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CAPITAL STRUCTURE, FIRM LIQUIDITY AND GROWTH

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Editorial

On May 27-28, 2002 the National Bank of Belgium hosted a Conference on *"New views on firms' investment and finance decisions"*. Papers presented at this conference are made available to a broader audience in the NBB Working Papers no 21 to 33.

Abstract

This paper is an exploration of the relationships among the firm's financial structure, its choice of liquid asset holdings, and growth. We present a theoretical model of the firm where external finance is costly and where retaining earnings as liquid assets serves a precautionary motive. One of the predictions of this model is that a long-term reliance on high levels of debt finance tends to be associated with high levels of liquid asset holding. We test this empirically by estimating the determinants of liquid asset holdings using panel data sets of Belgian and UK firms. We find evidence of a *positive* relation between leverage and liquid asset holding. This result leads us to identify a possible linkage from high debt to high liquidity to slow growth. In light of this we discuss the possible implications of the development of stock markets, private equity, and venture capital markets.

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1. Introduction

This paper is an exploration of the relationships among the firm's financial structure, its choice of liquid asset holdings, and growth. The literature on the determinants of economic growth has long studied the role of financial development promoting growth.[2] The literature corporate finance provides some microeconomic underpinnings for this relationship in the form of a variety of partial equilibrium analyses showing how capital structure can effect the firm's investment decisions and therefore its growth.[2] To date this literature has overlooked the channel between financial structure and growth that we examine here.

Briefly, the central thesis of our paper is that in choosing to hold its assets in liquid form, the firm will often forego an opportunity to invest in an illiquid and, possibly riskier, project that promises a higher expected return. In so doing, the growth of the firm is slowed since high returns on assets will pave the way for future investments. The decision to hold assets in liquid form may be motivated by a variety of considerations. Prominent among these is that liquid assets may allow the firm to invest in a more attractive growth opportunity that may present itself later (i.e., the option value of waiting to invest is high). The alternative reason that we focus on is a precautionary motive for keeping a high level of liquidity. Liquid assets provide a cushion that would allow the firm to survive a period of low earnings during which the firm might be unable to access capital markets or could do so only at a very high cost. The firm's financial structure will affect this decision because the degree of leverage used by the firm will affect the likelihood that cash flows will be insufficient to cover debt service and other fixed charges. This creates a possible linkage from high debt to high liquidity to slow growth.

We explore this idea in three way in what follows. First, we present the findings of a theoretical model of the firm where external finance is costly and where retaining earnings as liquid assets serves a precautionary motive. We study the policy that should be chosen by

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[1] This literature goes back at least to Schumpeter (1942). More recently the theme has been explored in theoretical models of growth, e.g., Greenwood and Jovanovich (1990) and in the empirical literature on growth, which has documented positive correlations between growth rates and various measures of financial development, e.g., King and Levine (1993).

[2] For a recent contribution including a review of the earlier corporate finance literature see Anderson and Nyborg (2002).

managers maximizing shareholder wealth and discuss its implications for dividend policy and liquid asset holding. One of the predictions of this model is that a long-term reliance on high levels of debt finance tends to be associated with high levels of liquid asset holding. We then study the question empirically by estimating the determinants of liquid asset holdings using panel data sets of Belgian and UK firms. After controlling growth opportunities and other important factors we find evidence of a *positive* relation between leverage and liquid asset holding. This is consistent with the theoretical analysis we presented and goes against previous studies, which documented a negative relationship between leverage and levels of liquid asset holding. Finally, we discuss the implications of these results from a broader institutional perspective. In particular, we discuss the possible implications of the development of stock markets, private equity, and venture capital markets.

The remainder of this paper is organized as follows. In section 2 the previous literature is reviewed. In section 3 we present the results of a theoretical analysis of a dynamic model of firm liquid asset holding. Section 4 is devoted to our empirical analysis. Section 5 discusses implications of the institutional development in light of our findings. Section 6 concludes.

2. Literature Review

The finance literature on the corporate choice of liquid asset holding is not very large. Unlike the enormous literature on capital structure, the composition of the left hand side of company balance sheets has not attracted a great deal of attention. The reason for this is in part attributable to the classic propositions of Modigliani and Miller establishing the irrelevance of financial structure and dividend decisions for the value of the firm and the cost of capital. For firms operating in an M&M world the assets of the firm will be composed of those investments available to the firm for which the net present value is positive. Firms can inflate their balance sheets by making zero NPV investments in liquid assets; however, there seems little reason to believe that firms would wish to do so on a systematic basis. That is, there will be no relationship between the firm's preference for liquidity and capital structure or other firm characteristics.

The enormous developments of the literature on corporate finance in the last twenty-five years have of course produced a plethora of ideas as to how capital structure does matter for the value of the firm and for the firm's investment decisions. Potentially, agency effects of various kinds may create important reasons for holding liquid assets with the further implications of different patterns of corporate liquidity depending on capital structure or other firm characteristics. This was one of the messages of Myers's original analysis of the corporate borrowing decision (Myers (1977)). By pointing out that problems of debt overhang (i.e., levered equity's disincentive to invest in positive NPV projects) could be overcome with 'financial slack' he established an important incentive for maintaining liquid asset holding. This notion has been further reinforced by the subsequent corporate finance literature that has emphasized the reasons why tapping capital markets may be relatively costly compared to retaining earnings.[3] Furthermore, the literature on real options has emphasized the option value of waiting to invest[4]. Thus maintaining liquid assets will be

[3] This idea was developed more explicitly in Myers and Majluf (1984). It is also studied in this volume in the paper of Van Cayseele.

[4] For developments of this idea and references to the literature see Cassimon et.al., Butzen et.al. and Gérard and Verschueren all in this volume.

important for firms faced with growth opportunities whose expected return fluctuates over time.

Other veins of the corporate finance literature have pointed toward possibly unfavourable effects of liquid asset holding. This is an implication of asset substitution problem first identified by Jensen and Meckling (1976). If levered equity holders have an incentive to engage in increasing the riskiness of assets, they can implement this only if the firm's assets are sufficiently liquid to allow this transformation to take place.

These positive and negative aspects of corporate liquidity have been studied together in a recent analysis by Myers and Rajan (1998). Asset liquidity bestows a benefit in the sense that it makes it possible for the firm to seize unforeseen opportunities or to survive during periods of poor business conditions. However, liquidity has a disadvantage that it makes it difficult for firm insiders to commit to a given course of actions. Their analysis assumes that assets in place generate cash flows at dates $t=1$ and $t=2$. They allow insiders to undertake non-contractible asset transformations at dates $t=0.5$ and $t=1.5$. The values of transformed assets are supposed to be appropriated entirely by firm insiders to the detriment of the firm's creditors. Asset liquidity is the proportion of the asset value that is retained upon transformation. They show that the debt capacity of the firm it typically non-monotonomic – firms with 'excessively liquid' can raise less debt than can a 'less liquid' firm. Rajan's and Myers' model is very stylised and their analysis is incomplete in many respects. However, they clearly identify a conflict of interests of debtholders and shareholders in regard to the degree of liquid asset holding.

Recently, Morellec (2001) provides an interesting analysis of the implications of liquidity that develops the asset transformation theme. He considers a dynamic model of a levered firm whose net revenue, given a capital stock, follows a geometric Brownian motion. The firm benefits from leverage because of the tax shields they bestow. He studies the firm-closure decision of a levered firm and obtains closed-form expressions for the values of debt and of equity. He then considers the possibility that the firm can liquidate a fraction of the assets of the firm prior to closing the firm entirely. He shows that shareholders will generally do so and that given a level of nominal debt, this partial asset sale increases the value of equity and reduces the value of debt. Thus, ex ante, asset liquidity (i.e., the capacity to engage in asset sales) reduces the value of the firm and the debt capacity of the firm. Consequently, asset liquidity can result in underinvestment relative to the illiquid asset benchmark case.

Kim, Mauer and Sherman (1998) present a theory of the choice of liquid assets when outside finance is costly. The basic motivation for holding liquid assets is the creation of financial slack which will allow firm insiders to pursue futures attractive investment opportunities when they present themselves (as in Myers and Majluf). They study this issue in a three period model. At time zero a firm with amount of funds available, $\overline{X}$ allocates these funds to an illiquid investment with a risky return, a liquid investment with a (low) riskless return, and dividends. At $t=1$, given the returns to initial investments, the shareholders issue, at a cost, an amount of debt and chooses a level of risky fixed investment. At time $t=2$ returns are paid our as a dividend and firm is dissolved. In this set-up we see that the motivation for holding liquid assets is to avoid issuing costly debt at time $t=1$.

Kim, Mauer and Sherman explore their theory in an empirical study of U.S. industrial firms over the period from 1975 through 1995. Their measure of liquidity is the ratio of cash and

marketable securities to the book value of assets. They consider explanatory variables measuring growth opportunities, cash flow volatility, debt ratio, cash flow, and bankruptcy risk. They interpret their findings as supportive of their theoretical model. This is based principally upon the finding of a positive relationship between growth opportunities and liquidity. It is notable that they find a negative relationship between leverage and corporate liquidity for which their theoretical analysis offers no explanation. We will discuss their results again in Section 4 when we turn to our own empirical analysis.

Opler, Pinkowitz, Stulz and Williamson (1999) also provide an empirical analysis of corporate holding of liquid assets. Their sample covers U.S. non-financial firms during the 1952-1994 period. Their results are similar to those of Kim et.al. In particular, they find a positive relationship with respect to growth opportunities (measures by market to book ratio or by R&D spending). One difference is that Opler et.al find that cash flow enters positively; whereas, Kim et.al. find a negative relation with cash flow. In agreement with Kim et.al., they find a negative relation between debt and corporate liquidity. We will return to this and other aspects of their analysis in Section 4 below.

3. The Precautionary Motive for Corporate Liquidity[5]

In this section we address the question: in a world where a firm may be exposed to persistent periods of relatively low (or high) cash flows and where accessing external capital markets is very costly what policy for paying out dividends or retaining earnings in the form of liquid assets will be in the interests of shareholders?

Consider a firm with given productive capacity (assets in place). The firm may accumulate liquid assets as a reserve to service debt and other fixed flow costs. To capture in a simple way the idea that outside finance is costly we simply do not allow for new equity issues or issue of new debt. Assets in place generate cash flows following a diffusion with stochastic drift. Liquid assets have a return less than the rate used to discount future profits, and less than the mean drift of the firm's risky assets.

Mathematically dS_t is the cash flow generated by assets in place, *r* is the discount rate, *I* is flow costs including debt service (i.e., debt is considered to be a perpetual bond with fixed interest). Then the technology is

$$dS_t = \rho_t dt + \sigma dW_t^S$$

where ρ_t is a stochastic drift term, σ is cash flow volatility (a constant) and dW_t^S is a Brownian motion. In order to reflect persistence in departures from 'normal levels' of cash flows we model the drift with mean reversion according to the Ornstein-Uhlenbeck process,

$$d\rho_t = \kappa(\bar{\rho} - \rho_t)dt + \eta dW_t^\rho$$

where dW_t^ρ is independent of dW_t^S. Shareholders are risk neutral and maximize the present discounted value of dividends.

[5] This section is based on unpublished joint work with Andrew Carverhill of Hong Kong University.

The difference between cash flows and cash outflows in the form of costs, debt service and dividends is accumulated in liquid assets belonging to the firm. So long as the cash flows plus liquid assets are sufficient to cover costs and debt service the firm is solvent. Otherwise the firm is bankrupt. In the case of bankruptcy the firm is instantaneously transferred to bondholders and the firm subsequently is operated as an all equity firm.

We assume that there are no bankruptcy costs. We furthermore assume that the return on liquid assets is zero; however, this is just a convenience. Our results hold true if returns to liquid assets held by the firm is bounded above by the risk-free rate.[6]

In this set up there is no accumulation of risky assets, so that the firm's only investment choice concerns the amount of liquid assets which are to be held. Therefore, the cost of holding liquid assets is the pure time value of money (r), i.e., the loss associated with consuming later rather than earlier. The benefit of holding liquid assets is that in times of low cash flow the equity holders can survive to benefit from future dividends. The assumption that there is no accumulation of risky assets is technically important because it reduces the dimensionality of the dynamic programming problem to be solved for optimal dividend policy. As was mentioned above we assume that it is not possible to issue new equity. Again this is a simple way of modelling the costliness of external finance. At the cost of additional analytical complexity, it could be relaxed to assume equity can be issued but only at a positive marginal cost ('hair cut').

Notice that the return on assets is decreasing in the amount of liquid assets held. As a consequence, the decision to increase the proportion of assets held in liquid form will reduce the growth rate of the firm. Stated in another way holding liquid assets inside the firm as opposed to paying them out and making them available for current consumption reduces the value of the (cum dividend) value of the firm. Thus the first best rule in these circumstances is to hold no liquid assets. This will imply that the levered firm enters bankruptcy almost surely. (This is the consequence of the cash flow process having unbounded variation.) However, in the absence of bankruptcy costs, this involves no loss of cash flows -- cash flow rights simply are transferred from old equity holders to debt holders who become the new shareholders.

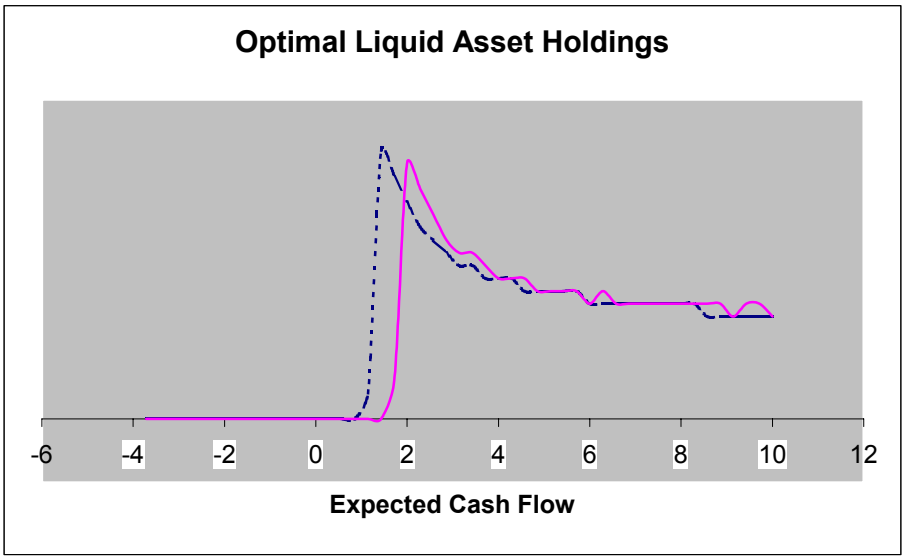
The policy that maximizes the value of shares will in general differ from this first best policy. Finding this policy involves solving a dynamic programming problem with two state variable, the current drift of the cash flow process, ρ_t, and the current level of liquid asset holdings, C_t. The dividend payout policy is given by $dS_t - Idt - dC_t$. Notice that we do not impose any cost of changing dividend policy from one moment to the next. Then in this setting we can apply fundamental results from the theory of controlled Brownian motion to note that the optimal dividend policy will be to payout all available cash flow and liquid assets in excess of a critical amount and to retain all available cash flows if liquid asset holdings are less than this critical amount. (See, Dutta and Radner (1999)). Specifically, a basic property of the model is:

[6] The return on the firm's liquid assets may be strictly less than the risk-free rate if their availability creates agency problems of the sort described by Jensen and Meckling (1976) or Myers and Rajan (1998).

Proposition 1: There is a critical level of cash holdings, $C^*(\rho_t)$, such that if the current level expected cash flow rate is ρ_t the firm will pay out all available liquid assets in excess of $C^*(\rho_t)$ as dividends and if liquid assets are currently less than $C^*(\rho_t)$ the firm will pay no dividends and will retain all cash flow in excess of debt service and other fixed charges in order to accumulate additional liquid assets.

It is important to point out that an implication of this proposition is that when cash flow tends to be high (high ρ_t) there will generally be a dividend paid which will fluctuate with movements of cash flows. In this high cash flow region the liquid asset holdings will be maintained close to the critical level $C^*(\rho_t)$ and will change only as the rate of *expected* cash flows (ρ_t) changes. In contrast, when expected cash flows are low (i.e., low ρ_t), then there will generally be a zero dividend and liquid asset holdings will fluctuate in step with cash flows. In this latter region, observed liquid asset holding (C_t) may be far less than desired levels of liquid asset holding, ($C^*(\rho_t)$).

The solution of the optimal policy in this context consists in characterizing the critical level of liquid asset holding $C^*(\rho_t)$ for all possible expected rates of cash flows. This is a complicated dynamic programming problem, which we have solved numerically. Some important characteristics of the solution can be seen in the graph where we have plotted $C^*(\rho_t)$ as a function of ρ_t under specific parametric assumptions. In this graph we have represented the solution for a 'low debt' case, which is given by the dotted line, and for a 'high debt' case given by the solid line. In the high debt case the parameter *I* is 50% higher than in the low debt case.



In examining the low debt case (the dotted line) notice that the optimal level of liquid asset holdings is a decreasing function of expected cash flows over the region of relatively high expected cash flows. The intuition for this is that, given that the currently high cash flows are

likely to persist, the prospect of financial distress is relatively remote. The firm need not carry very high levels of liquid assets. However, should expected cash flows begin to drop the shareholders will begin to target higher levels of liquid asset holding as a precaution against a time when cash flows will fall short of contractual costs. Note however that the optimal liquid asset holding is an increasing function of expected cash flows in the region of low expected cash flows. The reason is that if expected cash flows are low relative to costs (*Idt*) then the likelihood is that available liquid assets will be drawn down during the period of firm poor performance. At some point the shareholders decide that prospects of the firm are too poor and that it is better to pay out a large fraction of liquid assets as dividends. In so doing, they willingly increase the likelihood of insolvency and therefore sacrifice future dividends. We can summarize this discussion in,

> *Proposition 2:* There is a critical level of expected cash flows, $\rho^* = \arg\max(C^*(\rho_t))$, such that for $\rho_t < \rho^*$, the critical level of liquid assets $C^*(\rho_t)$ is weakly increasing in the expected cash flow and for $\rho_t > \rho^*$ the critical level $C^*(\rho_t)$ is weakly decreasing in the expected cash flow.

Notice that the non-monotonicity of the relation between optimal liquid asset holding and expected cash flows suggests that there will be no simple empirical relationship between observed cash flows and the level of liquid asset holding. If realized cash flow and liquid asset holdings were observed for a firm over an extended period of time it would not be surprising to find a positive correlation or a negative correlation or no significant correlation at all.

If we compare the graphs of the critical liquid assets for low debt (dotted curve) and high debt (solid curve), we notice that the critical level of cash flows is higher for the high debt firm than for the low debt firm, $\rho^*_L < \rho^*_H$. Furthermore, for expected cash flows greater than the critical level for the high debt firm, $\rho^*_H < \rho_t$, the target level of cash holdings for the high debt firm exceeds that of the low debt firm, $C^*_H(\rho_t) > C^*_L(\rho_t)$. If we combine this fact with the observation made above that in the range of relatively high expected cash flows actual liquid asset holdings are typically close to target holdings whereas for relatively low expected cash flows actual liquid assets holdings are generally far less than target holdings we arrive at an important empirical implication of this analysis. *Everything else equal high levels of debt tend to be associated with high levels of liquid asset holdings.*

In this section we have limited our discussion to the simplest version of our continuous time model of corporate liquid asset holding in order to highlight the implications of the model for changes in financial structure, the level of liquid asset holdings and the return of assets for the firm.[7] For reasons of limitation of space we have not presented the technicalities involved in solving this model and we have not explored its full implications. For example, the model allows us to consider the effect of increasing cash flow volatility, σ, the mean

[7] It is worth pointing out how this analysis differs from those of Kim et.al. and Morellec discussed in Section 3. Kim et.al. model is static in nature. The motivation for holding liquidity is to avoid issuing costly debt in order to pursue growth opportunities that arise. There is nothing comparable to the precautionary motive that we have emphasized. Morellec model is dynamic in nature, but his analysis of the liquidation decision is static. Specifically, he allows for a one-time asset sale. In contrast, our analysis allows for liquid assets to be sold or to be accumulated freely at all times. This is a more complicated problem which results in the fact that we need to solve it numerically.

cash flow rate, $\overline{\rho}$, or the volatility of the expected cash flow rate, η. Furthermore, with a slight modification to allow for debt related corporate tax shields, the framework could be used to derive the optimal capital structure.

4. Empirical tests

4.1 Hypotheses to be tested.

The analysis of the preceding section has served to demonstrate a link between capital structure and firm liquidity, which we believe has been overlooked in previous discussions of the determinants of firm liquidity. It is this predicted positive relationship between leverage and liquidity that we will focus on in our empirical analysis.

However, we recognize that leverage may be only one of the factors that determine a firm's choice of liquid asset holdings. Some other factors are suggested by other factors that appear explicitly in our model. In particular, we would expect asset volatility to be positively associated with liquid asset holding everything else equal.

There are very likely other important factors affecting the choice of liquid assets even though it has not been possible to incorporate them into our analysis. Foremost among these is the presence of growth opportunities which we would expect to be positively associated with liquid asset holding. The testing methodology we adopt should be careful to control for these additional affects appropriately.

In our review of the literature on the firm's choice of liquid asset holdings, we have discussed the two recent empirical studies that are closest to our study (Kim, Mauer and Sherman (1998) and Opler, Pinkowitz, Stulz, and Williamson (1999)). It is useful to summarize the findings of these studies and to compare them to our predictions based on the model we have summarized in Section 3 and the out-of-model predictions that we find unexceptionable. The following table does this:

Table 1: Factors determining liquid asset holdings

Variable	Kim et.al.finding	Opler et.al. finding	Our prediction
Cash flow	-	+	Ambiguous
Growth opportunities	+	+	+
Volatility	+	+	+
Leverage	-	-	+
Bankruptcy risk	-	n.a.	Ambiguous
Firm size	n.a.	-	n.a.

Notice that the Kim et.al. study finds a negative effect of cash flow on liquid asset holding and that Opler et.al. find a positive relation. This apparent puzzle is in some sense resolved by our model which points out explicitly that the relation between cash flow (understood as a proxy for expected cash flow) and liquidity is non-monotonic. The previous studies agree in finding positive relations with respect to growth opportunities and volatility and are consistent with our predictions.

The major difference between the previous studies and our predictions concerns the effect of leverage. Both previous studies found a negative effect; whereas, our prediction is of a positive effect. It should be noted that leverage was included in the earlier studies as a control and the authors provided no detailed rationale for the negative sign obtained. Furthermore, the earlier studies employed measures of leverage that aggregated debt of all maturities. In U.S. corporate financial structures short-term debt tends to predominate. In contrast, the formal model we described in Section 3 was based on the assumption that debt was long-term (indeed perpetual). As a result, we should be alert to the fact that the design of the previous empirical studies may not have been suited to testing our predictions. We will try to deal with this by including measures of both long-term and short-term debt in our analysis.

Finally, we should point out that one of the puzzling findings of the Kim et.al. study was that bankruptcy risk had a negative effect on liquid asset holdings. The measure of bankruptcy risk they employed was based on the Altman z-score which includes a variety of financial ratios that are positively correlated with cash-flow. Therefore, we note that the non-monotonicity result of our model suggests that this relationship may not necessarily be a robust or stable one.

4.2 Tests based on a panel of UK firms

Our first empirical estimates are based on an unbalanced panel data set of listed UK firms. The focus on listed firms is motivated by several considerations. First, these firms tend to be larger firms which would tend to have access to long-term debt finance. Second, these firms would tend to be those for which more reliable estimates of R&D expenditures (one of our proxies for growth options) are available. Finally, for these listed firms it is possible to calculate the ratio of market value to book value which may be an alternative indicator of growth options.

The data set is drawn from Datastream consisting of financial variables of non-financial firms included in the FTSE All Shares index in 2001. Our data is covers the annual reports over a maximum of 12 years per firm, 1989 through 2001.

Using the FTSE all shares index means that we cover large and medium sized firms based in the U.K. The fact that we have used firms that were in existence in 2001 creates a possible survivorship bias. Some of the firms that have disappeared from the sample may have done so through mergers. It is sometimes stated that highly liquid firms are attractive takeover targets. Our data will not allow us to identify this effect. Other firms may have disappeared through bankruptcy or distressed reorganization. Our model suggests that the choice of liquid asset holding by distressed firms (low ρ_t) will be very different from that of firms under normal conditions. To the extent that the construction of our data set excludes distressed firms, this means that our results are better characterizations of firms under normal operating conditions.

Table 2 summarizes the definitions of the variables used in our study of UK firms. The definitions we have adopted for liquid assets, cash flow, R&D, and market to book are

directly comparable to the definitions used by Kim et.al. and Opler et.al. As in their studies the dependent variable of our regression analysis is liqurat, the total liquid asset holding of the firm expressed as a fraction of total assets. Note that all variables have been divided by a scale indicator in order to reduce problems of heteroscedasticity.

Table 2: Data definitions

liqurat	Liquid asset	Sum of cash, bank balances, and investments in current assets divided by total assets
cfratio	Cash flow	Earnings before taxes and interest divided by total assets
ltlev	Long term debt	Debt greater than 5 years to maturity divided by total assets
mtlev	Medium term debt	Debt greater than 1 year and less than 5 years to maturity divided by total assets
stlev	Short term debt	Debt payable within 1 year divided by total assets
rdratio	R&D expenditures	Expenditures on R&D divided by total sales
MTBV	Market value to book value	Market value divided by net tangible assets, market value is share price multiplied by the number of ordinary shares outstanding; net tangible assets is ordinary shareholder's equity less intangible assets.

R&D expenditures and market to book ratio are included as a proxies for the firm's growth opportunities. In our view R&D is the preferred variable in that the link to growth appears to be the clearest. Its drawback is that not all firms report R&D expenditures. As a result, we have included market to book ratio which can be calculated for a larger set of firms. This variable is not ideal because high market to book may be indicative conditions favorable to the firm that have nothing to do with its future growth opportunities.

Unlike previous studies we distinguish long-term and short-term debt. UK financial reports are unusual in that they include indicators of debts with at least five years to maturity. Thus to clearly focus on the predictions of our model concerning debt as a persistent feature of the firm's capital structure we take long-term debt to be at least five years and short term years to be debt of a maximum maturity of one year. As an additional control we do some estimations including medium term debt (between one and five years).

In examining summary statistics for the variables included in our analysis it was noted that some implausibly high or low values of variable were observed. These may well reflect data errors. We deal with this by working with a truncated sample where the data points involving the smallest percentile or largest percentile of a variable are excluded.

In addition to the variables we have listed we have included in the analysis dummy variables for industrial categories and year of observation. We have also explored the effect of alternative definitions of leverage (including trade credit), lagged values of explanatory variables, and measures of cash flow volatility. It is not possible to present all these estimates here. Generally, we have found that industry dummies and year dummies are significant. Furthermore, once these industry dummies are included the estimated effect of volatility is not significant; although, this variable is significant when industry dummies are excluded. The inclusion of lagged regressors did not produce any systematic or interesting dynamics. The sign and significance of these variables were sensitive to exact specification

and estimation method. There inclusion had little effect on the sign and significance of the contemporaneous regressors. Therefore we report the results excluding these lagged regressors.

We have estimated the linear regression model between liquidity ratio and the explanatory variables we have listed. We have estimated this relation by Ordinary Least Squares. Furthermore, given the nature of our data set it is interesting to estimate the model using panel study techniques. A limitation of these techniques is that often the length of the panel is often too short to yield powerful results. In our case, we have a maximum of 11 years of data for a given firm. We consider this sufficient to make these techniques potentially interesting. We report results for both firm fixed effects and random effects versions of our models.

4.3 UK Results

Table 3 reports the results of the ordinary least squares regressions of the model based on the sample of UK firms described in the preceding section. Columns 1 presents the estimates including indicators for long-term and short-term leverage and using R&D expenditures as a proxy for growth opportunities. Since R&D is our preferred proxy for growth we view this regression as a benchmark for comparison with other results. Cash flow enters with positive sign and is significant.

Table 3: UK Firms, trimmed sample, OLS regressions, dependent variable liquidity ratio (t-statistics under parameter estimates)

cfratio	0.104065 2.683	0.023521 0.879	.1343059 3.450	.0748854 2.702
ltlev	0.255896 5.389	0.057081 1.715	.262579 5.567	.0546408 1.627
mtlev			-.1330946 -2.919	-.1540377 -5.196
stlev	-0.0098 -0.198	-0.03638 -0.99	-.0258692 -0.517	-.0400304 -1.075
rdratio	0.45305 7.702		.4320407 7.424	
MTBV		0.000778 2.743		.000659 2.294
year dummies	yes	yes	yes	yes
industry dummies	yes	yes	yes	yes
Adjusted R^2	0.1871	0.1223	.2003	.1546
Number of observations	929	1780	892	1692

Long term leverage has a positive coefficient which is highly significant. This is consistent with the prediction of our theoretical model. Short-term leverage enters with a negative sign but is insignificant. R&D spending is positive and highly significant. The industry dummies taken as a whole are significant. The same applies to the year dummies taken as a whole.

Column 2 differs from column 1 in that market to book ratio is taken as a proxy for growth opportunities. This regression is estimated on a larger data set since a large number of firms in the UK sample do not report expenditures on R&D spending. The results are consistent with the estimates of column 1. The proxy for growth opportunities enters with positive sign and is significant. The other variables enter with the same signs as in column 1. However, cash flow and short-term leverage are insignificant and long-term leverage is only marginally significant.

Columns 3 and 4 differ from columns 1 and 2 in that they include medium leverage (based on debt with 1 to 5 years maturity) in the regression. In both cases this variable enters with negative sign and is significant. Otherwise the pattern of estimates is similar to that seen in columns 1 and 2. Long-term leverage has a positive coefficient and is highly significant in the regression where R&D is a proxy for growth opportunities. When market to book is used to control for growth opportunities this variable still has a positive effect, but it is no longer significant. In both columns 3 and 4 short-term leverage enters with negative sign but is insignificant. Growth opportunities (R&D or market to book) enter positively and are significant.

The major finding from Table 3 is that other things equal, greater long-term debt is associated firms setting higher target levels of liquid assets. This is consistent with the theory of the choice of liquid assets we have elaborated above. Furthermore, these results raise doubts about the finding of previous studies which a negative relationship between firm liquidity and firm indebtedness. In our data set short-term leverage entered negatively into the relation and was insignificant. Medium term leverage entered negatively and was significant. These results suggest that firms may view long-term debt and short-term debt very differently. Long-term debt may reflect a durable feature of the firm's capital structure to which other policies, such as dividend and liquid asset holding are adapted. Short-term debt can be used more actively and may be substitutable for liquid asset holding.

In the regression analysis reported in Table 3 there is a risk that there are determinants of liquid asset choice beyond the measures of leverage, cash flow, and growth opportunities that we have explicitly introduced. We have attempted to control other possible factors by including dummy variables for time and the industry of the firm. These may be imperfect controls. The panel structure of our data set allows us to take an alternative approach by allowing for firm specific effects which are either constant over time (fixed effects) or are drawn randomly each year from a fixed distribution (random effects). In Table 4 we report the result of applying these panel techniques to our baseline model specifications which include leverage measures, cash flow, growth option proxies, and dummies for industry and year. Estimation is by generalized least squares.

Table 4: UK firms, panel estimates, trimmed sample, dependent variable liquidity ratio (z-statistics or t-statistics under parameter estimates)

	Random effects	Fixed firm effects	Random effects	Fixed firm effects
Cfratio	.0817506 2.089	.0421787 0.972	.0134804 0.500	-.0108182 -0.362
Ltlev	.158416 3.340	.1359057 2.672	.0558594 1.670	.0877992 2.398
Stlev	-.1024555 -2.126	-.1285672 -2.477	-.1297774 -3.750	-.1422015 -3.800
Rdratio	.4812984 8.406	.4959705 7.682		
MTBV			.0002276 0.915	.000015 0.055
year dummies	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes
Haussman test (p-value)	0.0370		0.0106	
Number of obs	928	928	1777	1777

Columns 1 and 2 of Table 4 presents the panel estimates based on R&D spending as a proxy for growth opportunities. The results of the Haussman test suggest that the fixed effects regression is the preferred specification; however, the coefficient estimates are similar in the two specifications. Long-term leverage enters with a positive sign and is significant. Interestingly, short-term leverage enters negatively and is significant in both specifications. Cash flow enters positively. It is significant in the random effects version of the model but not in the fixed effects version. As expected R&D enters positively and is highly significant in both the random effects and fixed effects versions of the model. is no longer significant. Short-term leverage has a negative coefficient and is significant. The market to book ratio enters positively but is insignificant. This tends to confirm our reservations expressed about this measure as a proxy for growth opportunities. Finally, cash flow enters positively in the random effects version of the model but negatively in the fixed effects version. In both cases it is insignificant.

The results of these panel estimates tend to confirm the main conclusions tentatively reached on the basis of the OLS regressions. We find significant evidence of a positive relationship between long-term leverage and liquid asset holding. This is consistent with the presence of a precautionary motive for holding liquid assets for firms that maintain high leverage as a durable feature of their capital structure. Beyond this there seems to be evidence of a

negative relationship between short-term leverage and asset liquidity. This suggests that short term debt and liquid asset holding may be substitutes in the sense that a firm facing persistently low cash flows will respond either by drawing down available liquid assets or by accumulating short term debt or both.

Another point that emerges from our analysis of the panel data set of UK firms is that the relationship between cash flow and liquid asset holding does not appear to be stable or robust. In the results reported here as well as in our experiments with alternative specifications of the model, we found that the estimate of the cash flow were sometime positive, sometimes negative and often insignificant. Our theoretical analysis of Section 3 suggests that this should not be surprising.

4.4 Testing based on a panel of Belgian firms

To further study the determinants of the firm's choice of liquid asset holding we have extended our analysis to an unbalanced panel data set of listed Belgian firms. This is based on the annual financial reports of Belgian firms for 1986 through 1999 as compiled by the National Bank of Belgium. From this data set we have selected non-financial firms that have been listed on the Belgian stock exchange. As in the case of the UK data, the focus on listed firms meant that we have studied relatively large firms which had access to capital markets and which might provide data on R&D spending (our main proxy for growth opportunities). It should be noted that by excluding non-financial firms we have excluded many of the largest Belgian firms which collectively have represented a large share of Belgium's total market capitalization.

In order to aid comparability of results we have tried to work with variables that are as close as possible to those we have used in our UK data base. In most cases the correspondence is close, but several differences should be noted. Most importantly, Belgian financial reports define short-term debt as payable within one year and all other debt considered long-term. Thus there is no measure directly comparable that for the UK which indicated debts of greater than five years.

In comparing Belgian and British measure of firm debt's we are alerted to possible ambiguities in what is meant by long-term and short-term debt. For example, if a firm has negotiated a revolving credit facility, by drawing upon the facility it may create a short-term liability even though maintaining some relatively high level of this liability may be a permanent feature of its capital structure.

Another feature of the NBB data set is that it does not include measures of the market value of the equity. Therefore, we have been unable to use market to book ratio as a proxy for growth opportunities. Given our conceptual reservations about this measure and the rather unstable results obtained for it in the UK data set, we do not consider this a major limitation of our study of Belgian firms.

As with our study of UK firms estimate the linear regression model of the determinants of the ratio of liquid assets to total assets. Estimates are obtained both by the method of ordinary least squares and by panel methods. In studying the descriptive statistics of our variables we have found evidence of outliers, which might be attributable to reporting or

coding errors. All the results we report are based on the trimmed sample with these apparent outliers eliminated.

4.5 Belgian results

Before attempting to explain the determinant of liquidity, it is useful to point out an important apparent difference between our UK and Belgian data sets. Table 5 reports the quartiles of the distribution of liquidity ratio for these two data sets. Based on these data we see that the level of liquid asset holding of Belgian listed non-financial companies appears to be considerably higher than that of their UK counterparts. For example, the median liquid asset holding is 11% in Belgium versus 7% in the UK. The high end of the distribution is quite surprising. About 25% of Belgian non-financial firms hold at least 23% of their assets in liquid form. In contrast, the top quartile of UK firms holds at least 14% of their assets in liquid form. These observations are sufficient to point out that liquid asset holding even for industrial and commercial firms can be quite substantial.

Table 5: Comparisons of corporate liquidity (ratio of liquid assets to total assets)

	25^{th} percentile	median	75^{th} percentile
UK	0.034	0.074	0.140
Belgium	0.048	0.111	0.233

The results of estimating the linear model of the determinants of liquid asset holding are reported in Table 6. Column 1 is devoted to variables included in the regressions are the same for each column. The columns differ with respect to estimation method. Otherwise the specifications of the models are identical.

We find a positive and significant relationship between the level of liquid asset holding and growth opportunities as proxied by R&D spending. We also find a positive and significant relationship with respect to short term leverage. In contrast, we find that long-term leverage enters negatively and is insignificant once firm effects (either fixed or random) are introduced to the regression. Cash flow ratio enters negatively in the OLS estimates but positively in the panel estimates.

Table 6: Belgian firms, Trimmed-sample regressions, dependent variable liquidity ratio (t-statistics or z-statistics under parameter estimates)

	OLS	Fixed effects	Random Effects
Cfratio	-.00686	.14574	.13186
	2.06	3.53	1.94
Ltlev	-.26516	-.04239	-.07017
	-6.12	-0.90	-1.56
Stlev	.22697	.22427	.21859
	5.88	5.59	5.67
Rdratio	.63488	1.5258	1.2858
	1.60	2.61	2.40
year dummies	yes	yes	yes
industry dummies	yes	yes	yes
Adjusted R^2	0.8674		
Number of observations	888	888	888
Haussman text (p-value)			0.9528

The main apparent difference between the results we have obtained for Belgian firms and those we obtained UK data set is the reversal of sign patterns for long-term and short-term leverage. There is no obvious or simple accounting for this. One possible source of discrepancy that we have already noted is that long-term liabilities coming due in one year or more for Belgian data whereas in the UK data set it pertains to debts greater than 5 years. However, it is not clear why this difference, in itself, explains the fact that short-term debt is positively associated with liquid asset holding in Belgium; whereas, in the UK it is long-term debt that is positively associated with leverage. Rather, it seems that our results point to some other institutional differences between the Belgian and UK contexts that are masked by the standard accounting definitions.

We have already mentioned the potential problem that a long-term revolving credit facility might be recorded as short-term debt even though it is a permanent feature of the firm's capital structure. Thus if this kind of arrangement more prevalent in Belgium as compared to the UK we might better understand why in Belgium it appears that short-term debt creates a strong precautionary motive for liquid asset holding. Unfortunately, our data does not allow us to determine whether this conjecture is correct. Therefore, this issue must await further study for clarification.

Finally, we note that in Table 6 the cash flow variable enters negatively in the OLS regression. In the panel estimates the sign of this variable becomes positive. This apparent

sensitivity of this variable to changes of specification or estimation method was observed with UK data and has been given an interpretation in our analytical discussion of Section 3.

5. Implications

It is useful to summarize the main stylised facts about corporate liquid asset holdings that emerge from the analysis of the preceding sections. First, within the universe of non-financial firms there are substantial differences across firms and across countries in the proportion of assets that are held in liquid form. Second, there appears to be a strong and robust positive relationship between the presence of growth opportunities and corporate liquidity. Third, cash flow volatility appears to be positively associated with liquid asset holding. Fourth, there does not appear to be a stable or robust relationship between cash flow and corporate liquidity. Fifth, US studies a negative relation between leverage and corporate liquidity; whereas, our studies of British and Belgian firms found evidence of a positive relationship between leverage and corporate liquidity.

This last observation highlights an issue that deserves further careful study. Our analysis of Belgian and UK firms shows that for the purposes of understanding corporate liquidity it is very important to differentiate debt according to maturity. The US studies used measures of leverage which combined debts of all maturities. Thus, it would be very interesting to reconsider the US data studied by Kim et.al. and Opler et.al. allowing for long-term and short-term leverage. Furthermore, it would be interesting to study the implications for corporate liquidity of finer indicators of capital structure, e.g., bank versus other debt, use of callable debt, or convertibles.

Thus our understanding of the way capital structure impacts corporate holding of liquid assets is still incomplete. Nevertheless, we believe that analysis in this paper clearly raises the possibility of an important precautionary motive for corporate liquidity in environments where access to external capital is costly. In particular, we have identified a channel that operates as follows: Liquidity grants a survival option to the shareholders of the levered firm. Consequently, these shareholders will choose a higher level of asset liquidity than would maximize the value of the firm. In so doing, they reduce the rate of return on assets and the growth of the firm. This effect is more pronounced the greater is the leverage used by the firm. Furthermore, it is more pronounced the more rigid is the financial structure and the more costly is accessing external financial markets.

In this section we draw out some of the possible implications of this channel. In this regard our analysis adds to the work on international comparisons of financial development as a determinant of differences in economic growth rates. In that literature, the study that most clearly links differences in *corporate growth* to the institutions of the financial sector is that of Rajan and Zingales (1999). That study did not specifically explore the channel that we have identified here. However, implicitly their earlier international comparison capital structure (Rajan and Zingales (1995)) did produce some results that are suggestive that this channel may be important. In particular, in that study they found when leverage is measured as non-equity liabilities divided by total assets, "the Anglo-American economies have considerably lower median leverage in 1991 (about 0.56) than companies in Continental Europe and Japan (0.70)." (Rajan and Zingales (1995), p. 1429). However, when they

deduct liquid asset holding from non-equity liabilities, they find that the leverage levels are similar across the countries. If anything Germany emerges as a low level country. *By implication high leverage is associated with high levels of liquid assets.*

We still do not have a complete understanding of what accounts for differences in leverage or other aspects of financial structure across countries. The study of Rajan and Zingales (1995) suggest that the traditional break-down between bank-based and market-based systems is at best only a crude explanation of observed differences. It is likely that differences tax incentives and ownership patterns (e.g. family and interlinked coalitions of investors versus dispersed ownership) account for more of these differences. Our highlighting the presence of a structure-liquidity-growth linkage brings an additional dimension to observations about institutional differences across financial systems.

Regarding the difference between bank-based versus market-based systems, our analysis suggests that a crucial aspect of financial structure will be the flexibility that it affords the firm in dealing with periods of cash flow short-fall. If close relationships to creditors mean that firms will be able to access additional credit during these periods, then this softens the precautionary motive for corporate liquidity. While this may be a potential advantage of systems based on close banking relationships, the recent work by Edwards and Fischer on German financial systems raises doubts about whether the *haus-bank* relationship really affords this flexibility.

Another important observation that has emerged from international comparisons of corporate financial practices is that some systems are characterised by structures that help to perpetuate the effective control over firms by family groups or other coalitions of investors. This appears to be what accounts for the prevalence of pyramids and interlinked ownership structures in some continental European systems. Our analysis points out a hidden implication of the reliance on debt finance in order to concentrate control rights over the firm in the hands of specific investors. If investor groups attempt retain control a firm through the heavy reliance on debt, they may be forced to maintaining a higher degree of asset liquidity than they would otherwise. In so doing they may be undermining the subsequent growth rates of the firm and condemning the firm to ultimate stagnation.

Our analysis also puts the widely observed growth of European equity markets in a new light. If equity market development has effectively brought down the barriers to equity finance for a wider range of firms, this potentially could have an important and long-lasting impact on the growth potential of these firms. If this source of finance effectively reduces the observed leverage levels, it also reduces the precautionary incentive for corporate liquidity. Firms may be freer in channelling their available cash flow into riskier positive NPV investment opportunities. Furthermore, our analysis points out one of the favourable consequences of equity based finance is that it can be growth promoting *even if new equity issuance is not the direct source of finance for risky projects.* By simply creating a structure whereby retentions can be channelled into risky projects rather than low return liquid assets, firm growth is promoted.

While our empirical analysis has focused on listed firms for reasons of data reliability, the capital structure-liquidity-growth channel we have identified can be at least as important for smaller firms with strong growth potential. Our analysis suggests that the environment may be seriously growth inhibiting if the only effective means of financing growth at early stages of the firm is through debt. For with increased leverage brings a stronger liquidity bias thus

potentially reducing the growth trajectory of the firm. In this regard, the emergence of private equity and venture capital are potentially very important developments for the growth of European firms. When these financing methods operate well, they can create much greater flexibility than traditional debt based financial structures. In so doing, they may allow the firm to operate with a smaller proportion of their assets tied up in liquid form. This can help in achieving higher average returns on assets and allow the firm to reach more quickly the stage where public equity issuance is feasible. In making this observation we do not wish to give the impression that these financial modes are a panacea for promoting economic growth. In practice the private equity financial structures impose tight constraints on the firm if the interests of investors are effectively protected (see Gilson 2000). Nevertheless, we feel it is important to point out that adding these investment modes as an alternatives to straight debt finance is potentially a deeply growth-promoting development.

6. Conclusion

In this paper we have identified a channel between financial structure and corporate growth which operates through the firm's choice of liquid asset holding. We have developed this idea first through a theoretical analysis of a dynamic model of the firm's choice of dividends and accumulation of liquid assets. In this model we see that the precautionary motive for corporate liquidity means that higher leverage will tend to be associated with higher average levels of liquid assets. We explore this idea empirically by studying two panel data sets, one based on UK listed firms and the other based on Belgian listed firms. The results revealed *positive* associations between leverage and liquid asset holding, thus running counter to previous studies based on US data which documented a negative relationship between total leverage and corporate liquidity. While reconciling these differences will require further study, our results clearly raise the prospect that the link between financial structure and corporate liquidity exits. In the final section of the paper we have drawn out the implications of this linkage and have identified some prominent features of the European financial landscape that may be seriously growth inhibiting while suggesting other features that may be growth promoting. These observations are necessarily somewhat speculative in nature. It is hope that the present paper will help to stimulate further study of these issues, as we believe that they contain many exciting avenues of inquiry that would repay serious research efforts.

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