R&D Investments and Corporate Cash Holdings*

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Abstract

This paper presents evidence about how research and development (R&D) expenditures affect corporate cash holdings in European country groups that differ in their innovation capacity. In theory, one can expect intangible investments such as R&D to result in higher cash stocks than fixed investments, particularly because intangible capital is less suitable as collateral for obtaining external funds. The relationship can be expected to be particularly strong in innovative countries. These countries carry out a relatively high proportion of cutting-edge R&D, which tends to be particularly risky and may be associated with substantial gestation lags before becoming productive. These features tend to increase firms' precautionary cash holdings. To investigate this issue in a European context, we examine different groups of countries that are clustered based on differences in their innovative capacity. Our estimation results confirm a positive relation between changes in R&D investment and changes in cash holdings, whereas changes in fixed investment do not appear to be related to changes in cash positions. The impact of changes in R&D on cash tends to be higher for country groups characterized by a high level of innovative capacity than for countries with moderate levels of innovative capacity. However, the differences across country groups are less pronounced than expected.

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1 Introduction

In this paper, we investigate the effects of R&D on corporate cash holdings in European country groups that differ in their innovation capacity. Firms' liquidity decisions have been a recurring topic in the finance and economic literature (for an overview, see Stein (2003)). The importance of internal funds for financing investment projects crucially depends on whether and to what extent firms face borrowing constraints when trying to obtain external funds. In a seminal paper, Fazzari, Hubbard and Petersen (1988) find that the availability of internal funds affects investment spending of firms with financial constraints.[1]

These constraints can be due to particular characteristics of the firms (e.g., small or non-investment grade) or to aggregate tightness in the credit market. It has also been stressed in the literature that the characteristics of an investment project affect borrowing constraints and the importance of corporate cash holdings (see, e.g., Hall and Lerner (2010) or Becker (2013)). In general, intangible investments such as R&D are more difficult to use as collateral to obtain external financing than tangible investments, mainly because tangible assets can be better seized in case of default. In addition, the intangible nature of R&D projects renders it difficult for outside investors to appropriately assess the value of this type of investment. Intangible investments such as R&D also tend to be associated with higher risk than tangible investment projects. Therefore, outside investors often have less accurate information on the likelihood of the success of R&D projects than for tangible investments (see, e.g., Hall and Lerner (2010)). This effect is reinforced if firms involved in R&D are reluctant to disclose sensitive information regarding their R&D projects (see, e.g., Cincera and Ravet (2010)). Provided that tangible capital can be better used as collateral, an increase in the importance of intangible capital reduces firms' debt capacities, which can be expected to lead to an increase in corporate cash holdings. Large cash holdings allow firms to keep projects running and to avoid selling assets in the face of refinancing problems (Harford, Klasa and Maxwell (2014)).[2]

[1] However, the robustness of these results has been challenged by Kaplan and Zingales (2000), among others.

[2] In addition to these explanations for corporate cash holdings, a variety of other reasons have been discussed in the literature (for a more extensive overview, see, e.g., Bates, Kahle and Stulz (2009)). Among them, an important reason is related to agency costs of managerial discretion. In this case, managers have incentives to accumulate liquid assets in order to carry out their own plans, e.g., to make investments that the shareholders or financial markets would not be willing to finance (Jensen (1986)). Another motive for cash holdings is related to transaction costs that arise when converting a non-liquid asset into cash.

The theoretical relation between corporate intangible investment decisions and cash holdings has been examined by, among others, Almeida, Campello and Weisbach (2004), Almeida and Campello (2007), Almeida, Campello and Weisbach (2011), and Falato, Kadyrzhanova and Sim (2013). A number of empirical papers have found a positive relation between intangibles - particularly R&D - and cash holdings. Many papers are based on data for the United States, but there are also studies for other countries (see, e.g., Bates et al. (2009), Brown and Petersen (2011), Brown, Martinsson and Petersen (2012), Baum, Caglayan and Talavera (2013), Falato et al. (2013), and Brown and Petersen (2015)).

The importance of internal funds may be particularly pronounced for firms carrying out cutting-edge (and often long-term oriented) R&D. Such projects are typically associated with higher risks and more substantial gestation lags than routine R&D. In addition, firms carrying out cutting-edge R&D may have better opportunities to turn R&D into highly successful products than firms doing routine R&D. Because negative shocks are more costly for corporations with cutting-edge R&D projects, they may hold more cash for precautionary reasons. The relevant literature investigating these issues includes, among others, Kamien and Schwartz (1978), Brown, Fazzari and Petersen (2009), Aghion, Angeletos, Banerjee and Manova (2010) or Czarnitzki and Hottenrott (2011). Given that cutting-edge R&D projects associated with substantial gestation lags are more important in innovative economies, we expect that R&D in these innovation leader countries will increase corporate cash holdings more strongly than in less innovative economies.

It has often been stressed that countries within Europe exhibit considerable differences in their capacity to innovate (see, e.g., Comin, Hobijn and Rovito (2006), Fagerberg and Verspagen (2014) or Veugelers (2016)). As shown by Veugelers (2016), the intra-European division with respect to corporate investment in research has increased, not decreased, since the onset of the financial crisis. In this paper, we investigate whether such differences in the capacity to innovate affect the relation between R&D spending and corporate cash holdings. This issue is not only of interest for the fields of innovation economics and finance but also for the economics of European integration and monetary economics. This is because differences in investment spending, borrowing constraints, and corporate cash holdings can affect the monetary transmission mechanism. This heterogeneity in the monetary transmission mechanism across countries is particularly important for the euro area. Previous studies have found that a country's economic and financial environment affects the relation between investment and financial factors, and vice versa (Cincera and

Ravet (2010)).

In our empirical analysis, we form groups of European countries with a similar level of innovation capacity. We adopt the classification by Veugelers (2016), who distinguishes different groups of European countries: innovation leaders, innovation followers, and moderate innovators. As discussed by Veugelers (2016), this classification is based on the Innovation Union Scoreboard indicator (IUS).[3] This indicator provides a useful and important basis for grouping countries according to their innovation capacity. However, one should be aware that such indicators can only approximately capture the complexity of a country's innovation system. While the innovation leaders and followers are all countries in Western Europe (with the exception of Estonia and Slovenia), moderate innovators are located in Southern Europe and in Central and Eastern Europe.[4] As discussed above, we expect the relation between R&D and cash to be strong for countries that are innovation leaders, but weak for moderate innovators.

We use data from the Thomson Reuters Worldscope database for listed companies. Obviously, using a database of public companies causes a bias towards large firms. In addition, it has been found that listed firms may systematically show different investment behaviors than privately held firms (Asker, Farre-Mensa and Ljungqvist (2015)). One should be aware that such biases may vary across country groups due to the various differences mentioned above. While the literature does not seem to have reached a consensus to provide a dominant empirical model, the empirical strategy of our paper is similar to that of several relevant contributions in the literature (Almeida et al. (2004) and Baum et al. (2013)). We investigate whether changes in investment expenditures lead to changes

[3]The index covers INNOVATION ENABLERS (human resources, public research systems, finance), FIRM ACTIVITIES (firm investment, linkages and entrepreneurship, intellectual assets) and OUTPUTS (innovators, economic effects). The ENABLERS capture the drivers of innovation that are external to firms. *Human resources* indicates the availability of a high-skilled and educated workforce. *Public research systems* capture the international competitiveness of the science base. The *finance dimension* indicates the ability of the financial system to provide finance for innovation projects. FIRM ACTIVITIES measure the drivers of innovation at the firm level. These include *firm investment* (R&D and non-R&D), but also the *linkages and entrepreneurship* dimension that attempts to capture entrepreneurial efforts and collaboration among innovative firms and also with the government. *Intellectual assets* measures intellectual property rights. OUTPUTS indicate the effects of innovation efforts. *Innovators* measures the number of firms that have produced innovations. *Economic effects* indicates the economic success of innovations in terms of sales, exports, and employment. A detailed discussion of the innovation scoreboard can be found in European Commission (2016).

[4]Innovation leaders are Denmark, Finland, Germany, and Sweden. Innovation followers are Austria, Belgium, Estonia, France, Ireland, Luxembourg, the Netherlands, Slovenia, and the United Kingdom. Moderate innovators are Croatia, the Czech Republic, Greece, Hungary, Italy, Lithuania, Poland, Portugal, Slovakia, and Spain. Veugelers (2016) also considers a group of so-called modest innovators comprising Bulgaria, Latvia, and Romania. We do not have enough observations for this group to report meaningful results.

in firms' cash holdings. Hence, we focus on the sensitivity of cash holdings to investment shifts and do not investigate related research questions, such as the determinants of the level of corporate cash holdings as, for example, in Bates et al. (2009). While the large and growing literature investigating the underlying reasons for the trend increase in corporate cash holdings is related to our paper, we focus on analyzing how changes in investment expenditures affect firms' liquidity decisions. Because we employ a dynamic panel data model, we use the system generalized method of moments (SGMM) estimator for dynamic panel data by Blundell and Bond (1998) and implement it in the Stata program based on the description in Roodman (2009).

In our regression analyses, we find either a slightly negative relation or no relation between changes in tangible investment and changes in cash holdings. Our results show a significant positive relation between changes in R&D and firms' cash holdings for innovation leaders and followers, but not for the group of moderate innovators that comprise the countries in Southern, Central, and Eastern Europe. These differences across country groups, however, are weaker than expected. In addition, we investigate whether the R&D-cash nexus depends on the size of the firms. Interestingly, the differences across country groups are visible across all firm size categories. However, we only find statistically significant coefficients for small firms in innovation leader and follower countries. We also analyze alternative country groups to check whether the main pattern of the results remain robust for different specifications of the country groups.

The rest of this paper is organized as follows. In Section 2 we discuss the data used in our empirical analysis and present descriptive statistics. Section 3 presents the empirical model and the sample selection criteria. In Section 4, we discuss the results of our empirical exercises. Finally, we present the conclusions in Section 5.

2 Data and Descriptive Statistics

We use unbalanced panels of quoted manufacturing firms for various European country groups as discussed above. The data are obtained from the Thomson Reuters Worldscope database for the period 1986-2014. In our empirical model, we analyze the following variables:[5] First, *Cash*, which is defined as the sum of cash and short term investments. Second, *Research and Development*, which represents all direct and indirect costs related to the creation and development of new processes, techniques, applications and products

[5]For a detailed description of these variables, see Thomson Financial (2013).

with commercial possibilities. Third, *Fixed investment*, which represents the funds used to acquire fixed assets, including mainly additions to property, plants, and equipment, along with investments in machinery and equipment. Fourth, *Cash flow*, which is a control variable representing a company's earnings before interest expenses, income taxes, depreciation and amortization (EBITDA). Fifth, *Short term debt* defined as debt payable within one year. Sixth, *Working capital*, which represents the difference between current assets and current liabilities. To avoid endogeneity problems, we subtract cash from this value and use working capital net of cash in our empirical model.

Tables 1 and 2 (see appendix) contain descriptive statistics for the level of cash, R&D, and fixed investment, normalized by total assets, for the whole period 1986-2014 and for a shorter period 2000-2014. There have been considerable changes to the financial systems in the world and in Europe since the end of the 1990s (Cincera and Ravet (2010)). This may have affected the relationship between investment and cash holdings - potentially in different ways in the country groups. As mentioned above, the country groups are innovation leaders (ILEAD), innovation followers (IFOLL), and moderate innovators (IMOD). Cash holdings for innovation leaders are slightly higher than for followers and account for 13.8% and 13.3% of total assets, respectively. For the shorter period starting in 2000, higher corporate cash holdings can be observed for these two groups. For the group of moderate innovators, which comprises Southern Europe and a number of Central and Eastern European countries, corporate cash holdings are significantly lower than for innovation leaders and followers. In addition, cash holdings are barely higher in the shorter period for moderate innovators. Such a rise in corporate cash holdings can be observed for many advanced economies, an issue that has been discussed extensively in the economic and finance literature (Falato et al. (2013)).

For R&D, a similar pattern can be observed: Innovation leaders show the highest value (1.7% of total assets), slightly higher than innovation followers (1.3%). R&D expenditure is considerably lower for moderate innovators (0.2%). For innovation leaders and followers, R&D investment is higher for the shorter period than for the longer period, while almost no difference can be observed for moderate innovators. For fixed capital, the ratio of fixed investment to total assets is lower in the shorter period than in the longer period for innovation leaders and followers, but not for moderate innovators. The increase in R&D spending in a number of advanced economies and the decrease in tangible fixed investment in almost all advanced economies in recent decades have been discussed extensively in the scientific and applied literature (see, e.g., Corrado, Haskel, Jona-Lasinio

and Iommi (2013) or Organisation for Economic Co-operation and Development (OECD) (2015)). The correlation coefficients ($\rho(\cdot, cash)$) imply that there is a positive correlation between cash holdings and R&D expenditures for innovation leaders and followers. For moderate innovators, the correlation coefficient is only slightly above zero. Conversely, the correlation coefficient between cash and fixed investment is slightly negative for all three country groups. For R&D, the median is close to or equal to 0, which implies that at least half of the firms in the dataset do not report any R&D expenditures, a result similar to those obtained by previous studies using firm level data. The number of firm-years differs across country groups due to the size of their economies and differences in stock market development.

3 The Empirical Model

Our empirical approach is similar to specifications in the existing literature (see, in particular, Almeida et al. (2004) and Baum et al. (2013)). The linear regression equation is defined as:

$$\begin{aligned}\Delta Cash_{i,t} =& \alpha_0 + \alpha_1 \Delta R\&D_{i,t} + \alpha_2 \Delta TangI_{i,t} + \alpha_3 \Delta Cash_{i,t-1} + \alpha_4 CashFlow_{i,t} \\ &+ \alpha_5 \Delta ShortDebt_{i,t} + \alpha_6 \Delta NWC_{i,t} + \mu_i + \tau_t + \epsilon_{i,t},\end{aligned} \tag{1}$$

where i indexes the firm and t the year. All variables are normalized by beginning-of-period total assets. The dependent variable is $\Delta Cash_{i,t}$, the change in corporate cash holdings; $\Delta Cash_{i,t-1}$ is its lag. The key coefficients of interest are α_1 and α_2, which determine the responses of cash holdings to changes in research and development expenditures, $\Delta R\&D_{i,t}$, and fixed capital investments, $\Delta TangI_{i,t}$, respectively. Under the plausible assumption that current investment projects were decided at least one period previously, they are not affected by changes in current cash holdings. We include the lag of the dependent variable in the regression to capture the persistence in changes of corporate cash holdings. In addition, the decision to hold cash may depend on cash flow ($CashFlow_{i,t}$) and changes in both net working capital ($\Delta NWC_{i,t}$) and short-term debt ($\Delta ShortDebt_{i,t}$). We follow Almeida et al. (2004) and Baum et al. (2013) and use the level of cash flow in our baseline regressions. However, we also perform sensitivity analysis using changes in cash flows. In addition, we run regressions in the levels of all variables to provide additional insights. The firm- and year-specific effects are denoted by μ_i and τ_t, respectively. Finally, $\epsilon_{i,t}$ is an idiosyncratic error term.

Our estimation strategy focuses on the effects of changes in investment expenditures on changes in cash holdings. Hence, we neither investigate the determinants of corporate

cash holdings nor the potential reasons for the trend increase in corporate cash holdings over recent decades. In addition, analyzing changes rather than levels avoids potential issues associated with non-stationarity. One implication of our approach is that firms reporting no changes in investment expenditures at low levels of investment are observationally equivalent to firms reporting no changes at high levels of investment and to firms reporting no investment expenditures at all. Obviously, the lagged dependent variable in our model causes fixed effect estimation to be biased and inconsistent; therefore, we use the two-step GMM system estimator to overcome the endogeneity issue. This estimator combines equations in levels of the variables with equations in differences. The lag length of the endogenous variables is limited with lag lengths between two and five periods. We implement the GMM estimator using the xtabond2 command in Stata, as described by Roodman (2009). The validity of the instruments is evaluated using the Sargan-Hansen J test for over-identified restrictions. In addition, we use an Arellano-Bond test for second-order serial correlation in the first-differenced error term. We compare the results obtained by the system GMM-estimator to those obtained from fixed effects regressions.

Prior to estimating our empirical models, we apply a number of sample selection criteria in a similar way to Almeida et al. (2004) and Baum et al. (2013). First, the top and bottom 1% of observations of all firm-specific variables are winsorized. Second, we drop companies that have undergone substantial changes in their composition during the sample period (e.g., participation in a merger, acquisition or substantial divestment). As these phenomena are not observable in the data, we calculate the growth rate of each firm's total assets and trim the annual distribution of those growth rates exceeding 100%. Third, we drop all companies with a cash-flow-to-assets ratio lower than -50% to remove companies in financial distress. Forth, we drop firms with fewer than three observations. Fifth, we replace missing values for R&D spending with zeros. All variables are CPI adjusted and standardized by beginning-of-period total assets.

4 Results

4.1 Main Results

The estimation results for each country group are depicted in Tables 3 to 5 in the appendix. We show estimation results for the whole period ranging from 1986 to 2014 (Column 1, 1986-2014) and for the shorter period starting in 2000 (Column 2, 2000-2014). We also report the results of regressions for the whole sample period after having

removed the firms with no R&D expenditures (Column 3, posrd). In addition, we run regressions using fixed effects (Column 4, fe dyn).

As expected from our discussion in Section 1, our GMM estimates reveal a clear difference between R&D and fixed investment. While the coefficient for R&D is positive, our regressions yield coefficients for fixed investments that are around zero. In most cases, we even find a slightly negative effect of changes in fixed investment on changes in corporate cash holdings. This confirms the previous findings in the literature, obtained with various specifications and data, that there are differences in the effects of tangible and intangible investment on corporate cash holdings. For instance, Bates et al. (2009) find a positive relation between the levels of R&D investments and cash, but a negative relation between fixed capital investment and cash. Brown et al. (2012) find that cash buffers are used by financially constrained firms for R&D but not for fixed investment. In addition, Brown and Petersen (2015) suggest that precautionary cash holdings during the financial crisis were used by firms mainly to stabilize R&D, whereas the same is not observed for fixed investment.

Overall, our results also tend to support the hypothesis discussed in Section 1, according to which innovative economies will see higher changes in cash holdings upon changes in R&D expenditures than less innovative countries. In innovation leader countries, R&D is more likely to be cutting-edge and long-term oriented. Higher risk and more substantial gestation lags lead to a higher demand for cash as a precaution. Innovation followers also carry out a considerable amount of long-term oriented R&D of a cutting-edge nature. Therefore, a significant positive relation between changes in R&D and changes in cash holdings can also be expected for innovation followers. In addition, innovation followers may be highly engaged in the process of adopting cutting-edge innovations, an activity that might be of a long-term oriented nature.

In our regressions, we find a significant positive coefficient for R&D for innovation leader and follower countries, but not for moderate innovators located in Southern and Eastern Europe. For the whole sample period, we obtain a value of 0.172 for innovation leaders and a slightly higher value of 0.231 for innovation followers. For moderate innovators, the value is lower and not significantly different from zero. For innovation leaders and followers, the coefficients for R&D are also positive and significant for the shorter sample period and for the sample only comprising firms with positive R&D expenditures. For moderate innovators, the value obtained for the shorter period is higher than for the

longer period, but still not significantly different from zero. When we drop the firms reporting no R&D expenditures, the estimated coefficient is also not significantly different from zero. Somewhat unexpectedly, the relation between changes in R&D and cash holdings is slightly stronger for innovation followers than for innovation leaders. Obviously, as discussed in Section 1, the indicator used to assess the degree of innovativeness may not fully capture the complex nature of a country's innovation system. However, provided that our indicator offers a sufficiently good approximation, our results suggest that the relation between the degree of innovativeness and the R&D-cash nexus may not be linear. For example, the process of adopting cutting-edge research output by innovation followers might be of a long-term nature. In addition, other factors such as labor regulations that influence R&D adjustment costs for R&D personnel or the nature of the financial system may interact in complex ways with the degree of innovativeness.

The cash flow sensitivity of cash, that is, the propensity of firms to change their cash holdings when cash flow increases, is significantly positive for all country groups, but the size of the effect differs. We find the highest values for innovation leaders (between 0.23 and 0.35), while the estimates obtained for the other country groups lie between 0.1 and 0.25. Using changes in cash flows instead of levels for the whole sample period leaves the estimated coefficients for the other variables including R&D and fixed investment almost unaffected (Table 6). The coefficients for working capital and short-term debt are similar to those found in the literature (see, e.g., Baum et al. (2013)).

As mentioned in Section 3, we also carry out additional regressions in the levels of all variables for the whole sample period. It is possible that regressions in levels provide additional insights into the properties of the data. The results indicate that fixed investment is associated with lower cash holdings in all three country groups (Table 7). Interestingly, there is no statistically significant relationship between R&D and cash holdings in all three groups. Whereas the coefficients for innovation leaders and followers are slightly above zero, the coefficient for moderate innovators is slightly below zero. These results further stress that fixed investment and R&D have different effects on corporate cash holdings. However, they do not provide additional evidence on significant differences between country groups regarding the effects of R&D on cash holdings.

It has been repeatedly argued that the firm size may be related to the degree to which firms are financially constrained (see, e.g., Baum et al. (2013)). This may be particularly important when it comes to financing R&D. Large firms may be more likely to

have established a track record of repaying a debt. In addition, large firms may have more tangible capital that can be used as collateral to obtain external finance for R&D projects. According to this reasoning, large firms are less financially constrained than small firms. For this paper, it is relevant to investigate whether the effects of innovative capacity on the R&D-cash nexus are greater for large or small firms. To analyze this issue, we rank firms within a country group according to their book value in each year. The top and bottom quartiles are assigned to large and small firms, respectively. The two medium quartiles are assigned to the group of medium sized firms. Firms with fewer than three observations in one category are dropped from this category.

Our findings confirm that small firms may have more borrowing constraints than medium-sized and big firms (Tables 8 to 10). The coefficient for R&D is considerably higher for small firms. In addition, the coefficient for R&D when considering medium and large firms is insignificant, while it is significant for small firms in innovation leader and follower countries. Overall, our findings imply that the differences in the R&D-cash nexus across country groups discussed above are visible - at least to some extent - across all firm sizes. For fixed investment, however, only small variations are found across different firm sizes.

4.2 An Alternative Grouping of Countries

While our grouping of countries is based on the objective criteria discussed in Veugelers (2016), it could nevertheless be the case that a somewhat different - but also conceivable - grouping of countries produces different results. For example, some people may argue that countries such as the United Kingdom or the Netherlands have been only slightly less or equally innovative than Germany. Also, one might object that Germany could drive the results for the innovation leader countries, or that the United Kingdom and Italy may drive the results for the groups of innovation followers and moderate innovators, respectively.

Importantly, our previous classification does not sufficiently account for the fact that labor market regulations have differed across European countries (see, e.g., Phelps and Sinn (2011)). Since wage costs for researchers and other people involved in the R&D process typically account for more than half of total R&D expenditures (Becker (2013)), differences in labor market regulations and welfare systems may affect the ability of firms to adjust R&D. Rigid labor laws can make adjustment costs for R&D especially large. Higher adjustment costs in turn may reinforce the precautionary motive to hold cash.

Differences in labor market regulations are a reason to analyze Anglo-Saxon countries, Scandinavia, and Continental Western Europe separately. They also provide a reason for separating countries in Southern Europe from Central and Eastern European countries.[6] In addition to these considerations, a further reason for analyzing Scandinavian countries separately is the frequently discussed particularity of the so-called Nordic (i.e., Scandinavian) innovation system (Phelps and Sinn (2011) and Fagerberg and Verspagen (2014)). Finally, there are also differences in the financial systems across Europe. These are especially pronounced between the Anglo-Saxon countries, whose financial systems are similar to the U.S. system with strong public equity markets; and a number of countries in Continental Western Europe such as Germany that tend to be "bank-based" economies.

Based on these reasons, we consider an alternative categorization of countries, which leads to the following five country groups: Continental Western Europe (CON), the Anglo-Saxon countries including the United Kingdom and Ireland (ANG), Scandinavia (SCAN), Southern Europe (SOU), and Central and Eastern Europe (EAS).[7] The groups of Continental Western Europe, Scandinavia, and the Anglo-Saxon countries can generally be characterized as having advanced economies, with high levels of income and considerable productivity levels and where cutting-edge R&D projects are relatively important. Therefore, one might expect a relatively strong relation between changes in R&D and cash holdings in these groups. However, as discussed above, variations in labor market regulations and financial systems may give rise to potential differences across the three country groups. In contrast to these three groups, countries in Southern and Eastern Europe tend to be less innovative. Southern European countries have seen relatively weak productivity growth since the 1990s - a trend temporarily masked by boom periods in some countries before the financial crisis, but reinforced since the outbreak of the financial crisis in 2008. The Eastern European countries have often seen fast productivity growth during the catch-up process of recent decades (European Bank for Reconstruction

[6] Almost identical or very similar groupings of European countries have been made in various literatures, e.g., the literature on education economics (see, e.g., Heckman and Jacobs (2011)), in labor and welfare economics (see Esping-Andersen (1990) or Beblavy, Maselli and Veselkova (2014)), or in the varieties of capitalism literature (Hall and Soskice (2001)). We use the term Continental Western Europe for countries on the European continent, but excluding Southern European countries and also formerly communist countries in Central and Eastern Europe. While the term "Continental Western Europe" has been occasionally used by several authors, for example, by Phelps and Sinn (2011), the exact list of countries may vary in the literature. For example, Phelps and Sinn (2011) also include Italy and Spain in this group.

[7] Continental Western Europe comprises Austria, Belgium, France, Germany, Luxembourg, and the Netherlands. Scandinavia consists of Denmark, Finland, Norway, and Sweden. Southern Europe consists of Greece, Italy, Portugal, and Spain. Eastern Europe consists of Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, and Slovakia.

and Development (EBRD) (2014)). Their productivity and income levels, however, are still below the levels seen in advanced economies. For these reasons, a weak relation between R&D and cash holdings may be expected in Southern Europe and in countries located in Central and Eastern Europe.

Tables 11 and 12 show descriptive statistics for the five country groups.[8] Cash holdings account for between 9% and 16% of total assets. Corporate cash holdings are similar for Continental Western Europe, the Anglo-Saxon countries and Scandinavia with values ranging from 0.134 to 0.145 for the whole period and even higher values between 0.148 and 0.164 for the shorter period. There is also a relatively wide variation in R&D expenditures in relation to total assets across the five country groups, with values ranging from less than 0.1% in Central and Eastern Europe and 0.3% in Southern Europe to approximately 2% in the other three country groups. Comparing the longer time period in Table 11 and the shorter time period in Table 12, one can see that the importance of R&D expenditures increased in Continental Western Europe, the Anglo-Saxon countries, and Scandinavia, while no such increase is observed in the southern and eastern parts of the continent. Fixed investment, in contrast, is lower for the more recent period than for the whole period starting in 1986. Continental Western Europe, the Anglo-Saxon countries, and Scandinavia all exhibit values of approximately 6% for the whole period and lower values of approximately 5% for the more recent period. In the countries of the southern European periphery, however, the level of fixed investment has stayed approximately the same and, at 4% of total assets, has been persistently lower than in the rest of Europe. Interestingly, for the period starting in 2000, the Central and Eastern European countries show fixed investment levels (approximately 5%) similar to those of the three Northern and Western European country groups.

The GMM estimations reveal a significant positive effect of changes in R&D upon changes in cash holdings for Continental Western Europe, the Anglo-Saxon countries, and Scandinavia (Tables 13 to 17). For Continental Western Europe, the estimated value is 0.172 for the whole sample period and 0.126 for the shorter period starting in 2000. For the Anglo-Saxon countries, we obtain values of approximately 0.2 for both periods. The highest values are found for the Scandinavian country group, with a value of 0.219 for the whole period and an even higher value of 0.348 for the short period. These results show that a positive significant relation between changes in R&D and cash holdings can

[8]For Central and Eastern Europe, we only depict descriptive statistics for the period 2000-2014, because of considerable data gaps in the 1980s and 1990s.

still be found if innovation leaders and followers are grouped in a different way. The results also suggest that differences in labor market regulations or financial systems might affect the R&D-cash nexus. For Southern and Eastern Europe, however, we do not find a significant positive relation between R&D and corporate cash holdings using GMM. For fixed investment, similar to the results for our baseline country grouping, the coefficient is either near zero or slightly negative for all country groups. When we drop the firms with no R&D expenditures, the coefficients tend to increase for most country groups. As with the baseline grouping of countries above, the coefficient on fixed investment tends to be slightly negative.

5 Conclusion

This paper analyzes the effects of shifts in R&D expenditures on changes in corporate cash holdings for European country groups that differ in their innovation capacity. We use unbalanced panels of manufacturing firms for the period 1986-2014 from the Thomson Reuters Worldscope database. In theory, one might expect intangible investments to lead to an increase in firms' cash holdings because intangible assets yield more uncertain returns than fixed investment and are less suitable as collateral for obtaining loans. In addition, one might expect that the demand for cash is higher in innovative countries where cutting-edge R&D is carried out. The risks and substantial gestation lags associated with such projects should increase the precautionary demand for liquid assets among firms. In less innovative countries where routine R&D is supposedly more important, demand for liquid assets might be lower. Overall, these theoretical expectations are confirmed in our empirical analysis. For countries showing a high degree of innovative capacity (innovation leaders and followers), we find a positive and significant relation; this is not the case for moderate innovators. The differences across country groups, however, are less strong than expected. Interestingly, the positive and significant relation between changes in R&D and changes in cash holdings can mainly be observed for small firms in all country groups. An alternative grouping of countries reveals that Continental Western Europe, Scandinavia, and the Anglo-Saxon countries that can be classified as innovative exhibit a positive relation between changes in R&D and cash, while moderate innovators in Southern and Eastern Europe do not. For fixed investment, the relation between changes in this type of investment and cash is weak and similar across all country groups, which corresponds to the expected outcome discussed in Section 1. In summary, we find considerable heterogeneity within Europe regarding the effects of R&D spending on corporate cash holdings. These differences may affect the transmission channels of

monetary policy, because differences in the management of corporate liquidity and debt may alter the way firms and financial market participants react to interest rate changes. In future research, it would be worth investigating whether the main results of our study can be confirmed with other datasets and specifications.

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A Appendix

Table 1: Summary descriptive statistics 1986-2014

	ILEAD	**IFOLL**	**IMOD**
Cash			
μ	0.138	0.133	0.094
σ^2	0.026	0.025	0.013
Median	0.081	0.080	0.057
R&D			
μ	0.017	0.013	0.002
σ^2	0.003	0.003	$<$0.001
Median	0	0	0
$\rho(\cdot, Cash)$	0.232	0.237	0.075
Fixed Investment			
μ	0.059	0.055	0.046
σ^2	0.096	0.033	0.004
Median	0.039	0.034	0.028
$\rho(\cdot, Cash)$	-0.064	-0.059	-0.069
$Firm - years$	27136	57197	19327

Notes: All figures are normalized by total assets.
μ and σ^2 represent mean and variance respectively.

Table 2: Summary descriptive statistics 2000-2014

	ILEAD	**IFOLL**	**IMOD**
Cash			
μ	0.158	0.148	0.096
σ^2	0.031	0.029	0.014
Median	0.098	0.091	0.057
R&D			
μ	0.022	0.017	0.002
σ^2	0.003	0.003	$<$0.001
Median	$<$0.001	0	0
$\rho(\cdot, Cash)$	0.252	0.278	0.079
Fixed Investment			
μ	0.050	0.045	0.046
σ^2	0.178	0.004	0.004
Median	0.030	0.027	0.028
$\rho(\cdot, Cash)$	-0.072	-0.112	-0.025
$Firm - years$	14189	31884	13476

Notes: All figures are normalized by total assets.
μ and σ^2 represent mean and variance respectively.

Table 3: Innovation Leaders

	1986-2014	2000-2014	posrd	fe dyn
	(1)	(2)	(3)	(4)
ΔRD_t	0.172***	0.209**	0.291**	0.027
	(0.064)	(0.083)	(0.115)	(0.064)
$\Delta FixInv_t$	-0.002	-0.008	0.004	-0.062
	(0.014)	(0.016)	(0.025)	(0.011)
$\Delta Cash_{t-1}$	-0.115***	-0.097***	-0.101***	-0.235***
	(0.016)	(0.018)	(0.031)	(0.015)
$CashFlow_t$	0.232***	0.231***	0.354***	0.225***
	(0.035)	(0.034)	(0.050)	(0.023)
$\Delta ShortDebt_t$	-0.141***	-0.146***	0.259***	-0.113***
	(0.021)	(0.026)	(0.038)	(0.015)
ΔNWC_t	-0.262***	-0.260***	-0.365***	-0.245***
	(0.019)	(0.022)	(0.039)	(0.014)
$Firm - years$	18916	12456	5395	21368
J	357.73	119.13	352.34	
$J\ p-value$	0.089	0.147	0.126	
$AR(2)\ p-value$	0.462	0.653	0.222	
$R-squared$				0.153

$\Delta Cash_t$ is the dependent variable. Robust standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Innovation Followers

	1986-2014	2000-2014	posrd	fe dyn
	(1)	(2)	(3)	(4)
ΔRD_t	0.231***	0.241***	0.278***	0.128
	(0.049)	(0.057)	(0.062)	(0.044)
$\Delta FixInv_t$	-0.017**	-0.015	0.013	-0.056***
	(0.007)	(0.011)	(0.015)	(0.007)
$\Delta Cash_{t-1}$	-0.085***	-0.092***	-0.122***	-0.215 ***
	(0.010)	(0.014)	(0.020)	(0.010)
$CashFlow_t$	0.141***	0.126***	0.249***	0.140***
	(0.030)	(0.041)	(0.037)	(0.031)
$\Delta ShortDebt_t$	-0.197***	-0.191***	-0.246***	-0.188***
	(0.016)	(0.021)	(0.035)	(0.011)
ΔNWC_t	-0.275***	-0.270***	-0.354***	-0.265***
	(0.016)	(0.020)	(0.032)	(0.012)
$Firm - years$	36605	21882	9281	42008
J	338.20	118.60	296.51	
$J\ p - value$	0.269	0.155	0.513	
$AR(2)\ p - value$	0.015	0.069	0.021	
$R - squared$				0.126

$\Delta Cash_t$ is the dependent variable. Robust standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Moderate Innovators

	1986-2014	2000-2014	posrd	fe dyn
	(1)	(2)	(3)	(4)
ΔRD_t	0.119	0.247	0.143	0.206
	(0.159)	(0.205)	(0.179)	(0.135)
$\Delta FixInv_t$	-0.003	0.002	0.001	-0.021
	(0.006)	(0.008)	(0.026)	(0.015)
$\Delta Cash_{t-1}$	-0.142***	-0.145***	-0.212***	-0.251***
	(0.013)	(0.015)	(0.038)	(0.029)
$CashFlow_t$	0.163***	0.172***	0.225***	0.119***
	(0.026)	(0.027)	(0.104)	(0.027)
$\Delta ShortDebt_t$	-0.092***	-0.108***	-0.139***	-0.067***
	(0.014)	(0.016)	(0.043)	(0.012)
ΔNWC_t	-0.148***	-0.155***	-0.271***	-0.125***
	(0.017)	(0.019)	(0.042)	(0.014)
$Firm - years$	14938	11807	1435	17403
J	352.89	144.77	184.43	
$J\ p-value$	0.121	0.005	0.913	
$AR(2)\ p-value$	0.002	0.006	0.175	
$R-squared$				0.114

$\Delta Cash_t$ is the dependent variable. Robust standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Changes in Cash Flows

	ILEAD	IFOLL	IMOD
	(1)	(2)	(3)
ΔRD_t	0.173***	0.236***	0.121
	(0.065)	(0.051)	(0.158)
$\Delta FixInv_t$	0.003	-0.015	-0.003
	(0.013)	(0.007)	(0.006)
$\Delta Cash_{t-1}$	-0.106***	-0.079***	-0.134***
	(0.017)	(0.010)	(0.014)
$\Delta CashFlow_t$	0.076***	0.073***	0.075***
	(0.023)	(0.014)	(0.020)
$\Delta ShortDebt_t$	-0.152***	-0.192***	-0.088***
	(0.022)	(0.016)	(0.014)
ΔNWC_t	-0.249***	-0.269***	-0.139***
	(0.020)	(0.015)	(0.017)
$Firm - years$	18916	36605	14938
J	357.27	341.82	346.43
$J\ p-value$	0.092	0.226	0.177
$AR(2)\ p-value$	0.555	0.020	0.005

$\Delta Cash_t$ is the dependent variable.

Robust standard errors in parentheses.

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

Table 7: Levels

	ILEAD	IFOLL	IMOD
	(1)	(2)	(3)
RD_t	0.055	0.064	-0.081
	(0.041)	(0.041)	(0.108)
$FixInv_t$	-0.317***	-0.314***	-0.227***
	(0.027)	(0.023)	(0.023)
$Cash_{t-1}$	0.447***	0.491***	0.375***
	(0.028)	(0.021)	(0.024)
$CashFlow_t$	0.031***	0.055***	0.071***
	(0.018)	(0.011)	(0.024)
$ShortDebt_t$	-0.259***	-0.280***	-0.147***
	(0.021)	(0.023)	(0.016)
NWC_t	-0.286***	-0.261***	-0.139***
	(0.018)	(0.022)	(0.018)
$Firm - years$	20193	42514	15587
J	419.82	435.85	322.96
$J\ p-value$	0.004	0.003	0.506
$AR(2)\ p-value$	0.138	0.318	0.664

$Cash_t$ is the dependent variable.

Robust standard errors in parentheses.

$^{*}\ p < 0.1$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

Table 8: Innovation Leaders: Different Firm Sizes

	small	medium	big
	(1)	(2)	(3)
ΔRD_t	0.205*	0.121	0.143
	(0.119)	(0.094)	(0.099)
$\Delta FixInv_t$	-0.035	0.022	-0.033
	(0.027)	(0.024)	(0.025)
$\Delta Cash_{t-1}$	-0.144***	-0.106***	-0.149***
	(0.038)	(0.020)	(0.043)
$CashFlow_t$	0.181***	0.296***	0.225***
	(0.051)	(0.043)	(0.086)
$\Delta ShortDebt_t$	-0.054	-0.186***	-0.076***
	(0.051)	(0.025)	(0.033)
ΔNWC_t	-0.218***	-0.324***	-0.221***
	(0.035)	(0.027)	(0.025)
$Firm - years$	3324	9117	4992
J	248.18	347.28	346.13
$J\ p - value$	0.799	0.169	0.180
$AR(2)\ p - value$	0.676	0.370	0.011

$\Delta Cash_t$ is the dependent variable.

Robust standard errors in parentheses.

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

Table 9: Innovation Followers: Different Firm Sizes

	small	medium	big
	(1)	(2)	(3)
ΔRD_t	0.287***	0.117	0.081
	(0.081)	(0.069)	(0.086)
$\Delta FixInv_t$	0.006	-0.029***	-0.006
	(0.025)	(0.010)	(0.007)
$\Delta Cash_{t-1}$	-0.135***	-0.064***	-0.122***
	(0.028)	(0.013)	(0.018)
$CashFlow_t$	0.092***	0.202***	0.188***
	(0.035)	(0.027)	(0.034)
$\Delta ShortDebt_t$	-0.179***	-0.206***	-0.168***
	(0.030)	(0.023)	(0.024)
ΔNWC_t	-0.221***	-0.361***	-0.273***
	(0.027)	(0.023)	(0.024)
$Firm-years$	5595	17507	9969
J	301.09	364.33	333.68
$J\ p-value$	0.804	0.056	0.329
$AR(2)\ p-value$	0.026	0.235	0.507

$\Delta Cash_t$ is the dependent variable.

Robust standard errors in parentheses.

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

Table 10: Moderate Innovators: Different Firm Sizes

	small	medium	big
	(1)	(2)	(3)
ΔRD_t	0.252	0.239	-0.027
	(0.371)	(0.206)	(0.228)
$\Delta FixInv_t$	-0.008	0.003	0.001
	(0.025)	(0.009)	(0.012)
$\Delta Cash_{t-1}$	-0.172***	-0.163***	-0.142***
	(0.028)	(0.017)	(0.023)
$CashFlow_t$	0.098***	0.202***	0.184***
	(0.028)	(0.043)	(0.046)
$\Delta ShortDebt_t$	-0.061***	-0.104***	-0.108***
	(0.016)	(0.021)	(0.028)
ΔNWC_t	-0.079***	-0.204***	-0.221***
	(0.019)	(0.023)	(0.033)
$Firm - years$	2776	6873	3868
J	249.99	345.03	270.03
$J\ p - value$	0.948	0.191	0.986
$AR(2)\ p - value$	0.531	0.026	0.016

$\Delta Cash_t$ is the dependent variable.

Robust standard errors in parentheses.

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

Table 11: Summary descriptive statistics 1986-2014

	CON	**ANG**	**SCAN**	**SOU**	**EAS**
Cash					
μ	0.134	0.139	0.145	0.094	
σ^2	0.022	0.029	0.023	0.012	
Median	0.083	0.078	0.096	0.058	
R&D					
μ	0.014	0.015	0.017	0.003	
σ^2	0.002	0.003	0.002	$<$0.001	
Median	0	0	0	0	
$\rho(\cdot, Cash)$	0.189	0.269	0.271	0.105	
Fixed Investment					
μ	0.058	0.057	0.061	0.040	
σ^2	0.009	0.027	0.005	0.003	
Median	0.040	0.037	0.043	0.023	
$\rho(\cdot, Cash)$	-0.051	-0.049	-0.109	-0.075	
$Firm - years$	38034	31880	13487	13899	

Notes: All figures are normalized by total assets.
μ and σ^2 represent mean and variance respectively.

Table 12: Summary descriptive statistics 2000-2014

	CON	**ANG**	**SCAN**	**SOU**	**EAS**
Cash					
μ	0.154	0.164	0.148	0.095	0.091
σ^2	0.027	0.038	0.027	0.013	0.017
Median	0.099	0.094	0.093	0.059	0.043
R&D					
μ	0.018	0.019	0.021	0.003	$<$0.001
σ^2	0.003	0.004	0.003	$<$0.001	$<$0.001
Median	0	0	0.001	0	0
$\rho(\cdot, Cash)$	0.231	0.264	0.355	0.132	0.003
Fixed Investment					
μ	0.048	0.044	0.051	0.039	0.049
σ^2	0.012	0.005	0.004	0.004	0.004
Median	0.030	0.023	0.033	0.022	0.028
$\rho(\cdot, Cash)$	-0.088	-0.082	-0.104	-0.060	-0.063
$Firm - years$	21298	16475	7778	8679	8150

Notes: All figures are normalized by total assets.
μ and σ^2 represent mean and variance respectively.

Table 13: Continental Western Europe

	1986-2014	2000-2014	posrd	fe dyn
	(1)	(2)	(3)	(4)
ΔRD_t	0.172***	0.126**	0.202***	0.115***
	(0.045)	(0.052)	(0.064)	(0.042)
$\Delta FixInv_t$	-0.011	-0.006	-0.007	-0.051***
	(0.010)	(0.014)	(0.021)	(0.009)
$\Delta Cash_{t-1}$	-0.091***	-0.066**	-0.097***	-0.206***
	(0.014)	(0.019)	(0.028)	(0.013)
$CashFlow_t$	0.139***	0.129*	0.251***	0.127**
	(0.035)	(0.042)	(0.040)	(0.013)
$\Delta ShortDebt_t$	-0.104***	-0.137***	-0.107***	-0.104***
	(0.019)	(0.024)	(0.021)	(0.019)
ΔNWC_t	-0.215***	-0.218***	-0.236***	-0.213***
	(0.015)	(0.021)	(0.033)	(0.012)
$Firm - years$	26381	14599	5844	29704
J	354.10	124.93	305.63	
$J\ p - value$	0.113	0.053	0.368	
$AR(2)\ p - value$	0.262	0.310	0.497	
$R - squared$				0.115

$\Delta Cash_t$ is the dependent variable. Robust standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 14: Anglo-Saxon

	1986-2014	2000-2014	posrd	fe dyn
	(1)	(2)	(3)	(4)
ΔRD_t	0.197**	0.192*	0.213**	0.086
	(0.081)	(0.115)	(0.098)	(0.070)
$\Delta FixInv_t$	-0.029***	-0.016	-0.014	-0.069***
	(0.008)	(0.017)	(0.018)	(0.008)
$\Delta Cash_{t-1}$	-0.106***	-0.102***	-0.126***	-0.235***
	(0.014)	(0.021)	(0.018)	(0.014)
$CashFlow_t$	0.179***	0.191***	0.245	0.191***
	(0.025)	(0.031)	(0.024)	(0.015)
$\Delta ShortDebt_t$	-0.248***	-0.214***	-0.281***	-0.239***
	(0.022)	(0.036)	(0.048)	(0.017)
ΔNWC_t	-0.326***	-0.302***	-0.389***	-0.308***
	(0.023)	(0.034)	(0.042)	(0.016)
$Firm - years$	19681	9216	5298	22958
J	314.40	98.02	309.61	
$J\ p-value$	0.246	0.197	0.310	
$AR(2)\ p-value$	0.010	0.688	0.019	
$R-squared$				0.154

$\Delta Cash_t$ is the dependent variable. Robust standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 15: Scandinavia

	1986-2014	2000-2014	posrd	fe dyn
	(1)	(2)	(3)	(4)
ΔRD_t	0.219**	0.348**	0.472***	0.023
	(0.097)	(0.154)	(0.158)	(0.097)
$\Delta FixInv_t$	0.011	0.005	-0.035	-0.032***
	(0.009)	(0.019)	(0.027)	(0.009)
$\Delta Cash_{t-1}$	-0.089***	-0.092***	-0.088**	-0.209***
	(0.019)	(0.023)	(0.041)	(0.018)
$CashFlow_t$	0.290***	0.286***	0.419***	0.251***
	(0.035)	(0.044)	(0.069)	(0.025)
$\Delta ShortDebt_t$	-0.234***	-0.233***	-0.354***	-0.196***
	(0.024)	(0.032)	(0.044)	(0.022)
ΔNWC_t	-0.337***	-0.305***	-0.447***	-0.304***
	(0.027)	(0.036)	(0.046)	(0.023)
$Firm - years$	9701	6316	2633	11382
J	312.36	101.69	264.91	
$J\ p-value$	0.272	0.362	0.547	
$AR(2)\ p-value$	0.055	0.193	0.411	
$R-squared$				0.153

$\Delta Cash_t$ is the dependent variable. Robust standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 16: Southern Europe

	1986-2014	2000-2014	posrd	fe dyn
	(1)	(2)	(3)	(4)
ΔRD_t	0.072	0.027	-0.067	0.264*
	(0.151)	(0.168)	(0.171)	(0.155)
$\Delta FixInv_t$	-0.001	0.008	0.027	-0.028***
	(0.008)	(0.011)	(0.03)	(0.007)
$\Delta Cash_{t-1}$	-0.142***	-0.153***	-0.199***	-0.228***
	(0.016)	(0.019)	(0.041)	(0.017)
$CashFlow_t$	0.124***	0.098***	0.205**	0.131***
	(0.028)	(0.032)	(0.101)	(0.015)
$\Delta ShortDebt_t$	-0.088***	-0.099***	-0.145***	-0.061***
	(0.014)	(0.047)	(0.012)	(0.012)
ΔNWC_t	-0.138***	-0.129***	-0.286***	-0.125***
	(0.018)	(0.024)	(0.047)	(0.014)
$Firm - years$	9868	6237	1156	11126
J	362.85	136.58	171.63	
$J\ p-value$	0.063	0.044	0.864	
$AR(2)\ p-value$	0.019	0.005	0.250	
$R-squared$				0.094

$\Delta Cash_t$ is the dependent variable. Robust standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 17: Central and Eastern Europe

	1986-2014	2000-2014	posrd	fe dyn
	(1)	(2)	(3)	(4)
ΔRD_t		0.006	0.263	-0.083
		(0.182)	(0.251)	(0.149)
$\Delta FixInv_t$		-0.003	-0.023	-0.012
		(0.011)	(0.035)	(0.038)
$\Delta Cash_{t-1}$		-0.151***	-0.323***	-0.281***
		(0.022)	(0.064)	(0.031)
$CashFlow_t$		0.181***	0.216	0.110*
		(0.045)	(0.114)	(0.049)
$\Delta ShortDebt_t$		-0.098***	-0.225***	-0.079***
		(0.092)	(0.098)	(0.023)
ΔNWC_t		-0.164***	-0.270***	-0.122***
		(0.029)	(0.084)	(0.026)
$Firm - years$		4677	432	5884
J		104.99	31.94	
$J\ p-value$		0.373	1.0	
$AR(2)\ p-value$		0.053	0.056	
$R-squared$				0.141

$\Delta Cash_t$ is the dependent variable. Robust standard errors in parentheses. Time fixed effects are included in all specifications.

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