The Demand for Cash Balances by Property-Liability Insurance Companies during the Financial Crisis

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Abstract
The market turmoil that began in mid-2007 highlighted the importance of adequate liquidity as financial institutions weathered adverse circumstances. If funding liquidity risk and market liquidity risk are not adequately managed, they can lead to severe liquidity spirals. We develop a theoretical model to explain the factors that affect the demand for cash and empirically examine the demand for cash by both property-casualty and life-health firms during the financial crisis. Empirical results are based on OLS to examine the long-run relationships and on Pooled Mean Group estimation (PGM) to estimate short-run changes in cash demand while holding long-run firm coefficients constant over time. Initial results show that stock firms and firms with significant growth opportunities demand higher levels of cash, while firms that are part of a group and firms with large assets hold less cash.

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1. Introduction

Existing literature summarizes four key reasons for firms to hold cash: a transaction motive, a precautionary motive, an agency/speculative motive and a tax motive. Under the *transaction motive*, firms hold cash to minimize transaction costs associated with converting receivables into cash. This motive is most often associated with smaller firms, as larger firms enjoy economies of scale that minimize their costs of raising cash from other current assets. There is much evidence supporting the existence of these economies of scale (see, for instance, Mulligan, 1997). By contrast, the *precautionary motive* induces firms to hold cash since access to cash through capital markets is costly. The precautionary motive also suggests that firms with better investment opportunities hold more cash because adverse shocks and financial distress are more costly for them (Kim et al., 1998; Opler et al., 1999; Palazzo, 2012). Some firms hold cash in response to an *agency/speculative motive*, which is influenced by governance and/or managerial incentives to retain cash when investment opportunities are poor (Pinkowitz et al., 2006; Acharya et al., 2007; Dittmar and Mahrt-Smith, 2007; Harford et al., 2008). Finally, firms seeking to *avoid taxes* associated with repatriation of foreign earnings or double-taxation of dividends may hold more cash (Foley et al., 2007¸ Gamba and Triantis, 2008; Riddick and Whited, 2009).[1]

The market turmoil that began in mid-2007 highlighted the importance of holding liquid assets and ensuring adequate liquidity to allow the financial system to withstand adverse circumstances (Kahle and Stulz, 2010).[2] The reversal in market conditions illustrated how the banking system came under severe stress, which required central bank action to support both the functioning of money markets and, in a few cases, individual institutions. Managing liquidity risk – both funding and market liquidity –is a fundamental aspect of intermediation between savers and borrowers, contributing to the efficient allocation of resources in the economy. Cornett et al. (2011) examine how banks

[1] For a survey see Bates et al. (2009).

[2] Papers by Brunnermeier (2009) and Farhi, Golosov, and Tsyvinski (2009) recognized that the financial crisis is a liquidity crisis rather than a credit risk crisis. The argument is similar to previous work by Diamond and Rajan (2001).

managed the liquidity shock during the financial crisis. If liquidity risks are not adequately managed, they can lead to severe liquidity spirals (Allen and Carletti, 2008).

The financial crisis prompted the Basel Committee on Banking Supervision to re-evaluate the principles and standards for capital, as well as for the measurement and management of liquidity risk. In particular, Basel III and the document on the Liquidity Coverage Ratio (LCR) more recently (Bank for International Settlements, 2013), represent a fundamental review of the risk management practices of banks related to funding and liquidity to address shortcomings revealed by the recent crisis. The liquidity framework is part of a comprehensive set of complementary and mutually reinforcing measures for regulatory reform that have been examined in the literature (Adrian and Shin, 2010; Goodhart, 2008; Krimminger, 2008).

Similarly, the finance literature has given attention to the recent increase in cash holdings of U.S. firms (Bates et al., 2009; Duchin, 2010). Since the early 1980s, improvements in information and financial technology have reduced the costs of obtaining and transferring capital. Thus, all else equal, reduced liquidity demands should have led to a reduction in corporate cash holdings, so the increase in cash balances has been under investigation to analyze whether the increase in cash holdings results from changes in firm characteristics (Opler et al., 1999).

So far, this subject as received scant attention in the insurance literature. To our knowledge, only Outreville (1987) and Colquitt et al. (1999) examine the determinants of cash holdings by property-liability insurance companies. In the life insurance sector, Outreville (1988) analyze the short-run and long-run demand for cash balances and Wells et al. (1995) examine the relation between the organizational form of the company and cash balances. In a similar vein, a recent policy paper by the Geneva Association (2012) identified the potential for life insurance policy surrenders to increase the liquidity risk for carriers under extreme circumstances.

This study contributes to a growing body of research on cash holdings by using the terminology and data of insurance companies. The specific relationships to be investigated are: the existence of economies of scale in the demand for cash balances, the influence of interest rates, and the characteristics of the insurance business that may affect the liquidity risk of the company. In relation to the widely examined long-run relationship in the demand for cash balances, we also examine the short-run adjustments of the demand related to interest rates during the period of the

financial crisis. The rest of the paper is organized to present separately the long-run analysis and the short-run analysis.

In section (2) we present the stock adjustment model of assets which explain the framework of the analysis of cash balances in a portfolio. The following sections (3) and (4) present the long-run analysis and the estimated results. In section (5) we present the results of the short-run estimations tested using the pooled mean group procedure. We offer some conclusions and suggestions in the last section.

2. The long-run and short-run demand for assets in a portfolio

In asset demand models, it is usually assumed that portfolio holders act to eliminate, in each time period, some fraction of the discrepancy between the actual portfolio and the long-term optimum required portfolio. The desired allocation is determined by interest rates, price expectations and other factors related to the firm and the business environment.

The allocation process for the long-run optimum required portfolio follows the following equation (1):

$$\begin{aligned} \frac{A_{i,t}^{*}}{W_t} &= \alpha_{i,0} + \sum_{k=1}^{n} \alpha_{i,k} R_{k,t} + \sum_{h=1}^{n} \beta_{i,h} X_{h,t} \ \ (i = 1, \dots, n) \\ \sum_{i=1}^{n} A_{i,t} &= W_t \\ \frac{A_{i,t}^{*}}{W} &= a_{i,t}^{*} \end{aligned} \tag{1}$$

where A^{*} are the desired equilibrium holding of the *i*th asset at time t and W_t is the total portfolio size at time t; $R_{k,t}$is the expected holding-period yield on the *k*th asset at time period t; $X_{h,t}$ is a vector of additional variables which influence the portfolio allocation; and subject to the following constraints:

$$\begin{aligned} &\sum_{i} \alpha_{i,k} = 0 \ \forall_k; \\ &\sum_{i} \beta_{i,h} = 0 \ \forall_h; \\ &\sum \alpha_{i,0} = 1. \end{aligned}$$

There are good reasons to assume that the long-run relationships are similar across groups due to regulatory constraints, arbitrage conditions, or common technologies influencing all groups in a similar way. According to Pesaran et al. (1999), there are less compelling reasons to assume that short-run adjustments are the same across groups. The Pooled Mean Group (PMG) estimation procedure allows us to estimate the common long-run coefficients without making the same assumption for short-run adjustments.

The analysis recognizes that decisions to invest in alternative assets respond only gradually to changes in asset yields that modify the optimum allocation in portfolios.[3] The hypothesis of the optimal marginal adjustment model predicts that net new flows will be allocated in the desired proportions, while readjustment of holdings only partially eliminates the differential between the desired and actual proportions of existing holdings (see appendix).[4]

3. Estimation procedures and the long-run demand for cash balances

The conventional long-run demand for cash balances derived from equation (1) has the following functional form (see Colquitt et al., 1999):

Cash holdings = f [firm size, financial strength, leverage, growth rate, variance of cash flows, business diversification, organizational form, group membership].

We employ this functional form and ordinary least squares (OLS) analysis to test changes in cash demand before and after the 2008 financial crisis. The following descriptions identify our data definitions and predictions. First, we use the natural log of the insurer's total assets to measure firm size. Previous studies of cash holdings of non-financial firms have investigated whether economies of scale exist in cash transactions. If such economies of scale exist, then there should be a negative relationship between firm size and cash demand, consistent with the *transaction* motive.

Financial strength and leverage are proxies for financial strength and probability of financial distress. The *precautionary* motive suggests that firms in the weakest financial position will have

[3] The response lag is usually attributed to transaction and agency costs.
[4] See the original paper by Friedman (1977) and an empirical example by Cummins and Outreville (1984).

the greatest need to hold cash. Our estimate of financial strength is the A.M. Best rating. In our analysis, we assign the lowest ratings an ordinal value of zero and the highest ratings we assign a value of five. Thus, there should be a negative relationship between A.M. Best category and cash demand. However, firms with higher leverage, defined as total liabilities divided by total assets, should demand more cash. Opler, et al. (1999) provide conflicting predictions on the relation between leverage and cash holdings. Firms with high leverage may hold more cash in order to avoid the need to raise outside funding or to take advantage of investment opportunities, also consistent with the *precautionary* motive. For example, as argued by Bates et al. (2009), payments to debtholders reduce the ability of firms to accumulate excess cash over time, which implies a negative relation between non-operational cash holdings and leverage. However, the hedging argument put forth in Acharya et al. (2007) and Gamba and Triantis (2008) predicts a positive relation between leverage and cash holdings. However, Opler, et al. (1999) argue that firms with low leverage are less subject to outside monitoring, so cash holdings may be inversely related to leverage, consistent with the *agency/speculative* motive. A positive relationship between leverage and cash demand would support the *precautionary* motive, while a negative relationship would support the *agency/speculative* motive.

An insurer with greater future investment opportunities is likely to maintain higher levels of cash in order to take advantage of opportunities as they arise without incurring flotation costs associated with external capital, consistent with the *precautionary* motive. Here, we follow Baber et al. (1996), who propose using past growth rates as a proxy for future investment opportunities. It is possible to consider the average over the prior three years of growth in assets, growth in direct premiums written, growth in net premiums written, and growth in surplus. We expect a positive relation between investment opportunities and cash holdings.

Kim, et al. (1998) document a positive relation between cash holdings and the variance of cash flows for non-financial firms. Cummins and Sommer (1996) and Sommer (1996) use historical quarterly return data on various categories of assets and liabilities to calculate the estimated volatility (standard deviation) of the insurer's asset-liability portfolio and find evidence of a positive relationship, consistent with the *precautionary* motive. We follow Cummins and Sommer (1996), but we use annual data.

The *precautionary* motive also suggests a negative relation between firm diversification and cash

demand. An insurer's need for cash clearly depends on the nature of business (short tail-lines versus long-tail lines, in particular) and the level of diversification. Durchin (2010) examines the interaction between corporate liquidity and corporate diversification and shows that diversification affects firm's leverage and is correlated with lower cash-holdings. We measure business concentration with the firm's business line Herfindahl-Hirschman Index.

Finally, we examine the impact of organizational form on cash demand. First, we examine the ownership relationship. The two most common organizational forms in the insurance industry are the stock form and the mutual form. While much has been written about the agency conflicts inherent in various ownership forms, their impact on the relation between organizational form and cash holdings is ambiguous. Opler et al. (1999) argue that when agency costs of debt are high, firms are likely to choose high levels of cash holdings, enabling them to take advantage of investment opportunities without having to raise additional outside funds. This argument leads to the hypothesis that stock insurers should hold more cash than mutual firms. Finally, assuming that an insurer is a member of a group, it would manage its liquidity recognizing that any shortage could be addressed within the group. Consequently, the expected sign on the group membership variable is negative.

4. Data and empirical results

Firm size is measured as natural log of assets, financial strength is represented by A.M. Best ratings, liquidity risk is measured by leverage, and variance of cash flows is accounted by annual total variance of asset returns and loss reserve growth. Investment opportunity set is represented by trailing three-year ROE growth and group membership and organizational form are observed from statutory demographic reports.

We use statutory data from the National Association of Insurance Commissioners' InfoPro database. We augment these data with asset return data from Ibbotson's *Stock, Bond, Bill and Index* report (Ibbotson Associates 2013), and data from the U.S. Bureau of Economic Analysis. Data are analyzed for reporting years ending 2005-2012, covering periods prior to and following the financial crisis, allowing us to examine how demand for cash was affected by the liquidity crisis of 2007-2008.

Results estimating long-run cash demand are shown in Table 1 and 2. They suggest that, as expected, firms with a larger asset base demand less cash, harnessing the economies of scale associated with size. Similarly, companies that are members of groups demand less cash in most years, presumably relying upon the parent company to infuse cash when necessary without having to access the capital markets. Conversely, stock companies demand more cash, which is not predicted by theory regarding the speculative/agency motive, but could be explained by the tax motive as stock firms hold more cash to avoid the double-taxation problem. Firms with high growth opportunities held more cash prior throughout the sample period, while firms with higher leverage retained less cash. There is no clear relationship between business diversification, cash flow risk or financial strength rating and demand for cash during the sample period.

Table 1: Property-Liability Cash Demand – Pre Crisis

	2004		2005		2006		2007	
Intercept	0.393	***	0.369	***	0.401	***	0.405	***
	(0.05)		(0.05)		(0.054)		(0.054)	
LN(Assets)	-0.015	***	-0.014	***	-0.018	***	-0.017	***
	(0.003)		(0.003)		(0.003)		(0.003)	
HHI	0.031	*	0.035	**	0.03	*	-0.002	
	(0.016)		(0.016)		(0.018)		(0.004)	
Average Growth	0.043	***	0.064	***	0.053	**	0.101	***
	(0.014)		(0.014)		(0.026)		(0.03)	
Leverage	-0.103	***	-0.13	***	-0.093	***	-0.079	**
	(0.031)		(0.032)		(0.035)		(0.037)	
Group	-0.021	**	-0.023	**	-0.023	*	-0.042	***
	(0.011)		(0.011)		(0.012)		(0.012)	
Stock	0.047	***	0.044	***	0.051	***	0.054	***
	(0.01)		(0.01)		(0.011)		(0.011)	
Cash Flow Variance	0.141	*	0.162	**	0.211	**	0.253	***
	(0.081)		(0.085)		(0.091)		(0.086)	
A.M. Best Rating	-0.003		0.002		0.005		0.002	
	(0.006)		(0.007)		(0.007)		(0.008)	
Observations	845		845		845		845	
Adj. R-Square	0.136		0.144		0.119		0.12	

Note: Cash demand is measured as cash to total assets. HHI is line of business diversification and a firm's A.M. Best rating is assigned to an ordinal scale where the lowest rating is assigned a value of zero and the highest rating is assigned a value of five. Standard errors are in parentheses and significance is indicated as follows: *** 1%; ** 5%; * 10%.

Table 2: Property-Liability Cash Demand – Post Crisis

	2008		2009		2010		2011		2012	
Intercept	0.432	***	0.39	***	0.341	***	0.322	***	0.276	***
	(0.054)		(0.05)		(0.047)		(0.043)		(0.055)	
LN(Assets)	-0.019	***	-0.015	***	-0.013	***	-0.014	***	-0.012	***
	(0.003)		(0.003)		(0.003)		(0.002)		(0.003)	
HHI	0.006		0.026		-0.001		0.126	***	0.06	
	(0.051)		(0.04)		(0.017)		(0.044)		(0.044)	
Average Growth	0.093	**	0.112	***	0.095	**	0.117	***	0.01	
	(0.043)		(0.041)		(0.04)		(0.041)		(0.014)	
Leverage	-0.081	**	-0.114	***	-0.085	***	-0.079	***	-0.073	***
	(0.034)		(0.032)		(0.031)		(0.026)		(0.028)	
Group	-0.026	**	-0.016		-0.019	*	-0.019	**	-0.03	***
	(0.011)		(0.011)		(0.011)		(0.009)		(0.01)	
Stock	0.049	***	0.037	***	0.038	***	0.033	***	0.042	***
	(0.01)		(0.01)		(0.01)		(0.008)		(0.009)	
Cash Flow Variance	0.166	***	0.202	***	0.181	***	0.134	**	0.121	*
	(0.074)		(0.067)		(0.066)		(0.061)		(0.066)	
A.M. Best Rating	0.008		0		0.001		-0.004		0.009	***
	(0.007)		(0.006)		(0.006)		(0.006)		(0.003)	
Observations	845		845		845		845		845	
Adj. R-Square	0.128		0.131		0.094		0.149		0.133	

Note: Cash demand is measured as cash to total assets. HHI is line of business diversification and a firm's A.M. Best rating is assigned to an ordinal scale where the lowest rating is assigned a value of zero and the highest rating is assigned a value of five. Standard errors are in parentheses and significance is indicated as follows: *** 1%; ** 5%; * 10%.

5. The PMG estimation for the short-run adjustments for cash balances

Assuming that the short-run adjustment are only driven by interest rates rather than by factors related to the firm, the functional form to calculate the speed of adjustment is mainly driven by the size, the leverage and short-term interest rates. We use pooled mean group (PMG) estimations (Pesaran et al., 1999) to estimate short-run changes in cash demand while holding long-run firm coefficients constant over time. The model also estimates the speed of adjustment over time. A speed of adjustment coefficient of zero indicates no evidence of a long-run relationship. A negative speed of adjustment coefficient suggests a return to the long-run equilibrium, according to Blackburne and Frank (2007).

Results are presented in Table 3. In the short-run, demand for cash balances increases for larger companies and decreases as interest rates rise. The speed of adjustment is negative, supporting our prediction of partial adjustment over time. The results also suggest that firms hold less cash as it becomes more costly to do so (interest rates rise), and that while leverage is an important indicator of cash demand in the long-run, it does not predict short-term changes in cash holdings. This is also consistent with the partial adjustment model.

Table 3: Property-Liability – Pooled Mean Group Estimates

	Coefficient	Std. Error	p-value
	Long-run		
LN(Assets)	-0.004	0.001	0.000
Leverage	0.091	0.003	0.000
Cash Flow Variance	-0.052	0.006	0.000
Short-Term Interest Rate	-0.001	<0.001	0.000
	Short-run		
Intercept	0.099	0.005	0.000
Speed of Adjustment	-0.914	0.023	0.000
LN(Assets)	0.077	0.030	0.010
Leverage	-0.027	0.052	0.597
Short-Term Interest Rate	-0.005	0.001	0.000
Observations	6,760		
Groups	845		
Maximized Log Likelihood	18,612.08		

Note: Pooled mean group estimates constrain the long-run coefficients to be equal across panels while allowing for short-run, group-specific adjustments. The dependent variable is cash to total assets.

6. Conclusion

This article has outlined arguments for changes in cash demand during financial crises. We demonstrate that the traditional predictions of cash flow holdings related to transaction, precautionary and speculative/agency motives are confirmed, even during financial crises. Furthermore, there is some support for the tax motive, as stock companies (subject to double taxation of dividends) hold more cash, all else equal.

In the short run, size and cost of holding cash continue to be important determinants of the demand for cash, but leverage is not. Furthermore, the negative coefficient on speed of adjustments supports the prediction that cash holdings consistently move toward a long-run equilibrium.

These results provide important insights regarding the impact of both liquidity constraints and government intervention on insurer behavior.

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Appendix: Adjustment model in the simplified case of two assets

A_1 and A_2 are two hypothetical assets in the portfolio
Ps are the respective prices/returns of the assets
W_t is the total value (wealth) of the portfolio

Y_{t-1} is the equilibrium position of the investor at time t-1. Y_t would be the equilibrium in t if nothing changes. However, Z^*_t is the new desired position for the portfolio (investment structure by assets types = the long-run objective). The resulting allocation of the portfolio is a move from Y_{t-1} to Z_t for funds already allocated in the portfolio and a move to Z^2_t for the new funds.