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Article

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Determinants of corporate cash holdings in tranquil and turbulent period: evidence from an emerging economy

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Abstract

Using a sample of 280 firms listed on the Pakistan Stock Exchange, we empirically investigate factors that determine corporate cash holdings in different periods from 2005 to 2014. We divide the sample into three sub-periods—pre-crisis, crisis, and post-crisis—and apply a panel data model to estimate the results. The results suggest that financial crises affect firms' cash holdings policies. Further, findings show that financial crisis has influenced the relationship of size and leverage with cash holdings. In particular, cash flow, liquidity, and tangibility are major determinants of cash holdings in the sub-periods. We present important implications for corporate managers, academicians, and policymakers.

Keywords: Cash holdings, Financial crisis, Pakistan, Emerging economy

Background

Corporate cash holdings have been extensively studied in the finance literature. Firms need cash for various reasons, such as day-to-day operations, to finance growth through profitable operations, to retire mature debts, for paying taxes, and for pre-cautionary motives (Kafayat et al. 2014; Opler et al. 1999; Uyar and Kuzey 2014). However, maintaining excessive cash reserves has both advantages and disadvantages. For example, on the one hand, firms need excessive cash reserves to prevent financial distress and precautionary motives. On the other hand, excess cash may incur opportunity costs by way of forgoing profitable projects (Uyar and Kuzey 2014). Therefore, there is still no consensus on how much cash amount firms need on their balance sheet.

Most studies have explored factors that determine corporate cash holdings for developed countries such as the United States, the United Kingdom, Japan, and Italy (see: Al-Najjar and Belghitar 2011; Bates et al. 2009; Bigelli and Sánchez-Vidal 2012; Chen 2008; Opler et al. 1999; Ozkan and Ozkan 2004), while a few have examined emerging equity markets (see: Al-Amarneh 2015; Kariuki et al. 2015; Shabbir et al. 2016; Uyar and Kuzey 2014). The literature on cash holdings comprises a few studies on factors that determine cash holdings in the context of a crisis (Al-Amarneh 2015; Momeni et al. 2016; Mugumisi and Mwanza 2014; Song and Lee 2012).

Considering the above, we investigate factors that determine corporate cash holdings in Pakistan's emerging economy. More specifically, we investigate corporate cash holdings in normal and crisis periods. The US subprime 2007 financial crisis has been providing researchers with opportunities to study firm behavior in crisis periods.¹ Like other emerging economies, Pakistan's economy was affected by the financial crisis (Jebran et al. 2017a, 2017b); corporate sectors faced problems in generating cash flow and capital. Considering the importance of funds that firms require in different situations, we designed our study to examine factors that are important in determining the corporate cash holdings in different contexts, namely, normal and crisis periods. There are numerous studies² in the extant literature that investigate the determinants of corporate cash holdings in Pakistan. However, none, to the best of our knowledge, have explored factors that determine corporate cash holdings during crises in the context of Pakistan.

Through our work, we contribute to extant literature in at least two ways. First, we investigate factors that affect corporate cash holdings during the pre-crisis, crisis, and post-crisis periods, thus offering valuable insights. Second, we especially focus on corporate cash holdings in the emerging market of Pakistan. The results will provide new insights about the cash holdings behavior of firms in emerging markets during normal and turbulent period.

The remainder of the paper is organized as follows. In [Determinants of corporate cash holdings](#), we review factors that determine corporate cash holdings. In [Methods](#), we discuss our methodology. In [Results and discussion](#), we present the results, and finally conclude the paper in [Conclusions](#).

Determinants of corporate cash holdings

The extant literature has indicated the existence of various factors that affect firms' corporate cash holdings, including but not limited to cash flow ratio, growth opportunities, tangibility, size, leverage, volatility of cash flows, working capital, and capital expenditure. These factors are mostly viewed in perspective of two widely used theories in finance literature, namely the theories of pecking order and trade-off. According to the trade-off theory, firms have target cash holdings based on the marginal benefits and costs of the holdings. Firms hold cash at the target level while considering marginal benefits. Therefore, most firms have a target cash holdings level. In contrast, the pecking order theory postulates that firms have no such target levels; however, they maintain excess cash to use as a buffer between retained earnings and investment needs. Firms thus hold cash to avoid external financing when retained earnings cannot adequately finance new investments (Opler et al. 1999; Uyar and Kuzey 2014). Based on these theories and the extant literature, we identify the following factors that can affect cash holdings.

Cash flow

The tradeoff theory indicates a negative association between cash holdings and cash flow, since firms that generate more cash flows from operations require fewer cash reserves. In contrast, the pecking order theory notes a positive association between cash reserve and cash flow. It suggests that firms generating more cash flows are likelier to hold more cash to use for investments and during periods of financial distress. Extant empirical studies also report both positive (Opler et al. 1999; Ozkan and Ozkan 2004; Uyar and Kuzey

2014) and negative (Chen 2008) effects of cash flow on cash holdings. Since most studies document a positive effect, we develop the following hypothesis:

H1: Cash flow has a positive effect on cash holdings

Capital expenditure

The pecking order theory postulates that investment decisions, such as those regarding capital expenditure, decrease a firm's cash balance. Therefore, there is a negative association between capital expenditure and cash balance.³ Extant literature also suggests a negative association between capital expenditure and cash holdings—for example, Opler et al. (1999). Further, Chen (2008) argued that firms with high capital expenditure have low levels of cash reserves. Uyar and Kuzey (2014), who based their work on Turkey, also reached similar conclusions. Thus, we develop the following hypothesis:

H2: Capital expenditure has a negative effect on cash holdings

Growth

Most studies state that firms with higher growth opportunities have a higher level of cash holdings because such firms are likelier to hold more cash reserves to avail opportunities. For example, Kim et al. (1998) argued that firms with high growth opportunities hold more cash reserves. Bigelli and Sánchez-Vidal (2012) reported similar results for private firms. They suggested that private firms have a higher risk of underinvestment because of fewer internal funds. Therefore, private firms hold more cash for growth opportunities. Most empirical studies show a positive effect of growth opportunities on cash holdings (Nguyen 2006; Shabbir et al. 2016; Opler et al. 1999). Therefore, we expect the association between cash holdings and growth opportunities to be positive. Thus, we develop the following hypothesis:

H3: Growth has a positive effect on cash holdings

Leverage

The trade-off theory postulates that firms with high leverage ratio also have higher risk and are likely to face bankruptcy. Therefore, high-leverage firms hold more cash reserves to prevent such situations. In such conditions, we note a positive association between leverage and cash ratio. In contrast, the pecking order theory postulates a negative association between leverage and cash flow, suggesting that leverage can be used as a proxy for issuing debt. Hence, debt can substitute holding cash, and firms holding more liquid assets can convert these assets into cash easily. Therefore, leverage and cash flow are characterized by a negative association (Opler et al. 1999). Majority of studies predict a negative effect of leverage on cash holdings (see: Chen 2008; Opler et al. 1999; Ozkan and Ozkan 2004; Shabbir et al. 2016; Uyar and Kuzey 2014). Thus, we develop the following hypothesis:

H4: Leverage has a negative effect on cash holdings

Liquidity

According to the trade-off theory, firms with more liquid assets are likely to have fewer cash reserves. This theory postulates that liquid assets can be used as a substitute for and converted into cash when required. Therefore, firms holding more cash holdings

are likelier to have fewer liquid assets, indicating a negative association between liquidity and cash holdings. Accordingly, Ferreira and Vilela (2004) suggested that firms facing a shortage of cash may easily convert liquid assets into cash. Empirical studies have also reported this negative association, consistent with the predictions of the trade-off theory (see: Al-Najjar and Belghitar 2011; Ozkan and Ozkan 2004; Shabbir et al. 2016; Opler et al. 1999; Uyar and Kuzey 2014). Thus, we develop the following hypothesis:

H5: Liquidity has a negative effect on cash holdings

Size

The trade-off theory postulates that large firms are stable, more profitable, and diversified. They have constant stream of cash flows and low probability of bankruptcy. These features allow large firms to hold fewer cash reserves.⁴ This indicates a negative association between cash holdings and firm size. In contrast, the pecking order theory posits that large firms perform better and have more resources (such as cash) than small firms do. Therefore, the relationship between firm size and cash holdings is positive (Opler et al. 1999). However, extant literature has shown both negative (Bigelli and Sánchez-Vidal 2012; Ferreira and Vilela 2004; Chen 2008; Ahn and Chung 2015; Opler et al. 1999) and positive (Kariuki et al. 2015; Shabbir et al. 2016) effects of size on cash holdings. Thus, we develop the following hypotheses:

H6a: Size has a positive effect on cash holdings

H6b: Size has a negative effect on cash holdings

Tangibility

According to Drobetz and Grüninger (2007), firms with more tangible assets are likelier to hold fewer liquid assets. However, tangible assets can be used as collateral when issuing debt. They can be sold in need of cash. This indicates a negative correlation between tangibility and cash holdings. Uyar and Kuzey (2014), on analyzing Turkish data, also found similar results. Since we expect a negative association between tangibility and cash holdings, we develop the following hypothesis:

H7: Tangibility has a negative effect on cash holdings

Cash flow volatility

The tradeoff theory posits that firms with high uncertainty of cash flow are likely to hold more cash. Therefore, the association between cash flow uncertainty and cash holdings is positive. Most empirical literature has also reported a positive association between cash flow and uncertainty thereof (see: Bigelli and Sánchez-Vidal 2012; Demir and Ersan 2017; Guney et al. 2007; Kariuki et al. 2015; Shabbir et al. 2016). However, few studies do report a negative effect of volatility on cash holdings (Ferreira and Vilela 2004; Paskelian et al. 2010). Thus, we develop the following hypothesis:

H8: Cash flow volatility has a positive effect on cash holdings

Methods

Data

We consider non-financial firms listed on Pakistan Stock Exchange. Based on prior studies concerning determinants of corporate cash holdings (Opler et al. 1999; Uyar

and Kuzey 2014; Ozkan and Ozkan 2004), we exclude firms from the finance industry because they have unique accounting standards and capital structure. There are 392 non-financial firms listed on Pakistan Stock Exchange.⁵ The final sample includes 280 firms spanning 2005 to 2014.⁶ We further divide the sample into three sub-periods: the pre-crisis period (2005–2007), the crisis period (2008–2010),⁷ and the post-crisis period (2011–2014). We use these sub-periods to obtain reliable results in the selected period. The data for all variables are obtained from the Financial Statement Analysis of companies issued by State Bank of Pakistan.⁸

Variables

“Cash holdings” is the dependent variable in our analysis, while the independent variables comprise cash flow ratio, capital expenditure, growth, leverage, liquidity, firm size, tangibility, and volatility of cash flow. Table 1 lists the variables definitions, their proxy, and expected relationship with cash holdings.

Model

We opt for a panel data model to estimate the results. Most studies have used a generalized method of moments (GMM) model to estimate the speed of adjustment toward the optimal cash holdings. However, owing to small firm-year observations, we find the GMM model inapplicable, and thus resort to the panel data model.⁹ The panel data has two models: fixed effect model and random effect model. We apply the Hausman specification test to select the appropriate model for our results. Given the variables in Table 1, a general econometric model for the purpose of estimation can be specified as follows:

$$CASH_{it} = \beta_0 + \beta_1 CF_{it} + \beta_2 CAP_{it} + \beta_3 G_{it} + \beta_4 LEV_{it} + \beta_5 LIQ_{it} + \beta_6 SIZE_{it} + \beta_7 TANG_{it} + \beta_8 VOL_{it} + \epsilon_{it} \tag{1}$$

In Eq. 1, β_0 is the intercept, β_1 to β_8 are the slope parameters, and ϵ_{it} is the general error term; i catches the values of firm 1 to 280, while t catches the values from 2005 to 2014. In Eq. 1, *CASH* is cash and cash equivalents divided by total assets; *CF* is the pre-tax profit plus depreciation and amortization divided by total assets; *CAP* is the change in fixed assets plus depreciation divided by total assets; *G* is the percentage change in total assets; *LEV* is the total liabilities divided by total assets; *LIQ* is the net

Table 1 Variables definitions

Variables	Symbol	Measurement	Expected sign
Cash and cash equivalents	<i>CASH</i>	Cash and cash equivalents divided by total assets	
Cash flow ratio	<i>CF</i>	Pre-tax profit plus depreciation and amortization divided by total assets	+
Capital expenditure	<i>CAP</i>	Change in fixed assets plus depreciation divided by total assets	-
Growth	<i>G</i>	Percentage change in total assets	+
Leverage	<i>LEV</i>	Total liabilities divided by total assets	+/-
Liquidity	<i>LIQ</i>	Net working capital less cash divided by total assets	-
Size	<i>SIZE</i>	The natural logarithm of total assets	+/-
Tangibility	<i>TANG</i>	Tangible fixed assets divided by total assets	-
Volatility	<i>VOL</i>	The standard deviation of cash flow divided by total assets	+

working capital less cash divided by total assets; *SIZE* is the natural logarithm of total assets; *TANG* is the tangible fixed assets divided by total assets; and *VOL* is the standard deviation of cash flow divided by total assets.

Results and discussion

Table 2 reports the summary statistics of the dependent and explanatory variables for our three sub-periods. The visual examination of the table indicates that most of the variables’ mean values decline during the financial crisis period. More specifically, the results show a decline in mean cash holdings. Similarly, in the same period, the mean values of cash flow, growth, and liquidity also decline, and we find an increase in the volatility of some variables (*CAP*, *CF*, and *G*). However, the mean values of all variables (except, *CAP* and *LEV*) increase in the post-crisis period. Thus, the financial crisis affects the value of the selected variables. Further, the values of most variables decline in the financial crisis period, but increase in the post-crisis period.

Table 3 reports the correlation between the dependent and independent variables for the three sub-periods. The results of the VIF confirm no issues of multicollinearity among variables. The findings show that capital expenditure has a positive correlation with cash holdings in the pre- and post-crisis period, while it is negative during the

Table 2 Summary statistics

Pre-crisis	<i>CASH</i>	<i>CAP</i>	<i>CF</i>	<i>G</i>	<i>LEV</i>	<i>LIQ</i>	<i>SIZE</i>	<i>TANG</i>	<i>VOL</i>
Mean	0.0400	0.0119	0.0757	0.1313	0.4138	0.0237	14.8886	0.3487	0.0573
Median	0.0126	0.0000	0.0558	0.0171	0.4250	0.0022	14.6991	0.3373	0.0486
Maximum	0.5223	3.2721	0.4850	3.4630	1.0482	0.7265	19.0871	0.8617	0.5645
Minimum	2.87E-05	-0.7115	-0.2969	-0.5563	0.0136	-0.6852	10.5961	0.0020	0.0067
Std. Dev.	0.0719	0.2262	0.0883	0.2887	0.1405	0.2049	1.4548	0.1629	0.0444
N	829	829	829	829	829	829	829	829	829
During-crisis									
Mean	0.0293	0.0941	0.0639	0.1147	0.4395	0.0235	15.2190	0.3809	0.0583
Median	0.0078	0.0019	0.0449	0.0553	0.4384	0.0036	15.0532	0.3720	0.0486
Maximum	0.3809	5.2965	0.4532	3.6587	1.7980	0.9531	19.7352	0.9422	0.5645
Minimum	1.47E-05	-1.0000	-1.3774	-0.7856	0.0231	-0.6679	9.5699	0.0005	0.0067
Std. Dev.	0.0549	0.4650	0.1013	0.3305	0.1749	0.1826	1.5741	0.1782	0.0491
N	832	832	832	832	832	832	832	832	832
Post-crisis									
Mean	0.0310	0.0318	0.0746	0.1205	0.4163	0.0495	15.5116	0.3888	0.0589
Median	0.0089	-0.0127	0.0600	0.0698	0.4091	0.0374	15.4052	0.3779	0.0487
Maximum	2.0061	5.5291	1.8189	5.7790	1.9728	0.9820	20.3085	0.9525	0.5645
Minimum	3.72E-05	-1.0000	-0.6884	-0.7449	0.0086	-0.8432	9.2275	0.0002	0.0067
Std. Dev.	0.0796	0.3546	0.1174	0.3511	0.1900	0.2006	1.6606	0.1765	0.0505
N	1107	1107	1107	1107	1107	1107	1107	1107	1107

This table reports summary statistics of variables. The pre-crisis period ranges from 2005 to 2007. The crisis period ranges from 2008 to 2010. The post-crisis period ranges from 2011 to 2014. *CASH* is defined as cash and cash equivalents divided by total assets; *CF* is defined as pre-tax profit plus depreciation and amortization divided by total assets; *CAP* is the change in fixed assets plus depreciation divided by total assets; *G* is defined as percentage change in total assets; *LEV* is defined as total liabilities divided by total assets; *LIQ* is defined as net working capital less cash divided by total assets; *SIZE* is defined as the natural logarithm of total assets; *TANG* is defined as tangible fixed assets divided by total assets; *VOL* is defined as the standard deviation of cash flow divided by total assets

Table 3 Correlation matrix

Pre-crisis	1	2	3	4	5	6	7	8	9	VIF
CASH	1									
CAP	-0.0043	1								1.04
CF	0.4180 ^a	0.0064	1							1.57
G	0.0138	-0.1660 ^a	0.0121	1						1.05
LEV	-0.3269 ^a	-0.0179	-0.5281 ^a	-0.0261	1					2.26
LIQ	0.4116 ^a	0.0206	0.5527 ^a	0.0193	-0.7063 ^a	1				2.72
SIZE	0.1986 ^a	0.0004	0.2272 ^a	0.1334 ^a	-0.08968 ^a	0.2135 ^a	1			1.14
TANG	-0.3042 ^a	0.0747 ^b	-0.1197 ^a	-0.0577 ^c	0.1111 ^a	-0.3530 ^a	-0.0156	1		1.22
VOL	0.0684 ^b	-0.0031	0.0308	-0.0398	-0.0147	0.0943 ^a	-0.1121 ^a	-0.0472	1	1.04
During-crisis	1	2	3	4	5	6	7	8	9	
CASH	1									
CAP	0.0603 ^c	1								1.04
CF	0.3249 ^a	0.0507	1							1.23
G	0.0435	-0.0792 ^b	0.0851 ^b	1						1.08
LEV	-0.2081 ^a	0.0326	-0.3101 ^a	-0.0858 ^b	1					1.52
LIQ	0.4519 ^a	-0.0250	0.3557 ^a	0.0156	-0.5578 ^a	1				1.71
SIZE	0.1188 ^a	0.0403	0.1086 ^a	0.2226 ^a	-0.1449 ^a	0.0687 ^b	1			1.09
TANG	-0.2536 ^a	0.1532 ^a	-0.0271	-0.1115 ^a	0.0913 ^a	-0.2737 ^a	-0.0324	1		1.13
VOL	0.0525	-0.0278	-0.1294 ^a	-0.0068	-0.0265	0.0939 ^a	-0.1242 ^a	-0.0073	1	1.06
Post-crisis	1	2	3	4	5	6	7	8	9	
CASH	1									
CAP	-0.0138	1								1.07
CF	0.1789 ^a	0.0397	1							1.30
G	-0.0100	-0.2281 ^a	0.0605 ^b	1						1.07
LEV	-0.0495 ^c	-0.0331	-0.2826 ^a	-0.0239	1					1.53
LIQ	0.2509 ^a	-0.0046	0.4323 ^a	0.0296	-0.5181 ^a	1				1.74
SIZE	-0.0294	-0.0118	0.0626 ^b	0.0945 ^a	-0.1970 ^a	-0.0185	1			1.11
TANG	-0.1169 ^a	0.0635 ^b	-0.0226	-0.0424	-0.0722 ^b	-0.1806 ^a	-0.0558 ^c	1		1.10
VOL	0.0599 ^b	0.0781 ^a	0.1467 ^a	-0.0307	0.0287	-0.0415	-0.1289 ^a	0.0442	1	1.06

This table provides information about the correlation between the dependent and explanatory variables. The pre-crisis period is from 2005 to 2007. The during-crisis period is from 2008 to 2010. The post-crisis period is from 2011 to 2014. CASH is the cash and cash equivalents divided by total assets; CF is the pre-tax profit plus depreciation and amortization divided by total assets; CAP is the change in fixed assets plus depreciation divided by total assets; G is the percentage change in total assets; LEV is the total liabilities divided by total assets; LIQ is the net working capital less cash divided by total assets; SIZE is the natural logarithm of total assets; TANG is the tangible fixed assets divided by total assets; VOL is the standard deviation of cash flow divided by total assets. VIF represents the multicollinearity among variables ^a, ^b, and ^c indicates significance at 1%, 5%, and 10% respectively

crisis period. Thus, the financial crisis affects the correlation between cash holdings and capital expenditure.

In addition, we find that size and growth have a positive association with cash holdings in the pre-crisis and crisis periods, while a negative one in the post-crisis period. The correlation among the explanatory variables and cash holdings also decreases during the crisis period, indicating that the association between cash holdings and explanatory factors thereof varies by period.

Table 4 reports the estimation results of the model for the three sub-periods.¹⁰ The results suggest that capital expenditure has an insignificant effect on corporate cash

Table 4 Results of regression

Variables	Pre-crisis	During-crisis	Post-crisis
<i>CAP</i>	−0.0028 (0.0072)	0.0021 (0.0023)	0.0002 (0.0062)
<i>CF</i>	0.1482 ^a (0.0319)	0.0701 ^a (0.0146)	0.0395 ^c (0.0227)
<i>G</i>	−0.0073 (0.0055)	0.0003 (0.0033)	−0.0028 (0.0063)
<i>LEV</i>	−0.0342 (0.0247)	0.0057 (0.0104)	0.0355 ^b (0.0181)
<i>LIQ</i>	0.0429 ^b (0.0179)	0.0924 ^a (0.0094)	0.0983 ^a (0.0179)
<i>SIZE</i>	0.0062 ^a (0.0022)	0.0027 ^c (0.0015)	−0.0001 (0.0018)
<i>TANG</i>	−0.0859 ^a (0.0183)	−0.0337 ^a (0.0105)	−0.0329 ^c (0.0170)
<i>VOL</i>	−0.0141 (0.0644)	0.0566 (0.0499)	0.0969 (0.0612)
<i>Constant</i>	−0.0191 (0.0355)	−0.0119 (0.0256)	0.0188 (0.0346)
<i>R</i> ²	0.26	0.26	0.08
<i>N</i>	879	832	1107

This table provides information about the regression results obtained from the panel data model. The pre-crisis period ranges from 2005 to 2007. The crisis period ranges from 2008 to 2010. The post-crisis period ranges from 2011 to 2014. *CF* is the pre-tax profit plus depreciation and amortization divided by total assets; *CAP* is the change in fixed assets plus depreciation divided by total assets; *G* is the percentage change in total assets; *LEV* is the total liabilities divided by total assets; *LIQ* is the net working capital less cash divided by total assets; *SIZE* is the natural logarithm of total assets; *TANG* is the tangible fixed assets divided by total assets; *VOL* is the standard deviation of cash flow divided by total assets. Standard errors are in parenthesis. ^{a,b,c} indicates significance at 1%, 5%, and 10% respectively

holdings in the three sub-periods. This result is inconsistent with other studies (e.g.: Chen 2008; Mugumisi and Mwanza 2014; Opler et al. 1999; Uyar and Kuzey 2014) whereas capital expenditure has a significant effect on cash holdings. However, our results corroborate to Al-Amarneh (2015), who reported the absence of a relationship between cash holdings and capital expenditure in the pre-crisis, the crisis, and the post-crisis periods in Jordan.

Cash flow has a significant and positive effect on cash holdings in all three sub-periods. This result is consistent with the pecking order theory, suggesting that firms with high cash flow ratio have high cash holdings too. The coefficient value and significance level are higher in the pre-crisis period than in the post-crisis period; thus, the financial crisis affects the relationship between cash holdings and cash flows. This result is consistent with many empirical studies,¹¹ though it is inconsistent with Al-Amarneh (2015), who reported an insignificant effect of cash flow ratio on cash holdings in the financial crisis period.

Growth has an insignificant effect on cash holdings in the three sub-periods, suggesting it does not play a significant role in determining firms' cash holdings in Pakistan. This result is consistent with few empirical studies, such as Bigelli and Sánchez-Vidal (2012) and Drobetz and Grüninger (2007), while inconsistent with most other empirical studies (e.g.: Opler et al. 1999; Nguyen 2006; Shabbir et al. 2016; Ozkan and Ozkan 2004).

Further, leverage has a significant and positive effect on cash holdings in the post-crisis period only, possibly because firms increase their leverage ratios to increase their cash in the post-crisis period. Momeni et al. (2016) also reported similar results based on data from Tehran Stock Exchange in the financial crisis period. However, this result is inconsistent with Lian et al. (2011) and Song and Lee (2012), who reported significant negative effect of leverage on cash holdings in the crisis period.

Liquidity has a significant and positive effect on cash holdings in the three sub-periods, indicating that firms with high liquidity ratios are likelier to hold high cash reserves. This result is inconsistent with the theoretical predictions of the tradeoff

theory that suggests liquidity and cash holdings have a negative association, and also inconsistent with prior empirical studies (e.g.: Al-Najjar and Belghitar 2011; Shabbir et al. 2016; Ozkan and Ozkan 2004; Uyar and Kuzey 2014; Opler et al. 1999).

Size has a significant and positive effect on cash holdings in the pre-crisis and crisis periods. However, this relationship is insignificant in the post-crisis period, suggesting that the financial crisis affects the association of size and cash holdings. The significant effect is consistent with the pecking order theory wherein large firms perform better and have more resources, such as cash, than small firms do. Thus, they have higher cash holdings. This result is consistent with some empirical studies (Lian et al. 2011; Song and Lee 2012).

Tangibility has a significant and negative effect on cash holdings in the three sub-periods. However, the significant level of tangibility in the pre-crisis period is higher than in the post-crisis period, suggesting that the financial crisis affects the significance level of tangibility on cash holdings. This result is consistent with Drobetz and Grüninger (2007), as well as Uyar and Kuzey (2014), who suggested that firms with more tangible assets are likelier to hold fewer liquid assets, since they can be used as collateral when issuing debt and sold in need of cash.

The volatility of cash flow has an insignificant effect on cash holdings in the three sub-periods. This result is inconsistent with most studies that have reported a significant effect of volatility of cash flows on cash holdings (e.g.: Bigelli and Sánchez-Vidal 2012; Guney et al. 2007; Kariuki et al. 2015; Shabbir et al. 2016). However, it is consistent with Song and Lee (2012), who reported an insignificant effect of cash flow volatility on cash holdings in the financial crisis period.

Robustness test using alternative proxy of cash holdings

To check the robustness of our findings, we follow Itzkowitz (2013) and use an alternative proxy of cash holdings, namely, the natural logarithm of one plus the ratio of cash and cash equivalent to total assets.

Table 5 presents the regression results using an alternative proxy of cash holdings. As expected, we find consistent results with those reported in Table 4. Specifically, in the pre-crisis and crisis periods, we find significant and positive coefficients on *CF*, *LIQ*, and *SIZE*, but a significant negative coefficient on *TANG*. Further, in the post-crisis period, the results show significant and positive coefficients on *CF*, *LIQ*, *VOL*, and *LEV*, but a significant negative coefficient on *TANG*. The results provide strong evidence that our results are insensitive to the alternative proxy of cash holdings.

Conclusions

This study explored the factors that determine corporate cash holdings in both the normal and crisis periods in Pakistan's emerging economy. We selected 280 nonfinancial firms listed on Pakistan Stock Exchange, with data spanning from 2005 to 2014. We further divided the sample into three sub-periods: the pre-crisis period (2005–2007), the crisis period (2008–2010), and the post-crisis period (2011–2014). We selected the most widely used indicators that can affect firms' corporate cash holding, and these included cash flow ratio, growth opportunities, tangibility, size, leverage, volatility of cash flows, working capital, and capital expenditure.

Table 5 Robustness test using alternative proxy of cash holding

Variables	Pre-crisis	During-crisis	Post-crisis
<i>CAP</i>	− 0.00329 (0.00636)	0.00211 (0.00214)	0.00150 (0.00399)
<i>CF</i>	0.133 ^a (0.0281)	0.0655 ^a (0.0134)	0.0291 ^c (0.0150)
<i>G</i>	−0.00560 (0.00490)	0.000338 (0.00308)	− 0.00127 (0.00407)
<i>LEV</i>	−0.0316 (0.0217)	0.00294 (0.00950)	0.0280 ^b (0.0133)
<i>LIQ</i>	0.0386 ^b (0.0158)	0.0827 ^a (0.00861)	0.0850 ^a (0.0131)
<i>SIZE</i>	0.00559 ^a (0.00196)	0.00246 ^c (0.00143)	0.000247 (0.00149)
<i>TANG</i>	−0.0733 ^a (0.0161)	−0.0305 ^a (0.00962)	−0.0324 ^b (0.0129)
<i>VOL</i>	−0.0160 (0.0566)	0.0538 (0.0456)	0.0857 ^c (0.0484)
<i>Constant</i>	−0.0168 (0.0312)	−0.00879 (0.0234)	0.0144 (0.0269)
<i>R</i> ²	0.27	0.27	0.13
<i>N</i>	829	832	1107

This table provides the regression results using alternative proxy of cash holdings. The pre-crisis period is from 2005 to 2007. The crisis period is from 2008 to 2010. The post-crisis period is from 2011 to 2014. *CF* is the pre-tax profit plus depreciation and amortization divided by total assets; *CAP* is the change in fixed assets plus depreciation divided by total assets; *G* is the percentage change in total assets; *LEV* is the total liabilities divided by total assets; *LIQ* is the net working capital less cash divided by total assets; *SIZE* is the natural logarithm of total assets; *TANG* is the tangible fixed assets divided by total assets; *VOL* is the standard deviation of cash flow divided by total assets. Standard errors are in parenthesis.

^{a, b, c} indicates significance at 1%, 5%, and 10% respectively

The results highlight some noteworthy points. We find a decrease in cash holdings of firms in the financial crisis period. In addition, the mean value of cash flow, growth, and liquidity also decline during the financial crisis period. However, we observe a significant increase in mean values of all variables (except, *CAP* and *LEV*) in the post-crisis period. We find that the financial crisis affects the correlation among cash holdings and the determining factors thereof. The regression results show that capital expenditure, growth, and volatility of cash flows have an insignificant effect on cash holdings in the three sub-periods. We find a significantly positive effect of cash flow and liquidity on cash holdings, as well as a significantly negative effect of tangibility, in the three sub-periods. The findings indicate that leverage affects the cash holdings only in the post-crisis period. In addition, the size has a significant negative effect on cash holdings in the pre-crisis and crisis periods, while the relationship is insignificant in the post-crisis period. Overall, the results demonstrate that financial crisis significantly affects the corporate cash holdings behavior of firms.

This study has important implications for corporate managers. The results provide valuable information about the factors that can affect corporate cash holdings in different periods. Managers can use this information and determine the cash holdings of the firms in different periods, especially during financial crisis.

Endnotes

¹It is well documented in the literature that financial crisis has influenced the various countries from different aspects (Jebran 2018; Mirza et al. 2017; Cheng and Yang 2017; Hamdi et al. 2017; Jebran et al. 2017; Panda and Nanda 2017).

²See for example, Ali et al. (2016); Azmat (2014); Kafayat et al. (2014); Shabbir et al. (2016); and Shah (2011).

³Kim et al. (2011) also argue that capital expenditure increases the assets, which can be used as collateral for borrowing and consequently it will decrease the need of

holding cash. In this aspect, the capital expenditure and cash holdings have negative correlation.

⁴Mulligan (1997) argue that large firms needs cash for economies of scale and therefore the relationship between cash holding and size should be negative.

⁵Source: Pakistan Stock Exchange official website.

⁶We consider three years data for before and during crisis period because we want to precisely measure for the effect of financial crisis period.

⁷The subprime financial crisis started in 2007, however the effect of financial crisis was visible on the Pakistan Stock Exchange in 2008. Therefore, we selected the time period of during crisis from 2008 to 2010.

⁸<http://www.sbp.org.pk/publications/index2.asp>

⁹Recently, Uyar and Kuzey (2014) estimated the results using both GMM model and simple OLS method. The results of both model are mostly similar, except the GMM model speed of adjustment variable. Therefore, we argue that by applying the simple panel data model can also provide reliable results in this study.

¹⁰We select the random effect model for estimation of results.

¹¹Most of the empirical studies also shows significant effect of cash flow ratio on cash holding during financial crisis period (see for example Lian et al. 2011; Mugumisi and Mawanza 2014).

Abbreviations

CAP: Capital Expenditure; CFR: Cash Flow Ratio; G: Growth of the Firm; GMM: Generalized Method of Moments; LEV: Leverage; SIZE: Size of the Firm; TANG: Tangibility; VOL: Volatility of Cash Flows

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Availability of data and materials

The data for all variables is obtained from Financial Statement Analysis of companies issued by State Bank of Pakistan. <http://www.sbp.org.pk/publications/index2.asp>

Authors' contributions

KJ wrote the first section of the manuscript and drafted the manuscript. AI wrote the second section of the manuscript. KUB collected the data and designed the method. MAK interpreted the results. MH incorporated reviewers' comments and prepared the final draft of the manuscript. The authors have read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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