THE JOURNAL OF FINANCE • VOL. LXV, NO. 3 • JUNE 2010

Cash Holdings and Corporate Diversification

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ABSTRACT

This paper studies the relation between corporate liquidity and diversification. The key finding is that multidivision firms hold significantly less cash than stand-alone firms because they are diversified in their investment opportunities. Lower cross-divisional correlations in investment opportunity and higher correlations between investment opportunity and cash flow correspond to lower cash holdings, even after controlling for cash flow volatility. The effects are strongest in financially constrained firms and in well-governed firms, and correspond to efficient fund transfers from low- to high-productivity divisions. Taken together, these results bring forth an efficient link between diversification and corporate liquidity.

CASH HOLDINGS OF U.S. companies are enormous and growing over time. As of fiscal year 2006, nonfinancial and nonutility firms in the Compustat universe reported aggregate cash holdings of over 1.7 trillion dollars, representing 9.2% of the total market value of these firms' equity.[1] The growth in cash holdings is equally impressive. According to Bates, Kahle, and Stulz (2009, BKS henceforth), listed U.S. industrial firms' average ratio of cash to assets increased from 10.5% in 1980 to 23.2% in 2006. This massive increase in cash has captured the attention of both academics and the media. For example, a recent article in *The New York Times* states that, "Publicly traded American firms hold so much cash that, as a group, they could pay off all their debt and still have money left over."[2]

While the dramatic increase in cash holdings is receiving growing attention, another noteworthy pattern is not widely recognized: The average cash holdings of stand-alone firms are almost double the cash holdings of diversified firms. From 1990 to 2006, diversified firms held on average 11.9% of their assets in cash, whereas stand-alone firms held more than 20.9% of their assets

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[1]Cash holdings are defined as cash and short-term investments. Note that aggregate cash holdings including financial firms and utilities were 6.8 trillion dollars in 2006, representing 27.6% of their total market value of equity, or 10.2% of their book assets.

[2]"Behind Those Stock Piles of Corporate Cash," by Mark Hulbert, *The New York Times*, October 22, 2006.

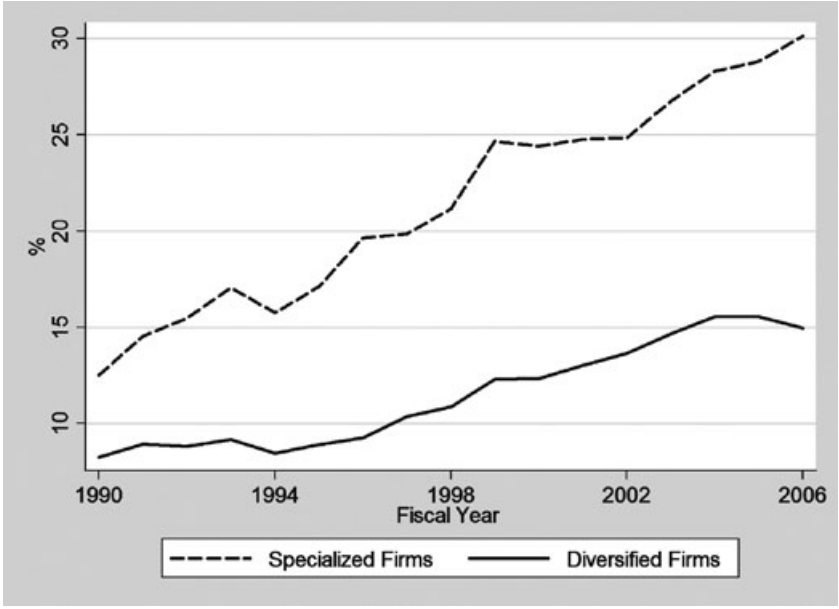

Figure 1. Average annual cash holdings (%) for specialized and diversified firms. This figure plots the average annual cash-to-assets ratios of specialized and diversified firms in the sample, which consists of nonfinancial and nonutility firm-years from 1990 to 2006 with nonmissing data on cash holdings and on the industry codes of each business segment, and with total market capitalization of $10M or more. Cash to assets is cash and short-term investments scaled by total assets. Specialized firms are firms that reported a single business segment on Compustat, whereas diversified firms are firms with two business segments or more.

in cash. Figure 1 breaks the universe of Compustat firms into stand-alone versus diversified firms, and compares their average cash holdings from 1990 to 2006. The figure shows not only the dramatic increase in cash holdings that others have noted but also the pronounced difference in cash policies of diversified and specialized firms, a pattern that has not received much attention. As more in-depth results below will show, these differences cannot be explained by economies of scale (e.g., Beltz and Frank (1996), Mulligan (1997)), growth opportunities or cash flow volatility (e.g., Opler et al. (1999)).

This paper suggests that diversified firms are well positioned to smooth investment opportunities and cash flows because both the opportunities and the outcomes of their divisions are not perfectly correlated. As a consequence, diversified firms will hold less precautionary cash, and increasingly so as cross-divisional correlations decrease. The results suggest that when studied separately, lower correlations in investment opportunity or cash flow, as well as higher correlations between investment opportunities and cash flows (i.e., smaller "financing gaps," as studied in Acharya, Almeida, and Campello (2007)), are associated with lower cash holdings, whereas when studied jointly, the correlations in investment opportunity play a more dominant role that subsumes the effect of cash flow correlations. Importantly, diversification in cash

flow still affects cash through the correlation between investment opportunities and cash flows, that is, the financing gap.

These results are consistent with the predominant approach to understanding corporate demand for cash, namely, the precautionary saving theory introduced by Keynes (1936). According to the theory, firms hold cash to protect themselves against adverse cash flow shocks that might force them to forgo valuable investment opportunities due to costly external financing. While previous studies have focused primarily on the relation between cash flow and cash holdings (e.g., Opler et al. (1999), Almeida, Campello, and Weisbach (2004)), this paper introduces the notion of investment opportunity risk and studies how it affects cash holdings (jointly with cash flow risk), and how it corresponds to corporate diversification and internal capital markets. A central finding is that the joint uncertainty of investment opportunity and cash flow is important mainly when firms are financially constrained. This finding is consistent with Modigliani and Miller's (1958) insight that cash only affects firm value when markets are not frictionless, as well as with the results in Almeida et al. (2004) that cash holdings and cash flows are correlated only in financially constrained firms.

Importantly, diversification is measured directly through the cross-divisional correlations in investment opportunity (measured by Tobin's Q) and cash flow (measured by earnings less interest and taxes), as well as the financing gap (measured by the correlation between Tobin's Q and earnings less interest and taxes).[3] When investment opportunities or cash flows across divisions are less correlated, firms enjoy greater diversification (or coinsurance). The findings suggest that diversified firms hold less cash exactly when their cross-divisional correlations in investment opportunity are lower, regardless of their number of divisions. They also hold less cash when the correlation between their cash flows and investment opportunities is higher. Interestingly, the correlation in cash flow has little effect on cash holdings once the correlation in investment opportunity and the financing gap are taken into account. As I discuss later in the paper, these results suggest that diversification in cash flow affects cash holdings mainly through the financing gap.

The magnitudes of the documented effects are both statistically and economically significant. For example, an increase of one standard deviation in the cross-divisional correlation in investment opportunity leads to an increase of 4.4% (9.1%) in the cash holdings of the average (median) firm. These results continue to hold after controlling for other determinants of cash holdings such as cash flow and investment levels, size, leverage, agency costs, and unobservable firm characteristics. (see, e.g., Dittmar and Mahrt-Smith (2007), Harford, Mansi, and Maxwell (2008), and Opler et al. (1999) for studies of the determinants cash holdings).

To gain further insight into the relation between liquidity and diversification, I study the interaction between cash holdings and internal capital markets (ICMs). As advocated by Stein (1997), Matsusaka and Nanda (2002), and

[3]See the Appendix for detailed variable definitions.

others, diversification has the potential benefit of insulating firms from the rationing and costs of external capital markets through the workings of ICMs. Using an indirect measure of cross-divisional transfers proposed by Rajan, Servaes, and Zingales (2000), I find that cross-divisional diversification in investment opportunity is positively related to transfers across divisions, and that firms hold less cash when transfers are abundant. Furthermore, holding less cash is correlated with efficient cross-divisional transfers to divisions with better investment opportunities. While Rajan, Servaes, and Zingales find that diversity in investment opportunities leads to inefficient fund allocations across divisions, my results imply that holding less cash due to diversification in investment opportunity is associated with efficient flows of funds to the more productive divisions.

The results show further that the relation between cash holdings and diversification is stronger in well-governed firms. Combined with the evidence on ICMs, these findings suggest that the reduction in cash holdings due to diversification is efficient. This suggests that saving on the costs of holding cash might be another important benefit of diversification, to be weighed against the various costs of diversification examined in previous studies (e.g., Rajan et al. (2000), Scharfstein and Stein (2000), Matsusaka and Nanda (2002), Ozbas (2005)).[4] However, one important caveat is that these results do not offer conclusive evidence as to whether or not diversification overall adds or destroys firm value.[5]

To directly test how diversification affects corporate liquidity, I adopt a longitudinal approach similar to Graham, Lemmon, and Wolf (2002) and Hyland and Diltz (2002) and study how acquisitions affect cash holdings. The results show that acquisitions that are more diversifying in investment opportunity (i.e., a lower correlation between the investment opportunities of the acquirer and the target) are followed by greater reductions in cash holdings. Interestingly, firms do not adjust their cash holdings instantaneously; cash holdings are gradually reduced over the 3 years that follow the acquisition.

Finally, the results have implications for the dramatic upward-sloping trend in cash holdings documented by BKS. I show that the average cross-divisional correlations in investment opportunity or cash flow have increased over time, which suggests that the average firm has adjusted its cash holdings upward in response to the increase in the joint risk of investment opportunity and cash flow. These results are in line with the 1990s trend of an increasing percentage of same-industry mergers documented by Andrade, Mitchell, and Stafford (2001). Thus, firms have a stronger precautionary demand for cash because they are less diversified in their investment opportunities and cash flows.

[4]The costs of holding cash include a liquidity premium, double taxation, and the agency costs of free cash flow.

[5]See Lang and Stulz (1994) and Berger and Ofek (1995) for evidence supporting a "diversification discount." See Campa and Kedia (2002), Chevalier (2004), and Villalonga (2004a, 2004b) for recent evidence questioning the existence of a discount.

This paper contributes to a growing body of research on cash holdings. The literature has highlighted various benefits and costs associated with cash, such as the financing of corporate investments (e.g., Kim, Mauer, and Sherman (1998), Acharya et al. (2007)), and Denis and Sibilkov (2009), taxes (e.g., Foley et al. (2007)), and agency (e.g., Jensen (1986), Dittmar, Mahrt-Smith, and Servaes (2003), Pinkowitz, Stulz, and Williamson (2006), Dittmar and Mahrt-Smith (2007), Harford et al. (2008)). Furthermore, Graham and Harvey (2001) report that managers consider financial flexibility to be an important feature of their financing policy. I focus on the role of cash in reducing the firm's exposure to investment risk, and suggest that diversified firms do not hold as much cash because they are less exposed to this risk.[6]

The paper proceeds as follows. Section I outlines the theoretical arguments, while Section II describes the data and methodology. Section III presents the main results, and Section IV considers some implications and extensions. Section V gives concluding remarks.

I. Theory

To formulate the main hypotheses investigated in the paper, consider a company that produces stochastic cash flows from existing assets and has investment opportunities that arrive randomly. The firm operates in imperfect capital markets, and therefore cannot raise sufficient funds to finance all of its investments today and in the future. To transfer funds to future states of the world, the firm can decide to save a portion of today's cash flow and carry it to the future as cash holdings. Because of the financing frictions the company faces, carrying cash is costly since it forces the firm to forgo valuable investment opportunities today. The benefit of carrying cash, however, is the ability to finance future expected investment opportunities. The optimal amount of cash equates the marginal profitability of current investments with the marginal expected profitability of future investments. Hence, this optimal cash level is a function of the joint distribution of investment opportunities and cash flows over time. This simple framework nests the essence of the precautionary demand for cash.

One characterization of the optimal amount of cash is that it increases in the volatility of cash flows from existing assets. This result is formalized by Kim et al. (1998) and tested by Opler et al. (1999), who find that, consistent with the theory, firms operating in more volatile industries hold significantly more cash as a fraction of their assets.

However, as noted above, a full account of the precautionary demand for cash implies that optimal cash levels are determined by the joint distribution of investment opportunities and cash flows. In other words, it is not only the uncertainty surrounding cash flows that affects cash holdings; rather, the uncertainty surrounding investment opportunities and the simultaneity of cash

[6]When precautionary demand for cash decreases due to diversification, it is optimal to hold less cash because of the costs associated with holding excess cash. These include a liquidity premium, double taxation, and the agency costs of free cash flow. These costs are collectively discussed in Opler et al. (1999). More recent literature largely focuses on the agency costs of cash (see, e.g., Harford (1999), Harford et al. (2008)).

flows and investment opportunities also should affect corporate cash holdings. Firms with more volatile investment opportunities should optimally hold more cash, as should firms whose cash flows and investment opportunities tend to arrive in different time periods.[7]

To understand how diversification might affect corporate cash holdings, let us consider a simplified example of a multidivision firm with two business segments. Each segment operates in an industry characterized by a stochastic stream of cash flows and investment opportunities that arrive randomly. Multidivisionalism can affect the firm's overall level of cash holdings through the effect of diversification on the joint distribution of investment opportunities and cash flows across divisions.

When the cross-divisional correlation in investment opportunity is low, firms are able to optimally hold less cash because they are less likely to encounter multiple investment opportunities in both divisions simultaneously. A lower correlation in investment opportunity across divisions decreases the marginal value of cash holdings, and therefore reduces the precautionary demand for cash. Similarly, when the cross-divisional correlation in cash flow is low, firms are able to optimally hold less cash because they are less likely to experience simultaneous adverse cash flow shocks in both divisions. Such adverse shocks would increase the marginal value of holding cash and as a result increase the precautionary demand for cash. A third dimension is the intradivisional correlation between investment opportunities and cash flows. When the correlation between cash flow and investment opportunity is high, the optimal amount of cash decreases because investments can be financed using internally generated cash flows without the need to resort to costly cash holdings.

This analysis suggests that diversified companies are well positioned to hold less cash due to a coinsurance effect across divisional investment opportunities and cash flows. In particular, it demonstrates that the key determinants of cash holdings are the cross-divisional correlations in investment opportunity and cash flow, as well as the degree of simultaneity (or correlation) between divisional cash flows and investment opportunities.

This analysis also highlights a number of additional empirical implications of the theory. First, if diversified firms hold less cash due to a lower precautionary demand for cash, then this behavior should be particularly strong for financially constrained firms.[8] Recall that a key assumption of the theory is that firms cannot finance all their investments using external funds. If they could, then consistent with Modigliani and Miller (1958), cash would not add value. Second, the benefit of diversification and coinsurance in facilitating lower cash holdings assumes the existence of, and the alignment of incentives with, efficient internal capital markets. Therefore, the lower cash balances in diversified firms should be accompanied by good governance and efficient cross-divisional transfers of funds to the more productive divisions of the company.

[7]Acharya et al. (2007) investigate the theoretical implications of the financing gap (correlation) between cash flows and investment opportunities.

[8]Consistent with this implication, Han and Qiu (2007) find that cash holdings are only significantly related to cash flow volatility in financially constrained firms.

The empirical investigation that follows tests these implications directly. I construct measures of the cross-divisional correlation in investment opportunity and cash flow as well as the intradivisional correlation between investment opportunities and cash flows, and show that their impact on cash holdings is consistent with the theory. Furthermore, I show that the effects are stronger in constrained firms. I also compute different measures of corporate governance and cross-divisional transfers, and find results consistent with the optimality of reduced cash holdings due to diversification in investment opportunity. The next section describes the data and the empirical methods in detail.

II. Data and Empirical Methods

A. Construction of Correlation Measures

To study the relation between risk, diversification, and cash holdings, I construct direct measures of volatility and cross-divisional correlation in investment opportunity and cash flow. The building blocks of the analysis are annual averages of investment opportunity and cash flow across all stand-alone firms in each three-digit North American Industry Classification System (NAICS) code industry, applied as indirect measures of divisional investment opportunity and cash flow, where investment opportunity is measured by Tobin's Q and cash flow is measured by earnings less interest and taxes. (See the Appendix for detailed variable definitions.) While the use of average industry stand-alone companies to proxy for the investment opportunities of conglomerate divisions has been criticized by previous studies (e.g., Campa and Kedia (2002), Villalonga (2004a)), I follow this methodology mainly due to nonavailability of direct measures of investment opportunities at the division level. Another concern is that segment reporting itself might be inaccurate, as suggested by Denis, Denis, and Sarin (1997) and Hyland and Diltz (2002). I address this issue directly by studying corporate acquisitions, which are less vulnerable to poor segment reporting, and by verifying that the results continue to hold after the introduction of SFAS 131, which requires greater segment disclosure (see, e.g, Berger and Hann (2003)).

In previous studies, diversification is measured by the number of different business segments or industries the firm reported. Opler et al. (1999) document an inverse relation between cash holdings and the number of business segments. While this measure is likely to be correlated with cross-divisional correlations, which tend to decrease as the number of segments increases, it suffers from a number of problems. First, it is unclear which dimension of diversification it captures. For example, multidivision firms might view their noncore segments (i.e., those segments that operate in secondary industries) as quasi-liquid entities, which can be liquidated in the event of an increased demand for liquidity and therefore serve as a substitute for cash.

Second, the number of segments is a crude proxy for diversification. For instance, all segments might operate in the same industry, in which case there is virtually no diversification. Or it might be the case that they operate in different industries, but these industries are closely related to each other. Finally, it

might also be the case that firms with more segments hold less cash because they spent it acquiring these segments. It is therefore important to measure cross-divisional correlations directly, and to include the number of business segments as a control.

Next, I describe how volatilities and correlations in investment opportunity and cash flow are measured. For each year t, define a time window of $[t-k, t-1]$ spanning the k years preceding year t. Let $INV^i_{t,k}$ denote the investment opportunity stream of the average stand-alone firm in industry i over $[t-k, t-1]$ and let $CF^i_{t,k}$ denote the corresponding cash flow stream. The volatility of the investment opportunity and cash flow of industry i is then defined as the standard deviation of the investment opportunity stream and cash flow stream, respectively

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

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

Throughout the paper, volatilities are estimated over a 10-year window, with a minimum requirement of 5 years of nonmissing data within the 10-year window.

Next, consider a firm with N business segments. Relying on industry-level measures of investment opportunities and cash flows, the volatilities of the firm's investment opportunity and cash flow in year t are defined as[9]

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

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

where $\rho(INV)_{i,j}$ and $\rho(CF)_{i,j}$are the correlations between the investment opportunity streams and the cash flow streams of industries i and j, respectively, and w_i is the weighting of segment i in the firm, given by the ratio between the segment's sales and the total sales of the firm. Note that, compared to previously employed measures of industry-level volatility in the empirical literature (e.g., Opler et al. (1999)), these measures have the advantage of taking into account all the industries in which the firm operates.

To measure the cross-divisional correlations in investment opportunity and cash flow, I calculate a measure of "no-diversification" average volatility by

[9]This is identical to the standard formulation of a portfolio's standard deviation.

assuming a pair-wise correlation of one between all segments

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

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

Throughout the paper I call these measures Industry Q volatility and Industry cash flow volatility, respectively, and include them in my regression estimations.

We can now define the firm's cross-divisional correlation in investment opportunity and in cash flow as follows:

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

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

Note that (7) and (8) are always less than or equal to zero, and measure the difference between volatility with correlation and volatility without correlation. Thus, they capture the overall effect of correlations on the volatility of investment opportunity and cash flow. As the differences in (7) and (8) become more negative, the correlation effect is stronger and vice versa. Thus, higher values (i.e., less negative values) of (7) and (8) imply a higher correlation and a smaller level of diversification in investment opportunity and cash flow.

So far, the analysis considers the volatility and correlation in investment opportunity and cash flow separately.[10] However, the division-level correlation between investment opportunity and cash flow is also important. For example, if investment opportunity and cash flow are perfectly positively correlated, firms should hold less cash even if volatilities are high because investments can be financed using internally generated cash flows. Conversely, if they are perfectly negatively correlated, firms should hold more cash even if volatilities are low because cash flow will not cover available profitable investments. Therefore, we should also control for the intra-industry correlations between investment opportunity and cash flow, that is, the "financing gap" studied in Acharya et al. (2007). This correlation is calculated as the sales-weighted average intraindustry correlation across all business segments:

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

The next subsection describes the sample construction and gives summary statistics.

[10]The overall correlation between correlation in investment opportunities and correlation in cash flows in the sample is approximately 0.35.

B. Sample

The sample includes all firms available from Compustat's North America Industrial Annual file and Compustat's Segments file. All data are CPI-adjusted into 1990 dollars. Compustat's Industrial Annual file is used to retrieve data on firms' cash holdings and short-term securities, book assets, sales, operational cash flows, market-to-book ratios, leverage, capital expenditures, dividend payments, stock repurchases, and net working capital. I use Compustat's Segments file to retrieve data on a firm's business segments, including the number of business segments within each firm and the industry of each segment (represented by three-digit NAICS codes). Since the Segments file might contain repeated data years if the reported segments appear on multiple source documents, I only consider the latest source year of each segment-year observation.

I exclude financial firms and utilities, but do not exclude industrial firms with financial segments because excluding these would eliminate from the sample many large conglomerates that maintain a finance division. Following Almeida et al. (2004), I also eliminate firm-years for which data on cash holdings are missing, those for which cash holdings exceed the value of total assets, those for which market capitalization is less than $10 million (in 1990 dollars), and those displaying asset or sales growth exceeding 100%. Following Berger and Ofek (1995), I eliminate all firm-year observations for which I do not have each segment's industry (NAICS code), and I require that the sum of segment sales be within 1% of the total sales of the firm to ensure the integrity of segment data.

Finally, I eliminate all firm-year observations for which one or more correlation measures are missing. That is, if correlation in investment opportunity, correlation in cash flow, or correlation between investment opportunity and cash flow is missing, the firm-year observation is excluded from the sample. I include this filter because my empirical investigation aims specifically at studying the effect of the joint distribution of investment opportunity and cash flow. Because the measures of volatility and correlation in investment opportunity and cash flow are based on past moving windows of 10 years (with a required minimum of five valid observations), the sample period begins in 1990 due to data availability on Compustat's segments file. Thus, the sample covers the 17-year period from 1990 to 2006 and consists of 50,905 firm-year observations on 9,357 firms.

Table I describes the various variables employed in this study. The table reveals a wide variation in cash holdings, with a mean of 18.8% and a standard deviation of 21.9%. The median firm has cash equal to 9.5% of its assets, which suggests that the cross-sectional distribution of cash holdings is right-skewed. The independent variables in the sample also reveal wide variation. For example, Tobin's Q, which is used as a proxy for investment opportunity, has a mean of 1.7 and a standard deviation of 0.9.

Table I also reveals significant variation in cross-divisional correlations: The standard deviation in the Q correlation is 3.7 times its absolute mean, and the standard deviation in cash flow correlation is 3.8 times its mean. Note that for

Table I
Summary Statistics

This table reports summary statistics for 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 $10M or more (in 1990 dollars). See the Appendix for variable definition.

Variable	Mean	Median	Standard Deviation	Number of Observations
Cash/assets	0.188	0.095	0.219	50,905
Q correlation	−0.003	0.000	0.011	50,905
Industry Q volatility	0.214	0.190	0.128	50,905
Cash flow correlation	−0.004	0.000	0.015	50,905
Industry cash flow volatility	0.262	0.178	0.252	50,905
Firm cash flow volatility	0.078	0.048	0.080	34,613
Q-cash flow correlation	0.173	0.249	0.440	50,905
Tobin's Q	1.744	1.457	0.943	50,905
CAPEX/assets	0.067	0.046	0.071	50,905
Cash flow/assets	0.034	0.081	0.195	50,905
Book leverage	0.221	0.172	0.240	50,844
Payout/assets	0.026	0.001	0.079	50,905
NWC/assets	0.093	0.082	0.211	49,548
Number of segments	1.426	1.000	0.922	50,905
Firm size	5.042	4.833	1.719	50,905

both correlations, the median is zero because the sample is largely dominated by stand-alone firms. To deal with potential inference problems that arise due to the overwhelming majority of specialized firms in the sample, subsequent analysis considers subsamples that exclude some or all single-segment firms.

Specifically, throughout the paper and the Internet Appendix,[11] the results are reported for three different samples: (1) all firms, (2) only diversified (multidivisional) firms, and (3) a "balanced" sample composed of all diversified firms and a randomly chosen subsample of 20% of the specialized firms. The main reason to consider the three samples is that the Compustat universe is largely dominated by single-segment firms, which have zero diversification by construction. However, a single-segment firm may still have some degree of diversification and operate in multiple industries but not report this because of the size of the other division or because it is "related enough" to the primary segment. It is therefore important to conduct the tests when such firms are excluded. At the same time, excluding all specialized firms might underestimate the relation between diversification and cash, because the difference in diversification is greatest between single-segment and two-segment firms.[12]

[11]The Internet Appendix is available at http://www.afajof.org/Supplements.asp.

[12]To see this, note that the average correlation in investment opportunity is zero for stand-alone firms, −0.009 for two-segment firms, −0.014 for three-segment firms, and −0.021 for firms with four segments or more. Furthermore, an analogous result in the diversification discount literature, reported by Lang and Stulz (1994) and subsequent studies, implies that the discount is most

Thus, I also consider a "balanced" sample that includes a proportional number of nondiversified firms but is not dominated by such firms.

III. Main Results

A. Differences in Means

The empirical analysis begins in Table II by looking at difference-in-means estimates of firm-level cash holdings associated with: (i) cross-divisional correlation in investment opportunity (Tobin's Q), (ii) cross-divisional correlation in cash flow, and (iii) intradivisional correlation between investment opportunity and cash flow. The results are reported for each of the three samples, and in all panels the differences-in-means and t-statistics are calculated annually and averaged across years (see, e.g., Fama and MacBeth (1973), Petersen (2009)).

The results in Panels A, C, and E show that firms with higher cross-divisional correlations in investment opportunity or cash flow, and lower correlations between investment opportunity and cash flow, hold significantly more cash. These results are robust across the different samples. As expected, the largest differences are recorded in the full sample, whereas the smallest differences are recorded in the sample of only diversified firms. While the full sample might overestimate the impact of cross-divisional correlations, the multidivision sample might underestimate their impact due to the nonlinearity of diversification in the number of segments discussed above. Thus, if we take the difference in the "balanced" sample to be the most reliable, then average cash holdings in firms with high cross-divisional correlations in investment opportunity (cash flow) are 6.1% (6.3%) higher than in firms with low correlations (see Panel C).

The results in Panels B, D, and F show that within similar-size bins, firms with lower cross-divisional correlations in investment opportunity hold significantly less cash. The results also confirm that there are economies of scale in cash holdings (see, e.g., Beltz and Frank (1996), Mulligan (1997)): Indeed, larger firms hold less cash relative to their total assets. Nevertheless, the effect of diversification in investment opportunity is still highly economically and statistically significant within each size bin across all three samples.

Interestingly, the differences in average cash holdings between high- and low-correlation firms are smaller for larger firms. In panel D, for example, the difference between high- and low-correlation firms is 6.9% for small firms and 2.7% for large firms. This is an intriguing result that I investigate in Table IV. As shown in Table IV, below, the effect of diversification on cash holdings is mostly concentrated in financially constrained firms, consistent with Modigliani and Miller's (1958) result that the precautionary demand for cash disappears in frictionless markets. As larger firms tend to be less constrained, it is not surprising that diversification has a smaller impact on cash holdings in those firms. Finally, note that the results continue to hold with difference-in-medians. These results are reported in the Internet Appendix.

significant between one- and two-segment firms, and less so between two-segment firms and firms with more than two segments.

Table II
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 2006, 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 $10M or more. 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 20% of the stand-alone firms in the sample. Panels E and F use only diversified firms that reported two business segments or more. See the Appendix for variable definitions.

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

Variable	Low	High	High Minus Low	t-Statistic
Q correlation	0.117	0.194	0.078	6.508
Cash flow correlation	0.115	0.195	0.080	6.717
Q–Cash flow correlation	0.191	0.146	−0.045	4.310

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

Size	Low Q Correlation	High Q Correlation	High Minus Low	t-Statistic
Small	0.180	0.279	0.099	3.094
Medium	0.138	0.184	0.047	2.145
Large	0.082	0.110	0.029	2.291

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

Variable	Low	High	High Minus Low	t-Statistic
Q correlation	0.117	0.177	0.061	5.021
Cash flow correlation	0.115	0.178	0.063	5.291
Q–Cash flow correlation	0.166	0.146	−0.020	2.251

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

Size	Low Q Correlation	High Q Correlation	High Minus Low	t-Statistic
Small	0.176	0.245	0.069	2.515
Medium	0.123	0.162	0.039	1.757
Large	0.081	0.108	0.027	1.807

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

Variable	Low	High	High Minus Low	t-Statistic
Q correlation	0.117	0.145	0.028	2.104
Cash flow correlation	0.115	0.147	0.032	2.484
Q–Cash flow correlation	0.146	0.117	−0.029	1.949

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

Size	Low Q Correlation	High Q Correlation	High Minus Low	t-Statistic
Small	0.169	0.188	0.019	2.091
Medium	0.111	0.132	0.021	1.882
Large	0.080	0.106	0.026	1.877

B. Regression Evidence

The univariate results of the previous subsection suggest that the correlations in investment opportunity and cash flow, as well as the correlation between investment opportunity and cash flow, have sizable effects on cash holdings. In this subsection I estimate panel regressions that control for various other variables known to affect corporate cash holdings, and I also include all these measures simultaneously. Hence, these regressions estimate the overall effect of the joint risk in investment opportunity and cash flow on cash holdings, controlling for other determinants of cash holdings.

Table III reports estimates from panel regressions explaining firm-level cash holdings for each of the three samples (All firms, Balanced sample, Diversified firms). All specifications are OLS regressions with year fixed effects and robust standard errors clustered by firm. The regressions do not control for leverage, payout, and capital expenditures because the three are choice variables that are jointly determined with cash holdings. However, the Internet Appendix reports the results for an extended specification that includes leverage, payout, and capital expenditure as additional controls. In the Internet Appendix I also adopt an instrumental variables approach to deal with the endogeneity concern.

Panel A considers each diversification measure separately and shows that when studied in isolation, the correlation in investment opportunity (Tobin's Q), the correlation in cash flow (earnings less interest and taxes), and the correlation between cash flow and investment opportunity are all significantly related to cash holdings after controlling for various other cross-sectional determinants of cash holdings.

The magnitudes of the effects are nontrivial: Based on the balanced sample (columns 4 to 6), a one-standard deviation increase in the correlation in investment opportunity (cash flow) corresponds to an increase of 5.4% (4.2%) in average cash holdings. A one-standard deviation decrease in the correlation between investment opportunity and cash flow corresponds to an increase of 7.0% in average cash holdings. These effects are all statistically significant at the 1% level.

Panel B of Table III studies all diversification measures together, and estimates two regression specifications, with and without firm fixed effects, for each of the three samples. The main takeaway from Panel B is that diversification in investment opportunity is an important determinant of cash holdings, which is both statistically and economically significant: Based on column 3, for example, a one-standard deviation increase in the correlation in investment opportunity corresponds to an increase of 4.4% (9.1%) in the cash holdings of the average (median) firm. These results hold even after controlling for the correlation and volatility in cash flow, and for the correlation between investment opportunity and cash flow.[13]

[13]For robustness, I also estimate the regressions controlling for firm-level cash flow volatility. One drawback of including firm-level volatility is that it decreases the sample size substantially because in many cases companies do not have enough available observations over the past 10

Importantly, the results indicate that diversification mainly affects cash holdings through investment opportunities. The correlation in cash flow is never statistically significant in Table III once we account for the correlation in investment opportunity and the correlation between investment opportunity and cash flow. However, industry cash flow volatility remains an important determinant of cash holdings. Furthermore, diversification in cash flow still affects cash holdings through the correlation between cash flow and investment opportunity, that is, the financing gap. The magnitude of the effect is nontrivial: Based on column 3, a one-standard deviation decrease in the correlation between cash flow and investment opportunity corresponds to an increase of 6.8% in average cash holdings.

One interpretation is that in the context of diversification, cash flow affects cash holdings mainly through its availability to fund investments (i.e., the correlation between investment opportunity and cash flow, or the financing gap, discussed in Acharya et al. (2007)). Nevertheless, the weaker results obtained for the correlation in cash flow and the correlation between investment opportunity and cash flow may simply be due to the fact that industry cash flow can be a poor proxy for the availability of internal funds at the divisional level. In contrast, it is likely that industry Q is a better proxy for division-level investment opportunities. For example, same-industry firms may have different past performances but similar future prospects. It may thus not be surprising that diversification seems to operate mostly through the correlation in investment opportunity. The above measurement error issue, as well the possibility that correlations change little over time, may also explain why the effects of the correlation in investment opportunity and the financing gap decrease after including firm fixed effects.

Finally, note that the correlation measures completely absorb the effect of the number of business segments on cash holdings documented by Opler et al. (1999). Thus, the relation between multidivisionalism and cash is fully explained by cross-divisional coinsurance and the financing gap. Furthermore, these findings are inconsistent with alternative hypotheses for the relation between diversification and cash. If diversified firms were holding less cash because they had spent it acquiring their divisions (see, for example, Harford (1999), who finds that cash holdings drive inefficient acquisitions), then the number of segments and not the correlation measures should be a significant determinant of cash holdings. Similarly, if diversified firms were holding less cash because of the "quasi-liquid" nature of noncore segments (as suggested by

years (with a minimum of five observations). This can be seen from Table I, which shows that the number of firm-level cash flow volatility observations is only 34,613 (compared to 50,905 available observations for the industry-based measures). These results are reported in the Internet Appendix, and they support the robustness of the findings here. Also, similar statistical and economic significance obtain with Fama and MacBeth (1973)–based regressions that estimate separate cross-sectional regressions in each sample year and average the coefficients and standard errors across years. The Internet Appendix reports these results.

Table III

The Cross-section of Corporate Cash-Holdings

This table presents estimates from panel regressions explaining firm-level cash holdings for fiscal years 1990 to 2006. 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 $10M or more. See the Appendix for variable definitions. All regressions include year fixed effects. Standard errors (in brackets) are heteroskedasticity consistent and clustered at the firm level.

	All Firms			"Balanced"			Only Diversified		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Separate Diversification Measures									
Q correlation	0.570***			0.566***			0.534***		
	[0.113]			[0.110]			[0.108]		
Cash flow correlation		0.311***			0.307***			0.280***	
		[0.079]			[0.076]			[0.075]	
Q-CF correlation			−0.042***			−0.027***			−0.023***
			[0.004]			[0.004]			[0.005]
Industry Q volatility	0.202***	0.199***	0.192***	0.231***	0.221***	0.216***	0.254***	0.237***	0.243***
	[0.023]	[0.023]	[0.022]	[0.024]	[0.024]	[0.024]	[0.033]	[0.032]	[0.033]
Industry cash flow volatility	0.070***	0.071***	0.056***	0.046***	0.050***	0.039***	0.022	0.029*	0.026*
	[0.011]	[0.011]	[0.011]	[0.012]	[0.012]	[0.012]	[0.015]	[0.015]	[0.015]
Cash flow/assets	−0.160***	−0.160***	−0.153***	−0.137***	−0.137***	−0.134***	−0.070***	−0.070***	−0.071***
	[0.010]	[0.010]	[0.009]	[0.013]	[0.013]	[0.013]	[0.019]	[0.019]	[0.019]
Tobin's Q	0.069***	0.068***	0.066***	0.065***	0.065***	0.064***	0.050***	0.050***	0.051***
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.004]	[0.004]	[0.004]
NWC/assets	−0.122***	−0.121***	−0.110***	−0.108***	−0.107***	−0.100***	−0.084***	−0.083***	−0.082***
	[0.011]	[0.011]	[0.010]	[0.016]	[0.016]	[0.016]	[0.021]	[0.021]	[0.021]
Number of segments	−0.007***	−0.008***	−0.011***	−0.008***	−0.009***	−0.011***	−0.001	−0.002	−0.004*
	[0.002]	[0.002]	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Firm size	−0.024***	−0.024***	−0.024***	−0.019***	−0.019***	−0.019***	−0.015***	−0.015***	−0.015***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]	[0.002]
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.33	0.33	0.335	0.325	0.325	0.326	0.276	0.275	0.273
N Obs	49,548	49,548	49,548	19,076	19,076	19,076	11,504	11,504	11,504

(*continued*)

Table III—*Continued*

	All Firms		"Balanced"		Only Diversified	
	Baseline (1)	Firm Fixed Effects (2)	Baseline (3)	Firm Fixed Effects (4)	Baseline (5)	Firm Fixed Effects (6)
Panel B: Joint Diversification Measures						
Q correlation	0.459***	0.278**	0.473***	0.281**	0.456***	0.225*
	[0.124]	[0.119]	[0.120]	[0.130]	[0.118]	[0.118]
Industry Q volatility	0.192***	0.038**	0.221***	−0.013	0.251***	−0.033
	[0.022]	[0.017]	[0.026]	[0.031]	[0.033]	[0.033]
Cash flow correlation	0.103	0.096	0.110	0.050	0.107	0.063
	[0.089]	[0.073]	[0.085]	[0.076]	[0.082]	[0.075]
Industry cash flow volatility	0.056***	−0.009	0.034***	0.012	0.025	0.038*
	[0.011]	[0.010]	[0.012]	[0.014]	[0.015]	[0.021]
Q-CF correlation	−0.042***	−0.007**	−0.025***	−0.006	0.003	−0.003
	[0.004]	[0.003]	[0.005]	[0.005]	[0.005]	[0.005]
Cash flow/assets	−0.153***	0.081***	−0.138***	0.090***	−0.070***	0.089***
	[0.009]	[0.009]	[0.013]	[0.020]	[0.019]	[0.020]
Tobin's Q	0.066***	0.023***	0.062***	0.024***	0.050***	0.019***
	[0.002]	[0.002]	[0.002]	[0.003]	[0.004]	[0.004]
NWC/assets	−0.111***	−0.156***	−0.098***	−0.144***	−0.085***	−0.139***
	[0.010]	[0.019]	[0.016]	[0.043]	[0.022]	[0.033]
Number of segments	−0.001	−0.001	−0.002	−0.001	−0.001	−0.002
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]
Firm size	−0.024***	−0.005*	−0.019***	−0.006	−0.015***	−0.004
	[0.001]	[0.003]	[0.001]	[0.005]	[0.002]	[0.006]
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Firm F.E.	No	Yes	No	Yes	No	Yes
R^2	0.336	0.833	0.320	0.876	0.277	0.850
N Obs	49,548	49,548	19,013	19,013	11,504	11,504

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

Opler et al. (1999)), we would expect the number of segments rather than the correlations to explain cash holdings.[14]

C. Financial Constraints

As noted above, Modigliani and Miller (1958) point out that in frictionless capital markets cash has zero net present value. This suggests that the precautionary saving motive of cash only matters to firms with costly external financing. Almeida et al. (2004), for instance, show that cash flows and cash are only correlated when firms are financially constrained, which suggests that they face high costs of external financing.

The same rationale applies to the relation between cash holdings and diversification in investment opportunity and cash flow. Unconstrained firms that can tap external capital markets without deadweight costs have no reason to adjust their cash holdings to the level of diversification. If cash flows are low and/or investment opportunities are abundant and cannot be financed internally in full, unconstrained firms can obtain external funds at little or no cost. However, diversification should be a concern for financially constrained firms.

To examine the impact of financial constraints, I adopt a similar approach as that of Almeida et al. (2004), and divide the sample into financially constrained firms and financially unconstrained firms. However, because diversified firms are on average larger firms, they might be less financially constrained. This interaction between diversification and the degree of financial constraints might contaminate the analysis. To deal with this concern, I employ two measures. First, I repeat the tests across the three different samples (All firms, Balanced sample, Diversified firms). Second, I estimate the breakpoints that separate constrained from unconstrained firms based on specialized firms only, and apply them to each of the three samples. This should neutralize the effect of diversified firms on the classification of firms into constrained and unconstrained firms.

[14]The Internet Appendix addresses a number of additional robustness issues. First, I verify that the correlation-based diversification measures continue to have a significant effect on cash holdings after a new, improved segment reporting standard (SFAS 131) was issued in 1997 (e.g., Berger and Hann (2003)). Next, I make use of the GIM index (Gompers et al. (2003)) to show that the results continue to hold after controlling for the possibility that diversified firms hold less cash because they are more prone to agency problems (e.g., Shleifer and Vishny (1989), Grossman and Hart (1982), Morck, Shleifer, and Vishny (1990), Harford (1999)). Third, I address the endogeneity of financial and investment decisions by reestimating the regressions with an instrumental variables approach using lagged variables as instruments, following Almeida, Campello, and Weisbach (2004) and Fazzari and Petersen (1993). The results indicate that the results here are not sensitive to this change in specification. Finally, I verify the robustness of the diversification measures when estimated over a 15-year window instead of a 10-year window. I find that the correlation in investment opportunity and the financing gap remain significant at the 10% level or better. Their magnitudes, however, decrease substantially, possibly because the estimation is based on investment opportunities and cash flows that are further away in time.

For robustness, I use five different measures of financial constraints: (i) the financial constrains index of Whited and Wu (2006),[15] (ii) firm size (Gilchrist and Himmelberg (1995)), (iii) payout ratio (Fazzari, Hubbard, and Petersen (1988)), (iv) bond ratings (e.g., Whited (1992), Kashyap, Lamont, and Stein (1994)), (v) commercial paper ratings (Calomiris, Himmelberg, and Wachtel (1995)).[16] In all cases, the annual median value of each measure, across specialized firms only, is used as the cutoff point between unconstrained and constrained firms.

Each panel in Table IV corresponds to a different measure of financial constraints and estimates the previous cash regressions (see Table III) separately for financially unconstrained and constrained firms. For brevity, I only report the coefficients on the correlation-based measures of diversification. Table IV reports the results for the balanced sample; the Internet Appendix reports the results for the full sample and the diversified sample.[17]

The results in Table IV suggest that, consistent with the theory, cash holdings are mostly sensitive to diversification when firms are financially constrained. Strikingly, across all five measures of financial constraints, the coefficients on the diversification measures are always more pronounced in constrained firms.

The economic magnitudes of these effects are nontrivial. For example, based on the Whited and Wu (2006) index, a one-standard deviation increase in the correlation in investment opportunity corresponds to an increase of 2.5% in average cash holdings of unconstrained firms, and 4.6% in cash holdings of constrained firms. For the correlation in cash flow and the correlation between investment opportunities and cash flows, the effects are statistically insignificant in unconstrained firms. For constrained firms, an increase of one standard deviation in the correlation in cash flow corresponds to an increase of 2.0% in average cash holdings, and a decrease of one standard deviation in the correlation between investment opportunity and cash flow corresponds to an increase of 11.8% in cash.

Importantly, the effect of the correlation between investment opportunity and cash flow (i.e., the financing gap) on cash holdings is always statistically significant at the 1% level for financially constrained firms. It is reassuring to find that consistent with the theory, the financing gap significantly affects cash holdings in the constrained sample even though it may not be robust for the entire sample (see Table III). The overall picture portrayed by Table IV suggests that the joint uncertainty of investment opportunity and cash flow significantly affects cash holdings, mainly in financially constrained firms. More specifically, greater diversification in investment opportunity and a smaller financing gap

[15]The Whited and Wu (2006) index is defined as:

$$WW_{index} = -0.091 \times CashFlow - 0.062 \times DividendDummy + 0.021 \times LongTermDebt - 0.044 \times Size + 0.102 \times IndustrySalesGrowth - 0.035 \times SalesGrowth.$$

[16]Recently, Campello, Graham, and Harvey (2009) use a more direct measure of financial constraints based on a survey of CFOs in the United States, Europe, and Asia. They find a more severe effect of the 2008 credit crisis on constrained firms.

[17]Table IV (A2) shows that even based on the conservative classification method into constrained and unconstrained firms, quite a few diversified firms are classified as financially constrained. Based on the Whited and Wu (2006) index, for example, 3,499 firm-year observations are classified as financially constrained, and 7,673 firm-year observations are classified as unconstrained.

Table IV

Financially Constrained vs. Unconstrained Firms (Balanced Sample)

This table presents estimates from panel regressions explaining firm-level cash holdings for fiscal years 1990 to 2006. 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 $10M or more. The regressions are estimated separately for financially constrained and financially unconstrained firms in a balanced sample consisting of all multisegment firms and 20% 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, (iv) commercial paper ratings, and (v) bond ratings. The table reports regression coefficients estimated from a full specification regression similar to the regression specification in Table III. Variable definitions are given in the Appendix. Standard errors (in brackets) are heteroskedasticity consistent and clustered at the firm level.

	Unconstrained	Constrained	Difference
Panel A: Financial Constraints Measured by the Whited and Wu (2006) Index			
Q correlation	0.235**	0.358**	0.123**
	[0.136]	[0.125]	[0.054]
CF correlation	0.092	0.211	0.119
	[0.089]	[0.172]	[0.118]
Q-CF correlation	0.008*	−0.057***	−0.065***
	[0.005]	[0.008]	[0.007]
N Obs	11,232	6,925	
Panel B: Financial Constraints Measured by Firm Size			
Q Correlation	0.391***	0.436*	0.045*
	[0.136]	[0.237]	[0.026]
CF correlation	−0.013	0.421**	0.434**
	[0.086]	[0.177]	[0.211]
Q-CF correlation	−0.002	−0.072***	−0.070***
	[0.005]	[0.009]	[0.008]
N Obs	13,118	5,958	
Panel C: Financial Constraints Measured by Shareholder Payouts			
Q correlation	0.291**	0.503**	0.212***
	[0.145]	[0.201]	[0.041]
CF correlation	0.158*	0.188	0.030
	[0.092]	[0.152]	[0.127]
Q-CF correlation	0.008*	−0.049***	−0.057***
	[0.005]	[0.007]	[0.008]
N Obs	9,014	8,630	
Panel D: Financial Constraints Measured by Commercial Paper Ratings			
Q correlation	0.171	0.525***	0.354***
	[0.133]	[0.161]	[0.111]
CF correlation	−0.031	0.227*	0.258*
	[0.100]	[0.116]	[0.135]
Q-CF correlation	0.011**	−0.040***	−0.051***
	[0.005]	[0.006]	[0.007]
N Obs	14,263	4,813	

(*continued*)

Table IV—*Continued*

	Unconstrained	Constrained	Difference
Panel E: Financial Constraints Measured by Bond Ratings			
Q correlation	0.314	0.463***	0.149***
	[0.239]	[0.124]	[0.041]
CF correlation	−0.240	0.146*	0.386*
	[0.164]	[0.089]	[0.199]
Q-CF correlation	0.018***	−0.029***	−0.047***
	[0.007]	[0.005]	[0.009]
N Obs	13,884	5,192	

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

between investment opportunity and cash flow push firms to hold less cash. Diversification in cash flow, however, does not affect cash holdings directly after controlling for diversification in investment opportunity and the financing gap.

Finally, similar results also obtain by employing a Fama–MacBeth-based regression approach. These results are reported in the Internet Appendix. Furthermore, a similar qualitative pattern, with smaller magnitudes, holds when the regressions are estimated with firm fixed effects. These results are also reported in the Internet Appendix.

IV. Implications and Extensions

A. *Internal Capital Markets*

The findings above suggest that diversified firms can hold less cash because diversification reduces the ex-ante probability of financing shortages that might lead to underinvestment. One way in which diversified firms can finance investments without resorting to their cash reserves is cash flow transfers from divisions without investments to divisions with investments. Thus, diversification in investment opportunity might facilitate transfers across divisions, which, in turn, reduce the demand for precautionary cash.

The literature on internal capital markets shows that one potential cost to being diversified is mismanagement of internal cash flows, which are not always allocated to high-growth divisions (see, for example, Shin and Stulz (1998), Rajan et al. (2000)). While the overall efficiency of internal capital markets is beyond the scope of this paper, this subsection examines whether active internal capital markets and cross-divisional transfers reduce the firm's demand for cash. The evidence presented below suggests that holding less cash is associated with *efficient* cross-divisional transfers to high-productivity divisions. Furthermore, the reduction in cash holdings due to diversification in investment opportunity and cash flow is shown to be partially driven by efficient internal capital market allocations.

To study the role of internal capital markets, I examine the relation between cross-divisional correlations, transfers, and cash. One potential problem, however, is that cross-divisional transfers cannot be observed directly. To overcome

this difficulty, I follow Rajan et al. (2000) and measure transfers by the difference between the investment a segment makes when it is part of a diversified firm and the investment it would have made had it been on its own. Note that this measure is based on the assumption that transfers of funds across divisions correspond to changes in divisional investments. The investment a segment would have made on its own is approximated by the weighted average of the ratio of capital expenditures to assets of single-segment firms in the same industry (defined by three-digit NAICS codes). As noted by Rajan et al. (2000), it is possible that diversified firms have more funds, perhaps because their cost of capital is lower. One therefore needs to further subtract the average industry-adjusted capital expenditure-to-assets ratio averaged across the segments of the firm. Thus, cross-divisional transfers are measured as

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

where $j = 1 \ldots N$ denotes segment j, ss refers to single-segment firms and w_j is segment j's share of total firm assets.

The first four columns of Table V estimate panel regressions explaining firm-level cash holdings of diversified firms, augmenting the regression models in Table III with various measures of cross-divisional transfers and efficiency. Column 1 of Table V examines the relation between cash holdings and overall ICM activity level, as measured by the sum of the absolute values of divisional transfers (see equation (10)) across all divisions. My hypothesis suggests that higher levels of ICM activity should reduce cash holdings. The results in column 1 suggest that cash holdings are indeed negatively related to the overall amount of cross-divisional transfers. This implies that more active internal capital markets, with greater amounts of fund transfers across divisions, facilitate lower cash holdings.

A natural question that arises is whether these transfers are efficient transfers from low-productivity to high-productivity divisions, or inefficient transfers from high-productivity divisions to low-productivity divisions. Rajan et al. (2000) find that diversity in divisional investment opportunity is associated with inefficient transfers. The question addressed here is more nuanced: Is the reduction in cash due to cross-divisional transfers driven by efficient or inefficient transfers?

To answer this question, I further distinguish between efficient and inefficient transfers by classifying divisions into low-productivity and high-productivity divisions based on whether their industry Q is lower or higher than the firm weighted-average Q. If it is higher, the division is classified as a high-productivity division. If it is lower, it is classified as a low-productivity division. For each company, I sum the transfers made to high- and low-productivity firms and examine their relation to cash holdings. The second column in Table V reports these results. It shows that inefficient transfers to low-productivity firms are not significantly related to cash. However, efficient transfers are significantly negatively related to cash holdings. This suggests that efficient transfers

Table V

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 $10M or more. 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 $j = 1 \ldots N$ denotes segment j, ss refers to single-segment firms, and w_j 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

$$\frac{\sum_{j=1}^{N} Assets_j (Q_j - \bar{Q}) \left(\frac{CAPEX_j}{Assets_j} - \frac{CAPEX_j^{ss}}{Assets_j^{ss}} - \sum_{j=1}^{N} W_j \left(\frac{CAPEX_j}{Assets_j} - \frac{CAPEX_j^{ss}}{Assets_j^{ss}} \right) \right)}{Total\,Assets},$$

where $j = 1 \ldots N$ denotes segment j, ss refers to single-segment firms, and w_j 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

$$\frac{\sum_{j=1}^{N} Assets_j (Q_j - 1) \left(\frac{CAPEX_j}{Assets_j} - \frac{CAPEX_j^{ss}}{Assets_j^{ss}} \right)}{Total\,Assets},$$

where $j = 1 \ldots N$ 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.

(*continued*)

Table V—*Continued*

	Cash/Assets				Reduction in Cash Due to Diversification			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total transfers	−0.173***				−0.011***			
	[0.029]				[0.002]			
Transfers to low-productivity divisions		−0.002				−0.008*		
		[0.054]				[0.004]		
Transfers to high-productivity divisions		−0.088**				0.015***		
		[0.041]				[0.004]		
Value added			−1.474***				0.069**	
			[0.416]				[0.030]	
Absolute value added				−0.599***				0.018**
				[0.119]				[0.008]
Q correlation	0.413***	0.457***	0.454***	0.438***				
	[0.116]	[0.117]	[0.118]	[0.117]				
Avg. industry Q volatility	0.224***	0.231***	0.231***	0.230***	0.003	0.003	0.004	0.004
	[0.033]	[0.033]	[0.033]	[0.033]	[0.002]	[0.002]	[0.002]	[0.002]
Cash flow correlation	0.051	0.052	0.056	0.066				
	[0.079]	[0.079]	[0.079]	[0.079]				
Avg. industry cash flow volatility	0.030**	0.032**	0.032**	0.030**	0.001	0.001	0.001	0.001
	[0.015]	[0.015]	[0.015]	[0.015]	[0.001]	[0.001]	[0.001]	[0.001]
Q–cash flow correlation	0.003	0.003	0.004	0.004				
	[0.005]	[0.005]	[0.005]	[0.005]				
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.298	0.293	0.293	0.295	0.049	0.047	0.044	0.044
N Obs	11,498	11,498	11,498	11,498	11,498	11,498	11,498	11,498

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

facilitate lower cash holdings, while inefficient transfers are not significantly related to cash holdings. Thus, efficient transfers allow firms to economize on their cash holdings.

The magnitude of these effects is economically significant. Based on column 1, a one-standard deviation increase in the amount of *total* cross-divisional transfers is associated with a reduction of 9.5% in average cash holdings. Based on column 2, a one-standard deviation increase in the amount of *efficient* cross-divisional transfers, from high-productivity to low-productivity divisions, is associated with a reduction of 6.2% in average cash holdings. These effects are statistically significant at the 5% level or better.

Columns 3 and 4 use two alternative measures of internal capital markets' efficiency. Column 3 examines the relation between cash holdings and the *value added* by cross-divisional transfers, defined by Rajan et al. (2000) as

$$\frac{\sum_{j=1}^{N} Assets_j(Q_j - \bar{Q})\left(\frac{CAPEX_j}{Assets_j} - \frac{CAPEX_j^{ss}}{Assets_j^{ss}} - \sum_{j=1}^{N} W_j\left(\frac{CAPEX_j}{Assets_j} - \frac{CAPEX_j^{ss}}{Assets_j^{ss}}\right)\right)}{Total\,Assets}. \tag{11}$$

In column 4, the efficiency of the transfer is measured by the *absolute value added* by cross-divisional transfers, defined by Rajan et al. (2000) as

$$\frac{\sum_{j=1}^{N} Assets_j(Q_j - 1)\left(\frac{CAPEX_j}{Assets_j} - \frac{CAPEX_j^{ss}}{Assets_j^{ss}}\right)}{Total\,Assets}. \tag{12}$$

In both columns, cash appears to be reduced by value-enhancing allocations. This suggests that efficient transfers across divisions facilitate cash reductions. Note that these results are not inconsistent with the overall inefficiency of diversity in Q shown in Rajan et al. (2000). In their case, the inefficiency resulted from other dimensions of the corporation, unrelated to its cash policy. Reductions in cash, however, appear to be associated with efficient transfers from low-Q divisions to high-Q divisions.

In columns 5 to 8, I specifically examine whether the reduction in cash *due to diversification* is associated with the efficient workings of internal capital markets. This line of investigation tries to underpin the effect of diversification in investment opportunity on cash holdings. It examines whether companies that choose to hold less cash due to diversification ex ante, make ex post investments by utilizing their internal capital market. The dependent variable in columns 5 to 8 is the reduction in cash holdings implied by the company's diversification. This measure is calculated as the difference between the predicted cash holdings from the previous regression models (see Table III), estimated without the diversification measures, and the predicted cash holdings from the previous regression model in Table III that include diversification. A bigger

difference between the two implies a larger reduction in cash holdings due to diversification.

The results presented in columns 5 to 8 indicate that the reduction in cash due to diversification is associated with more active (column 5) and efficient (columns 6 to 8) internal capital markets. The reduction in cash is larger when the company makes more cross-divisional transfers, and when these transfers are efficient transfers from low-Q divisions to high-Q divisions.

Thus, diversification in investment opportunity across divisions, which leads to reduced cash holdings, does imply that companies utilize their internal capital markets through efficient transfers to make investments.

B. Efficiency and Governance

The evidence presented so far suggests that diversification allows firms to hold less cash. Thus, given the costs associated with holding cash, the ability to hold less cash due to diversification should positively affect firm value.

To examine the efficiency of the cash-diversification relation, I test whether the relation between cash and diversification is stronger in well-governed firms, where there is reason to expect efficient considerations of cash management to play a stronger role. Table VI reports the coefficients on the correlation-based measures of diversification from the previous cash regressions, estimated separately for poorly governed and well-governed firms in the balanced sample.

Four different measures of governance are employed, and each panel in Table VI corresponds to a different measure of governance. The governance measures include: (i) the GIM index, (ii) the total percentage of shares held by institutional investors, (iii) the number of blockholders that hold 5% or more of the company's shares, and (iv) the percentage of shares held by the largest institutional shareholder. These measures are collectively examined in Gompers, Ishii, and Metrick (2003), Cremers and Nair (2005), and Bebchuk, Cohen, and Ferrell (2009).

Let us start with Panel A, where governance is measured by the GIM index. The results suggest that the correlations in investment opportunity and cash flow have a stronger impact on cash holdings in well-governed firms. Furthermore, the differences between poorly governed firms and well-governed firms are highly significant at the 5% level or better. The magnitudes of the effects are significant as well: A one-standard deviation increase in the correlation in investment opportunity (cash flow) corresponds to an increase of 2.7% (1.3%) in average cash holdings of poorly governed firms, and 5.6% (4.2%) in well-governed firms.

Panels B, C, and D employ the three alternative measures of governance. The results are generally consistent across all measures of governance: The cross-divisional correlations in investment opportunity and cash flow have a significantly stronger effect on the cash holdings of well-governed firms. Furthermore, with the exception of the GIM index, the effect of the financing gap is also significantly stronger for well-governed firms. For example, based on Panel B, the effect of the financing gap is insignificant in poorly governed firms. In

Table VI
Governance (Balanced Sample)

This table presents estimates from panel regressions explaining firm-level cash holdings for fiscal years 1990 to 2006. 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 $10M or more. The table reports coefficients from the extended specification in Table III, estimated in a "balanced" sample of all diversified firms and 20% of the single-segment firms chosen randomly. The regressions are estimated separately for poorly governed and well-governed firms. Governance is measured based on: (i) the Gompers et al. (2003) (GIM) governance index, (ii) the percentage of shares held by institutional investors, (iii) the number of institutional investors that hold 5% or more, and (iv) the maximal percentage of shares held by a single institutional investor. All regressions include year fixed effects. Standard errors (in brackets) are heteroskedasticity consistent and clustered at the firm level.

	Poor Governance	Good Governance	Difference
Panel A: Governance Measured by the GIM Index			
Q correlation	0.494**	0.814***	0.320***
	[0.213]	[0.214]	[0.084]
CF correlation	0.180	0.336**	0.156**
	[0.159]	[0.154]	[0.076]
Q-CF correlation	0.002	0.004	0.002
	[0.007]	[0.010]	[0.011]
N Obs	2,907	2,984	
Panel B: Governance Measured by Total Shares (in %) Held by Institutional Investors			
Q correlation	0.410*	0.650***	0.240***
	[0.223]	[0.164]	[0.071]
CF correlation	0.139	0.283**	0.144*
	[0.165]	[0.110]	[0.0078]
Q-CF correlation	−0.003	−0.018**	−0.015
	[0.006]	[0.009]	[0.006]
N Obs	5,022	6,292	
Panel C: Governance Measured by Number of Block Holders (5% or More)			
Q correlation	0.563***	0.556***	−0.007
	[0.202]	[0.156]	[0.136]
CF correlation	0.196	0.231**	0.035
	[0.133]	[0.114]	[0.153]
Q-CF correlation	−0.01	−0.011*	−0.001
	[0.008]	[0.006]	[0.009]
N Obs	5,364	5,950	
Panel D: Governance Measured by Maximal Block Holder			
Q correlation	0.474**	0.627***	0.153**
	[0.199]	[0.164]	[0.074]
CF correlation	0.068	0.361***	0.293***
	[0.130]	[0.130]	[0.088]
Q-CF correlation	−0.007	−0.014**	−0.007
	[0.008]	[0.007]	[0.007]
N Obs	5,272	6,017	

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

well-governed firms, a decrease of one standard deviation in the correlation between investment opportunities and cash flows corresponds to an increase of 8.6% in average cash holdings.

These results suggest that diversification has a bigger effect on cash holdings in well-governed firms. Because managers of well-governed firms are more likely to act efficiently, these results suggest that it is efficient for firms to hold less cash when they are more diversified. The Internet Appendix repeats the above analysis in the two remaining samples of all firms and diversified firms. In the Internet Appendix, I also augment the specification with firm fixed effects and repeat the analysis estimating Fama–MacBeth-based regressions in the balanced sample. The results are consistent with the results in Table VI.

C. Acquisitions

Recall that the results in Table III suggest that the magnitude of the effects and their statistical significance are smaller when firm fixed effects are introduced into the regression estimation. To test directly whether changes in diversification affect cash holdings, I next examine how acquisitions affect cash holdings. Such an approach has the additional advantage of mitigating concerns about inaccurate or strategic reporting of segment data (e.g., Villalonga (2004b)).

To directly test whether diversification is driving firms to hold less cash, I examine whether firms reduce their cash holdings by engaging in diversification. Table VII studies how corporate acquisitions affect postacquisition cash holdings, taking into account preacquisition cash holding, acquisition characteristics (value, method of payment), and other determinants of cash choices. This approach allows me to distinguish between acquisitions per se and their degree of diversification, and to accommodate slow adjustment rates of cash to the degree of diversification. A similar longitudinal approach is taken by other papers such as Graham et al. (2002), and Hyland and Diltz (2002), who study the effect of diversification on firm value.

I obtain data on mergers and acquisitions from the Securities Data Corporation (SDC) and include all completed acquisitions of public and private companies, as well as subsidiaries. Given that acquisition activity might generate short-term (transitory) fluctuations in cash holdings pre- and postacquisition, I consider changes in cash holdings over the 1- to 3-year period following the acquisition. Table VII reports estimates from panel regressions explaining the postacquisition cash holdings of acquiring firms. The table considers three subsamples from 1990 to 2006: all acquiring firms, diversified acquiring firms, and stand-alone acquiring firms. Three regression specifications are considered for each subsample. The specifications differ in the postacquisition period being considered: They consider cash holdings 1 to 3 years after the acquisition. For each specification, I exclude companies that made additional acquisitions during the relevant postacquisition period because this would change the company's postacquisition degree of diversification. All specifications control for

Table VII
Acquisitions

This table reports estimates from panel regressions explaining acquiring firms' postacquisition cash holdings over the 1 to 3 years following the acquisition. The sample consists of all firms that completed an acquisition between 1990 and 2006 based on the SDC database. Postacquisition cash is averaged over the 1 to 3 years following the acquisition, and preacquisition cash is estimated over the 1 to 3 years prior to the acquisition. Acquisition Q correlation is the correlation in Tobin's Q between the acquirer and the target companies over the 10 years before the acquisition. Acquisition cash flow correlation is defined analogously with respect to cash flows. The cash acquisition dummy is set to one if the acquisition's method of payment is cash, and to zero otherwise. Log(deal value) is the logarithm of the total value of the acquisition. Other control variables are defined in the Appendix and are estimated over the subsequent 1 to 3 years as well. The first three columns correspond to all acquiring firms, whereas columns 4 through 6 correspond to multisegment acquiring firms only. The last three columns correspond to single-segment acquiring firms only. Standard errors (in brackets) are heteroskedasticity consistent.

	All Acquirers			Only Diversified Acquirers			Only Stand-Alone Acquirers		
	1 Year (1)	2 Years (2)	3 Years (3)	1 Year (4)	2 Years (5)	3 Years (6)	1 Year (7)	2 Years (8)	3 Years (9)
Preacquisition cash	0.797***	0.690***	0.636***	0.756***	0.654***	0.653***	0.810***	0.702***	0.634***
	[0.008]	[0.011]	[0.014]	[0.013]	[0.019]	[0.024]	[0.010]	[0.014]	[0.018]
Acquisition Q correlation	0.074**	0.197***	0.185***	0.085*	0.097**	0.137***	0.070	0.311***	0.305***
	[0.035]	[0.050]	[0.062]	[0.046]	[0.045]	[0.043]	[0.051]	[0.073]	[0.092]
Acquisition cash flow correlation	0.051*	−0.015	0.011	0.025	0.105*	0.158**	0.065	−0.116**	−0.116
	[0.028]	[0.041]	[0.051]	[0.039]	[0.056]	[0.073]	[0.040]	[0.058]	[0.071]
Cash acquisition dummy	0.004	0.005	0.007	0.002	0.007	0.010	0.006*	0.003	0.004
	[0.002]	[0.003]	[0.004]	[0.003]	[0.005]	[0.006]	[0.003]	[0.005]	[0.006]
Log(deal value)	0.003***	0.007***	0.009***	0.002	0.003	0.009***	0.005***	0.010***	0.010***
	[0.001]	[0.001]	[0.002]	[0.001]	[0.002]	[0.003]	[0.001]	[0.002]	[0.002]
Cash flow/assets	−0.057***	−0.105***	−0.142***	−0.064***	−0.121***	−0.175***	−0.054***	−0.098***	−0.132***
	[0.007]	[0.010]	[0.013]	[0.011]	[0.018]	[0.023]	[0.009]	[0.013]	[0.016]
Tobin's Q	0.003**	0.005***	0.005**	0.005**	0.007**	0.008**	0.002	0.004	0.005
	[0.001]	[0.002]	[0.002]	[0.002]	[0.003]	[0.004]	[0.002]	[0.002]	[0.003]
Book leverage	−0.064***	−0.091***	−0.121***	−0.068***	−0.084***	−0.139***	−0.062***	−0.094***	−0.109***
	[0.006]	[0.008]	[0.010]	[0.009]	[0.013]	[0.016]	[0.008]	[0.011]	[0.013]
Payout/assets	−0.019	−0.027	−0.038	−0.021	−0.045*	−0.067**	−0.012	0.035	0.071
	[0.016]	[0.023]	[0.028]	[0.017]	[0.024]	[0.028]	[0.035]	[0.054]	[0.075]

(*continued*)

Table VII—*Continued*

	All Acquirers			Only Diversified Acquirers			Only Stand-Alone Acquirers		
	1 Year (1)	2 Years (2)	3 Years (3)	1 Year (4)	2 Years (5)	3 Years (6)	1 Year (7)	2 Years (8)	3 Years (9)
CAPEX/assets	−0.066***	−0.083***	−0.070***	−0.063**	−0.106***	0.000	−0.071***	−0.071***	−0.100***
	[0.015]	[0.020]	[0.025]	[0.025]	[0.035]	[0.045]	[0.018]	[0.025]	[0.031]
NWC/assets	−0.026***	−0.028***	−0.024*	−0.006	−0.023	−0.011	−0.034***	−0.030**	−0.028*
	[0.007]	[0.010]	[0.013]	[0.011]	[0.017]	[0.023]	[0.009]	[0.013]	[0.017]
Number of segments	0.001	0.001	0.001	0.002	−0.002	−0.002	−0.002	−0.005	−0.002
	[0.002]	[0.002]	[0.002]	[0.001]	[0.002]	[0.002]	[0.002]	[0.003]	[0.004]
Firm size	−0.001	−0.003*	−0.005**	0.000	0.000	−0.003	−0.002	−0.005**	−0.005*
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]	[0.002]	[0.002]	[0.003]
R^2	0.747	0.621	0.567	0.676	0.537	0.520	0.766	0.646	0.587
N Obs	7,302	5,457	4,118	2,895	2,156	1,628	4,407	3,301	2,490

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

both whether the acquisition was paid with cash and the acquisition value, as well as the usual set of control variables, recorded 1, 2, and 3 years after the acquisition.

The acquisition's degree of diversification is measured by the correlations in investment opportunity and cash flow between the acquiring and target firms, measured by the correlation between their industry average investment opportunities (Tobin's Q) and cash flows over the 10-year period prior to the acquisition.

The main result in Table VII is that a higher correlation in investment opportunity between the acquiring firm and the target firm leads to higher cash balances following the acquisition. Three years after the acquisition, the results are statistically significant at the 1% level and the magnitudes of the effects are nontrivial: An increase of one standard deviation in the correlation in investment opportunity between the acquirer and the target corresponds to an increase of 6.4% in cash holdings in the sample of all firms (column 3), 4.3% in the sample of diversified firms (column 6), and 8.0% in the sample of single-segment firms (column 9).

There are two other notable patterns worth mentioning. First, note that the effects are bigger in specialized acquiring firms than they are in diversified acquiring firms. These results are consistent with the results in Table III, where the magnitude of the effects is significantly bigger when specialized firms are included in the analysis. These results are due to the nonlinearity in the changes in diversification: The decrease in correlations due to the diversification of a previously specialized firm is on average much larger than the decrease in correlation due to the diversification of an already-diversified firm.

The second notable result is that the effects are generally weaker and less significant when we consider the immediate year subsequent to the acquisition. The effects become significantly stronger after 2 years and more so after 3 years, consistent with a slow, noninstantaneous adjustment of cash to changes in the degree of diversification.

D. Why Do Diversified Firms Hold More Cash Than They Used To?

The evidence presented thus far supports the notion that higher degrees of diversification correspond to lower ratios of cash to total assets. However, this does not explain why diversified firms tend to hold more cash than they used to. As Figure 1 shows, the average cash-to-assets ratio has increased dramatically from 1990 to 2006 in diversified firms (with two business segments or more). BKS show that increasing cash flow volatility is one of the main driving forces behind the increase in cash balances. Indeed, this is consistent with a number of recent studies (e.g., Irvine and Pontiff (2009)) that document a market-wide increase in idiosyncratic risk and cash flow volatility. Thus, the precautionary demand of firms for cash reserves is greater due to increasing levels of risk.

Consistent with the findings in BKS, Panel A of Figure 2 shows that the average cash flow volatility has also increased during the same period. Panel B

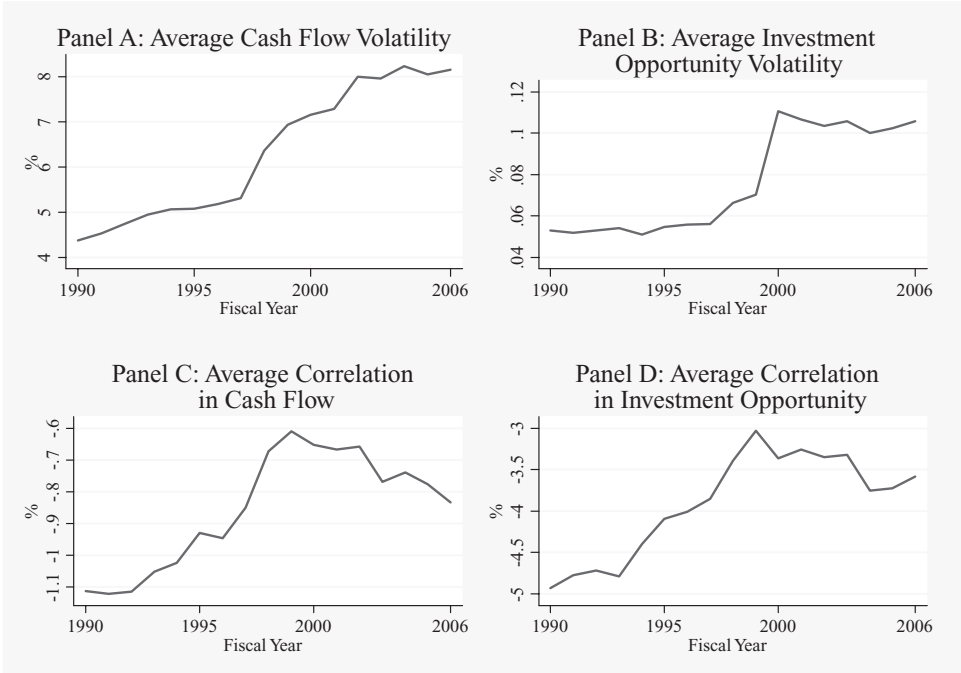

Figure 2. Average volatility and correlation in investment opportunity and cash flow. This figure plots the average annual volatility and correlation in investment opportunity and cash flow for all diversified firms in the sample, which consists of nonfinancial and nonutility firm-years from 1990 to 2006, with nonmissing data on cash holdings and on the industry codes of each business segment, and with total market capitalization of $10M or more. Diversified firms are firms that reported two business segments or more on Compustat. See the Appendix for variable definitions.

of Figure 2 shows further that the increase in average cash holdings has been accompanied by an increase in investment opportunity volatility. Given the previous finding of a positive relation between cash holdings and investment opportunity volatility, this suggests that the time trend in cash holdings is related to both cash flow and investment opportunity risks.

Interestingly, Panels C and D show that the cross-divisional correlations in cash flow and investment opportunity have also increased from 1990 to 2006. Thus, the increase in cash holdings has been accompanied not only by an increase in volatilities, but also by an increase in the correlations in investment opportunity and cash flow. It is important to note that these are two different effects. The volatility measures employed here are sales-weighted industry-level volatilities that do not incorporate cross-divisional diversification. Thus, they are very similar to the cash flow volatility measure used by BKS, which is also an industry-level measure of volatility. However, the results here show that the degree of diversification has decreased from 1990 to 2006, which might further explain why diversified firms hold more cash.

Table VIII

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 multidivision, nonfinancial, and nonutility firms with nonmissing data on cash holdings and the industry codes of each business segment, and with total market capitalization of $10M 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, the number of business segments, and firm size (see the Appendix for variable definitions).

	(1)	(2)	(3)	(4)	(5)
Q correlation	9.506**				
	[3.428]				
Cash flow correlation		8.134***			
		[1.332]			
Avg. industry Q volatility			0.653***		
			[0.125]		
Avg. industry cash flow volatility				0.313***	
				[0.024]	
Q–Cash flow correlation					0.133**
					[0.057]
Cash flow/assets	−1.006***	0.056	−0.412	−0.208*	−0.915**
	[0.283]	[0.255]	[0.235]	[0.111]	[0.308]
Tobin's Q	0.133**	0.076**	0.068	0.057***	0.139**
	[0.050]	[0.034]	[0.040]	[0.017]	[0.055]
Number of segments	0.399**	−0.019	0.214*	0.07	0.391**
	[0.158]	[0.119]	[0.116]	[0.056]	[0.169]
Firm size	0.031	0.090*	−0.003	−0.016	−0.09
	[0.066]	[0.043]	[0.045]	[0.020]	[0.075]
R^2	0.904	0.963	0.953	0.990	0.891
N Obs	17	17	17	17	17

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

The time-series relation between cash and investment opportunity/cash flow risk is further examined in Table VIII. This table estimates time-series regressions explaining annual average corporate cash holdings from 1990 to 2006. The results suggest that the above increases in correlation and volatility in investment opportunity and cash flow are significantly positively related to the upward time trend in cash holdings.

These effects are economically significant. For example, according to column 1, the increase in average Q correlation from 1990 to 2006 (from −1.8% to −0.9%) corresponds to an increase of 8.2% in average cash holdings. Furthermore, these effects are statistically significant at the 5% level or better.

Overall, these findings suggest that multidivisional firms are less diversified in their investment opportunities and cash flows than in the past, and therefore do not enjoy the benefits of investment and cash flow coinsurance as much as before. These results are in line with the 1990s trend of an increasing

percentage of same-industry mergers documented by Andrade et al. (2001). Thus, these firms are more exposed to investment and cash flow risks, and have a stronger precautionary motive for holding cash. It is important to note, however, that the increase in cross-divisional correlations is not the only reason cash holdings have increased over time. If it were the only reason, we would not have witnessed a similar increase in the cash holdings of specialized firms, as can be seen in Figure 1.

V. Conclusions

The interaction between corporate liquidity and corporate diversification is interesting theoretically as well as practically. From a theoretical point of view, diversified firms enjoy the benefit of coinsurance, which reduces their exposure to risk and allows them to hold reduced amounts of cash in comparison to their stand-alone counterparts. From a practical point of view, diversified U.S. firms hold a large fraction of total corporate cash. In 2006, for example, diversified firms held approximately 72% of aggregate corporate cash. Thus, it is important to understand the unique determinants and implications of diversified firms' cash holdings.

This paper shows that multidivision firms hold approximately half as much cash as specialized firms do, and that this difference can be attributed to diversification in investment opportunity and cash flow. The results emphasize the impact of the joint uncertainty in investment opportunity and cash flow on cash holdings. Specifically, diversification mainly affects cash through the cross-divisional correlation in investment opportunity and the financing gap, that is, the correlation between a firm's investment opportunities and cash flows. More diversified firms, with lower cross-divisional correlations in investment opportunity and smaller financing gaps, are well positioned to hold less cash. Previous literature has solely focused on cash flow volatility, and this paper augments the picture by considering the overall joint uncertainty in investment and cash flow.

Exploiting the imperfect correlations between divisions is also in line with the coinsurance effect, introduced by Lewellen (1971). In his work, the imperfect correlations between divisions' cash flows increase the debt capacity of firms by reducing the probability of default. This paper suggests that diversified firms also hold more *net debt* (defined as debt minus cash) as a fraction of assets. Thus, diversification also affects firms' leverage through its impact on net debt (see also Ahn, Denis, and Denis (2006)).

Another key finding is that diversification is mainly correlated with lower cash holdings in financially constrained firms. Thus, the precautionary theory of corporate cash holdings mainly applies to financially constrained firms, as suggested by the early work of Modigliani and Miller (1958). Cash has no benefit if firms are not financially constrained and can tap external capital markets without incurring deadweight costs.

Underlying the hypothesis that diversification allows firms to hold less cash is the assumption that the reduction in cash holdings is optimal because firms

save on the costs of holding cash. Consistent with this assumption, the findings in this paper also suggest that diversification primarily reduces cash holdings in well-governed firms, where managers are more likely to behave optimally. Furthermore, the reduction in cash holdings is correlated with efficient flows of funds to high-productivity divisions. These findings are altogether consistent with the notion that diversification allows firms to optimally hold less cash. Holding less cash should positively affect the value of diversified firms because they save on the costs of holding cash.

Finally, it is worth mentioning that holding cash is not the only way in which firms can manage liquidity. In particular, bank lines of credit are also a possibility (e.g., Sufi (2009)). Therefore, the interaction between diversification and the demand for bank lines of credit might be an interesting topic for future research.

Appendix: Variable Definitions

Note: All names in parentheses refer to the annual Compustat item name.

Accounting Variables

Cash/assets = cash and short-term investments (che)/book assets (at)

Cash flow/assets = (income before extraordinary items (ib) + depreciation and amortization (dp))/book assets (at)

Tobin's Q = market value of assets (book assets (at) + market value of common equity (csho $*$ prcc) − common equity (ceq) − deferred taxes (txdb))/ (0.9 $*$ book value of assets (at) + 0.1 $*$ market value of assets)

Book leverage = (debt in current liabilities (dlc) + long-term debt (dltt))/book assets (at)

Payout/assets = (total dividends (dvt) + purchase of common and preferred stock (prstkc))/book assets (at)

Capital expenditure (CAPEX)/assets = capital expenditure (capx)/book assets (at)

Net working capital excl. cash (NWC)/assets = (current assets (act) − current liabilities (lct) − cash (che))/book assets (at)

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

Firm size = natural logarithm of book assets (at)

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 industry over the past 10 years, where an industry is defined by its three-digit NAICS code

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

Cash flow correlation and Industry cash flow volatility = are defined analogously with respect to cash flows

Q-cash flow 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

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