider the possibility that the choice of a firm being public or private is an endogenous decision. That is, it is possible that some unobservable firm-specific factors may affect firm ownership and cash holding decisions simultaneously. In order to address this concern on endogeneity, we use the two-stage instrumental variable approach, as well as Heckman's (1979) two-stage method to correct for sample selection bias.

For instrumental variable estimation, we need instruments that are exogenous yet affect cash holdings solely through the firm's decision on ownership status. We identify three such instruments that influence the decision of a firm to change its ownership status. The first is "years since EU application," which is calculated as the number of years since a country applied for EU membership. The information on this for each country was collected from the EU website. The year of a country's application to the EU is exogenous for the firm but the connection between that and cash balance is roundabout. It is plausible that an EU entry provides certain benefits to the country, including increases in trade and investments, as well as economic growth and free factor movement through an economic integration. This, in turn, may have a positive impact on earnings and stock prices, and on corporate cash holdings. However, since this process and the realization of integration benefits may take time, it may be that private firms in late-entry countries are more likely to go public than those in older member countries to benefit from increased EU integration developed already in the past.

The second instrument is “percentage of sales by public firms” at industry level, which is calculated as the percentage of total sales by public firms in a Fama-French 48 industry framework. Campa and Kedia (2002) use a similar instrument for the decision to diversify to capture the overall attractiveness of a given industry to conglomerates. The logic is that the higher the share of sales by public firms in each industry, the more attractive it will be to private firms considering going public.

The third instrument is a “core Euro dummy,” which takes a value of one if a country is one of the original 11 core Euro founders (i.e., Belgium, Germany, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Austria, Portugal and Finland) and zero otherwise in the 33-country sample.

In the first stage, we estimate a probit model on a firm’s choice of an organizational form (i.e., public or private) as a function of three instruments and lagged firm variables in the baseline cash model. We use the predicted probability from the first stage probit model in the second stage of instrumental variable (IV) estimation as a proxy for the public firm dummy and in calculating lambda in Heckman’s (1979) self-selection model. Estimation results for the first stage probit model are presented in column 1 of Table 7. The second-stage results from the instrumental variable estimation and from the Heckman selection model are shown in column 2 and 3, respectively.

[Insert table 7 about here]

The results for the first stage show that the coefficient for the first instrument, years since EU application, is negative and highly significant. Specifically, firms in countries that joined the EU more recently are more likely to be public. The coefficient for the second instrument, the percentage of sales by public firms, is positive and highly significant, highlighting that firms are more likely to be public in industries where a higher share of the sales is accounted for by public firms. The negative and significant coefficient of the third instrument, the core Euro dummy, indicates that firms that are not in one of the original 11 Euro countries are more likely to be public firms.

In the second stage, the coefficient of the public firm dummy in the two-stage instrumental variable estimation is positive (10.4%) and highly significant, which confirms our earlier finding for H1 that public firms on average hold more cash per total assets than private firms, holding others constant. Moreover, the coefficient estimate for the Eurozone dummy is -4.7% and the interaction between the Eurozone and Public

dummies is +2.2%, and both showing significance at the 1% level, providing even stronger confirmation of our baseline findings in Table 4. We also use Heckman's (1979) two-stage method to control for endogeneity due to self-selection of firms that choose to be publicly listed. The results are presented in column 3 of Table 7. The Public dummy is positive (10.1%), the Eurozone dummy is negative (-4.6%), and the interaction term between the Eurozone and Public dummies is positive (1.9%) and statistically significant at the 1% level, confirming our main results. The coefficient for lambda,¹⁶ the correction for selection bias, is positive and significant at the 1% level. Namely, there is a positive correlation between a firm's choice to be public and its cash holdings, meaning that the firm's characteristics leading them to be public might also cause them to hold more cash. Even after correcting for self-selection, our baseline results hold even stronger, providing further robustness to our analysis.

4.5. Matching samples

To ensure better comparability between public and private firms, and to alleviate sample selection concerns, we constructed matching public and private firm samples. We use two matching methods: one based on industry and asset size, and the other on propensity scores. For the first matching sample, public firms are matched to private firms, one-on-one each year with replacement, based on their two-digit SIC industry code and closest asset size. To ensure a close match, we use a similar method as Asker, Farre-Mensa and Ljungqvist (2015) and impose a restriction that $\max\{\text{total asset (public), total asset(private)}\}/\min\{\text{total asset (public), total asset(private)}\} < 1.5$.¹⁷ This method effectively matches smaller public firms to larger private firms, which corresponds to the intersection of the two size distributions. As we match with replacement, the matched sample has 64,111 private firm-year observations representing 36,298 distinct private firms, and 64,111 public firm-year observations from 5,875 distinct public firms. The quality of the

¹⁶ We follow Campa and Kedia (2002) to calculate the sample-correction variable lambda. $Cash_{it} = \alpha_0 + \alpha_1 X_{it} + \alpha_2 Public_{it} + \alpha_3 \lambda + \varepsilon_{it}$, where $\lambda = \lambda_1(\beta Z_{it}) = \frac{\phi(\beta Z_{it})}{\Phi(\beta Z_{it})}$ when $Public_{it} = 1$ and $\lambda = \lambda_1(\beta Z_{it}) = \frac{-\phi(\beta Z_{it})}{1-\Phi(\beta Z_{it})}$ when $Public_{it} = 0$. $\phi(\cdot)$ and

$\Phi(\cdot)$ are the density and cumulative distribution functions of the standard normal, respectively. Z is a vector of controls. Predicted values from first stage probit are used to calculate sample-correction variables λ_1 and λ_2 . In the second stage, we estimate the cash model as specified above, including λ as sample-correction variable.

¹⁷ We obtain very similar inferences using a matched sample based on 3-digit SICs and changing the imposed restriction to 2 from 1.5.

match is shown graphically in Figure A2.1 of Appendix A2. The public and private firms in the matched sample are clearly much more comparable with each other than they are in the raw sample. The mean (median) private firm has total assets of \$ 1077.9 million (\$127.8 million), compared to \$1132.6million (\$127.8 million) for public firms. The difference in means (or medians) of firm sizes between public and private firm-year observations is not statistically significant in the matched sample.

In addition to industry-size matching, we also match public and private firms based on propensity scores. Figure A2.2 provides a histogram of propensity scores for the unmatched raw sample and a propensity score-matched sample based on the nearest neighbor with replacement (imposed caliber of 0.05), compared to the raw sample. Propensity scores come from a probit model, where the dependent variable is the Public dummy, and independent variables are Ln(Total assets), Sales growth, Ln(Firm age), and country, year, and industry dummies. The distributions of the propensity score-matched samples for private and public firms are more comparable. Since we perform a matching with replacement, the matched sample has 29,955 private firm-year observations representing 20,680 distinct private firms, and 29,955 public firm-year observations representing 4,507 distinct public firms.

Table 8 presents univariate tests of mean differences in cash ratios between Public and Private firms, as well as Eurozone and non-Eurozone countries for the matched samples. The results are statistically significant for both matching methods: nearest neighbor industry-size matching and propensity score matching. The first three columns confirm H1 and H3 that public firms hold more cash than private firms and the difference is larger in Eurozone countries. Moreover, column 4 shows that an average firm in the Eurozone has significantly lower cash ratios than an average comparable firm from non-Eurozone countries in both types of matched samples, supporting H2. Moreover, the difference of cash ratios between public and private firms is greater in the Eurozone than in non-Eurozone countries, supporting H3.

[Insert table 8 about here]

5. Further Empirical Analyses

In this section, we conduct a number of additional empirical analyses related to our main cash model in section 4. Specifically, we consider methodological issues such as IPOs and delistings, and changes equations

due to unobservable and jointly determined variables. Finally, we examine: (1) alternative specifications due to transitory cash, acquisition expenses and unused credit lines, (2) a target adjustment model, and (3) the cash flow sensitivity of cash.

5.1. IPOs and Delistings

We address the issue of how cash holdings change when a firm undergoes an IPO or a delisting and thereby changes its status from private to public or vice versa. During our sample period of 2002–2019, we identified 2,560 IPOs and 1,878 delistings in 33 European countries. To examine these effects on cash holdings, we constructed two subsamples: a sample of firms that conducted IPO and another sample of firms which were delisted from stock market.

The IPO sample effectively compares cash holdings of the firm, tracing changes in firm status from private to public. We run the baseline regression for IPO and delisting samples separately. The results provided in Table 9, are qualitatively the same as the ones from our baseline results in Table 4. IPO firms in the Eurozone hold less cash than their non-Eurozone counterparts. After listing on the stock market, the cash difference between Eurozone and non-Eurozone narrows, as indicated by the positive interaction term between the Eurozone dummy and the Public dummy. On average, after IPO, we expect cash ratios in Eurozone countries to increase significantly relative to non-Eurozone countries since valuations and cash raised in an IPO is expected to be much higher in more developed markets.

[Insert table 9 about here]

In the delisting sample, the Public firm dummy is positive and statistically significant, however we do not find any statistically significant difference in cash holdings between Eurozone and non-Eurozone firms. Delistings typically occur because of financial distress, which might explain the weak results in the delisting sample.

The next three parts provide further analyses for robustness or for additional issues pertaining to cash balance models beyond the scope of the basic empirical analysis discussed above.

5.2. Changes equation for unobservable firm characteristics

To account for the impact of unobservable firm characteristics on cash holdings, we estimate the following changes-in-variables model following Bates et al. (2009):

$$\begin{aligned}
Cash_{it} = & \beta_0 + \beta_1 Public_i + \beta_2 EMU_i + \beta_3 (EMU * Public)_i + \beta_4 \Delta \ln(Total\ asset)_{it} + \\
& \beta_5 Lag\ Cash_{it} + \beta_6 \Delta(Cash)_{it} + \beta_7 \Delta(Cash\ flow)_{it} + \beta_8 (CF\ volatility)_{it} + \beta_9 \Delta(Sales\ growth)_{it} + \\
& \beta_{10} \Delta(Leverage)_{it} + \beta_{11} \Delta(NWC)_{it} + \beta_{12} (Dividend)_{it} + \beta_{13} \Delta(PP\&E\ Growth)_{it} + \beta_{14} \Delta(R\&D)_{it} + \\
& \beta_{15} \ln(Firm\ age)_{it} + \beta_{16} \ln(Bus.\ segments)_{it} + year + industry + country + \varepsilon_{it}
\end{aligned}
\tag{2}$$

The estimation results in Table 10 are broadly consistent with those in Bates et al. (2009). The coefficient for the public firm dummy is still statistically significant at the 1% level. These results indicate that public firms on average add to their cash balances each year more than private firms. Moreover, the Eurozone dummy is negative and the interaction term between the Eurozone dummy and the Public dummy is positive, implying that firms in non-Eurozone countries add to their cash balances more than firms in Eurozone countries, and this effect is stronger for private firms. The adjusted R^2 of 24% is high for the changes-in-variables specification.

[Insert table 10 about here]

5.3 Further Discussion

In the Internet Appendix, we have performed additional empirical work to further reinforce the baseline model with more robustness controls and analyses. That includes the effects of jointly determined variables, transitory cash, acquisition expenses and unused credit lines, as well as alternative models such as a target adjustment model and cashflow sensitivity model. Untabulated results (available from authors) indicate that the basic empirical models in the text pertaining to countries' Eurozone membership status on corporate cash positions remain robust.

6. Conclusion

Liquid asset holdings of firms have become important in the recent decades of market volatility, and more so during the global financial crisis. The single currency regime within the Eurozone provides us with a unique set-up to study the cash holdings of companies when transnational monetary institution, i.e., the

Eurozone within EU, can create institutional schisms with national institutional and policy environments, and hence heterogeneously influence corporate liquidity decisions. The tradeoff is between the reduction in transaction demand for cash within the Eurozone, and an increase in precautionary cash demand by firms in the Eurozone due to the cost of economic adjustment caused by lack of exchange rate as a policy instrument.

Our unique sample is constituted of firms in 33 emerging and developed European countries from 2002 to 2019, thus encompassing an ample period since the beginnings of the Euro, as well as the European financial crisis. We document that corporate cash ratios are lower in the Eurozone than in non-Eurozone countries due to a lower transaction demand for cash through the adoption of a single currency in the Eurozone. However, the difference in cash ratios between public and private firms is higher in the Eurozone than in non-Eurozone countries.

Existing work on cash holdings of private firms is scant and, to our knowledge, we provide the first evidence on cash holdings in the context of Eurozone by using a large-scale cross-country data on cash holdings of publicly traded and privately held European firms. We find that European public firms on average hold more cash as a percentage of total assets than private firms. This is attributable to two factors. First, the precautionary cash demand is higher in the Eurozone due to the risk and difficulty of conducting economic adjustment policies without the existence of exchange rate changes in the Eurozone. Second, economic adjustments and transfers in the Eurozone operate through trade and market, with a greater impact on publicly listed firms than unlisted private firms. As a result, the extent to which public firms have higher cash ratios than private firms is greater in the Eurozone than in non-Eurozone countries. We also show that firms in Eurozone countries hold even less cash during the European financial crisis compared to firms in non-Eurozone countries. Our results are robust to using various model specifications, controlling for the endogeneity of a firm's choice of listing on a stock market, using matched samples, considering solely IPO, and delisting subsamples, using a dynamic model of target adjustment and accounting for the cash flow sensitivity of cash.

From the standpoint of institutional theory, this paper is an application of transnational institutions such as the EU and Eurozone, which influences corporate motivation to hold cash due to both precautionary and transaction demand for cash. It also creates potential institutional schism with national policy and

institutional environments depending on the Eurozone membership status. Specifics of national and transnational institutional interactions, as they relate to corporate liquidity, are open questions and remain to be investigated incorporating additional economic coordination channels such as the nature of fiscal union and other EU policies. Contrast between EU and Eurozone and external countries such as the U.S. in terms of corporate cash holdings from alternative channels is also largely open.

Appendix A1

Variable definitions

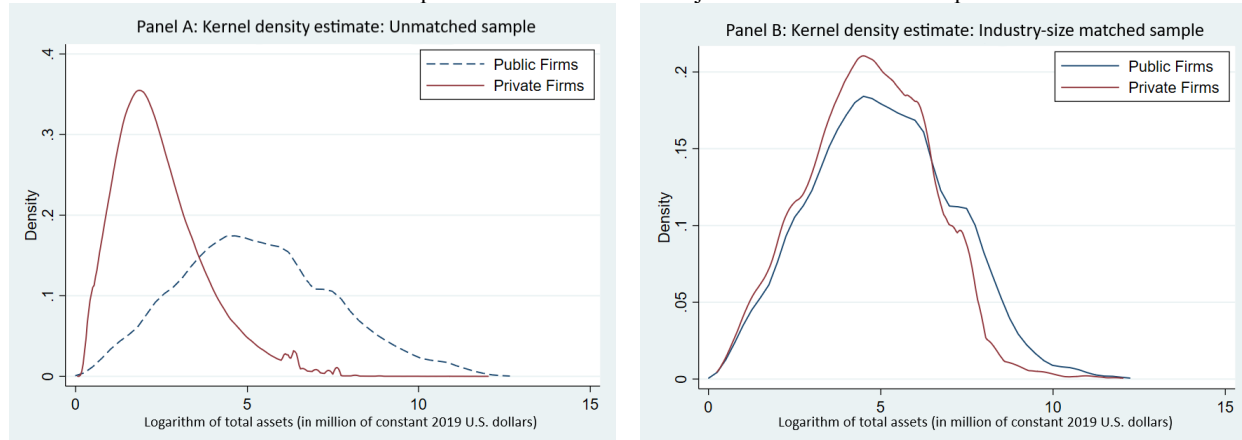
Cash	Cash and cash equivalents, including readily convertible deposits, securities and other instruments having maturities of less than 3 months at the time of purchase, short term, highly liquid investments as well as cash on hand consisting of coins, currency, undeposited checks, money orders and drafts, and deposits in banks scaled by total assets
Industry adj. cash	Cash minus industry (2-digit SIC) median cash scaled by total assets
Δ Cash	Cash (t) – Cash (t-1)
Asset (\$million)	Book value of total assets in millions of U.S. dollars
Sales (\$million)	Total sales revenue in millions of U.S. dollars
Sales growth	$(\text{Sales (t)} - \text{Sales (t-1)}) / \text{Sales (t-1)}$
Cash flow	Earnings before interest & taxes (EBIT), scaled by total assets.
CF volatility	Standard deviation of cash flow from operations for each firm (with missing observations when cash flow is missing)
Cash-ratio volatility	Standard deviation of cash-to-asset ratio for each firm
Leverage	Total debt, which is equal to short-term debt plus long-term debt scaled by total assets
Short-term Debt	Short-term debt scaled by total assets
NWC	Net working capital calculated as (current assets - current liabilities - cash and equivalents) scaled by total assets
CAPEX	Capital expenditures scaled by total assets
R&D dummy	Dummy variable that takes a value of one if firm has positive R&D expense, zero otherwise
Acquisition	Acquisition expense scaled by total assets
PP&E growth	Growth in property, plant, and equipment from time t-1 to time t
Unused credit line	Unused credit lines available to the firm
Dividend dummy	Dummy variable that takes a value of one if firm pays dividend, zero otherwise
ROA	Return on assets calculated as EBITDA divided by total assets
Bus. segments	Number of business segments in which a firm is operating
Employees	Number of employees
Firm age	Years since founding
% of sales by public firms	The percentage of total sales by public firms in industry
Years since EU application	The number of years since a country applied for EU membership
Core Euro dummy	A dummy variable that takes a value of one if a country is one of the original 11 core Euro founders (i.e., Belgium, Germany, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Austria, Portugal, and Finland), and zero otherwise

Appendix A2

Matching samples and cash holdings

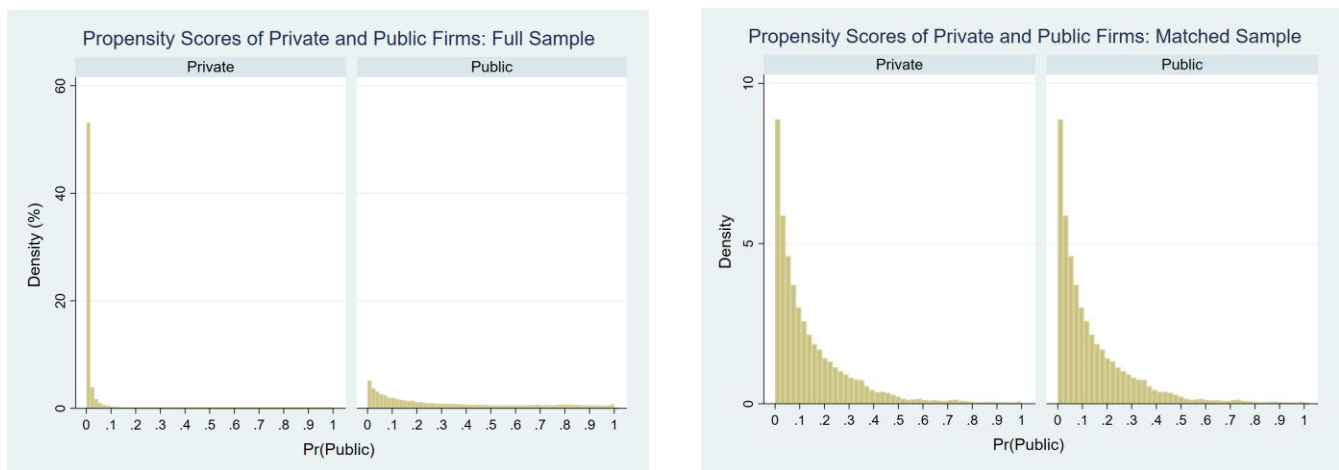
1. Figure A2.1: Industry-size matching

The figures provide kernel density estimates for firm size for the unmatched raw sample (panel A) and the matched sample (panel B) based on two-digit SIC industry codes and firm size. Each public firm is matched with a private firm in the same industry closest in asset size with the replacement method. We impose the restriction that $\max\{\text{Total asset (public)}, \text{Total asset(private)}\} / \min\{\text{Total asset (public)}, \text{Total asset(private)}\} < 1.5$ to ensure a close match. Firm size is measured as a natural logarithm of total assets in millions of constant 2019 U.S. dollars. The Wilcoxon-Mann-Whitney test rejects the null hypothesis of no difference in the underlying distributions at the 5% level for the raw sample whereas the null is not rejected for the matched sample.



2. Figure A2.2: Propensity score matching

The figures provide a histogram of propensity scores for the unmatched raw sample (panel A) and a propensity score-matched sample (panel B) based on the nearest neighbor with replacement. Propensity scores are calculated using a probit model, where the dependent variable is the Public dummy, and independent variables are $\ln(\text{Total assets})$, sales growth, $\ln(\text{Firm age})$, and country, year, and industry dummies.



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Table 1 Number of Observations
Panel A: By Country and Firm Type – full sample

	Private Firm	%N	Public Firm	%N	N	EU Membership*
Developed Europe						
Austria	54,839	98.64%	756	1.36%	55,595	Euro
Belgium	155,603	99.12%	1,387	0.88%	156,990	Euro
Cyprus	350	25.40%	1,028	74.60%	1,378	Euro
Denmark	66,886	97.61%	1,636	2.39%	68,522	EU
Finland	75,753	97.54%	1,913	2.46%	77,666	Euro
France	741,848	99.00%	7,501	1.00%	749,349	Euro
Germany	294,405	97.68%	6,993	2.32%	301,398	Euro
Greece	1,173	30.43%	2,682	69.57%	3,855	Euro
Iceland	97	35.79%	174	64.21%	271	non-EU
Ireland	24,393	95.54%	1,139	4.46%	25,532	Euro
Italy	1,115,614	99.73%	2,974	0.27%	1,118,588	Euro
Luxembourg	3,929	88.02%	535	11.98%	4,464	Euro
Netherlands	72,216	97.60%	1,778	2.40%	73,994	Euro
Norway	171,306	98.78%	2,108	1.22%	173,414	non-EU
Portugal	35,800	98.31%	616	1.69%	36,416	Euro
Spain	449,434	99.64%	1,620	0.36%	451,054	Euro
Sweden	197,907	97.16%	5,790	2.84%	203,697	EU
Switzerland	1,285	31.40%	2,807	68.60%	4,092	non-EU
UK	596,432	97.62%	14,556	2.38%	610,988	non-EU
Emerging Europe						
Bulgaria	174	22.11%	613	77.89%	787	EU
Croatia	495	35.23%	910	64.77%	1,405	EU
Czech Rep.	394	77.71%	113	22.29%	507	EU
Estonia	79	27.43%	209	72.57%	288	Euro
Hungary	140	43.75%	180	56.25%	320	EU
Latvia	86	18.49%	379	81.51%	465	EU
Lithuania	132	25.73%	381	74.27%	513	EU
Malta	60	18.93%	257	81.07%	317	Euro
Poland	2,061	30.33%	4,734	69.67%	6,795	EU
Romania	2,814	78.78%	758	21.22%	3,572	EU
Serbia	85	21.91%	303	78.09%	388	non-EU
Slovakia	170	57.82%	124	42.18%	294	Euro
Slovenia	168	34.64%	317	65.36%	485	Euro
Ukraine	201	49.88%	202	50.12%	403	non-EU
Grand total	4,066,329	98.37%	67,473	1.63%	4,133,802	

Panel B: By Industry and Firm Type – full sample

FF48 Code	Private Firm	%N	Public Firm	%N	N
1	61,658	99.18%	507	0.82%	62,165
2	110,528	97.86%	2,413	2.14%	112,941
3	8,671	97.88%	188	2.12%	8,859
4	20,070	95.27%	997	4.73%	21,067
5	840	85.19%	146	14.81%	986
6	11,544	97.02%	354	2.98%	11,898
7	53,471	96.68%	1,839	3.32%	55,310
8	37,809	97.23%	1,078	2.77%	38,887
9	62,020	97.60%	1,526	2.40%	63,546
10	38,207	97.17%	1,112	2.83%	39,319
11	62,342	99.21%	497	0.79%	62,839
12	14,802	89.76%	1,689	10.24%	16,491
13	17,248	82.97%	3,541	17.03%	20,789
14	54,381	97.21%	1,562	2.79%	55,943
15	62,663	98.48%	967	1.52%	63,630
16	42,585	98.43%	681	1.57%	43,266
17	188,100	98.77%	2,340	1.23%	190,440
18	404,664	99.38%	2,536	0.62%	407,200
19	38,280	96.84%	1,250	3.16%	39,530
20	46,993	99.38%	292	0.62%	47,285
21	138,881	97.67%	3,307	2.33%	142,188
22	40,895	97.15%	1,200	2.85%	42,095
23	39,943	97.28%	1,117	2.72%	41,060
24	3,963	92.59%	317	7.41%	4,280
25	8,435	96.43%	312	3.57%	8,747
26	1,535	95.05%	80	4.95%	1,615
27	109	24.01%	345	75.99%	454
28	15,860	94.32%	955	5.68%	16,815
29	419	74.16%	146	25.84%	565
30	14,570	85.67%	2,437	14.33%	17,007
32	23,775	92.67%	1,881	7.33%	25,656
33	163,180	99.70%	489	0.30%	163,669
34	554,909	97.98%	11,447	2.02%	566,356
35	8,949	83.60%	1,756	16.40%	10,705
36	18,415	87.61%	2,604	12.39%	21,019
37	19,735	96.54%	707	3.46%	20,442
38	31,054	97.04%	947	2.96%	32,001
39	16,509	98.66%	224	1.34%	16,733
40	244,205	98.66%	3,319	1.34%	247,524
41	849,912	99.66%	2,918	0.34%	852,830
42	399,551	99.30%	2,828	0.70%	402,379
43	83,585	98.33%	1,423	1.67%	85,008
48	51,064	97.71%	1,199	2.29%	52,263
Grand total	4,066,329	98.37%	67,473	1.63%	4,133,802

Table 2 Summary statistics for firm-specific variables: All European countries (2002-2019)**Panel A: Firm-specific variables for public and private firms – full sample**

This table presents summary statistics for key firm-specific variables for all 33 countries in the sample. Countries in the sample are Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Estonia, Malta, Slovakia, Slovenia, Denmark, Sweden, the UK, Bulgaria, the Czech Rep., Hungary, Latvia, Lithuania, Poland, Romania, Iceland, Norway, Switzerland, Croatia, Serbia, and Ukraine. All dollar values are expressed in 2019 constant US Dollars. All Ratios are scaled by Total Assets. All continuous variables are winsorized at 1% at each tail to reduce the impact of outliers. ***, **, * represent significance at 1%, 5% and 10% levels, respectively. Definitions of variables are given in Appendix A1.

	Public Firms						Private Firms						Difference in Means	Difference in Medians
	N	mean	st. dev	25th %	median	75th %	N	mean	st. dev	25th %	median	75th %		
Cash	67473	13.05%	15.16%	3.22%	7.82%	16.73%	4066329	11.42%	14.83%	1.15%	5.41%	15.92%	1.63%***	2.41%***
Industry adj. cash	67473	7.45%	15.00%	-1.93%	2.37%	10.98%	4066329	5.71%	14.61%	-3.75%	-0.04%	10.11%	1.74%***	2.41%***
Cash-ratio volatility	67473	7.45%	6.18%	3.05%	5.54%	9.83%	4066329	6.67%	5.84%	2.32%	5.17%	9.37%	0.78%	0.38%
Cash flow	67419	2.38%	15.13%	-0.16%	5.02%	9.55%	3921780	6.86%	13.20%	1.40%	4.93%	10.98%	-4.48%***	0.09%
CF volatility	67418	8.89%	11.35%	2.97%	5.11%	9.77%	3917120	7.57%	10.34%	2.91%	5.15%	8.94%	1.32%***	-0.04%
Total assets	67473	2640.64	11267.46	38.78	170.43	868.45	4066329	50.73	688.36	4.54	9.34	24.17	2589.90***	161.10***
Sales	66379	2058.09	8645.25	28.81	149.88	779.71	3865189	54.57	421.34	6.80	12.87	32.27	2003.52***	137.01***
Sales growth	62040	15.43%	68.43%	-6.73%	5.24%	20.86%	3399611	10.09%	53.73%	-9.80%	2.07%	17.09%	5.34%***	3.17%***
Leverage	50155	17.36%	16.15%	5.30%	13.57%	24.76%	1066328	13.45%	14.94%	3.29%	8.63%	18.08%	3.92%***	4.94%***
Short-term Debt	50105	9.36	10.57	1.93%	5.99%	12.98%	1065495	14.38%	14.40%	2.74%	10.06%	22.29%	-5.02%***	-4.07%***
NWC	67388	3.20%	21.26%	-7.26%	2.66%	14.78%	3946709	8.10%	28.00%	-6.67%	8.11%	25.14%	-4.90%***	-5.45%***
CAPEX	63414	4.52%	5.49%	1.17%	2.84%	5.70%	32664	5.14%	6.44%	1.19%	3.04%	6.44%	-0.61%*	-0.20%
R&D dummy	67473	0.36	0.48	0.00	0.00	1.00	4066329	0.00	0.04	0.00	0.00	0.00	0.36***	0.00
Acquisition	24288	4.19%	7.60%	0.22%	1.33%	4.76%	9999	5.26%	13.90%	0.18%	1.15%	5.22%	-1.07%***	0.17%
PP&E growth	62535	25.04%	115.98%	-9.68%	2.28%	19.45%	3408769	15.68%	115.62%	-16.78%	-3.52%	14.78%	9.36%***	5.80%***
Unused credit line	20030	13.25%	159.14%	4.35%	9.06%	15.82%	7650	10.80%	13.77%	3.29%	7.30%	13.93%	2.45%***	1.75%***
Dividend dummy	67473	0.51	0.50	0.00	1.00	1.00	4066329	0.00	0.06	0.00	0.00	0.00	0.51***	1.00***
ROA	66687	6.04%	17.21%	3.16%	8.62%	13.74%	3275495	9.89%	11.68%	3.81%	8.11%	14.74%	-3.85%***	0.51%
Bus. segments	67473	2.92	2.61	1.00	1.00	4.00	4066329	1.01	0.18	1.00	1.00	1.00	1.92***	0.00
Employees	41037	9560.85	27140.72	195.00	1038.00	5338.00	14614	7776.26	28811.09	160.00	798.50	3630.00	1784.59***	239.50***
Firm age	59273	53.53	52.03	16.00	32.00	80.00	2901438	26.95	24.35	11.00	21.00	34.00	26.59***	11.00***

Panel B: Pairwise correlation matrix

This table presents pairwise correlations between variables used in main regressions. The sample contains all firms in 33 European countries. * indicates significance at 5% level. All continuous variables are winsorized at 1% at each tail to reduce the impact of outliers. All dollar values are expressed in 2019 US dollars.

	1	2	3	4	5	6	7	9	10	11	12	13	14	15
1 Cash	1													
2 Public	0.0139*	1												
3 Ln(total assets)	-0.1469*	0.2535*	1											
4 Cash flow	0.1820*	-0.0436*	-0.0490*	1										
5 CF volatility	0.1083*	0.0164*	-0.0420*	0.2557*	1									
6 Sales growth	0.0084*	0.0131*	0.0404*	0.0765*	0.0351*	1								
7 Leverage	-0.2455*	0.0004	0.0845*	-0.1815*	-0.0281*	-0.0067*	1							
8 NWC	-0.2083*	-0.0225*	-0.0061*	0.1303*	-0.0771*	-0.0430*	-0.2509*							
9 Dividend	-0.0039*	0.6084*	0.2734*	0.0128*	-0.0247*	-0.0008	-0.0009	1						
10 CAPEX	-0.0930*	-0.0498*	0.0241*	0.0548*	-0.0252*	0.0802*	0.0877*	0.0057	1					
11 R&D	0.4377*	-0.0069	-0.3631*	-0.5589*	0.5488*	0.1097*	-0.0702*	-0.2934*	-0.0795*	1				
12 Acquisition	-0.0293*	-0.0492*	-0.1128*	-0.0271*	0.0753*	0.1906*	0.0733*	-0.0892*	-0.0581*	0.005	1			
13 PPE net growth	0.0003	0.0108*	0.0172*	0.0183*	0.0173*	0.1482*	0.0187*	0.0019*	0.1465*	0.0333*	0.2013*	1		
14 ROA (ebitda)	0.1974*	-0.0455*	-0.0557*	0.9329*	0.0346*	0.0904*	-0.1459*	0.0258*	0.1046*	-0.6006*	-0.0336*	0.0052*	1	
15 Ln (Firm age)	-0.0442*	0.0861*	0.2107*	-0.0197*	-0.0914*	-0.1519*	-0.0706*	0.1094*	-0.0787*	-0.3283*	-0.1372*	-0.0744*	-0.0130*	1

Table 3 Cash holdings of European public and private firms, 2002-2019

Panel A: Cash holdings of European public and private firms by country

This table presents summary statistics for the corporate cash ratio for each country. ***, **, * represent significance at 1%, 5% and 10% levels, respectively. Cash ratio is cash and cash equivalents scaled by total assets.

	Public Firms						Private Firms						Difference in Means	Difference in Medians
	N	mean	st. dev.	25th Percentile	median	75th Percentile	N	mean	st. dev.	25th Percentile	median	75th Percentile		
Developed Europe														
Austria	756	11.80%	12.50%	3.28%	8.43%	16.15%	54839	11.35%	15.30%	0.67%	4.52%	16.25%	0.46%	3.92%***
Belgium	1387	12.52%	14.94%	3.54%	7.05%	14.14%	155603	10.24%	13.49%	1.45%	5.05%	13.24%	2.28%***	2.00%***
Cyprus	1028	7.83%	10.66%	0.93%	3.58%	10.43%	350	10.49%	14.70%	0.82%	4.52%	13.50%	-2.66%***	-0.94%*
Denmark	1636	12.15%	16.67%	2.64%	5.64%	13.71%	66886	9.70%	14.49%	0.31%	3.11%	12.97%	2.45%***	2.53%***
Finland	1913	11.29%	11.93%	3.38%	7.57%	14.51%	75753	24.69%	23.33%	5.97%	17.07%	37.28%	13.40%***	-9.51%***
France	7501	14.28%	14.66%	4.91%	9.62%	17.71%	741848	10.93%	12.54%	1.77%	6.41%	15.56%	3.35%***	3.21%***
Germany	6993	15.46%	16.13%	4.26%	10.12%	20.53%	294405	11.80%	15.44%	1.06%	5.35%	16.51%	3.66%***	4.77%***
Greece	2682	8.06%	9.40%	1.72%	4.59%	10.86%	1173	5.93%	7.89%	1.27%	3.03%	7.25%	2.13%***	1.56%***
Iceland	174	6.13%	5.23%	2.50%	4.46%	7.63%	97	6.89%	8.79%	1.18%	3.37%	8.33%	-0.75%	1.09%
Ireland	1139	16.73%	18.93%	4.54%	10.10%	21.89%	24393	15.26%	19.12%	1.75%	7.38%	21.51%	1.47%***	2.72%***
Italy	2974	10.82%	10.04%	3.97%	8.01%	14.35%	1115614	8.62%	11.63%	0.73%	3.69%	11.80%	2.20%***	4.32%***
Luxembourg	535	12.36%	11.37%	5.11%	9.01%	16.20%	3929	12.56%	15.54%	1.42%	6.56%	17.44%	-0.20%	2.45%***
Netherlands	1778	11.67%	13.28%	3.31%	7.62%	14.90%	72216	13.64%	17.99%	0.85%	5.89%	19.48%	-1.97%***	1.73%***
Norway	2108	17.45%	19.72%	4.97%	10.02%	21.48%	171306	17.68%	19.11%	2.45%	10.42%	27.53%	-0.23%	-0.40%**
Portugal	616	6.20%	7.64%	0.91%	3.63%	8.65%	35800	0.60%	1.75%	0.01%	0.06%	0.30%	5.60%***	3.57%***
Spain	1620	8.77%	9.38%	2.65%	5.79%	11.17%	449434	9.80%	12.41%	1.36%	4.84%	13.34%	-1.03%***	0.95%***
Sweden	5790	16.06%	17.68%	3.89%	9.28%	21.81%	197907	14.41%	16.78%	0.98%	7.95%	22.51%	1.65%***	1.33%***
Switzerland	2807	16.37%	15.66%	6.39%	11.63%	21.16%	1285	12.40%	15.02%	3.33%	6.98%	15.03%	3.97%***	4.65%***
UK	14556	15.42%	17.24%	3.90%	9.17%	20.38%	596432	14.64%	17.99%	1.52%	7.51%	21.03%	0.78%***	1.66%***
Total	57993	13.98%	15.69%	3.77%	8.61%	17.90%	4059270	11.43%	14.82%	1.15%	5.42%	15.94%	2.55%***	3.19%***
Emerging Europe														
Bulgaria	613	6.16%	8.75%	0.78%	2.42%	7.62%	22	174	6.91%	9.64%	1.42%	3.21%	-0.75%	-0.78%**
Croatia	910	4.90%	6.62%	0.68%	2.28%	6.31%	18	495	2.38%	3.54%	0.27%	0.96%	2.52%***	1.32%***
Czech Rep.	113	10.03%	12.16%	3.20%	5.17%	10.64%	158	394	7.62%	9.17%	2.03%	4.36%	2.40%**	0.81%
Estonia	209	8.88%	9.35%	2.94%	5.24%	11.12%	57	79	9.66%	10.42%	2.93%	5.11%	-0.78%	0.14%
Hungary	180	8.60%	9.29%	2.73%	5.30%	10.32%	43	140	7.19%	8.16%	2.06%	4.31%	1.41%**	0.99%
Latvia	379	6.16%	8.54%	0.39%	2.19%	8.30%	15	86	13.25%	16.71%	1.81%	5.71%	-7.09%***	-3.52%***
Lithuania	381	5.11%	6.80%	0.85%	2.36%	6.31%	45	132	3.00%	5.19%	0.19%	0.84%	2.11%***	1.52%***
Malta	257	13.85%	15.24%	2.37%	7.62%	21.18%	60	35.96%	182.83%	1.33%	5.35%		-22.11%*	2.27%
Poland	4734	8.34%	10.11%	1.74%	4.64%	10.82%	503	2061	6.46%	8.28%	1.07%	3.22%	1.88%***	1.42%***
Romania	758	7.00%	9.10%	0.95%	3.28%	9.06%	73	2814	6.13%	9.88%	0.54%	2.07%	0.87%***	1.20%***
Serbia	303	4.65%	5.23%	0.61%	2.95%	6.74%	298	85	3.75%	8.06%	0.37%	1.00%	0.90%	1.95%***
Slovakia	124	11.41%	17.32%	1.48%	4.21%	12.19%	48	170	9.71%	12.33%	2.50%	4.23%	1.70%***	-0.03%
Slovenia	317	2.88%	3.84%	0.79%	1.50%	3.40%	25	168	2.47%	3.44%	0.56%	1.35%	0.41%	0.15%
Ukraine	202	5.28%	8.75%	0.63%	2.25%	5.85%	38	201	6.84%	13.89%	0.16%	1.33%	-1.56%**	0.92%**
Total	9480	7.40%	9.69%	1.24%	3.71%	9.44%	7059	6.40%	19.31%	0.73%	2.50%	7.38%	1.01%***	1.21%***

Panel B: Cash holdings of European public and private firms by EU membership status

This table presents cash variables for All of Europe, the European Union, the Eurozone, non-Eurozone Europe, and non-EU Europe. ***, **, * represent significance at 1%, 5% and 10% levels, respectively.

	Public Firms						Private Firms						Difference in Means	Difference in Medians
	N	mean	st. dev	25th %	median	75th %	N	mean	st. dev	25th %	median	75th %		
All Europe														
Cash	67473	13.05%	15.16%	3.22%	7.82%	16.73%	4066329	11.42%	14.83%	1.15%	5.41%	15.92%	1.63%***	2.41%***
Industry adj. cash	67473	7.45%	15.00%	-1.93%	2.37%	10.98%	4066329	5.71%	14.61%	-3.75%	-0.04%	10.11%	1.74%***	2.41%***
Cash-ratio volatility	67473	7.48%	6.34%	3.05%	5.54%	9.83%	4066329	6.72%	6.06%	2.32%	5.17%	9.37%	0.76%	0.38%
Cash flow	67419	2.38%	15.13%	-0.16%	5.02%	9.55%	3921780	6.86%	13.20%	1.40%	4.93%	10.98%	-4.48%***	0.09%
CF volatility	67418	8.89%	11.35%	2.97%	5.11%	9.77%	3917120	7.57%	10.34%	2.91%	5.15%	8.94%	1.32%***	-0.04%
European Union														
Cash	59739	13.08%	15.09%	3.25%	7.83%	16.75%	3891428	11.15%	14.56%	1.10%	5.28%	15.48%	1.93%***	2.55%***
Industry adj. cash	59739	7.41%	14.93%	-1.98%	2.33%	10.99%	3891428	5.44%	14.34%	-3.80%	-0.16%	9.68%	1.97%***	2.49%***
Cash-ratio volatility	59739	7.54%	6.34%	3.07%	5.61%	9.95%	3891428	6.62%	6.01%	2.28%	5.06%	9.22%	0.92%	0.55%
Cash flow	59686	2.31%	15.17%	-0.25%	5.02%	9.55%	3747104	6.73%	13.16%	1.40%	4.85%	10.73%	-4.43%***	0.17%***
CF volatility	59686	8.97%	11.27%	2.97%	5.22%	9.94%	3742457	7.46%	10.43%	2.85%	5.03%	8.74%	1.50%***	0.19%***
Eurozone														
Cash	31395	12.53%	13.90%	3.47%	8.02%	16.06%	3025483	10.29%	13.48%	1.08%	4.89%	14.17%	2.24%***	3.14%***
Industry adj. cash	31395	6.96%	13.73%	-1.66%	2.61%	10.41%	3025483	4.72%	13.31%	-3.76%	-0.42%	8.50%	2.25%***	3.03%***
Cash-ratio volatility	31395	6.75%	5.52%	2.99%	5.22%	8.63%	3025483	6.16%	5.67%	2.12%	4.68%	8.51%	0.59%	0.53%
Cash flow	31366	3.17%	11.98%	0.50%	4.86%	8.95%	2944573	6.38%	13.04%	1.43%	4.56%	9.90%	-3.21%***	0.31%***
CF volatility	31366	7.41%	9.33%	2.68%	4.51%	8.15%	2941819	6.78%	10.39%	2.63%	4.61%	7.91%	0.63%***	-0.10%***
Non-EU Europe														
Cash	7734	12.86%	15.74%	2.89%	7.74%	16.51%	174901	17.49%	19.05%	2.40%	10.12%	27.18%	-4.62%***	-2.38%***
Industry adj. cash	7734	7.77%	15.56%	-1.60%	2.70%	10.94%	174901	11.73%	18.63%	-2.48%	4.52%	21.15%	-3.96%***	-1.81%***
Cash-ratio volatility	7734	7.00%	6.28%	2.82%	5.19%	8.89%	174901	9.02%	6.77%	4.02%	7.93%	12.50%	-2.02%*	-2.74%
Cash flow	7733	2.91%	14.80%	0.45%	5.00%	9.60%	174676	9.57%	13.86%	1.33%	7.89%	16.99%	-6.66%***	-2.89%***
CF volatility	7732	8.32%	11.91%	2.91%	4.63%	8.23%	174663	9.94%	7.71%	4.99%	8.06%	12.50%	-1.62%***	-3.43%***
Non-Eurozone Europe														
Cash	36078	13.51%	16.17%	3.01%	7.62%	17.49%	1040846	14.72%	17.80%	1.45%	7.56%	21.81%	-1.21%***	0.06%
Industry adj. cash	36078	7.87%	16.02%	-2.15%	2.16%	11.66%	1040846	8.60%	17.54%	-3.73%	1.62%	15.57%	-0.73%*	0.54%***
Cash-ratio volatility	36078	8.12%	6.91%	3.13%	5.89%	11.01%	1040846	8.36%	6.82%	3.18%	6.96%	11.77%	-0.25%	-1.06%
Cash flow	36053	1.69%	17.38%	-0.98%	5.20%	10.15%	977207	8.30%	13.56%	1.25%	6.64%	14.56%	-6.62%***	-1.44%***
CF volatility	36052	10.18%	12.71%	3.28%	5.72%	11.38%	975301	9.97%	9.82%	4.23%	7.19%	12.00%	0.21%	-1.48%***

Difference in means across groups

This table presents a difference-in-means test among public firms and private firms in EU vs. non-EU and Eurozone vs. non-Eurozone countries.

	(EU) - (Non-EU)			(Eurozone) - (Non-Eurozone)		
	Public & Private	Public	Private	Public & Private	Public	Private
Cash	-6.11%***	0.21%	-6.34%***	-4.37%***	-0.98%***	-4.43%***
Industry Adj. Cash	-6.09%***	-0.36%	-6.29%***	-3.84%***	-0.91%***	-3.89%***

Figure 1 Cash holdings of European public and private firms by year, 2002-2019

This table presents the evolution of cash ratios from 2002 to 2019. EMU refers to Eurozone countries.

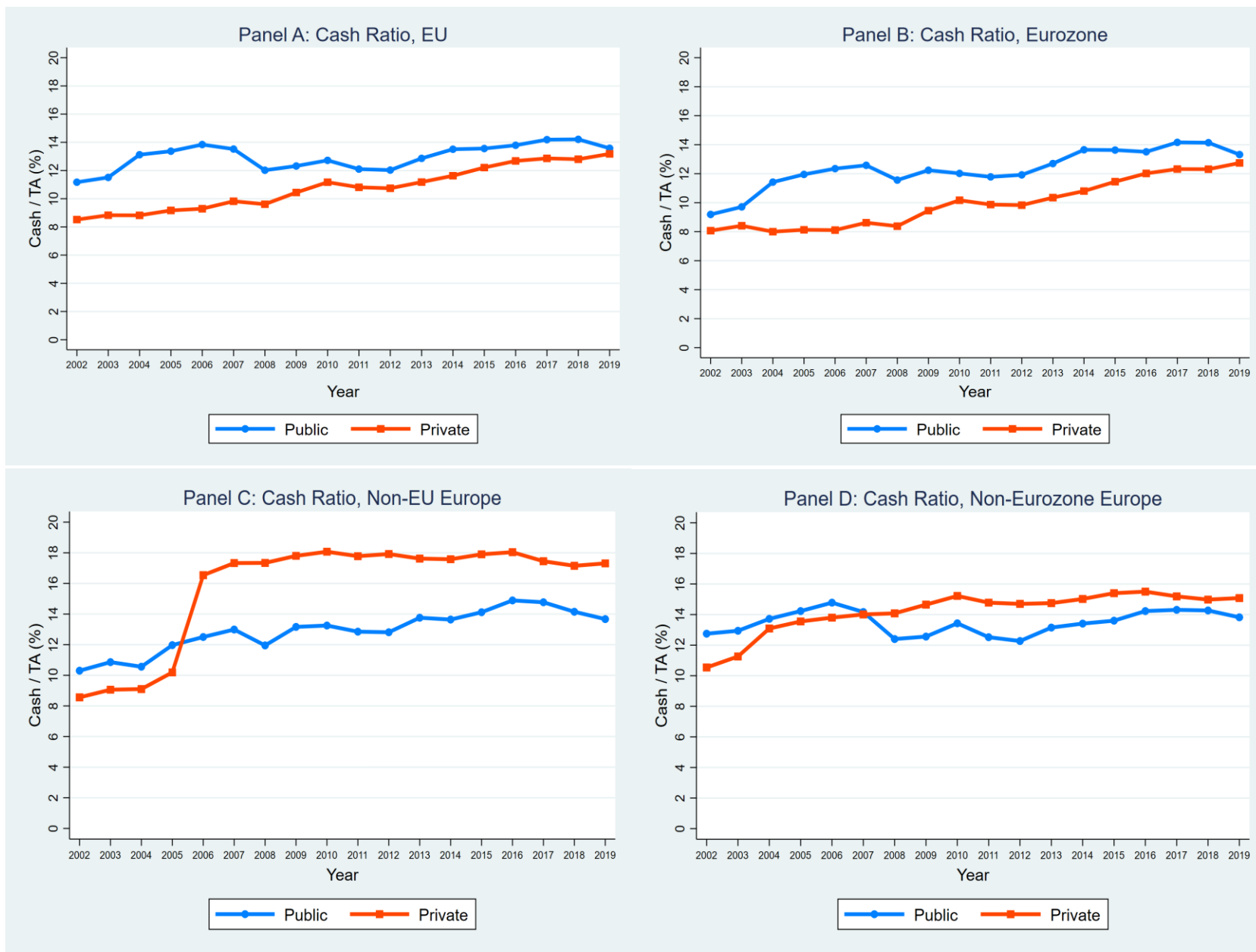


Table 4 Effects of Eurozone: Public and private firms

This table presents reduced form regressions of cash holdings on firm characteristics for Eurozone and non-Eurozone European countries between 2002 and 2019. We add a Eurozone dummy (one if the country is a Eurozone country and zero otherwise) and an interaction term between the Eurozone dummy and the Public firm dummy to examine how cash holdings of private and public firms differ between Eurozone and Non-Eurozone European countries. The dependent variable is cash and cash equivalents divided by total assets. See Appendix A1 for the definition of independent variables. The t-statistics reported in parentheses are based on standard errors clustered by country and year. Country, year, and industry dummies are included in all regressions. ***, **, * represent significance at 1%, 5% and 10% levels, respectively. All continuous variables are winsorized at 1% at each tail to reduce the impact of outliers. Dollar values are converted into 2019 constant dollars using the CPI.

	(1)	(2)	(3)	(4)	(5)
Public	0.050*** (25.50)		0.049*** (22.90)	0.058*** (25.59)	0.055*** (28.44)
Eurozone	-0.028*** (-4.57)	-0.016*** (-4.10)	-0.032*** (-6.70)		
Public*Eurozone	0.018*** (4.86)		0.016*** (6.04)		
Ln(Total assets)	-0.019*** (-35.71)	-0.011*** (-20.84)	-0.011*** (-20.48)	-0.020*** (-37.39)	-0.011*** (-20.79)
Cash flow		0.244*** (21.71)	0.249*** (22.51)		0.252*** (22.39)
CF volatility		0.115*** (17.62)	0.109*** (17.35)		0.111*** (18.37)
Sales growth		0.001 (1.58)	0.000 (1.08)		0.000 (0.88)
Leverage		-0.146*** (-33.27)	-0.145*** (-33.16)		-0.146*** (-33.08)
NWC		-0.114*** (-30.38)	-0.114*** (-30.57)		-0.115*** (-30.23)
Dividend		0.011*** (6.17)	-0.007*** (-3.08)		-0.005** (-2.36)
PP&E Growth		0.001* (1.88)	0.000* (1.72)		0.000* (1.75)
R&D		0.074*** (26.89)	0.057*** (26.23)		0.052*** (25.23)
Ln(Firm age)		0.003*** (6.13)	0.003*** (6.38)		0.003*** (5.92)
Ln(Bus. segments)		0.001 (0.95)	-0.013*** (-14.17)		-0.012*** (-12.71)
Country	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes
Constant	0.178*** (26.25)	0.141*** (24.49)	0.157*** (25.53)	0.149*** (45.80)	0.126*** (29.88)
N	4133711	1411310	1411310	4133711	1411310
adj. R ²	0.104	0.208	0.212	0.096	0.210

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5 Effects of Eurozone risk: Diff-and-Diff estimation for public firms

This table presents the difference-in-difference estimation on an extended sample from 1990 to 2019 for public firms only from Compustat Global. We add a core-Euro dummy (one if the country is one of 11 core-Euro countries and zero otherwise), “After-1999” dummy and an interaction term between the Core-Euro dummy and After-1999 dummy to examine how cash holdings of public firms differ before and after joining the Eurozone. The dependent variable is cash and cash equivalents divided by total assets. Firm-specific controls are Cash flow, CF volatility, Sales growth, Leverage, NWC, Dividend, CAPEX, and R&D. See Appendix A1 for the definition of independent variables. The t-statistics reported in parentheses are based on standard errors clustered by country and year. Industry dummies are included in all regressions. ***, **, * represent significance at 1%, 5% and 10% levels, respectively. All continuous variables are winsorized at 1% at each tail to reduce the impact of outliers. Dollar values are converted into 2019 constant dollars using the CPI.

	Core Euro Countries vs. Non-Euro Countries	
	(1)	(2)
Core-Euro	0.007** (2.47)	0.003 (1.19)
After-1999 dummy	0.034*** (13.39)	0.013*** (5.63)
Core Euro x After 1999	-0.029*** (-8.22)	-0.008** (-2.35)
Ln(Total assets)	-0.020*** (-44.55)	-0.010*** (-23.19)
Firm specific controls	No	Yes
Industry	No	Yes
Constant	0.223*** (63.29)	0.154*** (19.67)
<i>N</i>	131928	113117
adj. <i>R</i> ²	0.116	0.199

Table 6 European financial crisis

This table presents the regression of cash holdings on firm characteristics for Eurozone and Non-Eurozone, as well as All European countries between 2005 and 2013. We add a financial crisis dummy (one if during 2008 till 2010, and zero otherwise) and an interaction term between the Crisis dummy and Public firm dummy to examine how cash holdings of private and public firms were affected during the crisis. We also add an interaction term between Eurozone dummy (one if the country is a Eurozone country and zero otherwise) and crisis dummy to examine how cash holdings of Eurozone and non-Eurozone countries were affected during the crisis. The data for public and private firms comes from S&P's Capital IQ database. The dependent variable is cash and cash equivalents to asset ratio. Firm specific controls are Cash flow, CF volatility, Sales growth, Leverage, NWC, Dividend dummy, CAPEX, R&D, Ln(Firm age), Ln(Bus. segments). See Appendix A1 for the definition of independent variables. The t-statistics reported in parentheses are based on standard errors robust to clustering by country and year. Country and industry dummies are included in all regressions. ***, **, * represent significance at 1%, 5% and 10% levels, respectively. All continuous variables are winsorized at 1% at each tail to reduce the impact of outliers. Dollar values are converted into 2019 constant dollars using the CPI.

	Eurozone	Non-Eurozone Europe	All-Europe
	(1)	(2)	(3)
Public	0.052*** (22.60)	0.044*** (13.77)	0.050*** (26.80)
Crisis	-0.011*** (-3.56)	-0.003 (-1.09)	-0.001 (-0.45)
Public*Crisis	0.010*** (3.25)	0.001 (0.22)	-0.003 (-0.88)
Eurozone			0.004 (1.48)
Eurozone*Crisis			-0.010** (-2.17)
Public*Eurozone*Crisis			0.017*** (3.86)
Ln(Total assets)	-0.010*** (-15.99)	-0.009*** (-44.62)	-0.010*** (-20.82)
Firm specific controls	Yes	Yes	Yes
Constant	0.146*** (43.98)	0.160*** (103.47)	0.149*** (34.94)
<i>N</i>	784919	177820	962739
adj. <i>R</i> ²	0.202	0.214	0.204

Table 7 Instrumental variable (IV) and Heckman sample-selection estimation

This table presents the 2-stage least squares (2SLS) IV regression and Heckman's (1979) two-stage sample-selection estimation of cash holdings for 33 European countries between 2002 and 2019. The first-stage regression is Probit, where Public is a dummy variable that takes a value of one if a firm is publicly traded and zero otherwise. The second-stage regression for IV is pooled OLS, with cash ratios as the dependent variable. See Appendix A1 for the definition of independent variables. The instruments for the Public dummy are (a) "Years since EU application," which is the number of years since a country applied for EU membership; (b) "Percentage of sales by public firms," which is calculated as the percentage of total sales by public firms in an industry; (c) the core Euro dummy which takes a value of one if a country is one of the 11 core Euro founders (i.e. Belgium, Germany, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Austria, Portugal and Finland) and zero otherwise. Lagged firm-specific variables are included as controls in the first stage probit. The Null hypothesis for the endogeneity test is that the public dummy is exogenous. The t-statistics reported in parentheses are based on standard errors robust to clustering by country and year. ***, **, * represent significance at 1%, 5% and 10% levels, respectively. All continuous variables are winsorized at 1% at each tail to reduce the impact of outliers. Dollar values are converted into 2019 constant dollars using the CPI.

	First Stage (Public) (lagged controls)	Second Stage – IV (Cash) (contemporaneous controls)	Heckman Sample-selection (Cash) (contemporaneous controls)
Public			0.101*** (17.41)
Public predicted		0.104*** (17.74)	
Eurozone	0.922*** (8.04)	-0.047*** (-6.84)	-0.046*** (-7.14)
Eurozone * Public predicted		0.022*** (5.18)	0.019*** (5.00)
Ln(Total assets)	0.179*** (20.78)	-0.012*** (-20.07)	-0.012*** (-19.77)
Cash flow	-1.864*** (-27.14)	0.265*** (22.58)	0.269*** (22.98)
CF volatility	1.514*** (16.35)	0.116*** (16.63)	0.113*** (16.51)
Sales growth	0.085*** (7.72)	0.001 (0.86)	0.000 (0.35)
Leverage	-0.184*** (-5.52)	-0.148*** (-31.35)	-0.148*** (-31.26)
NWC	0.046** (2.09)	-0.114*** (-27.63)	-0.114*** (-27.75)
Dividend	1.504*** (28.73)	-0.018*** (-6.75)	-0.028*** (-9.28)
PPE growth	-0.000 (-1.61)	0.000 (1.16)	0.000 (1.16)
R&D	1.093*** (25.30)	0.034*** (19.91)	0.026*** (16.64)
Ln(Firm age)	-0.022*** (-2.74)	0.003*** (4.59)	0.003*** (4.87)
Ln(Bus. segments)	1.107*** (41.02)	-0.030*** (-13.96)	-0.036*** (-16.94)
Years since EU application	-1.339*** (-8.71)		
% of Sales by Public firms	0.809*** (3.84)		
Core Euro dummy	-1.289*** (-10.48)		
Country	No	Yes	Yes
Year & Industry	Yes	Yes	Yes
Constant	-1.612*** (-8.03)	0.168*** (22.32)	0.190*** (25.91)
Lambda			0.030*** (24.99)
N	1184402	1097075	1097075
Pseudo R ²	0.664		
Adj. R ²		0.213	0.216

Table 8 Matching samples - mean differences in cash holdings between in various specifications

This table presents average differences in cash ratios between public and private firms, (public-private), for the industry size-matched sample and propensity score-matched sample. Cash ratios are measured as cash and cash equivalents divided by total assets. ***, **, * represent significance at 1%, 5% and 10% levels, respectively. The t-statistics reported in parentheses. The properties of matched sample are discussed in Appendix A2.

	All Europe	Eurozone	Non-Eurozone	Eurozone – Non-Eurozone
	Public - Private	Public - Private	Public - Private	
Industry-size matched sample	0.042*** (47.73)	0.045*** (42.39)	0.031*** (21.23)	-0.022*** (-25.70)
Propensity score matched sample	0.056*** (45.60)	0.053*** (32.15)	0.060*** (32.71)	-0.147*** (-11.76)

Table 9 Change of firm status due to an IPO or a delisting

This table presents the regression of cash holdings on firm characteristics for 33 European countries between 2002 and 2019. The samples include firms that changed status, either by an IPO or by delisting from stock exchanges. The dependent variable is cash and cash equivalents divided by total assets. Firm specific controls are Ln(Total assets), Cash flow, CF volatility, Sales growth, Leverage, NWC, Dividend dummy, Property, Plant & Equipment growth, R&D, Ln(Firm age) Ln(Bus. segments). See Appendix A1 for the definition of independent variables. The t-statistics reported in parentheses are based on standard errors clustered by country and year. Country, year, and industry dummies are included in all regressions. ***, **, * represent significance at 1%, 5% and 10% levels, respectively. All continuous variables are winsorized at 1% at each tail to reduce the impact of outliers. Dollar values are converted into 2019 constant dollars using the CPI.

	IPO (1)	Delisting (2)
Public	0.006 (1.56)	0.012*** (3.99)
Eurozone	-0.041*** (-3.41)	0.011 (1.50)
Eurozone * Public	0.016*** (3.13)	-0.006 (-1.26)
Firm specific controls	Yes	Yes
Constant	0.323*** (19.59)	0.210*** (19.66)
<i>N</i>	17873	19849
adj. <i>R</i> ²	0.400	0.336

Table 10 Changes specification: Controlling for unobservable firm characteristics

This table presents regressions of changes in cash holdings on changes on firm characteristics for 33 European countries between 2002 and 2019. Regressions are grouped by all Europe, the European Union, the Eurozone, and non-EU Europe. The dependent variable is change in the cash and cash equivalents divided by total assets. Public is a dummy variable that takes the value of 1 if a firm is publicly traded and zero if it is a private firm. $\Delta \ln(\text{Total assets})$ is the change in the natural logarithm of book value of assets. Lag cash is the cash ratio at time $t-1$. $\Delta(\text{Cash flow})$ is the change in operating cash flows scaled by total assets. CF volatility is calculated as the standard deviation of cash flow for each firm. $\Delta(\text{Sales Growth})$ is the change in growth of revenue from time t to $t+1$. $\Delta(\text{Leverage})$ is the change in short-term debt plus long-term debt scaled by total assets. $\Delta(\text{NWC})$ is calculated as change in (current assets - current liabilities - cash and equivalents) scaled by total assets. Dividend is a dummy variable which takes a value of one if a firm pays dividends and zero otherwise. $\Delta(\text{PPE Growth})$ is the change in net growth of Property, Plant & Equipment. R&D is a dummy variable which takes a value of one if a firm has research and development expenditures and zero otherwise. $\ln(\text{Firm age})$ is calculated as the natural logarithm of years since founding. $\ln(\text{Bus. segment})$ is the natural logarithm of the number of business segments in which the firm is operating. The t-statistics reported in parentheses are based on standard errors clustered by country and year. Country, year, and industry dummies are included in all regressions. ***, **, * represent significance at 1%, 5% and 10% levels, respectively. All continuous variables are winsorized at 1% at each tail to reduce the impact of outliers. Dollar values are converted into 2019 constant dollars using the CPI.

	All Europe (1)	Non-EMU Europe (2)	Eurozone (3)
Public	0.007*** (4.55)	0.008*** (4.54)	0.012*** (6.07)
Eurozone	-0.011* (-1.84)		
Public * Eurozone	0.005*** (2.85)		
$\Delta \ln(\text{Total assets})$	-0.001*** (-6.67)	-0.000 (-0.60)	-0.001*** (-7.10)
Lag cash	-0.146*** (-33.93)	-0.138*** (-20.42)	-0.150*** (-29.32)
$\Delta(\text{Cash flow})$	0.175*** (33.56)	0.154*** (24.23)	0.185*** (29.72)
CF volatility	0.050*** (13.87)	0.060*** (11.31)	0.043*** (10.14)
$\Delta(\text{Sales growth})$	-0.001*** (-3.50)	-0.001* (-1.74)	-0.002*** (-2.94)
$\Delta(\text{Leverage})$	-0.059*** (-9.25)	-0.102*** (-18.14)	-0.047*** (-7.00)
$\Delta(\text{NWC})$	-0.222*** (-31.69)	-0.223*** (-37.18)	-0.222*** (-26.22)
Dividend	-0.005*** (-4.12)	-0.006*** (-3.63)	-0.004*** (-2.58)
$\Delta(\text{PPE Growth})$	-0.002*** (-6.30)	-0.005*** (-13.52)	-0.002*** (-5.89)
R&D	0.008*** (6.71)	0.005*** (3.73)	0.010*** (5.84)
$\ln(\text{Firm age})$	-0.000 (-1.50)	-0.000 (-1.06)	-0.000 (-1.42)
$\ln(\text{Bus. segments})$	-0.003*** (-6.20)	-0.004*** (-5.47)	-0.003*** (-3.76)
Country	Yes	Yes	Yes
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Constant	0.015*** (7.93)	0.015*** (7.95)	0.016*** (9.58)
N	550133	545913	452183
adj. R ²	0.236	0.237	0.244