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Cash Holdings and Corporate Diversification: Evidence From Nordic Companies

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Cash Holdings and Corporate Diversification
Evidence From Nordic Companies

A Master Thesis Report

MSc Business with Major in Finance

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Abstract

We examine the relationship between diversification and corporate liquidity in Nordic firms. The significant findings of this paper show that multidivisional firms hold less cash relative to their stand-alone counterpart due to diversification in their investment opportunities and cash flows. Mainly through a higher correlation between investment opportunity and cash flow, but also higher cross-divisional correlations in cash flow results in lower cash holdings, even after controlling for determinants such as cash flow volatility. Furthermore, we find that the most substantial effects apply to firms that are financially constrained. As a whole, the results provide an efficient link between corporate liquidity and diversification in the Nordic universe.

Acknowledgements

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1 Introduction

Over the last decades, companies have hoarded trillions in cash and severely increased their cash holdings. This hoarding has created a lot of confusion among financial experts. Nordic companies have billions in money laying around, and with an earning of only two percent interest on US treasury bond, this does not make much economic sense.

As cash holding has severely increased, its research has been receiving growing attention. Most of its focus has been on the relation between cash holding and cash flow (e.g., (Opler, Pinkowitz, Stulz, & Williamson, 1999), (Almeida, Campello, & Weisbach, 2004). In this study, we wish to include the effect of investment opportunity and its impact through diversification on cash holdings and apply a similar approach as Duchin (2010) to verify whether this factors also have a significant effect on the Nordic markets.

Duchin (2010) show that stand-alone firms, on average, almost possess twice as large cash holding as diversified firms. He shows through his analysis that diversified firms, with divisions not perfectly correlated, are better positioned to smooth cash flow and investment opportunities. Which leads to lower cash holdings due to the decreased need for precautionary cash. Duchin (2010) uses US firms with a dataset expanding from 1990 to 2006.

To set things into perspective, Apple, Google, and Microsoft alone are hoarding trillions of cash. More specific, at the end of 2017 these companies had around USD 464 billion in cash. By the finding of Duchin (2010), an increase in the cross-divisional correlation in investment opportunity leads to a rise in the cash holdings of the average firm. This amount of cash deserves some attention, and with similar research done in the US, we focus our attention to the Nordic market.

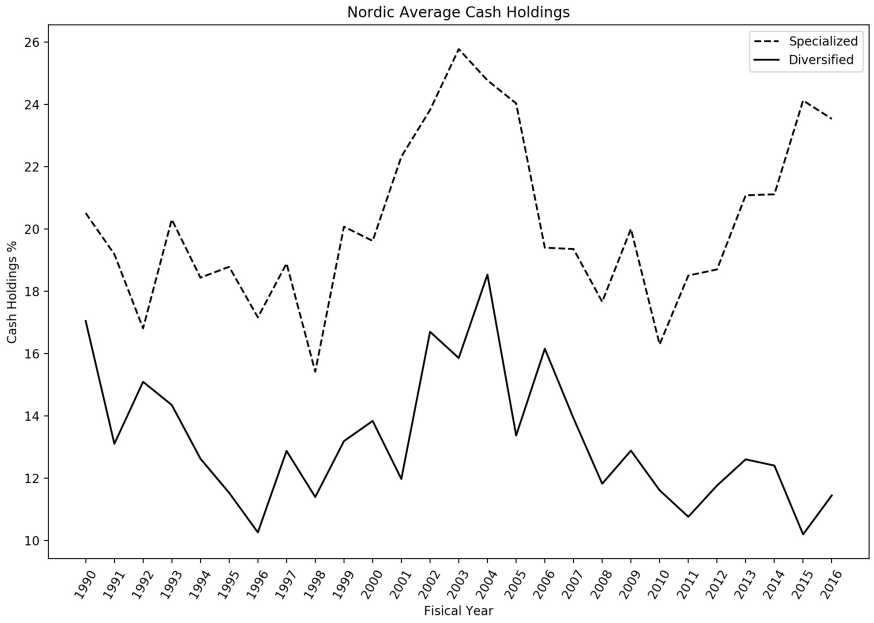
Duchin (2010) suggests that a firm which is diversified, relatively to its undiversified counterpart, can hold less cash, due to lower exposure to risk by the diversified firm. The lower exposure to risk in the current market, with low interest on cash holdings, would increase the firm value and make the firm able to use its holdings alternatively.

The motivation above leads us to our research question:

"How does a firm's diversification affect its cash holdings?"

The figure above divides the universe of Nordic average cash holdings into

Figure 1



Average annual cash holdings for specialized and diversified firms

This figure plots the average annual cash-to-assets ratios of specialized and diversified firms in the sample, which consists of nonfinancial and nonutility firm-years from 1990 to 2016 with non- missing data on cash holdings and on the industry codes of each business segment, and with total market capitalization of 50M or more in local currency. Cash to assets is cash and short-term investments scaled by total assets. Specialized firms are firms that reported a single business segment on Datastream, whereas diversified firms are firms with two business segments or more.

diversified versus stand-alone firms. Furthermore, the figure compares its average cash holdings from 1990 to 2016. One should not only note the significant increase in cash holding that peaks around 2005, but also the distinct different cash policies of specialized and diversified firms, a feature that has relative to the increase of cash holding, not received much attention. Specifically, diversified firms in our sample hold approximately 92% of the aggregate corporate cash. In addition, diversified firms also carry approximately 12.1% less cash as a ratio of assets, compared to their independent counterpart. Thus, understanding the principal elements and implications of diversified firms' cash holdings is of high economic value. Growth opportunities or cash flow volatility (e.g., (Opler et al., 1999) and economies of scale (e.g., (Beltz & Frank, 1996), (Mulligan, 1997)), don't explain these differences and we will investigate this more in-depth later in this paper.

2 Literature Review

There is done more and more research in the field of cash holdings, and this paper attributes to a growing body of research in this field. One study which focuses on the relationship between cash flow and cash holdings is done by Opler et al. (1999). Their paper find firms which have riskier cash flows and stronger growth opportunities holds a relatively larger portion of cash. Thus, they detect evidence that supports their static trade-off model, and firms hold more cash than expected by the static trade-off theory. As Opler et al. (1999) & Almeida et al. (2004) mainly focus their attention on the relationship between cash holding and cash flow. Where, Almeida et al. (2004) create a model that interconnect the relation between corporate liquidity demand and financial constraints. Showing that empirically the financially constrained firms holding of cash and other liquid assets should increase when cash flow is higher. Resulting in that constrained firm's cash flow sensitivity of cash would be positive. We incorporate the notion of investment opportunity risk and examine the effect it has on cash holding and how it corresponds to internal capital markets and diversification.

In this paper, we not only study the relationship between investment opportunity and cash flow (i.e., the financing gap as studied by Acharya, Almeida, and Campello (2007)) has on cash holding, but also suggest that diversified firms have the opportunity to have a lower cash holding when their cross-divisional correlation decrease. Thus, diversified firms could use internal cash flow instead of turning to costly external financing. As precautionary saving theory presented by Keynes (1936) suggests, firms could be forced to sacrifice valuable investment opportunities due to the need to protect themselves against adverse cash flow shocks because external financing could turn out to be expensive.

Furthermore, as insights of Miller and Modigliani (1958) postulates, cash does not affect firm value when markets are frictionless, implying that cash flows and cash holding are correlated only for financially constrained firms.

As mentioned above, our paper distinguish itself by not only studying the relation between cash flow and cash holding but also taking into consideration the notion of investment opportunity risk and its effect on cash holdings and how this interconnects with internal markets and corporate diversification. We study the relationship between cash holdings and internal capital markets, which is essential

when gaining further understanding of the relationship between liquidity and diversification. Matsusaka and Nanda (2002) develop a theory of organizations based on the cost and benefits of internal capital markets. Diversification could be beneficial through the working of the internal capital markets because it insulates firms from the cost of external capital markets and rationing (Stein, 1997). Rajan, Servaes, and Zingales (2000) show that when divisions have similar resources and opportunities, funds will be transferred to divisions with good investment opportunities from divisions with inadequate opportunities. As the difference in opportunities and resources increase, it may be the case that resource flow goes towards the most inefficient division. Therefore, leading to a less valuable firm and more inefficient investment. We apply a similar indirect measure of the cross-divisional transfer.

Graham, Lemmon, and Wolf (2002) & Hyland and Diltz (2002) analyze the effect of diversification on firm value. Thus, to study the impact of diversification on corporate liquidity, a similar longitudinal method could be used.

Furthermore, (Kim, Mauer, & Sherman, 1998) asks how a firm should decide to invest in liquid assets, given that external financing is costly. They find that the optimal investment in liquidity is increasing in 1) variance of future cash flow, 2) cost of external funding, and 3) return on future investment opportunities. Additionally, their model shows that the optimal investment in liquidity is decreasing in the return differential between liquid assets and firms' physical assets.

Studies by Denis and Sibilkov (2009) show that the value of holding cash is less for unconstrained firms than for financially constrained firms. More specifically, they study why this is apparent and the reason some constrained firms appear to hold too little cash. Higher cash holdings should, according to their study, result in a higher level of investment for constrained firms that have hedging needs. Additionally, constrained firms should experience a stronger link between investment and value than unconstrained firms. Their result suggests that higher cash holdings permit constrained firms to participate in value-increasing projects which otherwise would be bypassed.

3 Theory

The main research question in this paper is how diversification affects firms cash holdings. To investigate this question, we will in this section, introduce theories of

cash holdings and in the next part, present testable hypothesis to help us answer the research question.

Imagine a company that produces stochastic cash flows from a given asset and investment opportunities arrive randomly. Additionally, the firm is operating in an imperfect capital market, and it is not feasible to raise sufficient funds to finance all of the firms' investment opportunities, neither today nor in the future. The firm faces a dilemma regarding the allocation of funds in the future states of the world. The firm may save a part of today's cash flow and carry it to the future as cash holding. Of course, this decision has some economic implications. On one side, the firm faces financing frictions and thus carrying the cash holdings into the future, will imply that the firm sacrifice valuable investment opportunities today, which may turn out to be costly. At the same time, by carrying the cash holdings into the future state, it will increase the firm's ability to finance future expected investment opportunities. So, what should the firm do? Optimality can be found (i.e., the optimal amount of cash holdings) where the marginal profitability of current investment equals the marginal expected profitability of future investments. Therefore, in optimum, the level of cash is a function of the joint distribution of cash flow and investment opportunity. This framework captures the importance of precautionary demand for cash.

Theory suggests that firms that operate in more volatile industries should hold a higher proportion of cash as a fraction of their assets (Opler et al., 1999). However, as stated above, if the optimal cash level is a function of the joint distribution of investment opportunities and cash flow over time, it is not only the volatility of the cash flow that affects the cash holdings, but also the uncertainty in investment opportunities, and the simultaneity of cash flows and investment opportunities. To conclude, more volatile investment opportunities imply that firms should, in optimality, hold on to more cash. Furthermore, firms with cash flows and investment opportunity that arrive in different period should also, in optimality, hold on to more cash.

We continue with the thought process from above, to understand the diversification effect of cash holdings. Again, imagine a simple multidivisional firm with two business divisions. Where each division is operating in an industry that produces stochastic cash flows and investment opportunity that arrive randomly. Multiple divisions affect the level of a firm's cash holdings through the impact of diversifi-

cation on the joint distribution of cash flows and investment opportunities across divisions.

The thought process suggests that diversified companies are better positioned to have lower cash holdings because they can diversify the effect across division investment opportunities and cash flows. If cross-divisional correlation in investment opportunity is low, the multidivisional firm can hold less cash, because a lower correlation between divisions decreases the marginal value of holding cash. Implying that in an optimum, multidivisional firm is less likely to face several investment opportunities in its divisions at the same time. Hence, the firm has a lower precautionary demand for cash. Further, imagine an adverse cash flow shock, which increases the marginal value of cash holdings. Then a multidivisional firm, where the correlation in cash flow across divisions is low, can hold less cash because the probability of facing simultaneous adverse cash flow shock is lower. Lastly, if the correlation between cash flows and investment opportunities is high, implying that in optimum, the level of cash holdings should decrease. Since investment opportunities can now be financed through internal cash flow, rather than tapping into the costly cash holdings. Suggesting that essential factors of cash holdings are the cross-divisional correlation, not only in cash flow and investment opportunity but also the correlation between divisional cash flow and investment opportunities. This analysis implies several empirical implications of the theory. A fundamental assumption of the theory is that investments made by the firm cannot easily be financed using external funds. If this were the case, then cash holdings would add no extra value (Miller & Modigliani, 1958). Thus, this should mainly be the case for financially constrained firms, as investment opportunities not easily can be financed. However, there are several aspects to consider when following the benefits and costs of internal capital markets. A fundamental assumption before engaging in the discussion is that the transaction cost of raising internal funds is lower than the cost of raising external funds. Matsusaka and Nanda (2002) argue that an advantage of internal resource allocation is that it provides the firm with a real option to avoid external capital markets in more states of the world than a firm that operates in a single business. Nevertheless, the cost could imply that internal flexibility intensifies an overinvestment agency problem. Being beyond the scope of this paper, Matsusaka and Nanda (2002) argue further that asymmetric information and agency problems could promote firms to create a deadweight loss and overinvestments due

to external financing. If the firm finds itself in this environment, turning to internal capital markets may be beneficial because headquarters are able or allowed to transfers funds between divisions without incurring the cost of external finance. On the other hand, external capital markets could be beneficial for the firm because compared to internal capital markets that aid overinvestment by insulating headquarters from constraints of costly external finance.

4 Hypothesis Development

The theories presented above accumulate to our first hypothesis. We want to examine, in a Nordic setting, how diversification in cash flow affects cash holdings through the correlation between investment opportunity and cash flow. The primary goal of this paper is to answer this hypothesis. However, to thoroughly examine the research question, we need to introduce additional factors found to alter the cash holdings in a company.

4.1 Financial Constraints

Miller and Modigliani (1958) showed that in frictionless capital markets, the net present value of cash is zero. Suggesting that firms with limited access or higher costs regarding external financing have a more substantial incentive to hold cash. This is consistent with the results of Almeida et al. (2004), who finds that cash flows and cash holding only are correlated when firms are financially constrained. This indicates that financially constrained firms face higher costs of external financing, and therefore, can experience a positive present value of holding excess cash. The same rationale can be applied to the relationship between cash holdings and diversification in investment opportunity and cash flow, where unconstrained firms have access to external financing without high costs. Based on this, a financially unconstrained firm has little or no incentive to adjust their cash holdings based on their level of diversification. Therefore, if internal funds can not finance investment opportunity, financially unconstrained firms can obtain relatively cheap external financing. Hence, diversification should be a concern for financially constrained firms. By incorporating financial constraints, we build upon the hypothesis above and examine, in a Nordic setting, if cash holdings are mostly sensitive to

diversification when firms are financially constrained.

4.2 Internal Capital Markets

Diversified companies with multiple divisions which generate numerous cash flows and investment opportunity could finance investments by allocating cash from divisions with limited investment opportunities to high-growth divisions. As shown by Shin and Stulz (1998) & Rajan et al. (2000), a potential cost of being diversified is mismanagement when allocating internal cash flows. However, the overall efficiency of internal capital markets are beyond the scope of this paper, but we will investigate whether active internal capital markets and cross-divisional transfers reduce the Nordic firm's demand for cash and therefore have a lower level of cash holdings.

Given two firms, where firm one has higher activity in its internal capital market than firm two, it is not given that firm one has better management of internal cash flows than firm two. The question is whether these are efficient transfers from low- to high-productivity divisions, rather than inefficient transfers from high- to low-productivity divisions. It is shown in Rajan et al. (2000) that diversity in divisional investment opportunity is associated with an inefficient transfer. More specifically, we want to examine, in a Nordic setting, if the reduction in cash due to cross-divisional transfers driven by inefficient or efficient transfers.

5 Empirical Methodology and Sample selection

5.1 Methodology

When examining the relationship between risk, diversification, and cash holdings, we will use statistical techniques as Difference-in-means and panel data regression, with and without fixed effects, to investigate how diversification effects cash holdings and how financial constraints and internal capital markets affects the relationship between diversification and cash holdings.

We follow Duchin (2010) and employ a direct measure of volatilities and cross-divisional correlations, both in cash flow and investment opportunity. We use annual averages of cash flow and investment opportunity across all stand-alone firms categorized by each major group Standard Industrial Classification (SIC) code. The

observations provided by specialized firms, function as building blocks, and is applied as an indirect measure of divisional cash flow and investment opportunity.

While Campa and Kedia (2002) & Villalonga (2004) has criticized the use of stand-alone firms to approximate investment opportunities at a divisional level, we will follow this methodology, mainly due to the nonavailability of a direct measure of investment opportunities of conglomerate divisions. Mostly because this method is by far the most practical to implement.

Another concern raised by Denis, Denis, and Sarin (1997) & Hyland and Diltz (2002), is that segment which reports itself might be inaccurate. This issue could be addressed directly by studying corporate acquisitions since it is less vulnerable to poor segment reporting. However, this is beyond the scope of this paper.
Moreover, we use Tobin's Q as a measure of investment opportunity, and net income plus depreciation and amortization as a measure for cash flow.[1]

Previously, the number of segments has been used as an approximation of diversification, and Opler et al. (1999) showed an inverse relationship between cash holdings and an increased number of segments. However, this way of measuring the degree of diversification is criticized by Duchin (2010), who question which dimension of diversification this measure captures and argue it is a crude proxy. Firstly, multidivisional firms may view noncore segments as quasi-liquid, and have the opportunity to liquify, if the demand for liquidity were to increase. These firms see some of their divisions as a substitute for cash. Secondly, all segments of a multidivisional firm can operate in the same industry, or in closely correlated sectors, which would result in no or shallow degree of diversification. Finally, there is a possibility that multidivisional firms hold less cash because they spent it to acquire new divisions.

Therefore, we adopt the methodology of Duchin (2010) and measure cross-divisional correlation directly. Additionally, we will include the number of segments as a control variable. Compared to only adding the number of segments, the direct measures have the advantage of taking the different industries a firm is operating into account.

[1]Please see appendix for complete variable definitions

5.2 Measurement of volatilities and correlations

We will now move on to describe how the multi-divisional volatility and correlation in cash flow and investment opportunity are measured. First of all, we define the measure of volatility in Tobin's Q and cash flow of industry i as the standard deviation of the average stand-alone firm in the corresponding industry.

$$\sigma(INV)^i_{t,k} = \sigma(INV^i_{t,k}) \tag{1}$$

$$\sigma(CF)^i_{t,k} = \sigma(INV^i_{t,k}) \tag{2}$$

In the equations above, each year t define a time window of $[t-k, t-1]$ spanning k years preceding year t. $INV^i_{t,k}$ represent the average investment opportunity stream by stand-alone firm in industry i over $[t-k, t-1]$. Accordingly, $CF^i_{t,k}$ represents the corresponding cash flow stream of all stand-alone firms in the same industry. Volatilities are estimated over a 10-year window, with a minimum of 5 years available observations in the period.

These volatility measures, constructed by the observations of the specialized firms, is used as a foundation to construct measurements of volatility for the multi-divisional firm with N different segments. Therefore, we define the volatility in cash flow and investment opportunity, of a diversified firm with N segments in year t, as follows.[2]

$$\sigma(INV)_{t,k} = \sqrt{\sum_{i=1}^{N}\sum_{j=1}^{N} w_i w_j \rho(INV)_{i,j} \sigma(INV)^i_{t,k} \sigma(INV)^j_{t,k}} \tag{3}$$

$$\sigma(CF)_{t,k} = \sqrt{\sum_{i=1}^{N}\sum_{j=1}^{N} w_i w_j \rho(CF)_{i,j} \sigma(CF)^i_{t,k} \sigma(CF)^j_{t,k}} \tag{4}$$

In the equations above, $\rho(INV)_{i,j}$ and $\rho(CF)_{i,j}$ is the correlation between investment opportunity streams and cash flow streams of industries i and j, respectively. Furthermore, w_i represents the weight of segment i in regards to total sales, and is calculated as the ratio between segment's i sales over the total sales of the firm in

[2]Note that this is identical to the standard formulation of a portfolio's standard deviation.

the period. Consequently, by employing these measurements, we take the every industry a diversified firm operates into consideration. This is an advantage compared to the previously employed measure of industry-level volatility in the empirical literature (e.g. (Opler et al., 1999)).

By assuming a pair-wise correlation of one among all segments, we calculate a measure of "no-diversification" average volatility. This is done in order to later be able to estimate a measure for the cross-divisional correlation in cash flow and investment opportunity.

$$\overline{\sigma(INV)_{t,k}} = \sqrt{\sum_{i=1}^{N}\sum_{j=1}^{N} w_i w_j \sigma(INV)^i_{t,k}\sigma(INV)^j_{t,k}} \tag{5}$$

$$\overline{\sigma(CF)_{t,k}} = \sqrt{\sum_{i=1}^{N}\sum_{j=1}^{N} w_i w_j \sigma(CF)^i_{t,k}\sigma(CF)^j_{t,k}} \tag{6}$$

Throughout the rest of this paper, these two measurements will be referred to as Industry Q volatility and Industry cash flow volatility. Additionally, both of these two measures will be used in the regression estimates later in the paper. Both of the currently defined measurements are used to define a measurement of a firm's cross-divisional correlation in Tobin's Q and cash flow.

$$corr(INV)_{t,k} = \sigma(INV)_{t,k} - \overline{\sigma(INV)_{t,k}} \tag{7}$$

$$corr(CF)_{t,k} = \sigma(CF)_{t,k} - \overline{\sigma(CF)_{t,k}} \tag{8}$$

This measure the difference in volatility with and without correlation and therefore

capture the overall effect of correlation on the volatility of investment opportunity and cash flow. Since the correlation coefficient always is between minus one and one, the cross-divisional correlation measure will always be less or equal to zero. Meaning, as the measurement is approaching zero, the weaker the cross-divisional correlation. Thus, a value closer to zero implies a smaller level of diversification in investment opportunity and cash flow. Consequently, a more negative correlation measure, implies divisions are less correlated, and the company experience a higher degree of diversification.

Up to this point, we have only presented separate measurements of volatility and correlation in cash flow and investment opportunity[3]. Nevertheless, the divisional-level correlation between investment opportunity and cash flows is also of importance. Duchin (2010), argues that if investment opportunity and cash flows are perfectly positively correlated, the firm will hold less cash even if it experiences high volatility, due to the possibility of financing investments using internal funds generated by the cash flow. On the contrary, if a company were to have perfectly negatively correlated divisions with low volatility, the firm needs to hold more cash, since cash flow would not cover available, profitable, investments. Hence, it is critical to control for the intra-industry correlation between cash flow and investment opportunity. We will follow Acharya et al. (2007) and implement the "financing gap" in our study of diversification and cash holdings. The "financing gap" is calculated as a sales-weighted average intra-industry correlation across all business segments.

$$\rho(INV, CF)_{t,k} = \sum_{i=1}^{N} w_i \rho(INV, CF)^i_{t,k} \tag{9}$$

5.2.1 Measures of financial constraint

To investigate the impact of financial constraints and its effect on cash holdings, we will follow Almeida et al. (2004), and divided the sample into financially constrained and unconstrained firms. We suspect that most of the diversified firms on average are larger and thus, less financially constrained. For this reason, we

[3]The overall correlation between correlation in cash flow and correlation in investment opportunity in the sample is almost 80%

adopt the approach of Duchin (2010) and firstly test across the sample, then use specialized firms to estimate a breakpoint that separates constrained firms from unconstrained and applies this on the sample. This method should neutralize the effect of diversification on the classification of firms into constrained and unconstrained firms.

Due to the non-availability of a direct measure of the degree of financial constraint a firm faces, we will implement an indirect measure as a proxy. Financial constraint is difficult to proximate, and the literature is divided on the measure best to use in empirical studies. In this paper, we follow Farre-Mensa and Ljungqvist (2013) and employs a range of measures to ensure robustness. We use measures of:

i) Financial constrained index of Whited and Wu (2006)
ii) Firm size (Gilchrist & Himmelberg, 1995)
iii) Payout ratio (Fazzari, Hubbard, & Petersen, 1987)

5.2.2 Measures of Internal Capital Market

One potential problem when examining the relationship between cross-divisional correlations, transfers, and cash holdings, is that we cannot directly observe the transfers between divisions. In this paper, we follow a solution proposed by Rajan et al. (2000), and proxy transfers by the difference between the investment a segment make as part of a diversified firm, and investments it would have made as a specialized firm. The primary assumption when solving the problem is that transfers of funds across divisions correspond to changes in divisional investments. Firstly, we need an estimate for investments a segment would have done as a specialized firm. Consequently, we take the weighted average of the ratio of capital expenditures to assets of specialized firms in the same industry. Rajan et al. (2000) noted that diversified firms possibly hold more funds due to a lower cost of capital. Therefore, to adjust the measure, we subtract the average industry-adjusted capital expenditure-to-assets ratio, averaged across the segments by the firm. Doing this, we get a measure of cross-divisional transfers of:

$$\frac{CapEx_j}{Assets_j} - \frac{CapEx_j^{ss}}{Assets_j^{ss}} - \sum_{j=1}^{N} W_j \left(\frac{CapEx_j}{Assets_j} - \frac{CapEx_j^{ss}}{Assets_j^{ss}} \right) \tag{10}$$

Where j denotes segment j, ss refers to single segment firms and w_j is segment j's share of total firm assets.

This measure is used to answer the first hypothesis regarding internal capital markets, but to answer the second, we need to further distinguish between efficient and inefficient transfers. We do this by classifying divisions into low- and high-productivity divisions. We follow Duchin (2010) who ranked a division as high-production, if its industry Q is higher than the firms weighted average Q, and low-production, if it is lower than the firms, weighted average Q.

Then, for each company, sum the transfers made to low- and high-productivity firms and investigate their correspondents to cash holdings. To ensure robustness, we will add two alternative measures of internal capital markets efficiency. Firstly, to examine the relationship between cash holdings and value added by cross-divisional transfers, defined by Rajan et al. (2000) as:

$$\frac{\sum_{j=1}^{N} Assets_j (Q_j - \bar{Q}) \left(\frac{CapEx_j}{Assets_j} - \frac{CapEx_j^{ss}}{Assets_j^{ss}} - \sum_{j=1}^{N} W_j \left(\frac{CapEx_j}{Assets_j} - \frac{CapEx_j^{ss}}{Assets_j^{ss}} \right) \right)}{TotalAssets} \tag{11}$$

Secondly, to measure the efficiency of the transfers by the absolute value added by cross-divisional transfers, defined by Rajan et al. (2000) as:

$$\frac{\sum_{j=1}^{N} Assets_j (Q_j - 1) \left(\frac{CapEx_j}{Assets_j} - \frac{CapEx_j^{ss}}{Assets_j^{ss}} \right)}{TotalAssets} \tag{12}$$

5.3 Sample Selection

The sample includes all Nordic firms listed in the period 1990 until 2016. Datastream has been used to retrieve data on firms' cash holdings, short-term securities, sales, cash (operational), leverage, capital expenditures, market to book ratios, book assets, dividend payments, current assets, current liability and stock repurchases. To

classify companies and divisions into distinct industries, we employed Standard Industrial Classification (SIC) codes and organized them based on SIC major groups.

To separate between specialized and diversified firms, we used both segment SIC and segment revenue data. We define a diversified firm as every firm with more than one available segment SIC, and a specialized firm as every firm with less than two segments with revenue. Datastream was used to gather data regarding segment revenue, assets, and capital expenditure. However, we experience a limitation in the availability of segment data. Even though most of the segment revenues were available, the number of observations for segment SIC and capital expenditure, was limited. Due to this restriction in data availability, the sample consists of 419 specialized- and 191 diversified firms, before we incorporated additional constraints to the sample population. Hence, it is reasonable to believe that firms with available division SIC data are the largest and most followed firms.

The sample excludes financial firms since a financial firm might carry cash to meet capital requirements. Additionally, we also exclude utility firms, since cash holdings in these firms, might be affected by regulations. Therefore, including utilities or financial firms could lead to sample bias. However, we do not exclude industrial firms with a financial segment, since this would most likely eliminate too many large conglomerates which maintain a financing division.

Following Almeida et al. (2004), we exclude all firm-years were data on cash holding are not available or missing, eliminate firm-years were cash holding exceeds the value of total assets, market capitalization is less than 50 million in 1990 local currency and finally, where assets or sales growth exceeds 100%. We also follow Berger and Ofek (1995), and eliminate all firm-years where every observation for each segment's industry is not available and require that the sum of sales of segment sales is within 1% of total sales of the firm. The last requirement is to ensure the integrity of the segment data.

Finally, we exclude all firm-years were data on one or more correlation measures are missing. Thus, if the measure of correlation in investment opportunities, cash flow, or the joint correlation between investment opportunity and cash flow, is missing, the firm-year observation will be excluded from the sample. The last filter is included, due to the empirical investigation, which specifically aims to investigate the joint distribution of investment opportunity and cash flow. The sample covers

the 27 years from 1990 to 2016 and consist of 2539 firm-year observations.[4]

Table 1

Summary Statistics

This table reports summary statistics for the sample, which consists of non-financial and non-utility firm-years from 1990 to 2016 with non-missing data on cash holdings and on the industry codes of each business segment, and with total market capitalization of 50M or more in local currency.

	Mean	Median	Standard Deviation	Number of Observations
Cash/assets	0.173	0.108	0.176	2539
Q correlation	– 0.008	0.000	0.019	2539
Industry Q volatility	0.258	0.240	0.144	2539
CF correlation	– 0.002	0.000	0.005	2539
Industry CF volatility	0.051	0.037	0.069	2539
Firm cash flow volatility	0.071	0.037	0.131	1833
Q-CF correlation	0.245	0.290	0.366	2539
Tobin's Q	1.676	1.327	1.030	2539
CAPEX/assets	0.065	0.041	0.083	2539
CF/assets	0.025	0.082	0.295	2539
Book leverage	0.468	0.477	0.219	2539
Payout/assets	0.023	0.008	0.049	2539
NWC/assets	0.016	0.001	0.182	2539
Number of Segments	2.231	1.000	1.830	2539
Firms size	14.009	13.851	2.068	2539

The summary statistics of all measurements and variables, used in the empirical study, are available in the table above (Table 1). Reading from the table, one can note the mean cash holdings in the sample is 17.3%, with a median of 10.8% and a standard deviation of 17.6%. These findings indicate a right skewness in the cross-sectional distribution of cash holdings.

Further analysis reveals that the independent variables show a wide variation. An example of this is Tobin's Q, having a mean of 1.676 and a standard deviation of 1.03. Additionally, the table shows a significant variation in the cross-divisional correlations. Observing the Q correlation, we note that the standard deviation is

[4]See Appendix for link to the Online appendix which contains complete dataset and Python code used to run regressions

about 2.38 times its absolute mean. Additionally, the cash flow has a standard deviation of 2.5 times its mean.

Furthermore, we also note that the median value for both Q and cash flow correlation is zero, and the mean is close to zero. These values are due to the impact of stand-alone firms on the sample. To cope with possible inference problems, which could occur due to the superiority number of specialized firms, we follow Duchin (2010) and consider subsamples that exclude some and all single-segment firms. Due to the impact of single-segment firms, which have no diversification by definition, we implement a method consisting of multiple samples. Nonetheless, it is possible that single-segment firms experience some level of diversification and operate in various industries, but don't report the segments since its too closely related to the primary division, or the size of the division is too small.

Consequently, it is crucial to exclude these firms when testing. However, we find the difference in diversification to be highest between stand-alone- and two-segment firms. Additionally, we see a decrease in effect with additional segments[5]. This finding is sufficient with other diversification discount literature (Lang & Stulz, 1994).

Thus, excluding all specialized firms could lead to an underestimation of the relationship between cash and diversification. Therefore, we also study a "balanced" sample, which incorporates a proportional amount of non-diversified firms but not dominated by such firms.

Hence, we report results for three samples; all firms, "balanced" and only diversified. To construct the "balanced" subsample, we randomly pick 50% of specialized firms and combine them with all diversified firms. This approach gives us a subsample, with approximately equally many observations between diversified and specialized firms.

[5]Average correlation in investment opportunity is zero for stand-alone firms, – 0.017 for firms with two-segments, – 0.018 for firms with three-segments and – 0.021 for firms with four segments or more

6 Main Results

6.1 Difference in Means

The first empirical analysis is presented in Table 2, where we look at the difference-in-means of firm-level cash holding related to:

1. Cross-divisional correlation in investment opportunity (i.e., Tobin's Q)
2. Cross-divisional correlation in cash flow
3. Interdivisional correlation between cash flow and investment opportunity

Additionally, we will investigate if there are any economies of scale in cash holdings. Thus, we also two-way sort the sample by the correlation between investment opportunity and cash flow, and firm size. Fama and MacBeth (1973), & Petersen (2009), compute the difference in means and t-statistic on an annually and averaged across years basis. However, due to sample restriction and high in-year variation in cash holdings, the previous approach would lead to an underestimation of the correlation effect on cash holdings. Thus, we will use a more normalized t-test, where we 1) use the median value for each year to categorize the sample, and (2) Use the categorized sample to calculate differences-in-means and t-statistics over the entire period. Since we want to test if correlations measurements have a significant impact on cash holdings, we implement difference-in-means using the full sample. The table below (Table 2) reports the results.[6]

Firstly, by looking at Panel A, we note that firms with higher Q correlation, cash flow correlation, and a lower correlation between investment opportunity and cash flow hold more cash. Secondly, by looking at Panel C, the balanced sample, the same observation can be made. These results appear to be robust and statistically significant. Thirdly, for Panel E, the diversified sample, we note only the correlation between investment opportunity and cash flow appear to be statistically significant. The economic reasoning is the same as for the panel above. (i.e., that lower correlation between investment opportunity and cash flow results in more cash holding). Interestingly, neither the cross-divisional correlation in Tobin's Q or cash flow are statistically significant in Panel E.

[6]See Appendix for link to the Online appendix which contains complete dataset and Python code used to run regressions

Table 2

Average Annual Cash Holdings

This table presents difference-in-means estimates of firm-level annual cash holdings. The estimation involves a two-step procedure: (1) Use the median value for each year to categorize the sample, and (2) Use the categorized sample to calculate differences-in-means and t-statistics. The sample consists of nonfinancial and nonutility firm-years with nonmissing data on cash holdings and the industry codes of each business segment, and with total market capitalization of 50M or more in local currency. Panels A and B use the full sample. Panels C and D use a "balanced" sample, which consists of all diversified firms, and a randomly chosen subsample of 50% of the stand-alone firms in the sample. Panels E and F use only diversified firms that reported two business segments or more.

Panel A: All Firms—One-Way Sorting on Correlation

Variable	Low	High	High Minus Low	t-Statistic
Q correlation	0.131	0.189	0.058	9.234
Cash flow correlation	0.131	0.189	0.058	9.234
Q-Cash flow correlation	0.205	0.139	– 0.067	9.811

Panel B: All Firms—Two-Way Sorting on Correlation and Size

Size	Low Q-CF Correlation	High Q-CF Correlation	High Minus Low	t-Statistic
Small	0.150	0.110	– 0.040	6.300
Medium	0.180	0.130	– 0.050	4.679
Large	0.123	0.092	– 0.031	4.470

Panel C: "Balanced" Sample—One-Way Sorting on Correlation

Variable	Low	High	High Minus Low	t-Statistic
Q correlation	0.131	0.190	0.059	8.100
Cash flow correlation	0.131	0.190	0.059	8.100
Q-Cash flow correlation	0.191	0.140	– 0.051	6.559

Panel D: "Balanced" Sample—Two-Way Sorting on Correlation and Size

Size	Low Q-CF Correlation	High Q-CF Correlation	High Minus Low	t-Statistic
Small	0.132	0.108	– 0.023	3.664
Medium	0.150	0.124	– 0.027	2.488
Large	0.116	0.094	– 0.021	3.050

Panel E: Diversified Firms—One-Way Sorting on Correlation

Variable	Low	High	High Minus Low	t-Statistic
Q correlation	0.133	0.129	– 0.004	0.505
Cash flow correlation	0.134	0.128	– 0.006	0.789
Q-Cash flow correlation	0.147	0.114	– 0.033	4.576

Panel F: Diversified Firms—Two-Way Sorting on Correlation and Size

Size	Low Q-CF Correlation	High Q-CF Correlation	High Minus Low	t-Statistic
Small	0.119	0.097	– 0.022	3.359
Medium	0.119	0.082	– 0.037	3.753
Large	0.120	0.114	– 0.006	0.619

When investigating the effect of the correlation between cash flow and investment opportunity on cash holdings, we observe the most substantial difference between high and low in the full sample, whereas the smallest gap is in the subsample of only diversified firms. Due to the nonlinearity in diversification, we suspect the complete sample to overestimate the impact of cross-divisional correlations and, similarly, the diversified sample to underestimate the effect. Therefore, we find Panel C to be the most reliable, then the average cash holdings in firms with a lower correlation between investment opportunity and cash flow, hold 5.1% more cash than firms with higher correlation.

The results in Panel B, D, and F show that within similarly sized bins, firms with a lower cross-divisional correlation between cash flow and investment opportunity, hold significantly more cash, compared to firms with a stronger relationship. Moreover, the large firms in both Panels B and D hold significantly less cash compared to the small and medium-sized firms. Additionally, the difference between high and low is more modest for larger firms. In Panel D, the difference between high- and low-correlation firms is -2.7% for medium- and -2.1% for large-sized firms. These findings confirm there are economies of scale in cash holdings, and large firms hold less cash relative to their assets. (e.g. (Beltz & Frank, 1996), (Mulligan, 1997)).

Interestingly, we find that the largest firms in Panel F have no significant relationship between cash holdings and the financing gap. As proposed by Miller and Modigliani (1958) precautionary demand for cash should disappear in frictionless markets. Accordingly, larger firms tend to be less constrained, and thus, diversification should have a less substantial impact on cash holdings in these firms. We investigate this relationship further in our constrained vs. unconstrained table (Table 4).

6.2 Regression Evidence

The results above suggest that correlations in cash flow and investment opportunity in addition to the correlation between cash flow and investment opportunity, have effects on cash holdings. We now move on to estimating panel regressions that control for numerous variables which are known to be determinants of corporate

cash holdings. In conclusion, the regressions in Table 3 calculate the cumulative effect of the joint risk in investment opportunity and cash flow on cash holding, while controlling for other determinants of cash holdings.

Subsequently, Table 3 reports the estimates from panel regressions explaining firm-level cash holdings for the complete-, the balanced- and diversified sample, respectively. The specifications are Ordinary Least Squares (OLS) regressions with year fixed effects and robust standard errors. Choice variables, such as payout, leverage, and capital expenditures, are jointly determined with cash holdings and therefore excluded from the regression analysis.[7]

In Panel A, each diversification measure is included separately and thus studied in isolation. We find that the correlation in cash flow, correlation in investment opportunity (Tobin's Q), and the relationship between cash flow and investment opportunity all to be significantly related to cash holdings in the full and balanced sample. Interestingly, we find none of the correlation measures to be significant in the subsample of only diversified firms.

When investigating the balanced sample, we find that a one standard deviation increase in the correlation in cash flow and investment opportunity results in a rise of 0.94% and 0.69% in average cash holding. While a one standard deviation decrease in the correlation between cash flow and investment opportunity results in an increase of 1.87% in average cash holding, these effects are significant on a 5% level or lower.[8]

In Panel B, which study all diversification measures together, in addition to estimating two regression specifications, one with and one without firm fixed effects, for each of the three samples. The results indicate that diversification is mostly affected by cash holdings through the correlation between investment opportunity and cash flow. Consequently, we observe that neither investment opportunity- nor cash flow correlation is significant, once we account for the relationship between cash flow and investment opportunity.

However, we observe a high correlation between the cross-divisional correlation in cash flows and investment opportunities. Therefore, it is reasonable to believe these measures to be collinear, which in turn affects the calculation of their

[7]See Appendix for link to the Online appendix which contains Python code used to run regressions

[8]Summary statistics of the balanced and diversified sub-sample is located in the appendix

coefficients. Since we want to investigate the joint distribution of investment opportunities and cash flows in regards to cash holdings, the multicollinearity leads to a significant problem. Importantly, the correlation between cash flows and investment opportunity (i.e., the financing gap) are uncorrelated with the cross-divisional correlation in cash flows and investment opportunities [9]. Due to the collinearity, we implement two additional regression models, where we exclude one of the correlated measurements.[10]

When implementing Q correlation and cash flow correlation separately with financing gap, only correlations in cash flows is significant on a 5% level in the balanced subsample. Additionally, we do not find industry Q volatility to be significant in the balanced sample, while industry cash flow volatility is highly significant in the baseline model. Furthermore, we see the coefficient of the correlation between cash flow and investment opportunity is approximately the same in all the regression models.

One can argue that in the context of diversification, cash holdings are affected by cash flows predominantly through its availability to fund investments i.e., the financing gap (Acharya et al., 2007). Nevertheless, the poor results obtained by the correlation in investment opportunities is surprising. Especially since Duchin (2010), argues that industry Q is a better proxy for divisional-level investment opportunities, because firms in the same industry may have different past performance, but similar prospects. Thus, industry cash flow is a crude proxy for the availability of internal funds at the divisional level. The measurement errors discussed above, as well as the possibility of high consistency in correlations, may explain the decrease in the effect of the financing gap, and correlation in cash flow, when including fixed effects.

As Opler et al.(1999), when strictly including the financing gap in Panel A of Table 3, we find an inverse relationship between the number of segments a firm has and the amount of cash it is holding. However, remark that both correlation in cash flow and correlation in investment opportunities completely absorbed the impact of the number of segments in the balanced subsample in Panel A.

[9] See appendix for complete correlation matrix

[10] Tables in the appendix

Table 3 - Panel A

The Cross-section of Corporate Cash-Holdings

This table presents estimates from panel regressions explaining firm-level cash holdings for fiscal years 1990 to 2016. The sample consists of nonfinancial and nonutility firm-years, with nonmissing data on cash holdings and the industry codes of each business segment, and with inflation adjusted total market capitalization of 50M or more in local currency. All regressions include year fixed effects. Standard errors (in parentheses) are heteroskedasticity consistent

	All Firms			”Balanced”			Diversified		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Q correlation	0.435**			0.327**			0.024		
	(0.189)			(0.186)			(0.136)		
Cash flow correlation		1.894***			1.563**			0.515	
		(0.678)			(0.668)			(0.532)	
Q-CF correlation			– 0.058***			– 0.051***			– 0.006
			(0.009)			(0.010)			(0.010)
Industry Q volatility	– 0.020	– 0.025	– 0.006	– 0.045*	– 0.050*	– 0.034	– 0.097***	– 0.099***	– 0.096***
	(0.024)	(0.024)	(0.024)	(0.027)	(0.027)	(0.027)	(0.025)	(0.025)	(0.026)
Industry cash flow volatility	0.235***	0.257***	0.141***	0.190***	0.212***	0.117**	0.108**	0.125***	0.101**
	(0.050)	(0.052)	(0.048)	(0.050)	(0.052)	(0.049)	(0.043)	(0.046)	(0.042)
Cash flow / Assets	– 0.044***	– 0.044***	– 0.040***	– 0.032**	– 0.031**	– 0.029*	– 0.006	– 0.005	– 0.006
	(0.011)	(0.011)	(0.011)	(0.015)	(0.015)	(0.015)	(0.026)	(0.026)	(0.026)
Tobin’s Q	0.063***	0.063***	0.060***	0.058***	0.058***	0.056***	0.068***	0.068***	0.067***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
NWC / Assets	– 0.145***	– 0.145***	– 0.135***	– 0.121***	– 0.121***	– 0.109***	– 0.134***	– 0.135***	– 0.132***
	(0.017)	(0.017)	(0.017)	(0.022)	(0.022)	(0.022)	(0.023)	(0.023)	(0.022)
Number of segments	– 0.003	– 0.002	– 0.005***	– 0.004*	– 0.004	– 0.005**	– 0.004**	– 0.004*	– 0.004**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Firm size	– 0.014***	– 0.014***	– 0.013***	– 0.015***	– 0.015***	– 0.015***	– 0.007***	– 0.007***	– 0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Year F.E	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.293	0.294	0.304	0.282	0.283	0.292	0.254	0.254	0.254
N obs	2539	2539	2539	1799	1799	1799	1120	1120	1120

Significance at the 1%, 5%, and 10% levels is represented by ***,** and *, respectively & standard errors represented in parentheses

Joint Diversification Measures

	All Firms		”Balanced”		Only Diversified	
	Baseline	Firm Fixed Effects	Baseline	Firm Fixed Effects	Baseline	Firm Fixed Effects
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel B: Joint Diversification Measures					
Q correlation	0.078	0.290	-0.001	0.187	-0.141	-0.109
	(0.270)	(0.301)	(0.265)	(0.295)	(0.201)	(0.241)
Q volatility	– 0.010	0.043	– 0.037	0.022	– 0.099***	– 0.007
	(0.024)	(0.030)	(0.028)	(0.032)	(0.026)	(0.028)
Cash flow correlation	1.661*	– 0.258	1.534	0.042	0.865	1.109
	(0.972)	(0.890)	(0.953)	(0.875)	(0.733)	(0.719)
Industry cash flow volatility	0.196***	– 0.031	0.163***	-0.072	0.120**	– 0.185***
	(0.052)	(0.078)	(0.053)	(0.078)	(0.047)	(0.065)
Q-CF correlation	– 0.058***	– 0.024***	– 0.051***	– 0.016*	– 0.006	– 0.012
	(0.009)	(0.008)	(0.010)	(0.009)	(0.010)	(0.010)
Cash flow / Assets	– 0.039***	– 0.001	– 0.027*	0.008	– 0.005	0.019
	(0.011)	(0.010)	(0.015)	(0.015)	(0.026)	(0.023)
Tobin’s Q	0.060***	0.015***	0.056***	0.015***	0.067***	0.025***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
NWC / Assets	– 0.137***	– 0.140***	– 0.111***	– 0.142***	– 0.133***	– 0.225***
	(0.017)	(0.019)	(0.022)	(0.024)	(0.023)	(0.026)
Number of segments	– 0.003	– 0.000	– 0.004	– 0.001	– 0.004*	-0.000
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Firm size	– 0.013***	– 0.023***	– 0.015***	– 0.014***	– 0.007***	– 0.026***
	(0.002)	(0.004)	(0.002)	(0.005)	(0.002)	(0.005)
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Firm F.E.	No	Yes	No	Yes	No	Yes
R^2	0.307	0.757	0.294	0.753	0.256	0.689
N obs	2539	2539	1799	1799	1120	1120

Significance at the 1%, 5%, and 10% levels is represented by ***,** and *, respectively & standard errors represented in parentheses

However, only correlation in cash flow absorb the effect in the diversified subsample. The same findings hold when examining these two measurements separately with the correlation between investment opportunity and cash flow. Thus, the relation between cash and multidivisionalism, seems to be explained by the financing gap and the correlation in cash flow.

Interestingly, these findings are inconsistent with the alternative hypothesis regarding the relationship between cash holdings and diversification. If diversified firms hold less cash since they use it on inefficient acquisitions (Harford, 1999), likewise, if diversified firms hold less cash due to the quasi-liquid nature of non-core segments (Opler et al., 1999), we would expect the number of segments to be significant, and thus explain cash holdings.

Finally, as discussed in the sample selection section, we believe the diversified firms in our sample is the largest and most liquid in the Nordic equity universe, due to the limited availability of segment SIC codes. Thus, we also believe these firms face low to no financial constraints and therefore, able to hold less cash. In the next section, we will further investigate the effects of financial constraints on diversification and cash holdings.

6.3 Financial Constraints

As pointed out by Miller and Modigliani (1958), cash has a net present value of zero in frictionless capital markets. Thus, implying that firms with costly external financing, are the only ones which have a precautionary savings motive of cash. As shown by Almeida et al. (2004), cash holdings and cash flows are only correlated when firms are financially constrained. Thus, financially constrained firms face a higher cost of external financing. Duchin (2010) argues for the same rationale in the relation between cash holdings and diversification in cash flow and investment opportunity. An unconstrained firm can obtain external funds at very low or no cost if cash flow is low or investment opportunities are abundant and not to be financed in full by internal resources. Thus, unconstrained firms can extract capital markets without deadweight costs and therefore have no reason to adjust cash holdings accordingly to the degree of diversification.

However, financially constrained firms should be concerned about diversifica-

tion. To further investigate the effect of financial constraint, we adopt a similar approach as Almeida et al. (2004) and divide the sample into financially unconstrained and financially constrained firms. On average, diversified firms tend to be larger and thus less financially constrained. This interaction between the degree of financial constraints and diversification may impact the analysis. To deal with this issue, we follow the same approach as Duchin (2010) and employ two measures. Firstly, we repeat the test across the three different samples, including all firms, balanced sample, and diversified firms. Secondly, we calculate a breaking point to separate unconstrained firms from constrained firms based on specialized firms only. Finally, we apply the breaking point to each of the three samples.

Employing this method should neutralize the effect of diversified firms on the classification of firms into unconstrained firms and constrained firms. Due to robustness, we apply three different measures of financial constraint:

1. Financial constrains index of Whited and Wu (2006)[11]
2. Firm size Gilchrist and Himmelberg (1995),
3. Payout ratio Fazzari et al. (1987)

We used the annual median value, across specialized firms, as a cutoff point between constrained and unconstrained firms. In Table 4, every panel corresponds to a different measure of financial constraint. The regression estimates used are similar as in Table 3 and are done independently for constrained and unconstrained firms. Because of the likely collinearity between investment opportunity- and cash flow correlation, we also here regress these two measurements individually with the other variables. Additionally, to the unconstrained and constrained regressions, we add a third regression to investigate the difference between constrained and unconstrained firms. In the regression model, this is done by adding a dummy variable which equals one for constrained firms and zero for unconstrained firms. We will use this model to investigate if there is a significant difference between the diversification coefficients. Due to the research interest, we only report the coefficient for the correlation-based measurements of diversification. Since the coefficient of the correlation between cash flow and investment opportunity is equal in both regressions, we represent our findings in one table.

[11] $WW_{index} = -0.091 \times CashFlow - 0.062 \times Dividend_{Dummy} + 0.021 \times LongTermDebt - 0.044 \times Size + 0.0102 \times IndustrySalesGrowth - 0.035 \times SalesGrowth$

Balanced sample: Financially Constrained vs. Unconstrained Firms

This table presents estimates from panel regressions explaining firm-level cash holdings for fiscal years 1990 to 2016. The baseline sample consists of nonfinancial and nonutility firm-years with nonmissing data on cash holdings and the industry codes of each business segment, and with total market capitalization of 50M or more in local currency. The regressions are estimated separately both for financially constrained and financially unconstrained firms, and for Q correlation and cash flow correlation in a balanced sample consisting of all multisegment firms and 50% of the stand-alone firms in the baseline sample. Financial constraints are measured based on: (i) the Whited and Wu (2006) financial constraints index, (ii) firm size, (iii) dividend payouts and stock repurchases. The table reports regression coefficients estimated from a full specification regression similar to the regression specification in Table III. Standard errors (in parentheses) are heteroskedasticity consistent.

	Unconstrained	Constrained	Difference
Panel A: Financial Constraints Measured by the Whited and Wu (2006) Index			
Q correlation	0.012	0.740	0.728
	(0.159)	(0.734)	(0.539)
Cash flow correlation	0.837	3.166	2.329
	(0.580)	(2.374)	(1.776)
Q-CF correlation	– 0.037***	– 0.100***	– 0.062***
	(0.009)	(0.028)	(0.022)
N obs	1131	386	
Panel B: Financial Constraints Measured by Firm Size			
Q correlation	– 0.054	0.986	1.040*
	(0.158)	(0.809)	(0.607)
Cash flow correlation	0.241	4.739	4.498*
	(0.567)	(3.223)	(2.396)
Q-CF correlation	– 0.033***	– 0.103***	– 0.070***
	(0.009)	(0.026)	(0.022)
N obs	1311	488	
Panel C: Financial Constraints Measured by Shareholder Payouts			
Q correlation	0.269	0.265	-0.004
	(0.181)	(0.413)	(0.403)
Cash flow correlation	1.310*	1.496	0.186
	(0.704)	(1.326)	(1.389)
Q-CF correlation	– 0.046***	– 0.053***	– 0.006
	(0.010)	(0.019)	(0.020)
N obs	1061	738	

Significance at the 1%, 5%, and 10% levels is represented by ***,** and *, respectively

In Table 4, only the balanced sample is reported.[12]

The results in Table 4, display the effect of the correlation between investment opportunity and cash flow on cash holdings, to be significantly lower for constrained firms in both Panel A and B. Also in Panel C the coefficient is smaller, but we do not find it to be significantly different. These findings are consistent with the theory, and confirm cash holdings are mostly sensitive to diversification when the firm is financially constrained. Importantly, the correlation between cash flow and investment opportunity is statistically significant on a 1% level, for all measures for financially constrained firms.

Additionally, the economic extent of these effects is nontrivial. When looking at Whited and Wu (2006) index, a one-standard-deviation decrease in the correlation between cash flow and investment opportunity corresponds to an increase of 1.35% in cash holdings for an unconstrained firm, but a 3.66% increase for a constrained firm. The same holds for firm size, where a one standard deviation decrease in corresponds to 1.21% and 3.77% in financially unconstrained and constrained firms, respectively.

Thus, overall, the result in Table 4 suggest that the joint risk of cash flow and investment opportunity significantly influences cash holdings, and especially in financially constrained firms. Therefore, a lower financing gap between cash flow and investment opportunity push the firms to hold less cash.

6.4 Internal Capital Market

Another way diversified firms can fund their investments, without tapping into cash holdings, is to transfer cash flows from divisions without investment opportunities to divisions with apparent investment opportunities. Thus, diversified firms have the opportunity of transferring funds across divisions, and should, accordingly, have a lower demand for precautionary cash. Matsusaka and Nanda (2002) postulate that whether shareholders benefit or not from internal capital markets depend on the benefits of avoiding expensive external financing compared to the cost of over-investment. Additionally, they show that the cost could be lower or greater than the benefit causing diversification to add or destroy value, which is dependent on the

[12]See appendix for tables corresponding to the complete, and only diversified sample

relationship between the firm's productive opportunities and its cash flow.
As shown by Shin and Stulz (1998) & Rajan et al. (2000), one potential cost of diversification is mismanagement of internal cash flow funds, particularly, insufficient transfers to high-growth divisions. However, the efficiency of the internal capital market is beyond the scope of this paper. We aim to study whether active capital markets and cross-divisional transfer affects a diversified firm's demand for holding cash.

From Table 5, one can see the findings of our investigation. The columns from 1 until 4, estimate panel regressions, which explains firm-level cash holdings of diversified firms, augmenting the regression model in Table 3 and adding measurements of cross-divisional transfers and efficiency. The first column investigates the relationship between cash holdings and total internal capital market activity. We find total transfers not to be statistically significant. Thus, there is no support for our hypothesis, which states that a higher level of internal capital market activity reduces cash holdings.

Interestingly, in the second column of Table 5, which test if the reduction in cash is driven by efficient of inefficient cross-divisional transfers, we find the coefficient of inefficient transfers to low-productivity divisions to be negative and significant to cash holdings. Interestingly, we do not find efficient transfers to be statistically significant. These findings suggest that inefficient transfers lead to lower cash holding, while we find efficient transfers not to be significantly related to holding cash.

Moreover, in columns 3 and 4 presents two alternative measures of internal capital markets efficiency. Column 3 examines cash holdings and the value added by cross-divisional transfers. While column 4, measures the efficiency of transfers by the absolute value added by cross-divisional transfers. We find both measurements to be significant on a 5% level. Value added has a positive effect on cash holdings, while absolute value added has a negative relationship with cash holdings. These findings may indicate that the reduction in cash, appears to be related to inefficient transfers from high-productivity divisions to low-productivity divisions.

Columns 5 to 8, examine whether the reduction in cash, due to diversification, is related to the efficient workings of internal capital markets, and particularly try to underpin the effect of diversification in investment opportunity on cash holdings.

Internal Capital Markets

This table presents evidence from panel regressions on the relation between cash holdings and cross-divisional transfers. The sample consists of multidivision, nonfinancial, and nonutility firm-years with nonmissing data on cash holdings and the industry codes of each business segment, and with total market capitalization of 50M or more in local currency. Columns 1 through 4 estimate regressions explaining firm-level cash holdings, whereas columns 5 through 8 estimate regressions explaining firm-level reduction in cash due to diversification, that is, the reduction in cash holdings explained by the company's diversification in investment opportunity, cash flow, and the correlation between investment opportunity and cash flow. In columns 1 and 5, total transfers is the sum of the absolute value of fund transfers across divisions, where fund transfers are measured as in Rajan et al. (2000):

$$\frac{CapEx_j}{Assets_j} - \frac{CapEx_j^{ss}}{Assets_j^{ss}} - \sum_{j=1}^{N} W_j \left(\frac{CapEx_j}{Assets_j} - \frac{CapEx_j^{ss}}{Assets_j^{ss}} \right)$$

where j = 1 . . .N denotes segment j, ss refers to single-segment firms, and wj is segment j's share of total firm assets. In columns 2 and 6, the efficiency of the cross-divisional transfers is measured by summing all transfers to high-productivity and low-productivity divisions, where a division is classified as high (low) productivity if its average industry Tobin's Q is higher (lower) than the firm-weighted Tobin's Q. In columns 3 and 7, the efficiency of the cross-divisional transfers is measured by the value added, defined by Rajan et al. (2000) as

$$\frac{\sum_{j=1}^{N} Assets_j (Q_j - \bar{Q}) \left(\frac{CapEx_j}{Assets_j} - \frac{CapEx_j^{ss}}{Assets_j^{ss}} - \sum_{j=1}^{N} W_j \left(\frac{CapEx_j}{Assets_j} - \frac{CapEx_j^{ss}}{Assets_j^{ss}} \right) \right)}{TotalAssets}$$

where j = 1 . . .N denotes segment j, ss refers to single-segment firms, and wj is segment j's share of total firm assets. In columns 4 and 8, the efficiency of the transfer is measured by the absolute value added by cross-divisional transfers, defined by Rajan et al. (2000) as

$$\frac{\sum_{j=1}^{N} Assets_j (Q_j - 1) \left(\frac{CapEx_j}{Assets_j} - \frac{CapEx_j^{ss}}{Assets_j^{ss}} \right)}{TotalAssets}$$

where j = 1 . . .N denotes segment j and ss refers to single-segment firms. All other variables are defined in the Appendix. All regressions include year fixed effects. Standard errors (in brackets) are heteroskedasticity consistent and clustered at the firm level.

Table 5 - continued

	Cash / assets				Reduction in Cash due to Diversification			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total transfers	0.001				0.001			
	(0.005)				(0.004)			
Transfers to low-		– 0.012**				– 0.006		
productivity divisions		(0.006)				(0.004)		
Transfers to high-		0.000				0.001		
productivity divisions		(0.004)				(0.003)		
Value added			0.026**				0.004	
			(0.012)				(0.009)	
Absolute value added				– 0.191***				– 0.057
				(0.052)				(0.038)
Q correlation	0.010	0.046	0.018	0.072				
	(0.209)	(0.209)	(0.208)	(0.206)				
Industry Q volatility	– 0.185***	– 0.194***	– 0.199***	– 0.178***	– 0.069***	– 0.076***	– 0.072***	– 0.068***
	(0.035)	(0.035)	(0.035)	(0.034)	(0.025)	(0.025)	(0.025)	(0.025)
Cash flow correlation	0.792	0.435	0.690	0.499				
	(0.746)	(0.780)	(0.742)	(0.736)				
Industry cash flow volatility	0.628***	0.586***	0.609***	0.612***	0.498***	0.485***	0.496***	0.498***
	(0.129)	(0.130)	(0.129)	(0.127)	(0.088)	(0.087)	(0.088)	(0.087)
Q-CF correlation	– 0.004	– 0.002	– 0.003	– 0.005				
	(0.013)	(0.013)	(0.013)	(0.013)				
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.373	0.385	0.382	0.396	0.215	0.225	0.215	0.220
N obs	393	393	393	393	393	393	393	393

Significance at the 1%, 5%, and 10% levels is represented by ***,** and *, respectively

We follow Duchin (2010), who examines whether companies that choose to hold cash due to diversification ex-post, also make ex-post investments by using their internal capital market.

The dependent variable in this investigation is the reduction in cash holdings, implied by the firm's diversification. This measure is calculated as the difference between predicted values of the regression model in Table 3, estimated without and including the diversification measures. In this case, a more substantial difference implies a more considerable reduction in cash holdings due to diversification.

Interestingly, none of the measures of cross-divisional transfers are found to be statistically significant. Also, we find both industry Q- and industry cash flow volatility to be highly significant in all of the columns in Table 5. However, it is important to note the small sample size due to the restrictions in observations for capital expenditures per segment. This limitation makes the study less robust, and a larger sample size is preferable when establishing a statistical relationship.

6.5 Final Findings

The evidence up to this point seems to indicate that a higher degree of diversification corresponds to a lower holding of cash, with the correlation between investment opportunity and cash flow as its primary factor. The relationship between the simultaneous cash flows and investment opportunities and cash holdings is negative. Thus, when cash flows and investment opportunities arrive at the same time, firms hold less cash. However, in this section, we will investigate how the cash holdings have changed over time.

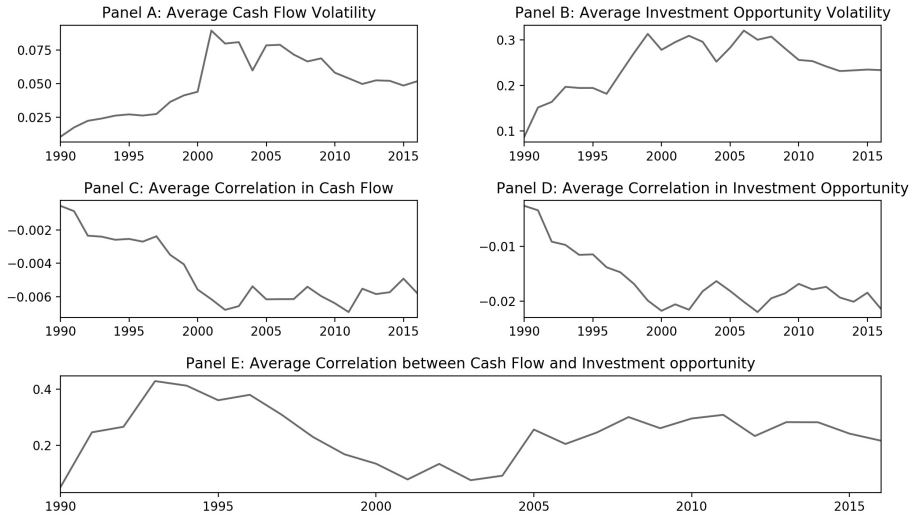
When looking at Figure 1, we observe a high variation in cash holdings in the period. Additionally, we find no significant trend in cash holdings when only regressing cash holdings and years. Looking at Panel A in the figure below (Figure 2), we find average cash flow volatility to have increased during the sample period. This finding is consistent with other studies, which have documented a market-wide increase in idiosyncratic risk and cash flow volatility (e.g., Irvine and Pontiff (2008)).

According to Bates, Kahle, and Stulz (2009), increased cash flow volatility is one of the key drivers behind the increases in cash holdings. The volatility measure we have employed are sales-weighted industry volatilities and are very similar to the

cash flow volatilities used by Bates et al. (2009), which also used an industry-level measure.

Furthermore, in Panel B of Figure 2, shows an increase in the average investment opportunity volatility. Given the previous findings of a positive relationship between cash holdings and cash flow volatility, and a negative relation between cash holdings and investment opportunity volatility in the diversified subsample, this suggests that these trends in volatilities cancel out. Thus, they contribute to explaining the nonexisting trend in cash holdings among diversified firms.

Figure 2



Average volatility and correlation in cash flow and investment opportunity
This figure plots the average annual volatility and correlation in investment opportunity and cash flow for all diversified firms in the sample, which consists of nonfinancial and nonutility firm-years from 1990 to 2006, with nonmissing data on cash holdings and on the industry codes of each business segment, and with total market capitalization of 50M or more in local currency. Diversified firms are firms that reported two business segments or more on Compustat. See the Appendix for variable definitions.

Interestingly, from Panel C and D, we see that both correlation measures have decreased in the sample period, indicating that diversified firms are more diversified in their cash flows and investment opportunities. These findings are inconsistent with the documented trend of an increasing percentage of same-industry mergers (Andrade, Mitchell, & Stafford, 2001). Thus, firms are less exposed to investment and cash flow risk, and therefore have a weaker motive for precautionary cash holdings.

However, neither correlation in cash flows or correlations in investment opportunity is found to be significant in the diversified sample previously in our investigation. Thus, the decreased exposure is not helping to explain cash holdings in our subsample of diversified firms.

Table 6

The Time Series of Aggregate Cash Holdings in Diversified Firms

This table presents evidence from time-series regressions explaining annual average corporate cash holdings. The sample consists of diversified, nonfinancial, and nonutility firms with nonmissing data on cash holdings and the industry codes of each business segment, and with total market capitalization of 50M or more. Independent variables include annual averages of correlations and volatilities in investment opportunity and cash flow, as well as the annual average correlation between investment opportunity and cash flow. Additional control variables include annual average cash flow/assets, Tobin's Q, number of business segments, and firm size

	(1)	(2)	(3)	(4)	(5)
Q correlation	1.098				
	(1.413)				
Cash flow correlation		– 1.111			
		(3.468)			
Avg. Industry Q volatility			0.030		
			(0.154)		
Avg. Industry Cash flow volatility				0.378	
				(0.284)	
Q-CF correlation					– 0.162***
					(0.040)
Cash flow / Assets	-0.140	-0.023	-0.030	0.092	0.246
	(0.211)	(0.217)	(0.238)	(0.211)	(0.158)
Tobin's Q	0.009	-0.013	-0.013	-0.021	-0.036*
	(0.033)	(0.027)	(0.030)	(0.025)	(0.019)
Number of segments	-0.001	0.008	0.008	0.019	-0.005
	(0.017)	(0.018)	(0.021)	(0.018)	(0.012)
Firm size	-0.014	-0.015	-0.013	-0.016	-0.008
	(0.014)	(0.014)	(0.015)	(0.013)	(0.010)
R^2	0.084	0.062	0.059	0.131	0.473
N obs	26	26	26	26	26

Significance at the 1%, 5%, and 10% levels is represented by ***,** and *, respectively & standard errors represented in parentheses

The table above (Table 6) represents the relation between cash holdings and investment opportunity and cash flow risk as a time-series. The regressions above try to explain annual average corporate cash holdings. However, we only find the correlation between cash flow and investment opportunity to be statistically significant (i.e., the financing gap). This further highlight our findings that increased correlation between investment opportunity and cash flow helps to lower ratios of cash to total assets and helps to explain the variation in cash holdings in the sample period.

7 Conclusion

The interconnection between corporate diversification and liquidity is not only interesting on a theoretical level but also pure practically. Theoretically, stand-alone firms do not benefit as their diversified counterparts, who enjoy the satisfaction of coinsurance due to lower exposure to risk, which in turn lets them hold on to smaller amounts of cash. Practically, diversified firms in our sample hold about 92% of the aggregate corporate cash. Thus, understanding the principal elements and implications of diversified firms' cash holdings is of high economic value.

This paper shows that diversified firms hold approximately 12.1% less cash as a ratio of assets, compared to their independent counterpart. This difference is due to determinants, such as investment opportunities and cash flow. Most importantly, the result emphasizes the impact of the correlation between cash flow and investment opportunity, (i.e., the financing gap) and the cross-divisional correlation in cash flow, as key determinants on how diversification affects cash. More diversified firms, with lower cross-divisional correlation in cash flow and a lower financing gap, is better positioned to hold less cash. As stated by Duchin (2010), previous literature has primarily focused their attention on cash flow volatility. In this paper, we take this one step further and expand the picture by including the overall joint uncertainty in cash flow and investment.

Another significant finding is that diversification is, for the most part, correlated with cash holdings in financially constrained firms. As suggested by Miller and Modigliani (1958), cash would add no additional value if the firm operates in a frictionless market and can tap external capital markets without incurring deadweight costs. Our findings support this suggestion, and we find financially constrained firms to be significantly more sensitive to diversification and cash holdings. We find the financing gap to be the primary driver for the difference in cash holdings between constrained and unconstrained firms, and constrained firms will hold significantly more cash if experiencing a one standard deviation increase in the financing gap.

Additionally, we do not find the total transfers a diversified firm does to have a significant impact on cash holdings. However, we find diversified firms with inefficient internal capital markets to hold less cash. Particularly, firms who transfers from high-productivity divisions to low-productivity divisions have significantly

lower cash holdings.

Finally, we find the sample period variation in average cash holdings to mainly be explained by the correlation between cash holdings and investment opportunities. This finding, combined with the rest of our results, indicates that the timing of cash flow and investment opportunities by far is the most crucial factor regarding cash holdings for our sample.

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Appendices

A Accounting Variables

Accounting Variables:

Cash / assets = cash and short-term investments / book assets

Cash flow / assets = (Net Income + Depreciation and Amortization) / book assets

Market value of assets = Book assets + Market value equity - Book equity - Deferred taxes

Tobin's Q = Market value of assets / (0.9 * Book assets + 0.1 * Market value of asset)

Book Leverage = (debt in current liabilities + long-term debt) / Book assets

Payout / assets = (Dividend + Buyback) / Book assets

CapEx / Assets = Capital expenditure / Book assets

NWC = Net working capital excl. cash

NWC / Assets = (Current assets - Current liabilities - Cash) / Book assets

Number of segments = Number of business segments reported by the firm

Firm Size = natural logarithm of Book assets

B Diversification and Volatility Variables

Industry Q volatility = Segments' sales-weighted Q volatility assuming a correlation of one between all segments. Segments Q volatility is measured as the volatility of the average stand-alone firm's Q in its industries over the past 10 years, where an industry is defined by its SIC major group.

Q-correlation = Difference between industry Q volatility and the Q volatility obtained after accounting for the cross-divisional Q-correlation

Q-CF correlation = Sales-weighted segments' correlation between Tobin's Q and Cash Flow. A segment's correlation between Tobin's Q and Cash Flow is measured as the correlation of the average stand-alone firm in the segment's industry over the past 10-years.

Firm cash flow volatility = Volatility of firm-level cash flow over the past 10 Years

C Online Appendix

https://drive.google.com/drive/folders/1p3u0UO0dq5wVVd1K5zTjSutHLsgUN4U_?usp=sharing

Important: In order for the link to work, make sure to add an underscore between U and the question mark. (The underscore will normally be substituted with space, and if this is not corrected, the link will not work.)

D Summary Statistics

Table 1.1

Summary Statistics: Balanced sample

This table reports summary statistics for the sample, which consists of non-financial and non-utility firm-years from 1990 to 2016 with non-missing data on cash holdings and on the industry codes of each business segment, and with constraints on total market capitalization

	Mean	Median	Standard Deviation	Number of Observations
Cash/assets	0.167	0.105	0.169	1799
Q correlation	-0.011	0.000	0.021	1799
Industry Q volatility	0.258	0.244	0.143	1799
CF correlation	-0.003	0.000	0.006	1799
Industry CF volatility	0.053	0.038	0.079	1799
Q-CF correlation	0.229	0.279	0.366	1799
Tobin's Q	1.686	1.325	1.052	1799
CAPEX/assets	0.065	0.044	0.072	1799
CF/assets	0.034	0.086	0.254	1799
Book leverage	0.470	0.478	0.221	1799
Payout/assets	0.025	0.010	0.052	1799
NWC/assets	0.019	0.007	0.169	1799
Number of Segments	2.873	3.000	2.008	1799
Firms size	14.327	14.291	2.157	1799

Table 1.2

Summary Statistics: Diversified only firms

This table reports summary statistics for the sample, which consists of non-financial and non-utility firm-years from 1990 to 2016 with non-missing data on cash holdings and on the industry codes of each business segment, and with constraints on total market capitalization

	Mean	Median	Standard Deviation	Number of Observations
Cash/assets	0.131	0.092	0.123	1120
Q correlation	-0.018	-0.008	0.025	1120
Industry Q volatility	0.257	0.246	0.149	1120
CF correlation	-0.005	-0.003	0.007	1120
Industry CF volatility	0.055	0.039	0.089	1120
Q-CF correlation	0.237	0.280	0.344	1120
Tobin's Q	1.487	1.264	0.738	1120
CAPEX/assets	0.070	0.052	0.069	1120
CF/assets	0.070	0.090	0.140	1120
Book leverage	0.513	0.520	0.172	1120
Payout/assets	0.021	0.013	0.031	1120
NWC/assets	0.014	0.008	0.156	1120
Number of Segments	4.008	4.000	1.750	1120
Firms size	15.234	15.239	1.944	1120

E Difference in Means

Table - 2.1 Average Annual Cash Holdings

This table presents difference-in-means estimates of firm-level annual cash holdings. The estimation involves a two-step procedure: (1) estimation of annual differences-in-means for each year from 1990 to 2016, and (2) time-series averaging of annual differences-in-means and t-statistics. The sample consists of nonfinancial and nonutility firm-years with nonmissing data on cash holdings and the industry codes of each business segment, and with total market capitalization of 50M or more in local currency. Panels A and B use the full sample. Panels C and D use a "balanced" sample, which consists of all diversified firms, and a randomly chosen subsample of 50% of the stand-alone firms in the sample. Panels E and F use only diversified firms that reported two business segments or more.

Panel A: All Firms—One-Way Sorting on Correlation				
Variable	Low	High	High Minus Low	t-Statistic
Q correlation	0.132	0.186	0.054	1.821
Cash flow correlation	0.132	0.186	0.054	1.821
Q-Cash flow correlation	0.196	0.147	– 0.049	1.510
Panel B: All Firms—Two-Way Sorting on Correlation and Size				
Size	Low Q-CF Correlation	High Q-CF Correlation	High Minus Low	t-Statistic
Small	0.152	0.126	– 0.026	1.074
Medium	0.176	0.140	– 0.036	1.156
Large	0.127	0.109	– 0.018	0.893
Panel C: "Balanced" Sample—One-Way Sorting on Correlation				
Variable	Low	High	High Minus Low	t-Statistic
Q correlation	0.132	0.187	0.056	1.593
Cash flow correlation	0.132	0.187	0.056	1.593
Q-Cash flow correlation	0.188	0.145	– 0.043	1.215
Panel D: "Balanced" Sample—Two-Way Sorting on Correlation and Size				
Size	Low Q-CF Correlation	High Q-CF Correlation	High Minus Low	t-Statistic
Small	0.134	0.125	– 0.009	0.929
Medium	0.141	0.141	– 0.000	0.945
Large	0.128	0.109	– 0.019	0.953
Panel E: Diversified Firms—One-Way Sorting on Correlation				
Variable	Low	High	High Minus Low	t-Statistic
Q correlation	0.134	0.130	– 0.004	0.119
Cash flow correlation	0.130	0.134	0.004	0.133
Q-Cash flow correlation	0.144	0.121	– 0.023	0.694
Panel F: Diversified Firms—Two-Way Sorting on Correlation and Size				
Size	Low Q-CF Correlation	High Q-CF Correlation	High Minus Low	t-Statistic
Small	0.122	0.107	– 0.015	0.902
Medium	0.122	0.102	– 0.020	1.299
Large	0.121	0.115	– 0.008	0.972

F Correlation Matrix

Cash holdings	1.000										
Q-correlation	0.087	1.000									
Cash flow correlation	0.096	0.800	1.000								
Q-CF correlation	– 0.233	0.042	0.064	1.000							
Industry Q volatility	0.113	– 0.107	– 0.081	– 0.039	1.000						
Industry cash flow volatility	0.123	– 0.296	– 0.367	– 0.186	0.418	1.000					
Cash flow/ Assets	– 0.237	– 0.050	– 0.048	0.139	– 0.124	– 0.108	1.000				
Tobin's Q	0.451	0.064	0.078	– 0.174	0.168	0.049	– 0.213	1.000			
NWC/Assets	– 0.162	0.068	0.061	0.092	– 0.081	– 0.081	0.229	– 0.024	1.000		
Number of segments	– 0.202	– 0.433	– 0.434	– 0.006	– 0.084	0.002	0.126	– 0.171	– 0.044	1.000	
Firm Size	– 0.340	– 0.218	– 0.241	0.083	– 0.107	– 0.082	0.234	– 0.384	– 0.105	0.568	1.000

Table 3.1 - Panel B

Joint Diversification Measures: Q correlation included

G Regression

	All Firms		”Balanced”		Only Diversified	
	Baseline	Firm Fixed Effects	Baseline	Firm Fixed Effects	Baseline	Firm Fixed Effects
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel B: Joint Diversification Measures					
Q correlation	0.411**	0.238	0.305*	0.195	0.022	0.112
	(0.187)	(0.242)	(0.184)	(0.237)	(0.146)	(0.194)
Q volatility	-0.005	0.043	-0.032	0.022	-0.096***	-0.006
	(0.024)	(0.030)	(0.027)	(0.032)	(0.026)	(0.028)
Indsutry cash flow volatility	0.173***	-0.029	0.141***	-0.072	0.103**	-0.190***
	(0.051)	(0.078)	(0.051)	(0.078)	(0.044)	(0.065)
Q-CF correlation	-0.058***	-0.024***	-0.051***	-0.016*	-0.006	-0.014
	(0.009)	(0.008)	(0.010)	(0.009)	(0.010)	(0.010)
Cash flow / Assets	-0.039***	-0.001	-0.027*	0.008	-0.006	0.019
	(0.011)	(0.010)	(0.015)	(0.015)	(0.026)	(0.023)
Tobin’s Q	0.060***	0.015***	0.056***	0.015***	0.067***	0.025***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
NWC / Assets	-0.137***	-0.140***	-0.111***	-0.142***	-0.133***	-0.224***
	(0.017)	(0.019)	(0.022)	(0.023)	(0.023)	(0.026)
Number of segments	-0.003	-0.000	-0.004*	-0.001	-0.004**	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Firm size	-0.014***	-0.023***	-0.015***	-0.014***	-0.007***	-0.026***
	(0.002)	(0.004)	(0.002)	(0.005)	(0.002)	(0.005)
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Firm F.E.	No	Yes	No	Yes	No	Yes
R^2	0.306	0.757	0.293	0.753	0.254	0.688
N obs	2539	2539	1799	1799	1120	1120

Significance at the 1%, 5%, and 10% levels is represented by ***,** and *, respectively & standard errors represented in parentheses

Table 3.2 - Panel B

Joint Diversification Measures: Cash flow correlation included

	All Firms		"Balanced"		Only Diversified	
	Baseline	Firm Fixed Effects	Baseline	Firm Fixed Effects	Baseline	Firm Fixed Effects
	(1)	(2)	(3)	(4)	(5)	(6)
Panel B: Joint Diversification Measures						
Industry Q volatility	-0.010	0.038	-0.037	0.018	-0.097***	-0.004
	(0.024)	(0.029)	(0.027)	(0.031)	(0.026)	(0.028)
Cash flow correlation	1.863***	0.252	1.532**	0.373	0.511	0.914
	(0.672)	(0.716)	(0.663)	(0.703)	(0.532)	(0.577)
Cash flow voltility	0.196***	-0.035	0.163***	-0.074	0.120**	-0.184***
	(0.052)	(0.078)	(0.052)	(0.078)	(0.047)	(0.065)
Q-CF correlation	-0.058***	-0.023***	-0.051***	-0.016*	-0.006	-0.012
	(0.009)	(0.008)	(0.010)	(0.009)	(0.010)	(0.010)
Cash flow/ Assets	-0.039***	-0.001	-0.027*	0.008	-0.004	0.019
	(0.011)	(0.010)	(0.015)	(0.015)	(0.026)	(0.023)
Tobin's Q	0.060***	0.015***	0.056***	0.015***	0.067***	0.025***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
NWC / Assets	-0.136***	-0.140***	-0.111***	-0.142***	-0.134***	-0.225***
	(0.017)	(0.019)	(0.022)	(0.023)	(0.023)	(0.026)
Number of segments	-0.003	-0.001	-0.004	-0.001	-0.004*	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Firm size	-0.013***	-0.023***	-0.015***	-0.014***	-0.007***	-0.026***
	(0.002)	(0.004)	(0.002)	(0.005)	(0.002)	(0.005)
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Firm F.E.	No	Yes	No	Yes	No	Yes
R^2	0.307	0.757	0.294	0.753	0.254	0.688
N obs	2539	2539	1799	1799	1120	1120

Significance at the 1%, 5%, and 10% levels is represented by ***,** and *, respectively

H Financially Constrained versus Unconstrained Firms

Table 4.3 - Sample: Complete sample robust

This table presents estimates from panel regressions explaining firm-level cash holdings for fiscal years 1990 to 2016. The baseline sample consists of nonfinancial and nonutility firm-years with nonmissing data on cash holdings and the industry codes of each business segment, and with total market capitalization of 50M or more. The regressions are estimated separately both for financially constrained and financially unconstrained firms, and for Q correlation and cash flow correlation in a balanced sample consisting of all multisegment firms and 50% of the stand-alone firms in the baseline sample. Financial constraints are measured based on: (i) the Whited and Wu (2006) financial constraints index, (ii) firm size, (iii) dividend payouts and stock repurchases. The table reports regression coefficients estimated from a full specification regression similar to the regression specification in Table III. Standard errors (in parentheses) are heteroskedasticity consistent.

	Unconstrained	Constrained	Difference
Panel A: Financial Constraints Measured by the Whited and Wu (2006) Index			
Q correlation	0.232	0.980	0.748
	(0.167)	(0.658)	(0.538)
Cash flow correlation	1.661***	3.965*	2.305
	(0.609)	(2.106)	(1.758)
Q-CF correlation	– 0.039***	– 0.096***	– 0.057***
	(0.009)	(0.021)	(0.019)
N obs	1107	671	
Panel B: Financial Constraints Measured by Firm Size			
Q correlation	0.130	1.108	0.978
	(0.164)	(0.751)	(0.616)
Cash flow correlation	0.802	4.937*	4.135*
	(0.589)	(2.975)	(2.414)
Q-CF correlation	– 0.041***	– 0.098***	– 0.057***
	(0.009)	(0.019)	(0.018)
N obs	1063	889	
Panel C: Financial Constraints Measured by Shareholder Payouts			
Q correlation	0.309*	0.486	0.177
	(0.180)	(0.406)	(0.406)
Cash flow correlation	1.558**	2.298*	0.740
	(0.699)	(1.300)	(1.398)
Q-CF correlation	– 0.044***	– 0.064***	– 0.019
	(0.009)	(0.015)	(0.017)
N obs	1188	764	

Significance at the 1%, 5%, and 10% levels is represented by ***,** and *, respectively

This table presents estimates from panel regressions explaining firm-level cash holdings for fiscal years 1990 to 2016. The baseline sample consists of nonfinancial and nonutility firm-years with nonmissing data on cash holdings and the industry codes of each business segment, and with total market capitalization of 50M or more. The regressions are estimated separately for financially constrained and financially unconstrained firms in a balanced sample consisting of all multisegment firms and 50% of the stand-alone firms in the baseline sample. Financial constraints are measured based on: (i) the Whited and Wu (2006) financial constraints index, (ii) firm size, (iii) dividend payouts and stock repurchases. The table reports regression coefficients estimated from a full specification regression similar to the regression specification in Table III.Standard errors represented in parentheses

	Unconstrained	Constrained	Difference
Panel A: Financial Constraints Measured by the Whited and Wu (2006) Index			
Q correlation	– 0.040	0.048	0.087
	(0.145)	(0.793)	(0.541)
Cash flow correlation	0.749	-0.241	-0.990
	(0.532)	(2.907)	(1.982)
Q-CF correlation	– 0.018*	0.006	0.025
	(0.010)	(0.051)	(0.035)
N obs	893	114	
Panel B: Financial Constraints Measured by Firm Size			
Q correlation	-0.204	0.918	1.122**
	(0.132)	(0.878)	(0.562)
Cash flow correlation	-0.167	7.011*	7.178***
	(0.475)	(3.964)	(2.530)
Q-CF correlation	– 0.015*	0.079	0.095***
	(0.009)	(0.051)	(0.033)
N obs	993	127	
Panel C: Financial Constraints Measured by Shareholder Payouts			
Q correlation	0.013	-0.377	-0.390
	(0.159)	(0.315)	(0.317)
Cash flow correlation	0.570	-0.594	-1.164
	(0.617)	(1.023)	(1.095)
Q-CF correlation	– 0.028***	0.032	0.061***
	(0.011)	(0.022)	(0.022)
N obs	774	346	

Significance at the 1%, 5%, and 10% levels is represented by ***,** and *, respectively