Effects of Macroeconomic Conditions on Corporate Liquidity—International Evidence

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Abstract
We investigate the effects of macroeconomic conditions on corporate liquidity (cash holdings) in 45 countries from 1994 to 2005. We control for conventional firm-specific variables and our methodology formally deals with the well-recognized endogeneity problem. Our results show that macroeconomic variables like GDP growth rate, inflation, short-term interest rate and government deficit affect corporate cash holdings. *Expectations* of future economic conditions also affect cash holdings. Further, we show that there is a target corporate liquidity and the adjustment towards this target is not instantaneous and is also influenced by macroeconomic conditions. Our study extends the extant liquidity literature by establishing the role of macro variables, besides the traditional firm-specific variables, as important determinants of corporate liquidity.

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Keywords: cash holdings; corporate liquidity; macroeconomic conditions; macro variables; adjustment
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1. Introduction

Why do firms hold cash and what explains variations in their cash holdings? In general, firms hold cash to reduce transaction costs, or for precautionary and speculative motives.[1] More specifically, they use cash to conduct day-to-day operations such as paying employees, purchasing inputs, and paying dividends to stockholders. Firms will hold less cash if the transaction cost (e.g., cost of liquidating assets or raising capital) is lower and vice versa. In addition, they hold cash for the precautionary reasons to invest in future growth opportunities in case they have difficulty raising funds and to manage increasing cash flow risk and idiosyncratic risk (Bates et al. 2006). The precautionary motive results from information asymmetry and the agency costs of debt. Information asymmetry arises because outsiders know less about the firm's operation than management, while agency costs of debt arise when the interests of the debt holders differ from those of the anti-directors. The higher the level of information asymmetry and the agency costs of debt, the greater will be the precautionary motive. Further, management might hoard cash because of its personal risk aversion or because it wants to satisfy its

[1] Firms need cash for the speculative motive to take advantage of bargain purchases, but conventional wisdom is that liquidity held for speculative motive is relatively minor compared to that held for transaction and precautionary motives.

own needs, e.g., consuming perquisites, termed the agency cost of managerial discretion (Opler et al. 1999).[2]

The primary contribution of this study to the existing international corporate liquidity literature is to show that macroeconomic factors are an important determinant of corporate liquidity. The early corporate liquidity literature dealt with identifying which of the alternative theories (tradeoff theory, financing hierarchy theory, and agency theory) best explained corporate liquidity. While its results are mixed, agency theory has received support as an important explanation of observed cash holdings. Recent studies investigate the value of cash and how corporate governance affects this value. Most previous studies use contemporaneous firm-specific variables to explain corporate liquidity. Surprisingly, the potential role of macroeconomic factors as determinants of corporate cash holdings has received little attention in the literature. We attempt to fill this gap. While country-specific variables like investor protection are used in some international corporate liquidity studies, macroeconomic variables have been largely ignored. Macro variables like GDP, inflation, short-term rate and government deficit should play a fundamental role in determining corporate liquidity since country specific factors influence all firms in a particular country

In addition to contemporaneous macroeconomic conditions, *expectations* regarding future macroeconomic conditions should also affect corporate cash holdings. That is, macro variables can affect corporate liquidity in an inter-temporal way. More precisely, future economic conditions should enter the management's decision of how much cash to hold. For example, the cash holdings should increase if management perceives the economy to be improving so that it will be able to fund any future profitable investment opportunities. Similarly, if management is expecting high inflation in the near future, holding cash is costly and management will reduce corporate liquidity. If the interest rates are expected to rise, the management will be better off holding less cash and investing more to take advantage of the upcoming higher return. Lastly, the expected government deficit might signal the change in the future interest rate. If the government deficit is expected to be higher, interest rates will be pushed up. It follows that with an

[2] Agency costs also include costs incurred to minimize the conflict between debt holders and equity holders or among different kinds of debt holders.

increase in the opportunity costs of holding cash, corporate cash holdings will decline. Expected increase in government deficit can also signal a decrease in GDP, which should decrease corporate liquidity due to the income effect. Consequently, management will hold less cash due to rising government deficit. Based on the above reasoning, government deficit should have a negative effect on corporate liquidity. The test of this expectations hypothesis is the second contribution of this paper, and to our knowledge, the first examination of this issue.

Third, this study examines the proposition that macro factors affect the speed by which cash holdings are adjusted to a target. An underlying assumption for this proposition is that cash adjustment is neither instantaneous nor costless and an optimal level of corporate liquidity exists. Banjeree, Heshmati and Whilborg (2004), Lööf (2004) and Hackbarth et al. (2005) argue that macroeconomic factors should affect the speed of adjustment in target capital structure. We provide the first evidence regarding how adjustment in corporate liquidity is affected by macroeconomic conditions.

Using comprehensive data from 45 countries spanning 1994 to 2005, our results reveal that macroeconomic variables like GDP growth rate, inflation, short-term interest rate and government deficit significantly affect corporate cash holdings. In addition, these holdings are affected by the *expected* macroeconomic conditions. Furthermore, the speed of adjustment to target corporate liquidity is also affected by these macro variables. More specifically, economic boom as proxied by higher GDP growth, higher inflation and lower government deficit tend to increase the adjustment speed. In general, our results establish that along with firm specific variables, macroeconomic variables are important determinants of liquidity which should not be ignored by future research.

Finally, though well recognized, the endogeneity problem has been largly ignored methodologically by empirical studies on corporate liquidity. Since ignoring the presence of the endogeneity can lead to biased estimation, our study explicitly deals with this problem and shows that it matters. We use the dynamic panel data model (Arellano and Bond 1991) to formally deal with the endogeneity problem associated with the determinants of corporate liquidity.

The next section reviews the relevant literature. Section 3 provides the empirical model and the hypothesis development. Section 4 describes the data employed. Section 5 contains a discussion of our results and Section 6 concludes the paper.

2. Literature Review

The early corporate liquidity literature focused on determining whether there is an optimal level of cash holdings (Opler et al. 1999). Three major theories are used to explain corporate liquidity (i.e., cash and its equivalents): tradeoff theory, financing hierarchy theory and agency theory. The tradeoff theory predicts an optimal corporate liquidity resulting from firms balancing the marginal cost of corporate liquidity and marginal cost of shortage of corporate liquidity (Keynes 1936).[3] The financing hierarchy theory claims that internal financing is preferred to external financing to fund new investments because of asymmetric information between managers and investors. Firms accumulate cash and repay debt when they have a surplus of internal funds; when they are short of internal funds, they use cash followed by issuing debt and then equity to fund new investments. According to this view, corporate liquidity is determined by changes in internal funds and thus there is no optimal corporate liquidity (Myers and Majluf 1984; Shyam-Sunder and Myers 1999). The agency theory suggests that the management tends to hoard cash to gain discretionary power; therefore, there is no optimal corporate liquidity (Jensen 1986). The predictions of each theory regarding the effect of firm-specific characteristics (e.g., size, cash flow, investment opportunity set, etc.) on corporate liquidity are mostly inconsistent (Kim et al. 1998; Opler et al. 1999). The benchmark determinants of corporate liquidity include market-to-book ratio, firm size, cash flow, net working capital, leverage, capital expenditure, dividend, anti-director rights, and managerial ownership.

Recent corporate liquidity literature falls into the following three categories: (1) studies using the U.S. data (Kim et al. 1998, Opler et al. 1999, Faulkender 2004, Harford et al. 2005), (2) single-country studies using non-U.S. data (Pinkowitz and Williamson

[3] According to Opler et al. (1999), marginal cost of corporate liquidity involves the return that could be earned by investing the amount of cash holdings in other assets. Marginal cost of shortage of corporate liquidity incorporates potential bankruptcy cost. Cash holding and financial distress are negatively related.

2001, Ozkan and Ozkan 2004) and (3) studies using multi-country data (Dittmar et al. 2003, Pinkowitz et al. 2007, Kalcheva and Lins 2007, Chen and Mahajan 2007, Ferreira and Vilela 2004). These studies attempt to identify the determinants of corporate liquidity and/or that theory which explains corporate liquidity better. Since the three theories' predictions of the relationship between corporate liquidity and its determinants are not mutually exclusive, it is difficult to empirically support one theory over the others unambiguously.

The use of multi-country data to investigate cash holdings is a relatively recent phenomenon. A global vantage point allows conducting richer tests to explain cash holdings and their "value" since multi-country data has wide variation of country-specific characteristics (Dittmar and Mahrt-Smith 2006; Pinkowitz et al. 2007; Kalchiva and Lins 2007). The financial economics literature on corporate liquidity has largly ignored macroeconomic factors. Yet it is well recognized that the economic and political environment in which a firm operates influences its use of factor inputs. Innovations in this environment can affect the more fundamental determinants of corporate liquidity. Conditions prevailing in the real and financial asset markets in which a firm operates directly affect the magnitude and volatility of corporate cash flows therefore its cash holdings as well. This issue remains virtually unexplored in the finance literature.

One distinct strand of macroeconomics literature centers on the scale economy and analyzes the effect of size on corporate money demand. It is found that large firms hold less cash as a percentage of sales than small ones. The elasticity of scale in the demand for money for firms is estimated to be less than one, suggesting the presence of economy of scale in corporate money demand (Mulligan 1997; Kim et al. 1998; Bover and Watson 2000). Kim et al. (1998) examine the determinants of corporate liquidity using a panel of the US industrial firms. They find that firms facing higher costs of external financing, having more volatile earnings or lower returns on physical assets than those on financial securities are inclined to hold more cash. In addition, they also find that firms hold more cash if they are expecting favorable economic conditions so that they have enough internal funds when profitable investment opportunities come along. Such studies are few in number and are conducted in a single country setting.

Our study investigates the effect of macro economic variables on cash holdings in a 45-country environment. In addition, the macroeconomics-oriented corporate money demand literature focuses on total amount of cash held. In contrast, this study analyzes cash holdings as percentage of total assets net of cash. We believe that this scaled cash variable is a more appropriate measure of corporate cash holdings because cash may increase in proportion as total assets increase. Examination of changes in total cash holdings does not suggest how firms change their asset allocation in response to different (macro) factors, which is the research focus of our study. Furthermore, while the macro-economic demand for money literature does not consider many firm-specific factors (like profitability, net working capital, leverage, dividend payout, etc.), these firm-specific variables are used as the control variables in our study. On the other hand, as discussed previously, the strand of liquidity literature in the financial economics literature has ignored the macro variables. By incorporating macro variables along with firm specific variables in our analysis, our study attempts to bridge the gap between these two distinct strands of literature.

3. The model and hypothesis development

In this section, we first describe the empirical model and then our hypotheses.

3.1 Empirical model

We use two kinds of estimation models in our study, i.e., fixed-effect panel data model and dynamic panel data model. The fixed-effect panel data regressions should give us a general picture about the how macro variables affect corporate liquidity. However, the endogeneity problem very likely exists when dealing with financial variables in the balance sheet and income statement because they are simultaneously determined (Harvey et al. 2004). Ignoring the endogeneity problem will cause the estimators to be biased. We formally deal with this problem by using the dynamic panel data model (Arellano and Bond 1991).[4] This model has been used in recent finance and economics literature (e.g.,

[4] First, panel data model rather than the OLS is fitted to our data, which is both cross sectional and time series. Second, instead of using the static model, we employ the dynamic model that uses first differences of a variable. There is always a question about whether to choose fixed or random effects for the static panel data model. With the dynamic panel data model, however, it becomes irrelevant whether the true

Hayashi and Inoue 1991; Blundell et al. 1992; Bond and Meghir 1994; Judson and Owen 1999; Ozkan and Ozkan 2004).

We used STATA 9 to estimate the dynamic panel data model. Building on Anderson and Hsiao (1981, 1982), Arellano and Bond (1999) used the Generalized Method of Moments (GMM) framework developed by Hansen (1982) to identify valid instruments from lagged levels of the dependent variable and the independent variables, including predetermined and endogenous variables. They also showed how to put together these lagged levels and differences of the strictly exogenous variables to form an instrument matrix. This dynamic panel data model allows us to deal with the endogeneity problem by using levels of the endogenous variables lagged two or more periods as instruments (Arellano and Bond 1991). The dynamic panel data model is as follows:

$$y_{it} = \delta y_{i,t-1} + \beta x_{it} + \gamma z_i + u_{it},$$

where the error term u_{it} is specified as a two-way error component model:

$$u_{it} = \mu_i + \lambda_t + \nu_{it},\ i = 1,\ldots,N,\ t = 1,\ldots,T_i,$$

where μ_i denotes a firm-specific effect[5,6]; subscript *i* denotes the i^{th} firm and *t* denotes the t^{th} year.[7] ; λ_t is a year-specific effect for year *t*; ν_{it} is a white noise for firm *i* and year *t*. y_{it}, corporate liquidity, is the natural log of the ratio of cash and its equivalents to net assets (i.e., total assets net of cash). x_{it} is a set of endogenous variables, including benchmark determinants for corporate liquidity such as size, cash flow/assets, net working capital/assets, capital expenditure/assets, leverage, dividend paying firm or not, and insider ownership. z_i is a set of exogenous variables, including macro variables like

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model has fixed or random effects. The reason is that individual effects will be purged by first differencing, which is the first step in estimating the dynamic model, irrespective of whether fixed or random effects exist. Further, unlike static corporate cash holdings models that implicitly assume instantaneous adjustment to a desired cash level in response to a random shock, we make the realistic assumption that cash adjustment can be costly making instant adjustment unlikely. In that case, the model should include a lag of corporate cash holdings as one of the determinants (Ozkan and Ozkan 2004). An insignificant coefficient for this variable will imply instantaneous adjustment in cash holdings.

[5] Each firm *i* has its unique number of years T_i because some firms in our sample stop existing and have unbalanced data. This precludes survivorship bias in our study.

[6] Even though the firms that we are interested in come from the same category (i.e., industrial), there are always time-invariant firm-specific effects because firms are likely to be heterogeneous. We use as many variables as possible to account for the firm-specific nature, but we also introduced a firm-specific dummy variable to capture any remaining firm-specific effects.

[7] See Ozkan and Ozkan (2004) for an application of this methodology to corporate liquidity.

GDP growth, inflation, short-term interest rate and government deficit. A first-difference transformation was used to estimate the model. The first- and second-order autocorrelations in the first differenced residuals are reported. Since we applied two-step estimation, we are more concerned with the second-order autocorrelation because its presence implies that the estimates are inconsistent. The Sargan test was also conducted to test for over-identification restrictions by testing whether the residuals and instruments are independent.

3.2 Hypotheses development

There are three hypotheses tested in this study. One, we hypothesize that beyond the benchmark firm-specific factors, macro variables like GDP growth, inflation, short-term interest rate and government deficit also determine corporate liquidity. The effects of these macro variables on corporate liquidity have not been examined in previous related literature. We hypothesize that since firms' operations are affected by macroeconomic conditions, the liquidity they maintain should respond to changes in the macro variables. To test this hypothesis, we examine the partial effect of the macro variables on corporate liquidity. We regress liquidity on macro variables and control for previously identified firm-specific determinants of corporate liquidity. More precisely, our null hypothesis is that the coefficients on the macro variables are zero against the alternative hypothesis that these coefficients are nonzero.

Two, we hypothesize that corporate liquidity is affected not only by the contemporaneous value of macro variables but also by expectations on these macro variables. It is well known that managerial decisions, in this case regarding cash holdings, incorporate future expectations. To test the hypothesis that expectations on macro variables affect liquidity, we assume that managers form rational expectations (perfect foresight) such that the expected values equal the realized values. We use the leading value of the macro variable (i.e., macro variable one year ahead) to measure the corresponding expected macro variable. We then examine the effect of the leading macro variables on liquidity by regressing cash holdings on leading macro variables while controlling for firm-specific determinants of liquidity. Our null hypothesis is that the

coefficients on the leading macro variables are zero against the alternative hypothesis that the coefficients are nonzero.

Three, we hypothesize that the four macro variables used in this study should affect the speed of adjustment towards target liquidity. When the economy is booming, the management should be optimistic about the future and thus manage liquid assets like cash holdings more aggressively. The underlying assumption is that there is a target cash level and the cash adjustment is not instantaneous, which necessitates the use of the dynamic panel data model. The rationale here is the same with what is employed in recent capital structure literature. It is argued that the adjustment to target capital structure should be faster in economic booms than in recessions implying that business cycle variables should affect the adjustment speed. (Banjeree et al. 2004; Hackbarth et al. 2005). We test whether the speed of adjustment to target cash holdings is also affected by business cycles. If it is, how does it compare to the adjustment speed for capital structure? Would the adjustment for corporate liquidity be faster in booms? To test this hypothesis, we first generate interaction variables by multiplying the lag of corporate liquidity by some macro variable one-year back. We then examine the effect of the interaction variable on corporate liquidity by regressing liquidity on the lag of some macro variable and its corresponding interaction variable while controlling for firm-specific determinants of liquidity.. Our null hypothesis is that the coefficients on the interaction variables are zero against the alternative hypothesis that the coefficients are nonzero.

4. Data

All data on macroeconomic variables (i.e., GDP growth, inflation, interest rates and government deficit) are obtained from International Financial Statistics. Firm-specific annual financial data are from Compact D Worldscope (CD Version of May 2005).[8] We retrieved data for all non-financial firms from 45 countries.[9] The data span 12

[8] The use of this data in international corporate liquidity literature is standard. While accounting differences across countries exist, Worldscope data analysts minimize this by adopting specific procedures. For example, they define each data item in a standard way. To increase comparability, any reported data items different from their definitions are standardized. If there is any variation in formats, Worldscope analysts conform the different formats into their standard industry templates. They also apply other standardization

years from 1994 to 2005. The raw data obtained from Worldscope were manipulated to obtain empirical variables used in this study (see Appendix 1 for definitions). A brief description of how these variables were derived follows. All variables used are ratios except size, which is the natural log of total assets.

Our key variable is corporate liquidity, which we define as the ratio of cash to total assets net of cash. GDP growth is obtained by calculating the percentage change in GDP. Inflation is obtained by calculating the percentage change in consumer price index (CPI). Interest rate is proxied by short-term rates. Government deficit/surplus is government deficit or surplus as a fraction of GDP.[10]

Our selection of other firm-specific determinants follows previous research. Size is proxied by total assets. Firm's profitability is proxied by cash flow, which is defined as earnings before interest and taxes, depreciation and amortization (EBITDA) less interest, taxes and common dividends. Net working capital proxies an additional liquid asset, which previous research has found to be a substitute for cash holdings. We measure net working capital (NWC) as total current assets less cash less total current liabilities.

Capital expenditure/assets proxies potential investment opportunities (Kacheva and Lins 2004) and is measured as additions to fixed assets as a fraction of total assets. Leverage (total debt as a fraction of total assets) is included because it has been considered a key determinant of corporate liquidity, and the financing hierarchy theory gives a clear prediction of its (negative) effect on corporate liquidity. Dividend payout is common stock dividends as a fraction of earnings, and we use it as a corporate governance variable affecting agency costs as is closely held shares, which is measured as shares held by insiders as a fraction of common shares outstanding.[11]

Data screening

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procedures to reconcile various reported data items reported due to different accounting systems, countries, industries and languages (Worldscope Database Data Definitions Guide 2000).

[9] We exclude non-financial firms belonging to the division of public administration with 2-digit SIC code ranging from 91 through 99 because they are government-related and their decision criteria may be quite different from the private firms.

[10] Positive (negative) values of government deficit means government is running budget deficit (surplus).

[11] Insiders include directors, officers and their immediate families as well as individuals who hold 5% or more of the outstanding shares (Worldscope Database Data Definitions Guide 2000).

As is common with international data, a careful examination of all data revealed some outliers. To ensure that each observation (firm-year) makes economic sense, we retained observations that satisfy the following criteria:[12]

$$0 \le \frac{cash}{total\ assets} \le 1;\ 0 \le leverage \le 1;\ \ -1 \le \frac{net\ working\ capital}{total\ assets} \le 1;$$

$$market - to - book\ ratio \ge 0;\ \frac{capital\ expenditure}{total\ assets} \le 1; 0 \le \frac{fixed\ assets}{total\ assets} \le 1$$

Following the previous corporate liquidity literature, we calculate the determinants in ratios using net assets (total assets net of cash) as the denominator. Next, we winsorize the observations at 1% and 99% levels to further remove outliers from the sample.

Table 1 provides descriptive statistics of corporate liquidity in 45 countries analyzed in this study. To be consistent with the observations used in our estimation models, we report the descriptive statistics for corporate liquidity using only the observations that had data available for the natural log of corporate liquidity and its corresponding determinants like size, cash flow, net working capital, capital expenditure, leverage, dividend payout and ownership. After applying the above data screening procedures, the remaining sample comprises 41,189 firm-year observations.

The average corporate liquidity across 45 countries is 36%, ranging from 9% (Argentina) to 67% (Israel). The medians tell a different story. Jordan has the highest median corporate liquidity (17%) while New Zealand has the lowest (1%). The average median for the whole sample is 5%.

Table 2 presents averages of the determinants of corporate liquidity. GDP growth rate (GDP) is the percentage change in GDP. Inflation is percentage change in consumer price index. Short-term rate (ST rate) is the interest rate with a short term-to-maturity. Government deficit (Deficit) is government deficit/surplus as percentage of GDP. GDP, inflation, short-term rate and government deficit are from International Financial Statistics. The values for the total sample are averages weighted by number of observations in each country. Total asset is in millions of USD. Cash flow (CF) is earnings before interest and taxes, depreciation and amortization (EBITDA), less interest, taxes, and common dividends. Net working capital (NWC) is defined as total current

[12] The ratio of fixed assets to total assets is not included as a determinant for corporate liquidity in our study, but it is used to ensure that firms included in our study have data that makes economic sense.

assets less cash less total current liabilities. Capital expenditure/assets (CAPX/assets) is additions to fixed assets over total assets. Leverage (LEV) is total debt as a fraction of total assets. Dividend (DIV) is the dummy variable that takes on one if a firm pays dividends and zero otherwise. Closely held shares (BLOCK) represents shares held by insiders as a fraction of common shares outstanding.

5. Empirical results

We obtained the correlation matrix between corporate liquidity and its determinants before performing multivariate analysis, including size, cash flow/assets, net working capital/assets, capital expenditure/assets, leverage, dividend paying firm or not, and closely held shares.[13] We found that corporate liquidity correlates with its determinants, confirming the appropriateness to include them in the estimation. First, we first examine the contemporaneous effects of macro variables on corporate cash holding and the results are presented in Table 3. Second, we test for the hypothesis that corporate liquidity is determined by the expectations of macro variables and the results are presented in Table 4. Third, we examine whether macro variables affect the speed of adjustment to the target corporate liquidity and the results are reported in Table 5.

Since our data are both time-series and cross sectional, estimation with the panel data model is more appropriate. Among static panel data models, fixed-effect model is chosen in our study because we performed Hausman specification test and found that the fixed-effect estimators are preferable to random- or between-effect estimators. In addition, we also use dynamic panel data model to capture the adjustment nature of corporate liquidity and to account for the endogeneity problem.

Effects of macro variables on corporate liquidity

In general, our estimation results regarding the firm-specific effects contained in Table 3 are consistent with those obtained by previous studies in terms of the signs associated with determinants of corporate liquidity. Size has a positive effect on corporate liquidity and the coefficient ranges from 0.79 to 0.89 in all five models, suggesting the presence of economies of scale and consistent with the results of previous literature. That

[13] We do not report these results for space consideration, but will provide them upon request.

is, an increase in total asset by 1% is associated with an increase in corporate liquidity by less than 1 %. Cash flow has a positive sign, suggesting that firms with high cash flow tend to accumulate cash for the precautionary purpose. Net working capital has a negative effect on corporate liquidity, suggesting that net working capital and corporate liquidity are substitutes. Capital expenditure has a positive effect, suggesting that firms facing greater investment opportunities hold more cash. Consistent with previous studies, leverage is negatively related to corporate liquidity, supporting the view that debt and cash are substitutes. If a firm pays dividends, it seems that it holds more cash. Closely held shares appear to have no effect on corporate liquidity.

Focusing on the macro variables, we find that in the first four models where only one macro variable is used at a time, GDP growth, inflation and government deficit have no significant effect except that real short-term interest rate has a positive effect. In model 5 where all macro variables are used at the same time, we find that GDP growth has a positive effect, suggesting that firms hold more cash in response to higher economic growth, consistent with the income effect prediction of the money demand theory. Inflation has a negative effect, suggesting that firms hold less cash in response to higher inflation resulting in erosion of purchasing power. Real short-term interest rate has a positive effect, suggesting that firms hold more cash when interest rates are high.[14]

Panel B presents results from dynamic panel data regressions. In all models, lag of cash has a positive coefficient, suggesting that adjustment to a target cash level is not instantaneous. Other firm-specific variables have the same effects as observed in the fixed-effect panel data regressions. We continue to observe economies of scale from the coefficient of size. Cash flow has a positive effect. Net working capital has a negative effect but in only one model while capital expenditure has a positive effect in three models. Leverage has a negative effect as before but whether a firm pays dividend does not seem to matter based on the results in panel B.

Results associated with macro variables are more significant in panel B. In models 1 through 4, short-term rate has the unintuitive positive effect on liquidity while government deficit has a negative effect. One explanation is that higher government

[14] Since the original short-term rates are nominal and are highly correlated with inflation, we use real short-term rates (i.e., nominal short-term rates adjusted for inflation) for all models to mitigate the multicollinearity problem especially when all macro variables are included in estimation.

deficit may result in higher inflation, which in turn will cause firms to hold less cash and invest in assets with higher return. Another explanation is that higher government deficit can lead to lower GDP, which might cause firms to hold less cash due to the income effect.

In model 5, we include all four macro variables and control for the potential endogeneity problem associated with them along with other firm-specific variables given that there is also high correlation between macro variables used in this study (see Appendix 2 for details). We obtain results that are more significant and intuitive in terms of the effects of macro variables. With model 5, GDP growth has a strong positive effect on corporate liquidity, suggesting that firms hold more cash in response to better economic conditions. This is the income effect. Inflation has a negative effect, consistent with the intuition that firms want to reduce cash holdings because their real value is eroding and invest instead in real assets. Government deficit continues to have a negative effect on corporate liquidity for the reasons discussed above and real short-term interest rate coefficient is now significant.

Effects of leading macro variables on corporate liquidity

Table 4 reports results for the effects of leading macro variables on cash holdings. Panel A reports results from the fixed-effect panel data regressions while panel B reports results from the dynamic panel data regressions. The purpose of these regressions is to examine whether corporate liquidity is affected by expectations on macro variables like GDP growth, inflation, real short-term interest rate and government deficit. That is, regressions in Table 4 examine the intertemporal relationship between macro variables and corporate liquidity as opposed to the contemporaneous relationship examined in Table 3.

Focusing on panel A, we observe that expected inflation has a negative effect on corporate liquidity, similar to what we observe in Table 3. This suggests that current inflation and expected inflation both contribute to a reduction in corporate liquidity. Consistent with value maximizing behavior, managers reduce cash holdings cash holdings when firms are facing high inflation, whether it is current or expected. The expected real short-term rate measured by the leading real short-term rate has a negative effect, suggesting that firms want to hold less cash in response to rising expected real

short-term rate, which is the opportunity cost of holding cash. Expected GDP growth and government deficit have no impact on corporate liquidity, suggesting that firms are concerned more about the current GDP growth and government deficit rather than their future values future values when managing cash. Including all macro variables in model 5, we show that expectations about high real interest rates result in a decline in cash holdings while expectations about the other three variables do not affect firm liquidity.

Turning to panel B where dynamic panel data regression results are presented, we have a more interesting story to tell. The lag of cash variable has significantly positive coefficients in all models, again supporting the hypothesis that cash adjustment is not instantaneous. Focusing on the first four models where only one macro variable is used at a time, we find that expected GDP growth has a positive effect, which is different from the results in panel A. Expectations regarding inflation and government deficit have no impact on liquidity while expected real short term interest rate continues having a negative effect.

Model 5 includes all these four macro variables and the results show that only expected real short-term rate has a negative effect on corporate liquidity. Controlling for the endogeneity problem in model 6, we find the effect of expected inflation remains insignificant while GDP growth has a positive effect. Expected real short-term interest rate has much stronger negative effect and government deficit also turns out to have a negative effect. In all, it is worth noting that while other macro variables fail to show consistent effects, the expected real short-term rate plays an important role in determining corporate liquidity and this effect is consistent with economic theory.

Effects of macro variables on the adjustment speed

Table 5 presents results for the effects of macro variables on the speed of adjustment to target corporate cash holdings.[15] We find that all interaction variables with macro variables except real short-term rate can affect the speed of adjustment to target corporate liquidity. More specifically, we find that interaction variable with GDP growth has a negative coefficient, meaning that GDP growth rate has a positive effect on the adjustment speed for cash, suggesting that corporate cash holdings converge to an

[15] It should be noted that the adjustment speed for cash is calculated by subtracting one from the coefficient of the lag of cash (Ozkan and Ozkan 2004). Hence, if the variable interacting with some macro variable has a negative coefficient, it means that the adjustment speed is faster.

optimal level faster in booms. Our finding is consistent with the argument that capital structure should adjust faster in economic booms than in recessions (Hackbarth et al. 2005). This further suggests that adjustment of cash holdings and capital structure are interrelated, corroborating the notion that cash and debt are substitutes. Both cash and capital structure adjust faster in economic booms and slower in recessions.

In addition, the interaction variable with inflation has a negative coefficient, suggesting that inflation also increases the adjustment speed for cash probably because higher inflation implies higher price risk and the management are more careful about cash management and thus adjust cash more quickly. Lastly, the interaction variable with government deficit has a positive effect, suggesting that an increase in government deficit will slow down the adjustment speed for cash. As discussed above, an increase in government deficit could imply an economic downturn, which further implies higher adjustment costs. Hence, the adjustment speed becomes slower when firms see an increase in government deficit.

6. Conclusion

This study is the first attempt to examine the effects of macro-economic variables on corporate liquidity in a multi-country setting. Overall, our results show that macro variables indeed affect corporate cash holdings. The macro variables like GDP growth, inflation, short-term rate and government deficit have significant impact on corporate liquidity. The positive effect of GDP growth is consistent with the income effect associated with the money demand theory. Firms want to hold more cash when the economy is expanding so that they have enough internal funds to finance profitable investment opportunities in the near future. The negative effect of inflation on corporate liquidity is consistent with the notion that higher inflation causes cash to value less and the management is better off reducing cash holdings and increasing investment in real assets. Real short-term interest rate has a positive effect on corporate liquidity, suggesting that firms increase their cash holdings in response to higher short-term rates. Government deficit has a negative effect, suggesting that higher government deficit may result in lower GDP growth, which indirectly results in lower corporate liquidity due to the

income effect. An alternative explanation is that higher government deficit may come with higher inflation, which causes firms to hold less cash.

Besides the contemporaneous effects of macro variables on corporate liquidity, we further explore the potential effect of expectations on macro variables on corporate liquidity. Assuming perfect foresight, we show that the expected macro variables also affect corporate liquidity. Similar to the contemporaneous effects, it appears that the leading GDP growth has a positive effect, leading inflation has a negative effect and leading government deficit has a negative effect probably due to the reasons discussed above. The expected real short-term rate has a negative effect on corporate liquidity, which is consistent throughout all models. This is in contrast to the positive effect that we observe in testing for the first hypothesis using the contemporaneous short-term interest rates. It is also consistent with the value maximizing behavior of managers. Managers reduce cash holdings when the real opportunity cost of holding cash is expected to increase.

Lastly, we demonstrate that macro variables also affect the speed of adjustment to target cash holdings. All macro variables used in our study except real short-term rate has significant impact on speed of adjustment. Similar to the previous finding regarding the adjustment of capital structure to the target level, we show that the adjustment speed is faster in booms for corporate liquidity, corroborating the notion that cash and debts are substitutes.

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Table 1
Descriptive statistics for corporate liquidity in 45 countries, 1994-2005

This table presents summary statistics of each country's mean, percentiles (*p25, p50,* and *p75*), standard deviation (*sd*), number of firms (*n*) and number of firm-year observations (*N*). Corporate liquidity is the ratio of cash holdings to net assets. The values for the total sample are weighted averages.

country	*mean*	*p25*	*p50*	*p75*	*sd*	*n*	*N*
Argentina	0.09	0.01	0.02	0.08	0.22	60	230
Australia	0.43	0.01	0.05	0.21	1.26	916	2,203
Austria	0.40	0.01	0.05	0.18	1.20	65	249
Belgium	0.31	0.01	0.05	0.22	0.85	85	306
Brazil	0.35	0.01	0.04	0.19	1.08	187	578
Canada	0.33	0.00	0.02	0.14	1.11	795	2,380
Chile	0.21	0.00	0.02	0.09	0.91	119	453
Colombia	0.28	0.01	0.05	0.17	0.64	22	75
Denmark	0.28	0.01	0.05	0.17	0.82	105	502
Egypt	0.33	0.07	0.14	0.46	0.39	11	29
Finland	0.28	0.01	0.05	0.23	0.74	102	411
France	0.33	0.01	0.04	0.21	0.97	550	1,757
Germany	0.32	0.01	0.03	0.15	1.06	550	1,762
Greece	0.37	0.02	0.07	0.27	0.96	187	440
Hong Kong	0.42	0.02	0.07	0.26	1.13	595	1,771
India	0.21	0.00	0.02	0.08	0.89	355	1,431
Indonesia	0.38	0.01	0.04	0.18	1.18	199	709
Ireland	0.43	0.01	0.04	0.26	1.21	48	232
Israel	0.67	0.02	0.11	0.49	1.55	89	209
Italy	0.39	0.01	0.05	0.21	1.08	188	659
Japan	0.43	0.02	0.08	0.30	1.14	2,777	9,230
Jordan	0.15	0.02	0.17	0.27	0.11	4	11
Malaysia	0.29	0.01	0.04	0.16	0.92	326	769
Mexico	0.18	0.01	0.02	0.13	0.67	86	288
Netherlands	0.37	0.00	0.02	0.13	1.17	107	327
New Zealand	0.19	0.00	0.01	0.09	0.77	54	120
Norway	0.52	0.01	0.08	0.28	1.55	90	201
Pakistan	0.42	0.01	0.04	0.35	1.03	46	113
Peru	0.37	0.00	0.02	0.15	1.15	36	94
Philippines	0.26	0.01	0.04	0.21	0.87	71	230
Portugal	0.12	0.01	0.03	0.06	0.34	37	125

Singapore	0.41	0.03	0.12	0.32	0.96	244	613
South Africa	0.39	0.01	0.06	0.23	1.18	99	261
South Korea	0.42	0.02	0.10	0.33	1.17	503	1,261
Spain	0.33	0.01	0.04	0.19	1.06	103	424
Sri Lanka	0.30	0.00	0.06	0.19	0.65	14	34
Sweden	0.40	0.01	0.06	0.26	1.19	227	717
Switzerland	0.35	0.01	0.06	0.24	1.03	158	749
Taiwan	0.48	0.02	0.08	0.33	1.29	674	1,546
Thailand	0.28	0.01	0.03	0.12	0.95	274	894
Turkey	0.28	0.01	0.03	0.13	1.04	132	371
UK	0.34	0.00	0.02	0.13	1.12	1,012	3,471
US	0.26	0.01	0.04	0.15	0.89	398	2,848
Venezuela	0.12	0.00	0.03	0.07	0.38	16	37
Zimbabwe	0.12	0.01	0.03	0.09	0.32	14	69
total	0.36	0.01	0.05	0.21	1.08	12,730	41,189

Table 2
Determinants of corporate liquidity by country, 1994-2005

This table presents averages of the determinants of corporate liquidity. GDP growth rate (GDP) is the percentage change in GDP. Inflation is percentage change in consumer price index. Short-term rate (ST rate) is the interest rates with short term to maturity. Government deficit (Deficit) is government deficit/surplus as percentage of GDP. GDP, inflation, short-term rate and government deficit are from International Financial Statistics. Total asset is in millions of USD. Cash flow (CF) is earnings before interest and taxes, depreciation and amortization (EBITDA), less interest, taxes, and common dividends. Net working capital (NWC) is defined as total current assets less cash less total current liabilities. Capital expenditure/assets (CAPX/assets) is additions to fixed assets over total assets. Leverage (LEV) is total debt as a fraction of total assets. Dividend (DIV) is the dummy variable that takes on one if a firm pays dividends and zero otherwise. Closely held shares (BLOCK) represents shares held by insiders as a fraction of common shares outstanding. All ratios are winsorized at the 1% and 99% level. All the financial characteristics are from Wolrdscope. The values for the total sample are weighted averages.

(Table 2)
Determinants of corporate liquidity by country, 1994-2005

Country	*GDP*	*Inflation*	*ST rate*	*Deficit*	*Total asset*	*CF/ assets*	*NWC/ assets*	*CAPX/ assets*	*LEV*	*DIV*	*BLOCK*
Argentina	0.09	0.07	0.13	-0.01	950	0.15	-0.06	0.04	0.29	0.27	0.55
Australia	0.07	0.03	0.05	0.00	66	0.01	-0.03	0.09	0.13	0.21	0.42
Austria	0.03	0.02	0.03	-0.04	628	0.29	0.03	0.10	0.28	0.60	0.57
Belgium	0.04	0.02	0.04	-0.02	628	0.17	0.06	0.09	0.28	0.61	0.54
Brazil	0.12	0.09	0.20	-0.08	906	0.22	-0.12	0.07	0.28	0.58	0.65
Canada	0.05	0.02	0.04	0.01	257	0.12	0.01	0.11	0.18	0.15	0.28
Chile	0.08	0.03	0.05	0.00	635	0.20	0.06	0.06	0.22	0.77	0.70
Colombia	0.12	0.11	0.15	-0.05	550	0.28	0.02	0.05	0.12	0.75	0.49
Denmark	0.04	0.02	0.04	0.01	426	0.21	0.08	0.09	0.25	0.66	0.34
Egypt	0.09	0.03	0.08	-0.02	838	0.10	-0.15	0.10	0.34	0.66	0.49
Finland	0.05	0.02	0.03	-0.03	676	0.24	0.09	0.10	0.24	0.75	0.43
France	0.04	0.02	0.04	-0.04	784	0.20	0.05	0.07	0.22	0.53	0.61
Germany	0.02	0.01	0.03	-0.01	576	0.15	0.11	0.09	0.21	0.44	0.61
Greece	0.09	0.04	0.14	-0.07	208	0.23	0.13	0.02	0.22	0.82	0.63
Hong Kong	0.00	-0.02	0.02	-0.03	179	0.08	0.01	0.06	0.18	0.39	0.58
India	0.11	0.05	0.09	-0.05	261	0.22	0.11	0.08	0.28	0.78	0.54
Indonesia	0.18	0.12	0.16	-0.01	129	0.19	0.07	0.07	0.33	0.46	0.68
Ireland	0.13	0.03	0.04	0.01	262	0.30	0.01	0.09	0.19	0.56	0.33
Israel	0.05	0.03	0.08	-0.02	574	0.10	-0.03	0.06	0.23	0.27	0.53
Italy	0.04	0.03	0.04	-0.04	1,122	0.22	0.06	0.07	0.24	0.60	0.53
Japan	0.00	0.00	0.00	.	543	0.15	-0.01	0.05	0.25	0.76	0.47
Jordan	0.06	0.02	0.04	-0.03	441	0.07	-0.02	0.08	0.21	0.82	0.73
Malaysia	0.07	0.02	0.03	-0.01	147	0.15	0.08	0.06	0.24	0.63	0.48
Mexico	0.13	0.09	0.15	-0.01	1,203	0.20	0.01	0.05	0.23	0.36	0.68
Netherlands	0.05	0.03	0.03	-0.01	851	0.30	0.07	0.09	0.25	0.66	0.42
New Zealand	0.06	0.02	0.06	0.01	229	0.34	-0.01	0.06	0.28	0.68	0.59
Norway	0.05	0.02	0.06	0.03	460	0.19	-0.04	0.11	0.31	0.39	0.44
Pakistan	0.12	0.04	0.05	-0.04	124	0.30	-0.11	0.07	0.35	0.68	0.58
Peru	0.05	0.02	0.04	-0.02	202	0.48	-0.02	0.05	0.28	0.32	0.55
Philippines	0.10	0.05	0.09	-0.04	207	0.13	-0.02	0.06	0.27	0.25	0.73
Portugal	0.07	0.03	0.04	-0.02	635	0.20	-0.05	0.07	0.32	0.42	0.64
Singapore	0.04	0.01	0.01	0.04	152	0.19	0.03	0.07	0.22	0.61	0.57
South Africa	0.11	0.07	0.11	-0.01	450	0.29	0.01	0.08	0.16	0.63	0.54
South Korea	.	.	.	.	344	0.26	-0.01	0.07	0.27	0.60	0.36
Spain	0.07	0.03	0.04	-0.04	1,259	0.22	0.02	0.08	0.21	0.71	0.51
Sri Lanka	0.13	0.09	0.19	-0.08	68	0.31	0.10	0.06	0.21	0.68	0.45
Sweden	0.04	0.02	0.04	0.00	379	0.10	0.08	0.07	0.16	0.41	0.37
Switzerland	0.02	0.01	0.01	0.00	608	0.20	0.11	0.07	0.26	0.68	0.47
Taiwan	0.03	0.00	0.02	-0.04	197	0.20	0.05	0.08	0.26	0.49	0.27
Thailand	0.06	0.02	0.03	-0.01	102	0.19	-0.04	0.07	0.32	0.54	0.58
Turkey	0.49	0.46	0.51	-0.14	97	0.24	0.13	0.08	0.23	0.36	0.63
UK	0.05	0.02	0.05	-0.01	402	0.14	-0.03	0.08	0.16	0.48	0.38
US	0.05	0.02	0.04	-0.01	9,041	0.26	0.03	0.07	0.25	0.65	0.11
Venezuela	0.38	0.37	0.14	-0.01	1,035	0.22	-0.02	0.05	0.16	0.49	0.49
Zimbabwe	1.07	0.62	0.55	-53.19	113	0.22	0.07	0.08	0.14	0.57	0.46
Total	0.05	0.02	0.04	-0.04	1,200	0.17	0.02	0.07	0.23	0.56	0.45

Table 3
Effect of contemporaneous macro variables on corporate liquidity for 45 countries, 1994-2005

The dependent variable for all models is the natural log of corporate liquidity (i.e., the ratio of cash plus its equivalents plus marketable securities to net assets (Cash)). GDP growth rate (GDP) is the percentage change in GDP. Inflation is percentage change in consumer price index. Real short-term rate (Real ST rate) is the real interest rates with short term to maturity. Government deficit (Deficit) is government deficit/surplus as percentage of GDP. Size is the natural log of total asset in millions of USD. Cash flow (CF) is earnings before interest and taxes, depreciation and amortization (EBITDA), less interest, taxes, and common dividends. Net working capital (NWC) is defined as total current assets less cash less total current liabilities. Capital expenditure/assets (CAPX/assets) is additions to fixed assets over total assets. Leverage (LEV) is total debt as a fraction of total assets. Dividend (DIV) is the dummy variable that takes on one if a firm pays dividends and zero otherwise. Closely held shares (BLOCK) represents shares held by insiders as a fraction of common shares outstanding. All ratios are winsorized at the 1% and 99% level. *N* represents the number of observations (firm-years); *n* stands for the number of firms. The numbers in the parentheses are t-statistics. ***, ** and * indicate coefficient is significant at the 1%, 5% and 10% level, respectively. In all models, year dummies are included, but the results are not reported.

(Table 3 A)
Fixed-effect panel data regressions for 45 countries, 1994-2005

	1	2	3	4	5
GDP	0.32 (1.84)				1.57*** (3.50)
Inflation		0.21 (0.79)			-0.47 (-1.02)
Real ST rate			0.27 (0.87)		1.04** (2.57)
deficit				0.03 (0.39)	0.06 (0.66)
Size	0.89*** (35.12)	0.89*** (35.18)	0.89*** (33.26)	0.79*** (22.95)	0.80*** (22.90)
CF/assets	0.49*** (20.35)	0.49*** (20.35)	0.46*** (17.72)	0.54*** (17.1)	0.54*** (16.91)
NWC/assets	-0.14*** (-4.27)	-0.14*** (-4.27)	-0.15*** (-4.22)	-0.10** (-2.37)	-0.10** (-2.31)
CAPX/assets	2.00*** (15.2)	2.00*** (15.2)	2.11*** (15.09)	1.67*** (9.03)	1.67*** (8.88)
LEV	-1.83*** (-17.67)	-1.84*** (-17.69)	-1.87*** (-16.91)	-1.04*** (-7.8)	-1.05*** (-7.82)
DIV	0.10** (2.56)	0.09** (2.45)	0.07 (1.70)	0.06 (1.11)	0.04 (0.83)
BLOCK	-0.09 (-1.13)	-0.09 (-1.07)	-0.06 (-0.72)	0.08 (0.71)	0.06 (0.58)
Constant	-13.14*** (-13.23)	-13.16*** (-13.26)	-13.22*** (-13.00)	-12.81*** (-30.89)	-12.96*** (-30.87)
N	26,506	26,495	24,113	12,450	12,202
n	8,182	8,181	7,521	4,255	4,192
R^2	0.13	0.13	0.12	0.14	0.15

(Table 3 B)
Dynamic panel data regressions for 45 countries, 1994-2005

	1	2	3	4	5 controlled for endogeneity
Lag of cash	0.29*** (16.45)	0.29*** (16.47)	0.28*** (18.20)	0.20*** (9.60)	0.22*** (18.00)
GDP	0.22 (1.82)				0.96*** (4.39)
Inflation		0.89 (1.96)			-0.65*** (-3.05)
Real ST rate			0.17 (0.35)		0.56* (2.05)
deficit				-2.56*** (-4.34)	-4.07*** (-10.15)
Size	0.58*** (5.35)	0.54*** (5.05)	0.73*** (7.03)	0.55*** (4.85)	0.43*** (6.93)
CF/assets	0.57*** (7.73)	0.57*** (7.65)	0.47*** (6.63)	0.43*** (7.40)	0.42*** (10.41)
NWC/assets	-0.15 (-1.55)	-0.14 (-1.39)	-0.01 (-0.14)	-0.25** (-2.64)	-0.09 (-1.34)
CAPX/assets	0.89* (2.04)	0.86 (1.96)	1.69*** (3.88)	0.36 (0.93)	0.53* (2.13)
LEV	-0.67* (-2.09)	-0.66* (-2.06)	-1.00*** (-3.35)	-1.60*** (-4.99)	-1.40*** (-6.67)
DIV		0.22 (1.84)	0.14 (1.13)	-0.05 (-0.45)	0.06 (1.07)
Constant	-0.03 (-1.51)	-0.02 (-0.88)	-0.03 (-1.39)	0.00 (-0.15)	-0.02 (-1.60)
N	15242	15,236	13,462	6,088	5,715
n	6,215	6,215	5,656	2,519	2,404
Correlation 1	-6.71	-6.70	-6.36	-5.17	-5.09
Correlation 2	1.51	1.54	1.57	0.50	.51
Sargan test (df)	331.98 (357)	333.80 (357)	315.24 (357)	299.90 (357)	440.09 (561)

Table 4
Effect of leading macro variables on corporate liquidity for 45 countries, 1994-2005

The dependent variable for all models is the natural log of corporate liquidity (i.e., the ratio of cash plus its equivalents plus marketable securities to net assets (Cash)). The lead of GDP growth rate (GDP lead) is the realized percentage change in GDP one year ahead. The lead of Inflation (Inflation lead) is the realized percentage change in consumer price index one year ahead. The lead of real short-term rate (Real ST rate lead) is the real interest rates with short term to maturity one year ahead. The lead of Government deficit (Deficit lead) is government deficit/surplus as percentage of GDP one year ahead. Size is the natural log of total asset in millions of USD. Cash flow (CF) is earnings before interest and taxes, depreciation and amortization (EBITDA), less interest, taxes, and common dividends. Net working capital (NWC) is defined as total current assets less cash less total current liabilities. Capital expenditure/assets (CAPX/assets) is additions to fixed assets over total assets. Leverage (LEV) is total debt as a fraction of total assets. Dividend (DIV) is the dummy variable that takes on one if a firm pays dividends and zero otherwise. Closely held shares (BLOCK) represents shares held by insiders as a fraction of common shares outstanding. All ratios are winsorized at the 1% and 99% level. *N* represents the number of observations (firm-years); *n* stands for the number of firms. The numbers in the parentheses are t-statistics. ***, ** and * indicate coefficient is significant at the 1%, 5% and 10% level, respectively. In all models, year dummies are included, but the results are not reported.

(Table 4 A)
Fixed-effect panel data regressions for 45 countries, 1994-2005

	1	2	3	4	5
GDP lead	-0.02 (-0.15)				0.63 (1.39)
Inflation lead		-0.63** (-2.33)			-0.58 (-1.23)
Real ST rate lead			-0.56* (-1.76)		-0.88* (-2.03)
Deficit lead				-0.95 (-1.41)	-1.23 (-1.72)
Size	0.88*** (35.05)	0.89*** (35.16)	0.89*** (33.06)	0.79*** (22.25)	0.79*** (22.98)
CF/assets	0.49*** (20.33)	0.49*** (20.25)	0.47*** (18.05)	0.54*** (16.37)	0.54*** (16.14)
NWC/assets	-0.14*** (-4.25)	-0.14*** (-4.27)	-0.15*** (-4.23)	-0.08 (-1.84)	-0.08 (-1.86)
CAPX/assets	2.00*** (15.21)	2.01*** (15.28)	2.07*** (14.72)	1.73*** (9.04)	1.76*** (9.04)
LEV	-1.83*** (-17.64)	-1.83*** (-17.62)	-1.87*** (-16.90)	-1.07*** (-7.87)	-1.10*** (-7.94)
DIV	0.10** (2.53)	0.09** (2.44)	0.08 (1.86)	0.11* (2.01)	0.08 (1.46)
BLOCK	-0.09 (-1.10)	-0.08 (-0.93)	-0.06 (-0.74)	-0.02 (-0.09)	-0.01 (-0.06)
Constant	-13.13*** (-13.23)	-13.12*** (-13.22)	-13.05*** (-12.78)	-12.82*** (-31.54)	-12.80*** (-31.07)
N	26,505	26,493	24,130	12,464	12,151
n	8,182	8,182	7,633	4,773	4,645
R^2	0.13	0.13	0.12	0.15	0.15

(Table 4 B)
Dynamic panel data regressions for 45 countries, 1994-2005

	1	2	3	4	5	6 controlled for endogeneity
Lag of cash	0.29*** (16.63)	0.29*** (16.61)	0.28*** (16.63)	0.33*** (15.43)	0.36*** (18.77)	0.37*** (33.48)
GDP lead	0.73** (2.42)				0.25 (0.76)	0.42* (2.03)
Inflation lead		-0.21 (-0.75)			-0.29 (-0.78)	-0.23 (-0.98)
Real ST rate lead			-0.77* (-1.90)		-0.96*** (-2.87)	-1.95*** (-8.31)
Deficit lead				-0.02 (-0.03)	-0.03 (-0.06)	-1.71*** (-3.35)
Size	0.57*** (5.22)	0.56*** (5.18)	0.71*** (6.97)	0.35*** (3.31)	0.40*** (4.04)	0.38*** (6.60)
CF/assets	0.57*** (7.91)	0.55*** (7.33)	0.39*** (5.41)	0.42*** (7.03)	0.43*** (7.62)	0.43*** (11.15)
NWC/assets	-0.15 (-1.56)	-0.14 (-1.48)	-0.19 (-1.95)	-0.20* (-2.11)	-0.19* (-2.18)	-0.11 (-1.70)
CAPX/assets	0.90* (2.06)	0.95* (2.17)	1.76*** (4.11)	-0.01 (-0.01)	0.38 (0.97)	0.48 (1.83)
LEV	-0.66* (-2.06)	-0.66* (-2.08)	-1.05*** (-3.47)	-0.63 (-1.83)	-0.90** (-2.75)	-1.24*** (-7.32)
DIV	0.22 (1.85)	0.22 (1.85)	0.16 (1.28)	-0.06 (-0.56)	0.06 (0.56)	0.06 (1.31)
Constant	-0.02 (-1.02)	-0.04 (-1.68)	-0.03 (-1.13)	0.03 (1.40)	0.02 (0.97)	0.01 (1.19)
N	15,241	15,229	13,285	5,457	5,143	5,143
n	6,215	6,214	5,521	2,224	2,092	2,092
Correlation 1	-6.72	-6.70	-6.32	-6.52	-6.29	-6.49
Correlation 2	1.51	1.48	1.50	0.57	0.27	0.25
Sargan test (df)	331.56 (357)	336.89 (357)	316.40 (357)	279.06 (357)	285.17 (357)	421.85 (561)

Table 5 Effect of macro variables on adjustment speed of corporate liquidity
Dynamic panel data regressions for 45 countries, 1994-2005

The dependent variable for all models is the natural log of corporate liquidity (i.e., the ratio of cash plus its equivalents plus marketable securities to net assets (Cash)). GDP growth rate (GDP) is the percentage change in GDP. Inflation is percentage change in consumer price index. Real short-term rate (Real ST rate) is the real interest rates with short term to maturity. Government deficit (Deficit) is government deficit/surplus as percentage of GDP. Other determinants of corporate liquidity are the same as those in Tables 3 and 4 except that in each model, an interaction variable is generated by multiplying the lag of Cash by the lag of some macro variable to examine whether the adjustment speed as proxied by the coefficient for the lag of Cash is affected by macro variables. Determinants of corporate liquidity other than the above variables are omitted to save space. *N* represents the number of observations (firm-years); *n* stands for the number of firms. The numbers in the parentheses are t-statistics. ***, ** and * indicate coefficient is significant at the 1%, 5% and 10% level, respectively. In all models, year dummies are included, but the results are not reported.

(Table 5)
Effect of macro variables on adjustment speed of corporate cash holdings[16]

	1	2	3	4
$Cash_{i,t-1}$	0.36*** (13.41)	0.35*** (19.65)	0.28*** (16.61)	0.33*** (15.43)
$GDP_{i,t-1}$* $Cash_{i,t-1}$	-1.30** (-5.09)			
$GDP_{i,t-1}$	-3.71*** (-3.62)			
$Inflation_{i,t-1}$* $Cash_{i,t-1}$		-1.43*** (-5.46)		
$Inflation_{i,t-1}$		-5.66*** (-5.60)		
Real ST $rate_{i,t-1}$* $Cash_{i,t-1}$			-0.10 (-0.32)	
Real ST $rate_{i,t-1}$			0.13 (0.11)	
$Deficit_{i,t-1}$* $Cash_{i,t-1}$				1.21*** (3.59)
$Deficit_{i,t-1}$				1.34 (1.24)
N	15,242	15,236	13,462	6,088
n	6,215	6,215	5,656	2,519
Correlation 1	-6.68	-6.68	-6.36	-5.14
Correlation 2	1.40	1.34	1.58	0.46
Sargan test (df)	327.16 (357)	327.27 (357)	314.36 (357)	313.12 (357)

[16] Other firm-specific variables are also included in each model but the results are not reported to save space.

Appendix 1

Variable definitions and sources

Variable	*Definition*	*source*
Cash	Cash plus its equivalents plus marketable securities	Worldscope
Size	*ln(*total assets in USD)	Worldscope
Cash flow (CF)	Cash flow is earnings before interest and taxes, depreciation and amortization (EBITDA), less interest, taxes, and common dividends.	Worldscope
Net working capital (NWC)	total current assets less cash less total current liabilities	Worldscope
Capital expenditure (CAPX)	Additions to fixed assets over total assets	Worldscope
Leverage (LEV)	Total debt divided by total assets	Worldscope
Dividend payout (DIV)	Common dividends as a fraction of earnings	Worldscope
Closely held shares (BLOCK)	Shares held by insiders as a fraction of common shares outstanding	Worldscope
GDP growth rate (GDP)	$(GDP_t - GDP_{t-1})/ GDP_{t-1}$	International Financial Statistics
Inflation	$(CPI_t - CPI_{t-1})/CPI_{t-1}$	International Financial Statistics
Short-term rate	Interest rate with short term to maturity, including money market rate, call money rate, 3-month interbank rate, Treasury bill rate, etc.	International Financial Statistics
Deficit	Government deficit/surplus as a fraction of GDP	International Financial Statistics

Appendix 2

Correlation matrix[17]

The following table presents the correlation matrix for the macro variables that potentially affect corporate cash holdings. GDP growth rate (GDP) is the percentage change in GDP. Inflation is percentage change in consumer price index. Real short-term rate (Real ST rate) is the real interest rates with short term to maturity (less than one year). Government deficit (Deficit) is government deficit/surplus as percentage of GDP. GDP, inflation, short-term rate and government deficit are from International Financial Statistics.

	GDP	Inflation	Real ST rate	G deficit
GDP	1			
Inflation	0.8990*	1		
Real ST rate	-0.0394*	-0.0485 *	1	
G deficit	-0.0636*	-0.0580*	-0.0239	1

[17] * means the correlation coefficient is significantly different from zero at the 0.1% level.