Corporate Liquid Reserves: 
An Empirical Investigation of Greek Companies

Nikos I. Arnis
Technological Educational Institute of Epirus, Psathaki, Preveza 48100, Greece
arnis@telep.gr

Georgios D. Koliass1,2
Agricultural Bank of Greece, Dagkli & Korai 9 Street, Ioannina 45100, Greece
koliassg@otenet.gr

Vasilios P. Filios
Department of Business Administration of Food and Agricultural Products, University of Ioannina, Seferi 9 Street, Agrinio Greece
vfilios@cc.uoi.gr

Abstract

In this study we investigate the determinants of liquid reserves during the period 1993-2004 in Greek nonfinancial sector. The study is based on an econometric analysis of liquidity management behavior. By employing panel data techniques it was found that the ratio of cash plus marketable securities to total assets is negatively correlated with firm size and debt ratio and positively correlated with return on assets, growth options and a measure of cash-flow volatility. We also find that time-varying characteristics drove firms to increase their cash holdings during the period 1999-2001. This finding may support the dominance of the speculative motive when the markets was booming.

JEL Classification: C33, D01, G32, L21.

Key words: liquidity holdings, panel data, time-specific effects.

1 Corresponding author: e-mail: koliassg@otenet.gr,
Tel: ++302651058680
Fax: ++302651020059

2 Any views or opinions presented are solely those of the author and do not necessarily represent those of Agricultural Bank of Greece Group.
1. Introduction

The most important of all the liquidity responsibilities of the financial manager is the managing of cash flows and cash balances. Management attention has focus on the proper level of liquidity with a view to reducing the risk of technical insolvency to an acceptable level as well as to minimizing the need to seek costly external financing to support projects generate cash flows with positive net present value. On the other hand investment in liquidity is costly since liquid assets earn a low rate of return. The tradeoff between the holding cost and benefits of liquid assets forces firms to maintain a considerable amount of liquidity.

Baskin (1987) reports that the average ratio of cash and marketable securities to total assets for a sample of the 338 most important US firms in 1972 was 9.6%. John (1993) reports an average ratio of 6.3% based on a sample of 223 US firms during the period 1979-1981. The same percentage (6.3 %) for the same period also report Papaioannou and Travlos (1992). Kim et al. (1998) show that in a sample of 915 industrial firms during the period 1975-1994 the average ratio of cash and marketable securities to total assets was 8.1%. Ozkan και Ozkan (2004) report 9.9% for this index. Likewise, our dataset on 322 non financial, publicly listed Greek firms, show that, during the period 1993-2004, cash plus marketable securities represent on average 8.6% of total assets.

Keynes (1936) has described the key motives for holding cash balances as transactions, precautionary and speculative:

The transactions motive. Cash is a medium of exchange to finance normal transactions (e.g. payments for supplies and wages). The optimum level of cash balances depends significantly on the firms' size and the timing of cash inflows and outflows. Large firms tend to make more transactions. If cash flows and outflows are highly synchronized, cash balances can be smaller.

The precautionary motive. Cash provides purchasing power in case of unexpected contingencies or unpredictable opportunities. The precautionary balances act as a buffer against the increasing uncertainty of a changing economic environment. Their level depends primarily upon the opportunity cost of funds. Key attributes of this approach are high security, high liquidity, and the immediate transferability from security to cash.

The speculative motive. This motive arises in connection with management's desire to have cash available to take advantage of profitable opportunities that may arise unexpectedly. Management must have expectations of achieving higher returns on such balances than are likely to be available in its normal line of business.
Although Keynes did not deal with the efficient level of cash balances, he established the foundation for the development of cash balances theory. There are a number of factors to take into account in determining the level of cash holdings. However, those factors are empirically investigated only in the last decade (e.g. Kim et al. (1996), Opler et al. (1999).

In this study we investigate the determinants of cash holdings during the period 1993-2004 in Greek nonfinancial sector. The study is based on an econometric analysis of liquidity management behavior. We use a sample of financial data for 322 publicly listed Greek companies. By employing panel data techniques it was found that liquidity ratio, defined as the ratio of cash plus marketable securities to total assets, is negatively correlated with firm size and debt ratio and positively correlated with return on assets, growth opportunities and a measure of cash-flow volatility.

We also used the time-specific effects of our panel data model to estimate the time trend in liquidity ratio after adjusting for the correlation with the explanatory variables. We find that time-varying characteristics which remain constant between firms drove them to increase their cash holdings during the period 1999-2001. This finding may support the dominance of the speculative motive throughout the year 1999 when the money market was booming.

The remainder of this paper is organized as follows. In section 2, a review of the relative literature is presented and the determinants of liquidity holdings are discussed. In section 3, the data set is explained and the econometric model is specified. In section 4 we report the results of our research. We conclude the paper in section 5 showing directions for future research.

2. Literature review – Hypothesis Development

In recent years increasing attention has been devoted to cash management to determine the appropriate level of safety and anticipation stocks of liquid assets and marketable securities. Theoretically, management of cash position that maximizes shareholder wealth should select the level of cash and near-cash balances at which the expected cost of maintaining the optimal amount of liquidity exceeds the expected cost of bankruptcy by a margin large enough to satisfy shareholders. After the decision on the amount of total liquidity and whether to provide for liquidity by a store of assets or by access to liabilities, another question remains to be addressed: “how often and in what quantities should marketable securities be bought or sold to adjust the desirable cash balance?”. Three main cash management models, developed by Baumol (1952), Miller and Orr (1966) and Stone (1972), can be used to reallocate the cash and marketable securities mix through time.
Baumol (1952) used an economic order quantity (EOQ) model, similar to that used in inventory management, to explain how firms may minimize the total costs involved with transferring funds out of marketable securities into cash during a given period. The model incorporates the following features:

- The demand for cash is known with perfect accuracy for the given period, which is used at continuous constant rate.
- When the initial cash balance is drawn down to zero the balance is replenished by a sale of securities identical in size to the initial cash balance.

The cash flow assumptions of the Baumol model are rather simplistic and far from realistic for most firms. Hence, adjustments should be made to include uncertainty in the cash flows.

Miller and Orr (1966), improving Baumol model based on the same objective function, assume that the cash flows are completely uncertain (both in direction and in magnitude) and follow a random walk. They use a control-limit model to decide when to buy or sell securities establishing an upper limit and a lower limit for the cash balance. As long as it remains within these limits there are no security transactions. When the upper limit is reached, securities are purchased in an amount sufficient to shift the cash balance to its initial level. The lower control limit triggers a sale of securities large enough to bring the cash balance to the return level. However, Miller-Orr model has some shortcomings regarding the statistical assumptions of the cash flows. Cash flows are assumed to be unpredictable, normally distributed with constant variance and uncorrelated across successive time periods. Those restrictive assumptions plague the model because, in reality, cash managers do have same forecasting ability about cash inflows and even greater about cash outflows (e.g. payments for wages are known with certainty). Therefore, in some cases, managers outperform the strategies suggested by the model.

Stone (1972) using a deferent objective function, improves on the realism of the Miller-Orr model by incorporating the managers' knowledge of cash flow patterns in the process. The objective of managing the cash balance is to maintain the agreed-upon average balances while minimizing transaction costs. Cash flows are represented as consisting of two parts, one that can be estimated and another that is random. He uses a control-limit model.

---

1 Beranek (1963) has developed a similar model assuming continuous cash receipts and lumpy disbursements.
2 Emery (1981) in an empirical study rejects the normality assumption and reports statistically significant correlation across time.
3 Cash-flow forecasting framework is a very important part of cash budgeting. Many studies focus on this issue e.g Lerner (1968) who used simulation methodology, Stone and Wood (1977) and Miller and Stone (1985).
similar in spirit to that of Miller and Orr, but with two sets of limits and without using stochastic calculus to set the limits. The cash balance is allowed to fluctuate without security transactions as long as the outer limits are not reached. In the case where outer limits are reached the forecast is checked for the next days before any security transactions are made.

If the estimated cash flow is expected to move inside the inner (modified) limits there is no need to incur any transactions costs. If, however, the forecasted ending balance is outside these inner limits marketable securities are purchased or sold in an amount that will result in the expected balance.

The Stone model uses the managers’ forecasting ability as input, and thus, fits well into the operating mode of them. Moreover this model has minimal statistical and data requirements.

Although those models tend to focus on the transaction-motive of holding cash, the addition of a safety stock buffer enables the incorporation of the precautionary and speculative motives of holding cash. With the view of the precautionary motive, a minimum balance is kept to cope with unpredictable shortages in cash flows, perhaps related to unexpected sales declines. The above discussion shows that two main parameters influence cash holdings; the accuracy of the managers’ estimates about feature cash flows and the impact of random events. Those events are either operational or financial in nature. In general, the volatility of firms’ cash flows outlines these parameters and may be a significant determinant of liquidity reserves. We set up Hypothesis 1 to test the relationship between cash flows’ uncertainty and liquidity holdings:

**Hypothesis 1.** The higher the volatility of cash flows the higher the liquidity holdings.

We test Hypothesis 1 using the ratio of the standard deviation of operating earnings to total assets as a proxy for cash flows’ uncertainty.

However, optimization models do not determine the factors affecting the optimum liquidity level (if there exists), namely, the sum of cash and marketable securities. Opler et al. (1999) consider two explanations for liquidity based on capital structure literature; the trade-off theory and the pecking order theory. According to the Static trade-off model (Meyers (1977)) firms select optimal capital structures by trading off various tax and incentive benefits of debt financing against financial distress costs. This trade-off generates an optimal capital structure. An alternative model, the pecking order model (Meyers and Majluf (1984)), suggests that firms prefer internal to external finance. When outside funds are necessary, firms prefer debt to equity because of lower information costs associated with debt issues, emphasizing the frictions due to asymmetric information between managers and outside investors. According to pecking order theory there is no optimal debt-equity mix. The capital structure of the firm is a function of its internally generated cash flows as well as of its investment opportunities.
Opler et al. (1999) - based on arguments similar to the pecking order and trade-off theory of capital structure - suggest that firms either trade-off the costs and benefits of corporate liquidity to derive the optimal level of liquidity, taking into consideration the transaction motive as well as the agency costs of outside financing and the related costs of asymmetric information or have a preferred hierarchy for financing decisions seeing debt and cash merely as opposite sides of the same coin. The authors state that, with the financing hierarchy view, there might not be an optimal amount of cash, because there is no optimal amount of net debt. These two theories of corporate holdings provide explanations of the relations between cash holdings and the factors affect them.

Opler et al. (1999) argue that the distinction between the financing hierarchy model and the static tradeoff model “...is not as clear-cut as one might want.” Generally, it is not an easy task to investigate the explanatory power of the theories because both of them dominated by the three main motives of corporate cash holdings. Nevertheless, Opler et al. (1999) state that, over the period 1952-1994, there is substantial support for the trade-off theory for all of the firms on the Compustat database.

We formulate hypotheses to relate liquidity holdings to variables - other than cash flows’ uncertainty - potentially affect them. Assumptions of both trade-off and pecking order theory are considered.

Hypothesis 2. Liquidity holdings are negatively correlated with firm size.

We set up Hypothesis 2 considering the presence of economies of scale, the cost of asymmetric information as well as agency conflicts.

The smallest firms lack sophisticated treasury operations, and thus accumulate cash for precautionary reasons. Schnure (1998) argue that as firms get larger, their access to credit markets improves and the need for precautionary balances falls, leading to the drop in security holdings relative to total assets.

Large firms have lower cost of external financing because of scale economies resulting from the large portion of fixed costs relative to that of variable costs of total issuance costs (Barclay and Smith (1995)).

Moreover, large firms have less information asymmetry than small firms (Collins et al. (1981), Brennan and Hughes (1991)). Besides, small firms are more borrowing constrained than large firms resulting in higher costs of external financing for small firms (Whited (1992), Fazzari and Petersen (1993)). Hence, small firms are expected to hold more cash to avoid expensive external financing.

Furthermore, small firms are less likely to be diversified and thus more likely to experience financial distress (Titman and Wessels (1988). The higher the probability of financial distress the greater the “requirement” for holding more cash.
We test hypothesis 2 using the natural log of assets as a proxy for firm size.

This hypothesis is confirmed by the empirical studies of Kim et al. (1998), Schmure (1998), Opler et al. (1999) and Ozkan and Ozkan (2004).

Hypothesis 3. Liquidity holdings are positively correlated with growth opportunities.

Agency problems and asymmetric information also shape this relationship. Ozkan and Ozkan (2004) state that firms with greater growth opportunities are more likely to build up cash to have financial flexibility as well as to avoid costly external financing. Meyers and Majluf (1984) report that in the presence of asymmetric information, firms prefer internal to external financing because the process in external financing is more sensitive to information asymmetry. Thus the expected increased costs of external financing lead in increased levels of liquidity holdings. In addition, companies of which their value is largely determined by their greater growth opportunities they hold increased levels of liquidity so that they reduce the probability of abandonment from profitable future investments (Williamson (1988), Harris et al. (1990)). Kim et al. (1998) find that growth options are positively correlated with cash holdings.

We test hypothesis 3 using the natural log of fixed assets as a proxy for growth opportunities 4.

Hypothesis 4. Liquidity holdings are negatively correlated with the likelihood of financial distress.

The consequences of illiquidity are a sequence of severe actions taken by managers when faced with the inability to pay the firm’s obligations. Bankruptcy is frequently the last of the whole series of events. The first action taken by managers in the case of financial difficulties is likely to be a reduction in the size of marketable securities portfolio. A second action may be to use any unutilized amount of the available credit line. A renegotiation of credit agreement follows, in order to increase the amount of credit available. If these steps fail to provide sufficient funds, management may try to decrease cash outflows to obtain a more positive net cash flow. The reduction of research and development and marketing expenses is the easiest way to do so.

More drastic measures, like attempting to sell assets, is the last stage before the firm defaults on its payments and becomes bankrupt. Throughout these steps, the probability of financial distress is getting larger while at the same time liquid reserves decline.

---

4 Ozkan and Ozkan (2004) and Kim et al. (1998) test the relation between cash holdings and growth option using the market- to- book ratio as a proxy for growth opportunities. Kim et al. (1998) also suggest another proxy, the ratio of advertising expenditures to sales as well as the ratio of development expenditures to sales.
Kim et al. (1998) report that firms with a greater likelihood of financial distress are expected to have lower level of liquidity. Using the inverse function of Altman’s (1968) z-score (as a measure of the probability of financial distress) they find a statistically significant negative relation between this variable and the ratio of cash plus marketable securities to the book value of total assets.

We also use the inverse function of z-score to test hypothesis 4.

**Hypothesis 5.** Liquidity holdings are negatively correlated with debt ratio. According to John (1993), firms with access to debt markets can use borrowing as a substitute for maintaining a stock of liquid assets. Kim et al. (1998) states that firms with access to long term debt markets are also more likely to have commercial paper programs that provide short term financing for current liquidity needs. If debt ratio is a proxy for the access to debt markets, then we expect negative relationship between debt ratio and liquidity holdings. The prediction of the negative relationship is in accordance with Baskin (1987) who argues that as firm uses more debt, the cost of the investment in liquidity is getting larger thereby reducing funded liquidity.

Empirical studies (Baskin et al. (1987), Papaioannou et al. (1992), Opler et al. (1999)) support this hypothesis.

Debt ratio is used to test Hypothesis 5

**Hypothesis 6.** Liquidity holdings are positively correlated with return on assets.

According to financing pecking order model (Opler et al. (1999)) firms have a built-in preference to use internal to external financing. If they have sufficient resources to invest in the profitable projects available, they repay debt when is needed, and accumulate assets otherwise. Controlling for dividend and investment policy, firms with higher returns on assets built up higher cash position. Baskin (1987) finds a positive relationship between return on assets and holdings of marketable securities.

The ratio of earnings before interest, tax, depreciation and amortization to total assets is used to test Hypothesis 6
3. Data description – econometric analysis

We use financial data for 322 publicly listed Greek companies for 12-year period 1993-2004, drawn from their annual balance sheets and income statements. The total observations per variable of our panel set was 2811.

3.1 Definition of variables

Using the data described earlier, the following variables were calculated for the estimation purposes of this study:

**Liq_ratio**: the ratio of cash plus marketable securities to total assets minus cash minus marketable securities.

**debt_ratio**: the debt to total assets ratio.

**size**: the log of total assets.

**growth**: the log of net fixed assets.

**RoA**: the ratio of earnings before interest, tax, depreciation and amortization to total assets.

**Sd_cfl**: the ratio of the standard deviation of operating profits to total assets.

**iz**: the inverse function of z-score. We note that we exclude from the original function the working capital variable because it includes the dependent variable:

\[ iz = (3.3(EBIT / Tot\_as) + 1.0 (sales/Tot\_as) + 0.6 (Eq\_ratio) + 1.4 (ret\_ear/total\_as))' \]

where

**EBIT**: the earnings before interest and taxes

**Tot\_as**: the total assets

**sales**: the sales

**Eq\_ratio**: the market to book ratio

**ret\_ear**: the retained earnings

Table 1 presents summary statistics of the variables for the whole period of the data set. It lists the mean, the median, the standard deviation and the interquartile range of the variables. Table 2 shows the correlation matrix of the variables.
Table 1: Summary statistics of the variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>mean</th>
<th>median</th>
<th>standard deviation</th>
<th>interquartile range</th>
</tr>
</thead>
<tbody>
<tr>
<td>liq_ratio</td>
<td>0.094</td>
<td>0.059</td>
<td>0.104</td>
<td>0.161</td>
</tr>
<tr>
<td>size</td>
<td>17.404</td>
<td>17.312</td>
<td>14.511</td>
<td>18.994</td>
</tr>
<tr>
<td>iz</td>
<td>0.507</td>
<td>0.440</td>
<td>0.922</td>
<td>0.310</td>
</tr>
<tr>
<td>debt_ratio</td>
<td>0.458</td>
<td>0.463</td>
<td>0.216</td>
<td>0.317</td>
</tr>
<tr>
<td>sd_cfl</td>
<td>0.239</td>
<td>0.064</td>
<td>1.802</td>
<td>0.104</td>
</tr>
<tr>
<td>RoA</td>
<td>0.083</td>
<td>0.070</td>
<td>0.097</td>
<td>0.010</td>
</tr>
</tbody>
</table>

Table 2 Correlation matrix of the variables

<table>
<thead>
<tr>
<th></th>
<th>liquid_ratio</th>
<th>size</th>
<th>div</th>
<th>RoA</th>
<th>iz</th>
<th>growth</th>
<th>sd_cfl</th>
</tr>
</thead>
<tbody>
<tr>
<td>liq_ratio</td>
<td>1.000</td>
<td>-0.074</td>
<td>-0.289</td>
<td>0.266</td>
<td>-0.095</td>
<td>0.398</td>
<td>0.132</td>
</tr>
<tr>
<td>size</td>
<td>-0.074</td>
<td>1.000</td>
<td>-0.054</td>
<td>-0.196</td>
<td>0.022</td>
<td>0.607</td>
<td>-0.203</td>
</tr>
<tr>
<td>debt_ratio</td>
<td>-0.289</td>
<td>-0.054</td>
<td>1.000</td>
<td>-0.289</td>
<td>-0.289</td>
<td>-0.055</td>
<td>-0.007</td>
</tr>
<tr>
<td>RoA</td>
<td>0.266</td>
<td>-0.196</td>
<td>-0.289</td>
<td>1.000</td>
<td>0.266</td>
<td>0.162</td>
<td>-0.007</td>
</tr>
<tr>
<td>iz</td>
<td>-0.095</td>
<td>0.022</td>
<td>-0.289</td>
<td>0.266</td>
<td>1.000</td>
<td>0.046</td>
<td>0.080</td>
</tr>
<tr>
<td>growth</td>
<td>0.398</td>
<td>0.607</td>
<td>-0.055</td>
<td>0.162</td>
<td>0.046</td>
<td>1.000</td>
<td>-0.005</td>
</tr>
<tr>
<td>sd_cfl</td>
<td>0.132</td>
<td>-0.203</td>
<td>-0.007</td>
<td>-0.007</td>
<td>-0.005</td>
<td>-0.015</td>
<td>1.000</td>
</tr>
</tbody>
</table>

3.2 Econometric Analysis

We specify a model based on the results of recent studies that were analyzed in previous section. Thus, the model takes the following form:

\[
\ln(\text{Liq\_ratio})_t = F_i + C_t + b_1 \text{size}_t + b_2 \text{growth}_t + b_3 \text{debt\_ratio}_t + b_4 \text{sd\_cfl}_t + b_5 \text{iz}_t + b_6 \text{RoA}_t + u_t \quad (1)
\]

where \(i, t\) refer to each firm and year, respectively. We use the log of the liquidity ratio as the dependent variable and the variables \text{size, growth, debt\_ratio, sd\_cfl, RoA and iz}\ defined earlier as independent variables.

\(F_i\) (firm-specific effects): Unobserved time-constant variables but varying across firms.

\(C_t\) (time-specific effects): Denotes the period-fixed effects, which are unobservable effects constant across firms but varying over time. \(b\_x\) (\(x=1,2...6\)) denote the coefficients to be estimated.

We consider a structure of the variance –covariance matrix of residuals \((U_u)\) with heteroskedasticity and first order autocorrelation because our data are annual time series. For this variance structure OLS estimates are not valid. Thus, we use GLS estimates with AR(1) disturbances (see, e.g. Hsiao (2003), Wooldridge (2002)).
4. Results

Table 3 presents the results of the estimation of model 1.

<table>
<thead>
<tr>
<th>Dependent variable : Ln(Liq_ratio)</th>
<th>Coef.</th>
<th>Std.Err.</th>
<th>z</th>
<th>P&gt;z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>size</td>
<td>-0.656</td>
<td>0.024</td>
<td>-27.370</td>
<td>0.000</td>
</tr>
<tr>
<td>growth</td>
<td>0.712</td>
<td>0.011</td>
<td>62.820</td>
<td>0.000</td>
</tr>
<tr>
<td>debt_ratio</td>
<td>-1.013</td>
<td>0.105</td>
<td>-9.600</td>
<td>0.000</td>
</tr>
<tr>
<td>sd_cfl</td>
<td>0.029</td>
<td>0.008</td>
<td>3.720</td>
<td>0.000</td>
</tr>
<tr>
<td>iz</td>
<td>-0.002</td>
<td>0.015</td>
<td>-0.160</td>
<td>0.869</td>
</tr>
<tr>
<td>RoA</td>
<td>0.568</td>
<td>0.195</td>
<td>2.920</td>
<td>0.004</td>
</tr>
<tr>
<td>year_1994</td>
<td>0.142</td>
<td>0.063</td>
<td>2.240</td>
<td>0.025</td>
</tr>
<tr>
<td>year_1995</td>
<td>0.011</td>
<td>0.072</td>
<td>0.160</td>
<td>0.876</td>
</tr>
<tr>
<td>year_1996</td>
<td>-0.020</td>
<td>0.075</td>
<td>-0.260</td>
<td>0.793</td>
</tr>
<tr>
<td>year_1997</td>
<td>0.043</td>
<td>0.077</td>
<td>0.560</td>
<td>0.573</td>
</tr>
<tr>
<td>year_1998</td>
<td>-0.045</td>
<td>0.078</td>
<td>-0.570</td>
<td>0.566</td>
</tr>
<tr>
<td>year_1999</td>
<td>0.170</td>
<td>0.082</td>
<td>2.080</td>
<td>0.038</td>
</tr>
<tr>
<td>year_2000</td>
<td>0.286</td>
<td>0.085</td>
<td>3.350</td>
<td>0.001</td>
</tr>
<tr>
<td>year_2001</td>
<td>0.248</td>
<td>0.088</td>
<td>2.830</td>
<td>0.005</td>
</tr>
<tr>
<td>year_2002</td>
<td>0.152</td>
<td>0.091</td>
<td>1.680</td>
<td>0.093</td>
</tr>
<tr>
<td>year_2003</td>
<td>0.133</td>
<td>0.089</td>
<td>1.500</td>
<td>0.134</td>
</tr>
<tr>
<td>year_2004</td>
<td>-0.014</td>
<td>0.09</td>
<td>-0.150</td>
<td>0.880</td>
</tr>
<tr>
<td>constant</td>
<td>-1.218</td>
<td>0.374</td>
<td>-3.260</td>
<td>0.001</td>
</tr>
<tr>
<td>autocorrelation coefficient</td>
<td>0.440</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-sq:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>within</td>
<td>58.73%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>between</td>
<td>74.58%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>overall</td>
<td>67.04%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The overall prediction accuracy of our model is 67.04%. Moreover, 58.73% of the within-firms variation and 74.58% of the between-firms variation is explained.

The results confirm hypotheses developed in the previous section and are in accordance with the results in other papers on the same issue. More specifically:

1. There is a negative relation between size and liquidity holdings. The coefficient of size is found negative and statistically significant (p<0.001). This result shows that there are economies of scale in liquid assets which is in line with the tradeoff model.
2. There is a negative relation between dept and liquidity holdings. The coefficient of \textit{debt\_ratio} is found negative and statistically significant (p<0.001).
3. There is a positive relation between growth options and liquidity holdings. The coefficient of \textit{growth} is found positive and statistically significant (p<0.001).
4. There is a positive relationship between liquidity ratio and cash flow uncertainty. The coefficient of \textit{sd\_cfl} variable is found positive and statistically significant (p<0.001).
5. There is a positive relation between firm profitability (as it expressed by ROA) and liquidity holdings. The coefficient of \textit{ROA} is found positive and statistically significant (p=0.004).
6. The coefficient of \textit{iz} is found negative though statistically insignificant (p=0.87). The reason might be that the Altmans' model is not an accurate forecaster of failure for our panel data set.

Figure 1 shows the plot of time-specific effects (Ct) for model 1. The estimates for the years 1999-2001 are significantly larger that those for the other years. This shows that controlling for the impact of the explanatory variables, liquidity holdings have increased with time during the period 1999-2001. One possible explanation is the extraordinary returns of the markets in that period. This finding may support the dominance of the speculative motive throughout the year 1999. Another reason is that some of the cash holdings are transitory, because throughout this period firms was raising funds that was waiting to spend. If this is the case, namely, firm has unusually high cash because they just raised funds that will be spend next year, then time - specific effects capture the part of liquidity reserves that is transitory.

\textbf{Figure 1: Plot of Time-Specific Effects for Model 1}
5. Conclusions

We examine the determinants of liquid reserves between publicly traded Greek companies during the period from 1993 to 2004. We find that corporate holdings of cash and marketable securities are positively correlated with growth options, cash flow uncertainty and firms' profitability. Our data set also support a strong, negative relation between liquidity holdings and the size of the firm as well as with debt ratio. These findings are in accordance with the results of other papers investigating the determinants of liquid reserves for larger countries. Finally, we find that during the period of market booming in the late '90s firms hold unusual amount of liquidity supporting the dominance of speculative motive.

Addressing the sources of the variation of the level of cash holdings both across firms and over time, as well as the consequences of high liquid reserves, would contribute to financial and business strategic literature.
References


Myers, S.C., Majluf, N.S., 1984, “Corporate financing and investment decisions when firms have information that investors do not have” Journal of Financial Economics.


