

CORPORATE CASH HOLDING AND FIRM VALUE

**CRISTINA MARTÍNEZ-SOLA
PEDRO J. GARCÍA-TERUEL
PEDRO MARTÍNEZ-SOLANO**

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De conformidad con la base quinta de la convocatoria del Programa de Estímulo a la Investigación, este trabajo ha sido sometido a evaluación externa anónima de especialistas cualificados a fin de contrastar su nivel técnico.

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CORPORATE CASH HOLDING AND FIRM VALUE

Cristina Martínez-Sola*

Pedro J. García-Teruel**

Pedro Martínez-Solano***

Abstract

The aim of this paper is to contrast the effect of cash holding on firm value for a sample of US industrial firms over the period 2001-2007. In order to do this, we first empirically test the existence of an optimal cash level that maximizes firm value. Secondly, we analyze whether deviations from the optimum cash level reduce firm value. Our results show a concave relation between cash holding and firm value, verifying that there is an optimal level of cash holding. Additionally, and consistent with the initial analysis, we also find that deviations above and below optimal cash holding decrease firm value.

Keywords: Cash holdings, firm value, asymmetric information

JEL classification: G30, G31

Corresponding author: Pedro J. Garcia-Teruel, Dpt. Management and Finance, Faculty of Economics and Business, University of Murcia, Murcia (30100), Spain. E-mail: pjteruel@um.es

* Dep. Business Administration, Account and Sociology -Faculty Social Sciences and Law--University of Jaen. Tel: +34 953 211957, Fax: +34953211869, E-mail: mmsola@ujaen.es

** Dep. Management and Finance -Faculty of Economics and Business--University of Murcia. Tel: +34 868 887828, Fax: +34 868887537, E-mail: pjteruel@um.es

*** Dep. Management and Finance -Faculty of Economics and Business--University of Murcia. Tel: +34 868883747, Fax: +34 868887537, E-mail: pmsolano@um.es

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1. INTRODUCTION

In the recent years there has been a growing interest in corporate cash holdings in the finance literature. This interest has been especially motivated by the fact that corporations hold significant amounts of cash in their balance sheets. Specifically, Dittmar and Marth-Smith (2007) state that in 2003, the sum of all cash and marketable securities represented more than 13% of the sum of all assets for large publicly traded US firms. From another perspective, the aggregate cash held by publicly traded US firms in 2003 represents approximately 10% of annual US GDP. Consequently, the cash reserves held by a firm are a relevant factor of study and one that affects firm's value.

The first studies focus on this topic looked at the determinants of corporate cash holdings (Kim, Mauer, and Sherman, 1998, Opler, Pinkowitz, Stulz, and Williamson, 1999 Ozkan and Ozkan, 2004; Ferreira and Vilela, 2004; Garcia-Teruel and Martinez-Solano, 2008). Most of these papers have considered that a target cash level exists, proving that cash decisions follow a partial adjustment model, though there is no empirical evidence to justify why firms follow a partial adjustment model. Following this line of research, recent papers have investigated the marginal value of cash from different perspectives. They study how valuable or necessary is cash by analyzing the increase in shareholder value associated with one additional dollar held by the firm, splitting the sample into subsamples according to firm-specific conditions. Specifically, Pinkowitz, Stulz and Williamson (2006) estimate the marginal value of cash and find that the relation between cash holdings and firm value is much weaker in countries with poor investor protection than in other countries. Dittmar and Marth-Smith (2007) investigate how corporate governance impacts firm value by comparing the value and use of cash holdings in poorly and well-governed firms. Another group of studies links the value of cash to firm's investment opportunities (Pinkowitz and Williamson, 2007) or to corporate financial policies (Faulkender and Wang, 2006). More recently, Drobetz, Grüninger and Hirschvogel (2009) have studied the marginal value of cash in connection with firm-specific and time varying information asymmetry, obtaining that indicating information asymmetry decreases the marginal value of cash. Finally, Tong (2009) studies the effect of firm diversification on the value of corporate cash holdings, by employing Faulkender and Wang (2006) methodology to measure the marginal value of cash holdings.

However, despite the increasing amount of literature on corporate cash holding, there are no studies focused on the straight link-on effect of corporate cash holdings on firm value. In this sense, corporate cash holdings have benefits and costs for the firm and consequently may be an optimal cash level at which the value of the firm is maximized. The benefits of holding cash balances stem from several motives. First, for precautionary motives, firms maintain liquidity to meet unexpected contingencies. Second, for transactional motives, to meet the needs that come from the firm's normal activities. Third, firms could retain internally-generated cash to take advantage of their investment opportunities, since the existence of information asymmetry could increase the cost of external finance (Myers and Majluf, 1984). Moreover, as the existence of agency conflicts also make it more expensive to obtain external funding, this could lead firms to pass up positive-NPV investment (Myers, 1984) and assets substitution (Jensen and Meckling, 1976). Hence, managers hold liquid assets in order to reduce the cost of relying on external finance.

Conversely investing in liquid assets also has costs. On the one hand, large cash reserves can increase agency conflicts between managers and shareholders. In this way, the free cash flow might increase discretion by managers, which goes against shareholders' interest (Jensen, 1986). On the other hand, holding liquid assets implies an opportunity cost, due to the lower return of these assets, especially if the firm gives up more profitable investments to hold that level of cash.

Thus, a firm's optimal cash holding can be viewed as determined by a trade-off between costs and benefits of having liquid assets to derive an optimal cash level, as is predicted by the model developed by Kim et al (1998). The firm balances the benefits of cash holdings against various costs of holding large cash reserves. The optimal cash level should be the point where marginal costs of cash just offset the marginal benefits.

To date, there is no clear prediction about the overall value effect of corporate cash holdings. So, this paper contributes to the literature by testing empirically if firms have an optimal cash level at which to maximize their value. In order to do this we employ two approaches. The first approach is to consider a non-linear relationship (concave) between cash holdings and firm value. If a concave relation is confirmed, it can be expected that deviations from the inflexion point (maximum) will reduce firm value. So, secondly, we try to answer the following question: Does firm value decrease if the level of cash moves away from its optimal level? Following Tong's methodology (2008), we describe a model which includes the residuals of the optimal cash level regression to

analyze that question. In order to get robust results, we use three different proxies for firm value.

This paper provides new evidence on the relationship between corporate cash holdings and firm value. The results show empirically that there is an optimal level of cash holdings at which firm value is maximized, for a sample of 472 listed US industrial companies over the period 2001-2007. Specifically, we show that the optimal level is around 14% of total assets. Moreover, deviations from the optimal level reduce firm value. This has important implications for researchers and managers, since it shows that firms can increase their market value merely by being around the optimal level of cash, which seems coherent according to the trade-off between benefits and cost of cash holdings.

The remainder of this paper is organized as follows: in Section 2, we review corporate finance literature, focusing on cash and firm value literature. In section 3, we give a general description of the sample and variables employed. In section 4, we describe the quadratic model linking cash holding and firm value, and we report the results. In section 5 we analyse the effect on firm value of the deviation from optimal cash holding level. Finally, we present the main conclusions and implications of our study.

2. THEORETICAL FOUNDATIONS AND HYPOTHESIS

According to Stiglitz (1974), in the absence of market imperfections, firms' financial decisions would not affect their value. In this theoretical situation, external finance can always be obtained without problem and at a reasonable price. Moreover, the absence of a premium for liquidity or taxes would mean that keeping cash would have neither an opportunity cost nor fiscal disadvantages. In this context, keeping liquid financial assets would be irrelevant and decisions about investment in liquid assets would not affect shareholders' wealth (Opler, Pinkowitz, Stulz and Williamson, 2001). However, in practice, the irrelevance of cash is not supported. The existence of market imperfections implies that there is possibly an optimal cash level that balances costs and benefits and maximizes the value of the firm.

With regard to the benefits, firms need cash to carry out their normal activities, to take advantage of profitable future investment opportunities and to meet unforeseen events (transactional and precautionary motives). Moreover, from holding cash include a reduction of the firm's dependence on costly external financing. Due to the presence of

information asymmetry between creditors and debtors, it is more difficult and expensive for firms to obtain external funding because of problems related to adverse selection. In this situation, firms establish a hierarchy in their financing and prefer finances with internally generated resources before issuing in the market, following the Pecking order theory (Myers and Majluf, 1984). Furthermore, this can generate underinvestment problems because it creates the possibility that the firm will choose not to issue, and will therefore pass up a positive-NPV investment (Myers, 1977). However, this cost can be avoided if the firm can retain enough internally-generated cash to cover its positive-NPV opportunities (Myers, 1984). In other words, managers can avoid this problem by building up the firm's cash reserves. For this reason, cash holding may be beneficial (or financial slack is valuable) so as not to limit firm's investment opportunities, especially for firms with difficulties in accessing external financing. Additionally, corporate liquidity reduces the likelihood of incurring financial distress costs if the firm's operations do not generate sufficient cash flow to meet obligatory debt payments (Faulkender and Wang, 2006).

However, following previous literature, we can highlight the lower rate of return of corporate cash holdings (opportunity cost) as the cost of holding liquid assets. Furthermore, corporate liquidity can cause agency problems between managers and shareholders since cash may provide funds for managers to invest in projects which offer non-pecuniary benefits but which destroy shareholder value (Jensen and Meckling, 1976). Thus the existence of large free cash flow can generate discretionary behaviors in the managers that are harmful to shareholders' interests (Jensen, 1986).

Consequently, in finance literature there are two confronting positions regarding cash balances. Myers and Majluf (1984) argue that firms optimally carry large cash balances to avoid having to raise outside capital because cash balances confer financial flexibility benefits but entail no agency costs. Meanwhile, Jensen (1986) proposes that firms optimally carry only minimal cash balances because excess cash balances entail agency costs but provide no flexibility benefits. For this reason, DeAngelo and DeAngelo (2007) consider that cash balances both entail agency costs and confer flexibility benefits, and thus cash accumulation is no longer uniformly beneficial (as in Myers and Majluf, 1984) and investors will pressure firms to limit cash balances to mitigate agency costs while also encouraging managers to maintain a cash cushion that is sufficient to fund moderate unanticipated capital needs that may arise.

A firm's optimal cash holding can be viewed therefore as being determined by a trade-off between costs and benefits of having liquid assets to derive optimal cash level. Actually, previous studies analysing cash holdings determinants implicitly assume the existence of optimal cash holding (Opler et al., 1999; Kim et al., 1998) and demonstrates that cash holding can be viewed as a target-adjustment model where corporate cash holdings are periodically adjusted to the target level (Ozkan and Ozkan, 2004, and Garcia-Teruel and Martinez-Solano, 2008).

As we say in the previous section, there are papers that analyze the value and use of cash holdings according to country investor protection (Pinkowitz, Stulz and Williamson, 2006), to corporate financial policies (Faulkender and Wang, 2006), to firm corporate governance (Dittmar and Marth-Smith, 2007), and to firm diversification (Tong, 2009). However, there is no evidence that contrasts how a firm's cash holdings affect its value. Thus, we test for two different effects of cash holding on firm value. On the one hand, at lower levels of cash, transaction and precautionary motives will predominate, and so an increase in cash levels is followed by increases in firm value. On the other hand, at higher levels of cash, the free cash flow and opportunity cost will predominate, and then an increase in cash levels is followed by reductions in firm value. Thus, we expect a non linear relationship (concave) between cash holdings and value of the firm. The turning point will represent the maximum value of the company.

3. DATA AND VARIABLES

Data

Data from Balance sheets and Profit and Loss accounts were obtain from the OSIRIS database. We also use US interest rates (short and long term debt), capital goods prices and the wholesale index.

Following papers like Kim et al. (1998), or Opler et al (2001) who employed a panel of US industrial firms to study determinants of cash holding, and Pinkowitz and Williamson (2001) who used a sample of industrial firms from US, Germany, and Japan to study the effect of bank power on cash holdings, we also use a sample of industrial firms. Specifically we selected publicly traded US firms belonging to SIC Code from 3000 to 5999, from the period 2001 to 2007.

The information obtained was screened, eliminating cases with errors in the accounting data or lost values for some of the variables from the sample. Firms with fewer than five consecutive observations were also dropped from the sample. It was a necessary requisite to perform the Hansen test. As for results, we have an unbalanced panel comprising 472 companies. It represents 3,055 firm-year observations. We do not use a sample of balanced panel data in the analysis in order to avoid surveillance bias.

Variables

The dependent variable in our study is firm value. We use Tobin's Q (Q) as a proxy for firm value. This is the ratio of the firm's market value to the replacement cost of its assets (Lewellen and Badrinath, 1997). Tobin's Q is often used in corporate finance studies to measure firm valuation (Morck et al 1988; McConnell and Servaes 1990; Tong, 2008; McConnell, Servaes and Lins, 2008; Lin and Su, 2008; among others). Also Tobin's Q is employed as a proxy for corporate performance (Demsetz and Villalonga, 2001). We have also constructed two other additional proxies for firm value in order to test the robustness of the results. First, Market-To-Book ratio 1 (MKBOOK1), defined as the ratio of market value of firm (market value of equity plus book value of total debt) to book value of firm (total assets) - this is the approximation for Tobin's Q suggested by Chung and Pruitt (1994). Second, Market-To-Book ratio 2 (MKBOOK2), which is the ratio of market value of equity to book value of equity.

The key independent variable is CASH. We measure CASH as cash and cash equivalent to total assets. According to the Federal Reserve System (FRS), Cash equivalents are short-term, highly liquid investments that are easy to convert into cash and that carry an insignificant risk of loss in value. We include CASH and its square (CASH²) to test the existence of a non linear model. We expect a positive relationship between cash and firm value when cash level is below the optimal. Similarly, we expect a negative association between the cash and value when we are above the optimal cash holding level. For this reason, we expect a positive sign for variable CASH and a negative one for CASH².

We also include the control variables considered by Morck, Shleifer, and Vishny (1988) and McConnell and Servaes (1990) as important determinants of Tobin's Q. These control variables include investment in intangible assets, firm size, and leverage. INTANGIBLE is the ratio of intangible assets to total assets and measures the extent to which firms invest in intangible capital, and it is considered as a proxy of growth

opportunities. The size (SIZE) is calculated as the natural logarithm of gross sales. Finally, the leverage (LEV) is measured as total debt divided by shareholder equity.

Table 1 presents descriptive statistics for the variables used in our study. It reveals that the mean cash ratio is 7.9% and the median is 4.48%. These values are in line with the median values reported by Kim et al. (1998) in the same market (USA), 8.1%, Ozkan and Ozkan (2004) in the UK, 9.9%, and Garcia-Teruel and Martinez-Solano (2008) in Spain, 6.57%.

Table 1
Descriptive Statistics

<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Median</i>	<i>perc 10</i>	<i>perc 90</i>
Q	3055	1.2550	0.8019	1.0262	0.6908	2.0418
MKBOOK1	3055	1.5730	0.9327	1.3023	0.9070	2.4941
MKBOOK2	3055	2.6527	12.3742	1.7406	0.7697	4.2151
CASH	3055	0.0790	0.0925	0.0448	0.0067	0.2031
INTANGIBLE	3055	0.1764	0.1583	0.1294	0.0152	0.4028
SIZE	3055	13.2897	2.1075	13.3636	10.4510	15.9889
LEV	3055	1.8885	4.0427	1.1970	0.3566	3.4623

This table provides descriptive statistics for the data employed in the analysis. The data is from 2001 to 2007. The variables are the followings: ratio of the firm's market value to the replacement cost of its assets (Q), ratio market value of firm to total assets (MKBOOK1), ratio between market capitalisation to equity book value (MKBOOK2), ratio of cash and cash equivalents to total assets (CASH), ratio of intangibles to total assets (INTANGIBLE), natural logarithm of gross sales (SIZE) and ratio of total liabilities and debt to shareholders' equity (LEV).

It should be highlighted that ten per cent of firms in our sample have a very small ratio of cash. They hold less than one per cent of cash over total assets. Ten percent of firms hold more than twenty per cent of cash.

There are important differences between the firm value proxies: the mean of the variables Q and MKBOOK1 is above their median value, indicating a strong scattering towards the right tail, i.e. there are companies whose value is much higher than the rest; the variable MKBOOK2 observed is, however, the opposite. Also, the dispersion of MKBOOK2 is almost eight times higher than the other two variables. Therefore, the empirical distribution of these variables is very different. These divergences between these three proxies are one of the main reasons for including two additional different proxies in order to give robustness to our main results, and employing Tobin's Q as dependent variable.

Table 2
Correlation Matrix

	Q	MKBOOK1	MKBOOK2	CASH	INTANGIBLE	SIZE
Q	1.0000					
MKBOOK1	0.9613 ^{***}	1.0000				
MKBOOK2	0.2496 ^{***}	0.2560 ^{***}	1.0000			
CASH	0.2923 ^{***}	0.2769 ^{***}	0.0239	1.0000		
INTANGIBLE	-0.0216	-0.0561 ^{***}	-0.0116	-0.1214 ^{***}	1.0000	
SIZE	-0.0814 ^{***}	-0.0648 ^{***}	-0.0299 [*]	-0.2395 ^{***}	0.1054 ^{***}	1.0000
LEV	0.0053	-0.0006	0.6050 ^{***}	-0.0984 ^{***}	-0.0380 ^{**}	0.0821 ^{***}

The variables are the followings: ratio of the firm's market value to the replacement cost of its assets (Q), ratio market value of firm to total assets (MKBOOK1), ratio between market capitalisation to equity book value (MKBOOK2), ratio of cash and cash equivalents to total assets (CASH), ratio of intangibles to total assets (INTANGIBLE), natural logarithm of gross sales (SIZE) and ratio of total liabilities and debt to shareholders' equity (LEV).

***significant at 1%, **significant at 5%, *significant at 10% level

In table 2 we present the correlation matrix. There are no high correlations between independent variables, which could lead to multicollinearity problems and, consequently, inconsistent estimations.

4. CORPORATE CASH HOLDING AND FIRM VALUE

In order to study if there is an optimum level of cash holding we estimate Model 1, where the market value in firm *i* at time *t* depends on cash holdings and its square. The inclusion of these two variables in the model allows us to test both the transactional and precautionary motives for holding cash and the free cash flow theory and opportunity costs, as well as to optimally determine the breakpoint of the value-cash relationship. As we point out above, we also control for intangible assets, size, and leverage, as in Morck et al. (1988) and McConnell and Servaes (1990).

Model 1:

$$V_{it} = \beta_0 + \beta_1 (CASH_{it}) + \beta_2 (CASH_{it}^2) + \beta_3 (INTANGIBLE_{it}) + \beta_4 (SIZE_{it}) + \beta_5 (LEV_{it}) + \eta_i + \lambda_t + \varepsilon_{it} \quad (1)$$

where the dependent variable (V_{it}) is the firm value, and the independent variables are $CASH_{it}$, which measures cash and cash equivalent to total assets holding by firm *i* at time *t*, $INTANGIBLE_{it}$ which measure the growth opportunities, $SIZE_{it}$ the size of the firms and LEV_{it} the leverage. η_i is the unobservable heterogeneity. It measures both firms' particular characteristics and the characteristics of the sector in which they

operate. λ_t are dummy variables that change in time but are equal for all firms in each of the periods considered. In this way we try to capture the economic variables that firms cannot control and which may affect their value. ε_{it} is the error term.

Following Arellano and Bond (1991), we employed the GMM method of estimation on the model in first differences, which controls for unobservable heterogeneity and prevents potential endogeneity problems. We use this technique because firms are heterogeneous, and there are always factors influencing firm value that are difficult to measure or hard to obtain (see Himmelberg, Hubbard, and Palia, 1999). Moreover, the endogeneity problem has often been considered in cash literature (i.e. Ozkan and Ozkan, 2004).

This estimation assumes that there is no second-order serial correlation in the errors in first differences. For this reason, in order to test the consistency of the estimations, we used the test for the absence of second-order serial correlation proposed by Arellano and Bond (1991). Likewise, we employed the Hansen test for over-identifying restrictions, which tests for the absence of correlation between the instruments and the error term.

Table 3 shows the results of the estimation of model 1 using three different proxies for firm value. In the first column we calculate firm value as Tobin's Q (Q). In the second and third columns we use MKBOOK1 and MKBOOK2 as proxy for firm value respectively. Consistent with our expectations, CASH is positive and statistically significant, while $CASH^2$ is negative and significant at 1% level for the three different specifications of dependent variables. This means that cash holding increases the value of the firm up to the breakpoint, after which, increases in the cash holding reduces the firm's value. We can determine the cut-off point of that quadratic function. It is $\beta_1 / -2\beta_2$. Therefore, the level of cash holding (over asset) which maximizes the firm value is 13.81% (in column 2, 19.98% and in column 3, 14.82%). From the point of view of cash, and considering that the mean value for cash holding is around 8%, it could be considered that, on average, US industrial firms could increase their value by increasing their cash balances.

Table 3
Corporate cash holdings and firm value

	Q (1)	MKBOOK1 (2)	MKBOOK2 (3)
CASH	0.8201*** 2.78	2.0894*** 6.3	16.6872*** 4.92
CASH²	-2.9694*** -7.33	-5.2281*** -10.64	-56.3101*** -9.97
INTANGIBLE	-2.5613*** -5.43	-0.2019 -0.43	-12.4402** -1.97
SIZE	-0.0019 -0.02	-0.2669** -2.31	-2.0171* -1.84
LEV	0.0118*** 5.55	0.0133*** 5.51	2.7802*** 13.2
<i>m</i> ₂	0.962	0.795	0.197
Hansen test (df)	76.57 (58)	69.42 (58)	54.42 (58)
p-value Hansen test	0.052	0.145	0.609

All estimations have been carried out using the two-step GMM estimator. All variables are treated as endogenous and the lagged independent variables are used as instrument. In column (1) the dependent variable is Q (Tobin's Q). In column (2) the dependent variable employed to proxy firm valuation is MKBOOK1, which is market value of firm to total assets. In column (3) the dependent variable is MKBOOK2, which is the ratio of market capitalisation to equity book value. CASH and CASH² measure cash holding. Control variables are INTANGIBLE, SIZE, and LEV. Time dummies are included in all regressions

*m*₂ is test statistic for second order autocorrelations in residuals, distributed as standard normal N(0,1) under the null hypothesis of no serial correlation. Hansen test is a test of overidentifying restrictions, distributed as chi-square under the null of instrument validity.

***significant at 1%, **significant at 5%, *significant at 10% level

The stability of the estimated coefficients for three different specifications of dependent variable demonstrates the robustness of our findings regarding the non-linear relationship between cash holdings and firm value.

In accordance with control variables, LEV is positively related to the three proxies of firm value. Additionally, the coefficient of the variable SIZE is negative, but not always significant. Also Demsetz and Villalonga (2001) reported a non significant relation between firm size and firm performance. There is a negative relationship between firm size and firm value when we proxy firm value as MKBOOK1 and MKBOOK2, at 5% level and 10% level respectively. Moreover, contrary to what might be expected,

INTANGIBLE has a negative and significant impact on firm value. However, this result is in line with Lin and Su (2008), who also find a negative relation for growth opportunities. This result implies that firms with higher growth opportunities present a lower value on the stock market. This might be explained because firms with more growth opportunities could face higher specific risk (Cao, Simin and Zhao, 2008), and, as Shin and Stulz (2000) state, Tobin's q falls with the firm's unsystematic risk, showing that investment opportunities do not mitigate the adverse impact of increase of risk on firms value.

5. ROBUSTNESS: DEVIATION FROM THE OPTIMAL CASH LEVEL

We have shown that there is a quadratic relation (concave) between firm cash holdings and firm value, as a consequence of two contrary effects. Our aim in this section is to provide evidence to give an additional support to the fact that firm value will be reduced if firms move away from this optimum.

Because of the costs associated with holding cash in excess (such as opportunity cost or agency costs), the market might not place a high value on such cash holdings above the optimal level. However, the market will place a higher value on liquidity for those firms that are below optimal cash holding level. With this, we follow Tong's (2008) methodology to analyze the relation between deviations from optimal cash holdings and firm value. Tong (2008) develops that methodology to study the relation between deviations on either side of optimal CEO ownership and firm value. So, if a non-linear cash-value relationship is confirmed in our first study, where an optimal point which maximizes firm value exists, it is expected that deviations from this optimal cash level will reduce firm value. Specifically, in our model 1 we eliminate variable CASH and CASH² and include the residual estimated in the benchmark specification for the determinants of cash holdings as explanatory variable.

In order to do that, we consider that benchmark specification for the determinants of cash holdings is explained by the equation below which has been supported by previous studies on the determinants of cash holdings (Opler et al., 1999; Kim et al., 1998; Ozkan and Ozkan, 2004; and Garcia-Teruel and Martinez-Solano, 2008).

Model 2:

$$\text{CASH}_{it} = \beta_0 + \beta_1 (\text{CFLOW}_{it}) + \beta_2 (\text{LIQ}_{it}) + \beta_3 (\text{LEV}_{it}) + \beta_4 (\text{SIZE}_{it}) + \beta_5 (\text{BANKD}_{it}) + \beta_6 (\text{INTANGIBLE}_{it}) + \eta_i + \lambda_t + \varepsilon_{it} \quad (2)$$

where $CASH_{it}$ is cash and cash equivalent to total assets; $CFLOW_{it}$ is earnings after tax plus depreciation divided by gross sales; LIQ_{it} , proxy for liquid assets, is defined as working capital less total cash and short term investment to total assets; LEV_{it} , leverage, is total liabilities and debt divided by shareholders' equity; $SIZE_{it}$ is the size of the firm, $BANKD_{it}$ is the ratio of bank loans to total debt; and $INTANGIBLE_{it}$, proxy for growth opportunities, is intangible to total assets; η_i is the unobservable heterogeneity. λ_t are time dummy variables and ε_{it} is the error term. Appendix A includes the estimation of model 2.

Next, we obtain residuals from Model 2 and we include these residuals in model 1 after eliminating $CASH$ and $CASH^2$ (model 3). In this way, we define $DEVIATION$ as the absolute value of these residuals. The aim is to find if deviations from the optimal cash level affects a firm's value. In order to do this we estimate the following model:

Model 3:

$$V_{it} = \beta_0 + \beta_1 (DEVIATION_{it}) + \beta_2 (INTANGIBLE_{it}) + \beta_3 (SIZE_{it}) + \beta_4 (LEV_{it}) + \eta_i + \lambda_t + \varepsilon_{it} \quad (3)$$

where V_{it} is firm value, proxied as Tobin's Q, MKBOOK1, and MKBOOK2. The main dependent variable is $DEVIATION_{it}$, defined as the absolute value of residuals of equation 2, and $INTANGIBLE_{it}$, $SIZE_{it}$, and LEV_{it} are control variables defined as above.

We expect $\beta_1 < 0$ in Model 3, implying a negative relation between deviations from optimal cash holding level and firm value.

In Table 4 we present panel data regressions to explain whether deviations from optimal cash holding influence firm value (model 3) for three alternative measures of the firm value. In accordance with our expectations, $DEVIATION$ is inversely related to firm value, since its coefficient is negative and significant at 1%. It confirms the existence of a point at which firm value is maximized, and as we move away from this point, firm value decreases. As before, we proxy value as Tobin's Q, MKBOOK1 and MKBOOK2, and we obtain the same results. However, in this model we are not distinguishing whether these deviations are positive or negative.

Table 4

Deviation from the optimal cash level and firm value (I)			
	Q (1)	MKBOOK1 (2)	MKBOOK2 (3)
DEVIATION	-0.7256*** -2.60	-1.0229*** -3.49	-15.7288*** -7.93
INTANGIBLE	-3.1915*** -7.09	-1.2565** -2.48	-21.9361*** -3.98
SIZE	-0.0592 -0.74	-0.2529*** -2.93	-2.4682*** -2.99
LEV	0.0163*** 8.24	0.0196*** 8.29	2.9055*** 16.69
m_2	0.928	0.687	0.326
Hansen test (df)	93.52 (81)	92.26 (81)	78.26 (81)
p-value Hansen test	0.161	0.185	0.565

All estimations have been carried out using the two-step GMM estimator. All variables are treated as endogenous and the lagged independent variables are used as instrument. In column (1) the dependent variable is Q (Tobin's Q). In column (2) the dependent variable employed to proxy firm valuation is MKBOOK1, which is market value of firm to total assets. In column (3) the dependent variable is MKBOOK2, which is the ratio of market capitalisation to equity book value. DEVIATION is the absolute value of residuals from optimal cash holding level regression. Control variables are INTANGIBLE, SIZE, and LEV. Time dummies are included in all regressions

m_2 is test statistic for second order autocorrelations in residuals, distributed as standard normal $N(0,1)$ under the null hypothesis of no serial correlation. Hansen test is a test of overidentifying restrictions, distributed as chi-square under the null of instrument validity.

***significant at 1%, **significant at 5%, *significant at 10% level

Additionally, to analyze the way in which both deviations, above and below optimal cash level, affect firm value, we include an interaction term in model 4. So, we define variable INTERACT as Above-optimal*DEVIATION. Above-Optimal is a dummy variable that takes 1 for positive residuals and 0 otherwise. With this, we also estimate model 4, which is defined as follows:

Model 4:

$$V_{it} = \beta_0 + \beta_1 (\text{DEVIATION}_{it}) + \beta_2 (\text{INTERACT}_{it}) + \beta_3 (\text{INTANGIBLE}_{it}) + \beta_4 (\text{SIZE}_{it}) + \beta_5 (\text{LEV}_{it}) + \eta_i + \lambda_t + \varepsilon_{it} \quad (4)$$

where V_{it} is firm value, proxied as Tobin's Q, MKBOOK1, and MKBOOK2. The main dependent variables are $DEVIATION_{it}$, defined as the absolute value of residuals, and $INTERACT_{it}$. As in the previous model, control variables are $INTANGIBLE_{it}$, $SIZE_{it}$, and LEV_{it} .

We investigate how variables $DEVIATION$ (coefficient β_1) and $DEVIATION + INTERACT$ (coefficients $\beta_1 + \beta_2$) affect firm value. We expect $\beta_1 < 0$ and $\beta_1 + \beta_2 < 0$. This implies a negative effect of both above-optimal and below-optimal deviations on firm value. In the case that residuals are positive, above-optimal variable takes the value 1, and the effect on firm value it is explained by $\beta_1 + \beta_2$. Otherwise, when residuals are negatives, above-optimal variable takes the value 0, therefore $INTERACT$ is zero, and the effect is explained by β_1 .

As displayed in table 5, $DEVIATION$ is negative and statistically significant in all three cases. On the other hand, $INTERACT$ is positively related to firm value in columns 1 and 2. As Tong (2008) points out, $INTERACT$ could be positive due to the fact that positive and negative residuals offset each other. However, we are interested in the sum of the coefficients $\beta_1 + \beta_2$. Hence, we perform an F test, to prove that $\beta_1 + \beta_2$ remains negative and statistically significant. Indeed, the F-test reveals that the sum of these two coefficients is significant at better than 10% level. These results support the hypothesis that deviations on either side of optimal cash holding reduce firm value.

In column 3 Table 5, $DEVIATION$ is once again both negative and statistically significant, and $INTERACT$ is not statistically significant. This means that firms can increase their value both by increasing their cash balances in those situations when they are below-optimal cash level and by reducing their investment in liquid assets if they are above-optimal.

Finally, the results are strongly consistent with our hypothesis if we use the three different proxies for firm value. All in all, we find a quadratic relationship between cash holdings and firm value, and moreover, deviations from optimal cash holdings (above and below the optimal level) significantly reduce firm value.

Table 5

Deviation from the optimal cash level and firm value (II)			
	Q	MKBOOK1	MKBOOK2
	(1)	(2)	(3)
DEVIATION	-1.2754*** -2.96	-2.8190*** -6.4	-13.5508*** -3.13
INTERACT	0.8228** 2.03	2.3083*** 4.74	-4.1597 -0.79
INTANGIBLE	-3.1352*** -8.31	-1.6044*** -3.67	-20.1820*** -5.66
SIZE	-0.1123 -1.59	-0.3720*** -4.84	-2.6427*** -4.45
LEV	0.0168*** 6.65	0.0192*** 5.95	2.7967*** 19.18
m_2	0.871	0.601	0.293
Hansen test (df)	122.49 (101)	122.01 (101)	106.19 (101)
p-value Hansen test	0.072	0.076	0.342
F-test (p- value)	3.22 (0.0727)	3.27 (0.0707)	95.66 (0.0000)

All estimations have been carried out using the two-step GMM estimator. All variables are treated as endogenous and the lagged independent variables are used as instrument. In column (1) the dependent variable is Q (Tobin's Q). In column (2) the dependent variable is MKBOOK1, which is market value of firm to total assets. In column (3) the dependent variable is MKBOOK2, which is the ratio of market capitalisation to equity book value. DEVIATION is the absolute value of residuals from optimal cash holding level regression. INTERACT is Above-optimal*DEVIATION where Above-Optimal is a dummy variable that takes 1 for positive residuals and 0 otherwise.

Control variables are INTANGIBLE, SIZE, and LEV. Time dummies are included in all regressions

m_2 is test statistic for second order autocorrelations in residuals, distributed as standard normal $N(0,1)$ under the null hypothesis of no serial correlation. Hansen test is a test of overidentifying restrictions, distributed as chi-square under the null of instrument validity.

F-test refers to an F test on the null hypothesis that the sum of the coefficients of deviation and interact is zero. The p-value is noted in the brackets.

***significant at 1%, **significant at 5%, *significant at 10% level

6. CONCLUSION

The aim of this paper was to contrast the effect of cash holding on firm value. With this in mind, we used a sample of 472 US industrial firms to conduct a study with panel data during the period 2001-2007. In order to do this, we first empirically tested the existence of an optimal cash level that maximizes firm value. Secondly, we analyzed whether deviations from the optimum cash level reduce firm value.

The results obtained show that there is a level of cash holding which maximizes firm value. Specifically, we show empirically that the optimal level is around 14% for a sample of listed US industrial companies over the period from 2001 to 2007. Moreover, deviations from the optimal level reduce firm value. Our results imply a positive marginal value of cash in those situations in which we are below optimal cash level, and a negative marginal value of cash when we are above optimal cash level.

It is worthwhile pointing out the implications of our study for researchers and managers, since it shows that firms can increase their market value merely by being around the optimal level of cash, which seems rational according to the trade-off between benefits and cost of cash holdings. Hence, we find that the management of firm liquidity is an important element, which affects shareholder value.

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Appendix

Determinants of Cash Holding

	CASH
CFLOW	0.0080 ^{***}
	8.30
LIQ	-0.1542 ^{***}
	-7.52
LEV	-0.0030 ^{***}
	-19.25
BANKD	0.0364 ^{***}
	2.71
INTANGIBLE	-0.3672 ^{***}
	-12.66
SIZE	-0.0286
	-5.49
m_2	0.155
Hansen test (df)	143.92 (120)

p-value Hansen test	0.068
Wald test (df)	841.21 (12)
p-value Wald test	0.000

The estimation has been carried out using the two-step GMM estimator. All variables are treated as endogenous and the lagged independent variables are used as instrument. The dependent variable is CASH, which is the ratio of cash and cash equivalents to total assets. Independent variables are CFLOW, earnings after tax plus depreciation divided by gross sales; LIQ, defined as working capital less total cash and short term investment to total assets; LEV, total liabilities and debt divided by shareholders' equity; SIZE, natural logarithm of gross sales; BANKD, ratio of bank loans to total debt; and INTANGIBLE, intangible assets to total assets. Time dummies are included in all regressions. m_2 is test statistic for second order autocorrelations in residuals, distributed as standard normal $N(0,1)$ under the null hypothesis of no serial correlation. Hansen test is a test of overidentifying restrictions, distributed as chi-square under the null of instrument validity. Wald Test tests the joint significance of estimated coefficients asymptotically distributed as chi-square (df) under the null of no relationship.

***significant at 1%, **significant at 5%, *significant at 10% level

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