CASH HOLDINGS, CAPITAL STRUCTURE AND FINANCIAL FLEXIBILITY

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ABSTRACT

This thesis is structured into two main parts to investigate the role of financial flexibility in firms' liquidity and financing management. Financial flexibility is the most important practical determinant to managers when they make financing decisions. This missing link, financial flexibility, is identified by practitioners and used in this thesis to fill the missing gap between theory and practice in corporate finance. Part A of this thesis analyses the trends in firms' *internal financial flexibility* and examines the role of this internal flexibility on *investment behaviour* of firms. Part B of this thesis then move on to examine the role of both *internal and external financial flexibility* on firms' *financing behaviour*.

Part A examines the relationship between debt capacity and cash as part of firms' internal financial flexibility. Firms use both debt capacity and cash holdings for their internal flexibility management; and debt capacity is used here to explain the trends observed in cash holdings. Debt capacity is the most important determinant of cash holdings and has better ability to predict cash level compared to conventional cash determinants. Together, both debt capacity and cash contribute to firms' internal financial flexibility and are able to explain most of firms' investment behaviour, even during a recession period.

Part B examines the role of financial flexibility in capital structure decisions. Financial flexibility is measured internally as cash and debt capacity, and externally as equity liquidity using a novel external equity flexibility index based on common equity liquidity measures. The conventional pecking order and trade-off models are used to measure the impact of financial flexibility on firms' capital structure. The pecking order theory is contingent upon firms' internal flexibility – debt capacity. Finally, supporting the notion that financial flexibility is the most important consideration in financing decisions, debt capacity and external equity flexibility are shown to be the most important determinants of leverage.

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PART A

Debt Capacity and Corporate Cash holdings

ABSTRACT A

Using a sample of public US firms over the period 1980 to 2008, the relationship between debt capacity and corporate cash holdings as part of firms' internal financial flexibility is examined. Evidence found substantial substitution effect between debt capacity and cash, and the historical trend of cash appears to mirror that of debt capacity. The negative relationship between debt capacity and cash is robust even after considering conventional cash determinants such as firm size and idiosyncratic risk. Debt capacity is the most important cash determinant and the relationship between cash and conventional variables is weakened once debt capacity is considered. When financial constraints are considered, it is found that previous cash determinants are only useful in explaining cash holdings of constrained firms, while debt capacity remains a significant variable for both constrained and unconstrained firms. Furthermore, debt capacity is found to have better predictive ability for cash holdings. The relationship between cash and debt capacity is proven robust even across different industry groups. Together, both debt capacity and cash are found to explain most of the changes in investment behaviour. However, during a recession, debt capacity increases firm value by increasing firms' ability to invest during the recession, while cash may take on a more precautionary role, for operational requirements rather than investment need, by cushioning the drop in cash flows during the recession.

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Abbreviation List

ACQUI	Acquisition to total assets ratio
ADJ R-SQ	Adjusted R Squared statistics
BKDEBT	Book value of debt to total assets ratio
BKS	Bates Khale and Stulz (2009)
CAPEX	Capital expenditure to total assets ratio
CASH	Cash to total assets ratio
CFe	Cash flow to total assets ratio (computed using earnings method)
CFcf	Net cash flow to total assets ratio (computed using income method)
CRSP	The Center for Research in Security Prices
DC	Debt capacity to total assets ratio
DCASH	Change in cash to total assets ratio
DEF	Financing deficit
DIVDUM	Dividend dummy
FE	Fixed effects regression
FM	Fama McBeth regression
INDSTDCF	Industry cash flow volatility
INVTMT	Gross investment ratio
IPO	Initial public offering
IF	Internal flexibility
LAG(var)	Lagged variable by one period, e.g. LAGCASH, LAGDC
LNAT	Natural logarithm of total assets
LNCASH _NETASSET	Natural logarithm of cash to net assets ratio
NINVTMT	Net investment ratio
NWC	Net working capital
OBS	Observations (in number)
OLS	Ordinary least square regression
SIC	Standard industry classification code
R&D	Research and development
R-SQ	R squared statistics
RD_SALE	Research and development expenses to total sales ratio
Q	Q ratio (also known as market-to-book assets ratio)
UDC	Unused debt capacity to total assets ratio
VIF	Variance inflation factor
∆DEBT	Net debt issues to total assets ratio
∆EQUITY	Net equity issues to total assets ratio

The following abbreviation follows the variable labels in CRSP/Compustat Fundamentals Annual database for items reported in the financial statements of firms.

AT	Total assets
AQC	Acquisition expense
CAPX	Capital expenditure
CEQ	Book value of equity
CHE	Cash and cash equivalents (marketable securities)
CSHO	Common shares outstanding
DLC	Long-term portion of current debt
DLT	Long-term debt
DPC	Depreciation and amortization
DVC	Common dividend issued
EBITDA	Earnings before interest, depreciation and amortization
ESUBC	Equity in net loss (earnings)
IBC	Income before extraordinary items
INVT	Inventory
IVCH	Increase in investment
RECT	Receivables
PPENT	Property, Plant and Equipment
PRCC_F	Equity price at financial year end
PRSTKC	Purchase of common and preferred equity
SALE	Total sales
SSPIC	Gains (loss) from sale of property, plant and equipment, and investment
SSPIV	Sale of property, plant and equipment, and investment
SSTK	Sale of common and preferred equity
TXDC	Deferred tax
TXT	Tax expense
WCAD	Working capital
XIDOC	Extra items and discontinued operations
XINT	Interest expense
XRD	Research and development expense

CHAPTER A1. INTRODUCTION

Practical determinants of capital structure have been under the spotlight since the survey of 392 CFOs of the top US corporations by Graham and Harvey (2001). According to this survey, the most important debt policy factors are (1) financial flexibility (60%), (2) credit rating (57%), (3) earnings and cash flow volatility (47%), and (4) insufficient internal funds (46%). These top four factors are all related to firms' liquidity, cash flow and the ability to secure future funds. Subsequent surveys in the European context (Bancel and Mittoo, 2004, Brounen et al., 2004) found similar importance of liquidity factors in firm's financing decisions. More recent surveys study firms' internal flexibility management directly by looking at the use of cash and credit facilities, and the practical considerations and interactions between them in face of crisis and external shocks (Bancel and Mittoo, 2011, Campello et al., 2011, Lins et al., 2010).

In general terms, financial flexibility relates to a firm's overall financial structure and whether there is sufficient flexibility to take advantage of or counter unforeseen opportunities or conditions. In order to value flexibility, Gamba and Triantis (2008) defined it as the "ability of a firm to access and restructure its financing at a low cost; these firms are able to avoid financial distress in the face of negative shocks, and to fund investment readily when profitable opportunities arise." Flexibility enables firms to respond in a timely manner to maximise firm value (Byoun, May 2008).

The two most common proxies used to measure internal financial flexibility are cash-on-hand and leverage in terms of used/unused credit line and debt capacity. This internal component is influenced by the volatility of cash and earnings, and managerial discretion and preference over a firm's liquidity position. In general, cash holdings and expected future cash flow are used to assess firms' ability to meet downside risk, while credit line and debt capacity are used in appraising firms' performance through their investment ability at the upside. However, past studies examine cash and debt capacity separately and little is known about the interaction between the two most important components of internal liquidity. Both cash and debt capacity provide reliable sources of liquidity for firms but the relationship between them is "neither simple nor mechanical" (Lins et al., 2010). While papers studying cash policies have surged in recent corporate finance research (e.g. Almeida et al., 2004, Bates et al., 2009, Denis and Sibilkov, 2010, Faulkender and Wang, 2006), credit line and debt capacity are not in the limelight for the practical reason of data unavailability[1] and measurement difficulty[2] respectively. Recent studies on lines of credit include Sufi (2009) and Acharya et al. (Feb 2012). Sufi (2009) analysed the interaction between cash and bank lines of credit (both total credit and unused credit) and finds that the relationship between the two is influenced by a firm's cash flow and cash flow volatility.[3] In other words, although the two instruments are used in internal liquidity management, cash and bank credit are not perfect substitutes for each other depending on firm's cash flow position.

For the cash component, Bates et al. (2009) provided evidence of a significant increase in cash holdings over time. Increase in idiosyncratic risks is found to be the main driver behind the increase in cash, with a precautionary motive. However, according to the internal financial flexibility hypothesis, this trend may possibly be

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[1] Data on lines of credit are only available on the Thomson Reuters' Dealscan database and are limited to large firms which report their total and unused committed credit line in their financial reports.
[2] There are variations in the measurement of debt capacity in the literature. Proxies for debt capacity include credit rating, lagged leverage level, total assets, financial distress measures, and financial constraints index, e.g. Whited and Wu (2006).
[3] Due to data availability, the sample used in Sufi (2009) is limited to larger firms.

explained by the fall in debt capacity over time. Due to the change in nature of business formed, average debt capacity of US firms fell over time. As such, firms have to hold more cash. The general trend of increased cash holdings over time may be due to increased credit constraints faced by firms. Eliminating the periodic trend, firms with lower debt capacities are found to hold greater cash at any particular point in time. Firms' declining borrowing capacity may be due to (1) debt requiring higher risk premium such that more collateral is required for each unit of debt raised, or (2) a change in business asset structure such that firms now hold fewer tangible assets compared to the past. The latter conjecture is supported by the negative relationship between cash and debt capacity, where firms are found to have lower debt capacities and, consequently, greater cash holdings. At the same time, firms are found to exhibit increasing dispersion in their internal characteristics. Instead of behaving like their peers and appearing in clusters, firms are more dissimilar over time.

The relationship between cash and debt capacity is important because it contributes to the dynamics of internal financial flexibility. Debt capacity is dependent on the nature of firms' assets and considered a more stable and predictable characteristic of a firm. On the other hand, cash is easily varied periodically and is more susceptible to change according to changes to cash flow and profitability. Since cash and debt capacity are partial substitutes for each other, firms often make decisions to balance between the two; and since level of cash is more changeable compared to debt capacity, it is hypothesized that the amount of cash held depends largely on debt capacity in the same period. This effectively makes debt capacity an important determinant of cash holdings.

The sample used in this thesis is first matched with the Bates, Khale and Stulz (2009) (henceforth BKS) sample. In order to understand the internal flexibility dynamics, time series analysis of cash and debt capacity is first performed. Similar to BKS, a significant increased in cash holdings since 1970s is reported. During the same period, debt capacity follows a falling trend which almost mirrors that of cash holdings in the opposite direction. Subsequent analyses on the interaction between cash and debt capacity clearly show a negative substitution effect between the two instruments. Following BKS, firm size, cash flow and idiosyncratic risks (measured using industry cash flow volatility) are used to help explain the trend in cash holdings. However, when debt capacity is included, these conventional firm characteristics do not remain robust in terms of their impact on cash holdings.

After supportive univariate evidence, the base cash model adapted from BKS is performed and results support the transactional, firm value and strategic motives of holding cash. Precautionary cash holdings are no longer important once firm and year fixed effects are considered. Following on, debt capacity is included in the cash model and has the greatest impact on cash holdings (even more than industry cash flow volatility). While BKS showed that increased in cash holdings in due mainly to changes in net working capital, cash flow volatility, capital expenditure and research and development expenses, these variables no longer significantly predict cash holdings once debt capacity is considered. There is a large substitution effect present between cash and debt capacity for a firm’s precautionary purposes. In the lagged cash model, evidence suggests that cash decisions are current decisions made by managers based on existing firm conditions.

As both debt capacity and industry cash flow volatility are found to be important cash determinants, further tests are performed using orthogonalized cash regressions to distinguish the actual effect of each variable on cash. The orthogonalized regressions provide evidence to show that debt capacity has greater impact on cash compared to volatility. Volatility has reduced impact on cash holdings after controlling for debt capacity, suggesting that the impact of volatility on cash holdings is partially dependent on the level of debt capacity. To investigate the actual impact of debt capacity and volatility on cash further, additional tests are performed with an interaction term between debt capacity and volatility. Results from the interaction term show that debt capacity is important in cash management, while cash flow volatility may only be an important determinant under certain conditions, for instance lower debt capacity.

Chapter A5 moves to split the sample via commonly used financial constraint criteria. Division of firms into credit constrained and unconstrained categories allow us to examine the effect of financial constraints on the relationship between cash and debt capacity. The sample and financial constraint criterion is first matched with Campello et al. (2011). The cash models performed across firms with varying financial constraints show that industry cash flow volatility is a more important cash determinant for constrained firms. Evidence suggests that constrained firms consider funding from leverage and cash as substitutes for each other more than unconstrained firms; and investments are funded proportionately more by cash in constrained firms. When debt capacity is considered, previous important cash determinants – cash flow volatility, net working capital, and capital expenditure - are no longer significant in explaining cash level in unconstrained firms, while debt capacity and research and development expenses remain significant (although of different magnitude) for all firms. The substitution effect between debt capacity and cash is larger when firms have greater financial constraints.

Moving on, the modified cash model is used in Chapter A6 to predict cash holdings in order to determine if the new model predicts cash holdings better than the original BKS model. The original BKS model is found to predict cash holdings better for constrained firms. The modified model (with debt capacity) performs better and reports predicted cash holdings that are closer to actual ratios. The estimated contribution from the determinants in the modified model matches the actual change in cash better, where the change in cash over time is largely explained by corresponding change in debt capacity alone. The results confirm that debt capacity is an important determinant of cash, helps predict cash holdings better and has the ability to replace previous determinants and explain a substantial part of the variance in cash.

After the series of cash regressions and the proven trade-off between cash and debt capacity, Chapter A7 performs the reverse model using debt capacity as the dependent variable because the bivariate Granger test shows a significant feedback relationship between cash and debt capacity. The debt capacity model is adapted from Campello et al. (2011) and Sufi (2009). Unused debt capacity is further used to test the reverse-causality effect between cash and debt capacity.

Cash flow, previously identified as an important determinant of debt capacity, is found to have little impact on debt capacity when cash and cash flow risk are considered, since the bulk of the variance is explained by the latter two variables. The impact of cash holdings on debt capacity remains similar for constrained and unconstrained firms. Results support the hypothesis that debt capacity is a first-level variable that exhibits less periodic changes compared to the second-level variable cash which can be monitored and adjusted in each period. Results from the unused debt capacity models support the trade-off between cash and debt capacity as firms use less of their borrowing capacity when cash holdings are higher; while less use of debt capacity cannot cause firms to have greater cash on hand, reverse-causality is eliminated. The reverse causality problem is also more prominent for constrained firms, since the use of debt capacity is more likely to add positively to cash holdings because constrained firms have less ability to preserve capacity without restrictions.

In the final series of cash and debt capacity analysis in Chapter A8, industry effect is considered because univariate analysis shows significant variation in the level of cash and debt capacity held by firms across different industries, The time trend analysis of average cash over time shows cash increasing at a significant rate only for certain industries. The substitution effect is the greatest in software, biotechnology and manufacturing industries because high technology industry has large intangibles and research and development activities that contribute little to firms' borrowing capacity, and cash is an important source of funding for investments, while the manufacturing firms hold higher cash for competitive reasons to prevent losing valuable investment opportunities and market share (Haushalter et al., 2007).

Finally, Chapter A9 investigates the effect of cash and debt capacity on investments over the entire sample and during recessionary periods. Earlier studies have found that firms with greater unused borrowing capacity perform better in the long run because they can invest more (Denis and McKeon, March 2012, Marchica and Mura, 2010). In the face of negative shocks, firms with greater financial flexibility are able to withstand external shocks and perform better with greater pools of cash (Campello et al., 2011, Harford et al., April 2003) and unused debt capacity (Arslana et al., 2011). Results from the investment model show that cash and debt capacity account for most of the changes in investment, while other variables exhibit trivial impact. Supporting the credit multiplier effect (Almeida and Campello, 2007), debt capacity is found to have greater impact on investment compared to cash. The results are extended to the investment model with recessionary impact as debt capacity is found to positively impact investment during recession, but cash is not found to positively influence investment during recession.

The remainder of this thesis is organized as follows. The next Chapter reviews the internal flexibility theories, describes the measurements for cash and debt capacity, and reports the sample and detailed variable definitions. Chapter A3 gives basic descriptive statistics of the data and analyses the periodic and cross-sectional trend of cash and debt capacity. Chapter A4 presents the cash regression specifications and results to investigate the determinants of cash. Chapter A5 investigates the interaction between internal flexibility and financial constraints; and Chapter A6 uses the adapted model to predict cash holdings. Chapter A7 presents the debt capacity models and results to examine the reverse causality between debt capacity and cash. Chapter A8 investigates the interaction of internal flexibility with industry effect, and Chapter A9 investigates the use of cash and debt capacity in investment activities. Finally, Chapter A10 concludes the thesis.

CHAPTER A2. INTERNAL FLEXIBILITY: DEBT CAPACITY AND CASH HOLDINGS

In practice, liquidity constraints play a critical role in financing decisions because managers are forward-looking and consider the expected liquidity position of their firms in future periods when making financing decisions. Forward-looking financing decisions involve consideration of the opportunity cost of the consequent future inability to borrow if a decision to borrow is made in the current period (DeAngelo et al., 2011). This suggests that a borrowing cost incurred by firms not only includes the usual floatation cost but also the opportunity cost, which is the main reason why firms preserve debt capacity and hold more cash. Recent survey evidence (Campello et al., 2010) supports the view that managers preserve debt capacity both for future use and to maintain a strong reputation. This preserves untapped credit lines and avoids potential denial of new sources of funding or new investors. During the most recent financial crisis, 81% of the surveyed constrained firms have limited access to credit with more than half having problems finding new sources of funds, thereby resulting in heavy usage of internal funds, both cash holdings and new cash flows (Campello et al., 2010). Evidently, practical constraints affect financing decisions and even more so during a credit crisis. Preserving financial flexibility thus becomes a first order consideration.

A2.1 Internal flexibility motives

Conventionally, there are four motives of firms holding cash – precautionary, transaction, tax and agency. These motives may be used in a similar manner for preservation of debt capacity. Here, we theoretically identify and differentiate the different factors behind holding cash and debt capacity. In addition to the four conventional motives, we list the recent grounds for cash and debt capacity to explain collectively the purpose of preserving internal flexibility.

A2.1.1 Precautionary motive

Precautionary purpose is probably the most important practical reason behind holding cash. In the literature, many papers have identified firms which are more likely to hold extra cash, e.g. firms with low and/or more volatile cash flow (Bates et al., 2009, Han and Qiu, 2007, Opler et al., 1999), poor access to external capital (Opler et al., 1999), undervalued equity (Acharya et al., 2007, Almeida et al., 2004), greater yet financially constrained investment opportunities (Denis and Sibilkov, 2010), or consistent dividend payout policies (Lins et al., 2010). With the exception of dividend paying firms, the above effectively characterise financially constrained firms. More cash is held when firms are financially constrained. Notwithstanding the numerous measures for financial constraints in the literature (e.g. firm size, credit rating, dividend policy, Kaplan and Zingales (1997) index, cash flow sensitivity of cash), firms with greater constraints and higher probability of distress are found to hold cash for flexibility because debt capacity is a poor substitute for cash in these firms (Sufi, 2009). On the other hand, debt capacity is maintained by financially unconstrained firms to ‘safeguard’ investment opportunities and fund future growth options (Lins et al., 2010). The debt capacity precautionary motive preserves a firm’s ability to invest and reduces the opportunity costs involved when valuable projects are missed due to insufficient funds.

A2.1.2 Transaction motive

Conventional models of finance advocate the importance of transaction costs in firms' financing decisions. Due to the cost in converting non-cash assets into cash, firms hold cash for liquidity purposes and this is more prominent in smaller firms because large firms enjoy economies of scale in the conversion of assets (Baumol, 1952, Meltzer, 1963, Miller and Orr, 1966). Accordingly, operational cash holdings should make up a substantial portion of cash held by firms to avoid transaction costs because ad-hoc non-operational cash requirements are difficult to predict, and holding cash for non-operational purposes incurs substantial costs (e.g. tax and agency costs). Debt capacity, on the other hand, may be preserved for non-operational purposes and tapped only when funds are needed. Debt is generally less expensive than equity; and private issues are cheaper than public issues. As such, firms preserve debt capacity to avoid expensive public issues. Similar to the transactional motive for cash, smaller firms have greater tendency to maintain debt capacity, because these firms have limited access to the capital market and less negotiating power with underwriters and banks. In general, the transaction motive of holding cash and preserving debt capacity is important because it prevents unnecessary fire sales of assets which generate lower than true value cash and result in investors' negative sentiment and signalling. Recent empirical evidence suggests that the presence of transactional costs alters firms' financial policy because firms owners prefer lower fixed costs when sourcing for funds (Faulkender and Wang, 2006).

A2.1.3 Tax motive

Multinational firms hold greater cash to avoid higher tax rates when repatriating their foreign earnings. This is more prominent for financially unconstrained firms and technology intensive multinational firms (Foley et al., 2007). However, for the majority of domestic firms, holding large amounts of cash involves taxes on interest income, while debt allows for deductible interest payments (Demiroglua and James, 2011, Riddick and Whited, 2009). Thus, some firms prefer using credit line or debt capacity instead of cash for internal liquidity management. The tax argument effectively puts cash and debt capacity as substitutes for each other.

A2.1.4 Agency motive

Managers' preference for large cash-on-hand is the conventional agency argument of the high cash holdings held by firms. Jensen (1986) argues that entrenched managers prefer retaining cash within the firm rather than increasing dividend payments to shareholders. Cash holdings are larger when the agency problem is greater. The agency argument for holding large amount of cash within firms has been extensively researched (e.g. Blanchard and Lopez-de-Silanes, 1994, Dittmar and Mahrt-Smith, 2007, Dittmar et al., 2003, Harford, 1999, Harford et al., 2008, Kalcheva and Lins, 2007, Opler et al., 1999, Pinkowitz et al., 2006). On the other hand, the agency problem may also be used to explain the large debt capacity preserved by firms. Entrenched managers are more likely to resist debt financing, thereby keeping a larger portion of debt capacity unused, because debt instruments constrain managers' behaviour and actions. Zweibel (1996) reported that firms with high equity value or recent equity issue are likely to resist debt financing. Furthermore, lines of credit reduce the agency problem caused by large cash holdings because the bank imposes covenants and closer monitoring when committed credit lines have been issued (Demiroglua and James, 2011, Sufi, 2009, Yun, 2009). Following this argument, entrenched managers would try to reduce the level of committed credit and prefer to keep a larger portion of debt capacity unused yet conditional. This conditional form of liquidity is then exercised when the firm is performing well enough to satisfy covenant restrictions (Sufi, 2009).

A2.1.5 Firm value motive

Maintenance of financial flexibility directly affects a firm's financing decisions (Graham and Harvey, 2001). Financial flexibility has positive impact on firm value, especially for firms with low capital or low profitability (younger or financially constrained firms) (Gamba and Triantis, 2008). Unused debt capacity boosts firms' financial flexibility, allowing them to make better investments and add positively to firm value (Marchica and Mura, 2010), even more so compared to investments made using cash-on-hand (Demiroglua and James, 2011). Similarly, firms with high cash and conservative leverage policy are found to perform better due to their ability to invest better (Arslana et al., 2011), and firms with excess cash and better investments have greater stock returns (Simutin, 2010). Therefore, the firm value motive may be a practical reason behind firms' high cash and low leverage (i.e. high debt capacity) policy because such policy adds to firm value through valuable financial flexibility.

A2.1.6 Strategic motive

Firms gain competitive edge against competitors when they have more credit lines because this borrowing capacity lowers expansion costs (Maksimovic, 1990). Strategic benefits of flexibility from both cash and debt capacity suggest that firms may make liquidity choices based on competitors' internal flexibility position, even more so in more competitive industries (Lins et al., 2010). Haushalter et al. (2007) find that firms' predatory behaviour causes them to hold more cash in order to prevent loss of valuable growth opportunities and market share to their rivals. Although this motive is not theoretically determined, empirical evidence suggests that the strategic motive for holding more cash and debt capacity exists, because strategic benefits from better liquidity management enable firms to handle crises and shocks to cash flow better, and to seize investment opportunities in a timely manner.

The above motives postulate that firms actively manage their cash and debt capacity level to maintain sufficient internal flexibility to handle negative shocks and embrace positive opportunities. The relationship between cash and debt capacity thus becomes important because it contributes to the dynamics of internal financial flexibility. Theoretically, debt capacity and cash are perfect substitutes of liquidity for each other. However, debt capacity is subject to the availability of credit and liquidity in external capital markets. Some papers (e.g. Demiroglua and James, 2011, Sufi, 2009) report evidence that debt capacity may not be a viable substitute of cash for all firms; while others report supportive evidence for the trade-off between cash and debt capacity (e.g. Campello et al., 2011, Lins et al., 2010). These mixed results motivate further investigation to determine the relationship between debt capacity and cash holdings.

A2.2 Internal flexibility measures

As defined, internal flexibility comprises of two main components – (1) liquid assets and cash holdings, and (2) credit lines and debt capacity. Inflexibility is caused by the existence of issuance costs, distress costs and financing constraints (mainly a result of asset tangibility) because these costs cause firms to face difficulty or higher costs in seeking external funds when internal funds are insufficient in bad times or for unexpected growth opportunities. Hence, firms seek to preserve flexibility in order to avoid higher costs. Flexibility, however, cannot be attained by holding large internal funds because there are both tax disincentives and agency costs in holding cash. There is tax disincentive to hold cash because interest on cash is taxed at a (higher) corporate level rather than personal level (Gamba and Triantis, 2008); and the tax costs involved in repatriating foreign income are considerably higher (Foley et al., 2007). Agency theory postulates that non-value adding investments using excess cash is harmful to shareholder value (Jensen and Meckling, 1976). Furthermore, there is also an opportunity cost of cash since greater cash holdings reduces current positive investment, (Almeida et al., 2004). Other than cash, firms use debt capacity to maintain internal flexibility. Evidence on preserved unused debt capacity is provided by Sufi (2009), where firms are found to have unused lines of credit twice the size of existing credit. Firms are also found to limit the use of debt to maintain specific credit rating or avoid any change in credit rating (Kisgen, 2007), because the access to capital and choice of debt is related to credit history and current credit quality of firm (Denis and Mihov, 2003).

While both cash and debt capacity provide internal flexibility to firms, their values to firms differ according to firms' current financial position. Recognising the differential cash and debt values, Faulkender and Wang (2006) examine the value of cash holdings with respect to corporate financing using three cash regimes, where the value of cash depends largely on the purpose of each additional dollar of cash held.[4] Marginal value of cash holdings differ significantly across firms with different cash holdings, leverage levels, and access to capital market.

As Almeida and Campello (2007) describes the capacity for external finance generated by new investment is a positive function of the tangibility of firms' assets.[5] Lambrecht and Myers (2008) model a positive relationship between target debt level and closure (book) value of firm explicitly and suggest that debt level is determined by the liquidity of firm's assets at closure and, if book value approximates closure value, debt level will be close to book leverage target. Accordingly, there is a close relationship between the nature and value of assets and debt capacity. Debt capacity is measured as the maximum borrowing capacity of firm, estimated by the value of its assets in liquidation. Since debt capacity and optimal debt levels are constrained by asset illiquidity, the redeployability of assets in times of distress here measures assets' liquidation value (i.e. capacity to command additional debt) instead of the usual accounting measure of tangible assets. The proxy construed for the tangibility measure scaled by total assets is a firm-level measure of expected asset liquidation value from Berger et al. (1996), and used in Almeida and Campello (2007) and Hahn and Lee (2009).

Total debt capacity = Estimated tangibility/Total assets
= [0.715*Receivables (RECT[2]) + 0.547*Inventory (INVT[3]) + 0.535*Property Plant and Equipment (PPE) (PPENT[8]) + Cash holdings (CHE[1])] / (AT[6])[6]

[4] Cash is held by firms for one of the following three purposes - (1) Distribution to equity holders in the form of dividends, (2) Servicing of debt or liabilities, and (3) Investment and raising internal funds to reduce the level of debt and equity issue.
[5] Rationale behind the firm-level credit multiplier and the effect of tangibility can be sourced from the following four arguments – (1) Inalienability of human capital and creditor bargaining power, (2) Information asymmetry, (3) Agency costs, and (4) Moral hazard in project choice (Almeida and Campello, 2007).
[6] The initials beside each parenthesis represent the variable labels in CRSP/Compustat Fundamentals Annual database and its relevant item number in the square brackets. Many papers use the *Industrial* Annual instead of *Fundamentals*

Previous studies (Almeida and Campello, 2007, Hahn and Lee, 2009) use the above tangibility measure of existing assets as a proxy for tangibility of new investment. Rather than using the measure as a proxy, it is implicitly assumed here that it is in fact the tangibility of existing assets that matters because they provide collateral for total firm debt. Due to the hypothesized negative relationship between cash and debt capacity, it is important to separate them into two distinct measures. This also helps to reduce the positive bias in debt capacity since it represents the maximum borrowing capacity if lenders have perfect information. In the imperfect market, actual borrowing capacity is likely to be lower. Debt capacity is measured as follows.

Debt capacity, DC = Tangibility/Total assets

= [0.715*Receivables (RECT[2]) + 0.547*Inventory (INVT[3]) + 0.535*PPE (PPENT[8])] / (AT[6])

Cash, by itself, plays a vital role in dictating total internal capacity.[7] However, cash is an imperfect substitute for debt capacity (Bates et al., 2009, Sufi, 2009). Nevertheless, it gives flexibility to firms with differential access to external markets and different levels of risks. BKS document a dramatic two-fold increase in the average cash ratio for the period 1980 to 2006 in the US,[8] and the precautionary motive to hold cash is the most important determinant of demand of cash because firms face risks that may not be hedged appropriately with little cost.

Annual database, and represent data items using numbers, e.g. long term debt = Item 9 + Item 34 and total assets = item 6. The variable item number is no longer updated and used by CRSP and Compustat after fiscal year 2006, when the sample data are extracted from the Fundamentals Annual database in the Xpressfeed format. As such, relevant variable labels are documented alongside with their old data item numbers. It should be noted that after the change in variable identification, there are some variables which are no longer available as they are combined with other items in the financial statements. Similarly, there are additional new variables which were conventionally reported as part of the variable in the old format, now report separately as individual items.

[7] Cash holdings, CASH, (CHE[1])] equals cash and cash equivalents (marketable securities) reported in the balance sheet of the financial statements.

[8] The four main reasons documented for such significant increase is the fall of inventories and capital expenditure, and increase in cash flow risk and research and development expenses.

Froot et al. (1993) suggest that insufficient internal funds result in two costly alternatives – (1) increasing cost of financing as external funds are sought to maintain investment level, or (2) costly suboptimal investment as external funds are not sought and investment opportunities are forgone (Copeland et al., 2005). Hence, internal funds (cash) should be maintained at an optimal level where the value of flexibility from cash holdings trades off exactly the sum of tax disincentive and agency costs (between managers and shareholders).

In addition, internal flexibility is a result of strategic decisions relating to capital structure, liquidity and investment whilst taking into account corporate and personal tax rates and liquidity value of capital. As such, financially flexible firms should be valued at a premium, (Gamba and Triantis, 2008). Adapting the prior theoretical and empirical evidence (Chan and Chen, 1991, Hahn and Lee, 2009, Lamont et al., 2001, Livdan et al., 2009, Whited and Wu, 2006), it is implicitly assumed that financial inflexibility is a priced risk. As such, pro-active management of internal liquidity has the potential to increase firm value. This impact is relatively larger when there is significant upside growth opportunity or poor performance. Since internal flexibility enables firms to weather exogenous shocks, flexible firms are better equipped to weather recessions and shocks in the credit market. Hence, analysing whether flexibility truly protect firms during a slump and/or boost firms during a boom would substantiate the empirical evidence for the value of internal flexibility that is not well-documented in the literature.

A2.3 Sample and variable definitions

The sample is taken from the WRDS merged CRSP/Compustat files for the period 1980 to 2008. All firms are included with the exception of financial (SIC=69000-

6999), utilities (SIC 4900-4999), and government and non-profitable (SIC=9000-9999) firms, because these firms may face different regulations and have capital requirements that may not be solely due to economic or business motives. Firms with missing or negative total assets (Compustat data item AT[6]) and total sales (Compustat data item SALE[12]) are excluded. Firms that have undergone mergers and acquisitions or have major changes in sales (where footnote of total sales Compustat data item SALE[12] in the financial statement has the code "AB") are excluded.

Outliers for firm variables are winsorized in standard format following BKS and Bharath et al. (2009). Cash ratio is censored at [0,1] where ratio more than one is made equal to one, and ratio less than zero equals zero. Debt capacity is censored at the top tier where ratio more than one is made equal to one.[9] Cash flow ratio (CFe) and net working capital (NWC) ratio are winsorized at the bottom 1% level. Q (market-to-book) ratio is winsorized at the top 1% level. The rest of the ratios (net cash flow to assets (CFcf), R&D to sales, R&D to assets, acquisitions to assets, industry cash flow volatility[10], capital expenditure to assets, and logarithm of cash to net assets) are winsorized at both the top and bottom 1% level. Due to extreme values, gross investment to capital stock and net investment to total assets are winsorized at the top and bottom 5% level.

Computation of variables used in the thesis is as follows.

[9] No negative debt capacity is reported in the sample.

[10] Industry cash flow volatility is computed according to BKS and winsorized at the top and bottom 1% after all computations are performed (standard deviation of cash flow ratio and averaging of standard deviations across industries). Slight variation in the computation of volatility is trialled – (1) standard deviation of cash flow is computed after the cash flow ratio is being treated for outliers (winsorized at the bottom 1%), then average across different industries are taken, or (2) standard deviation of cash flow is computed first and winsorisation is performed on the standard deviations, then average is taken across different industries. These variations in measurements produce the same qualitative results (both univariate and multivariate) and thus are not reported. As specific winsorisation process is not specified in previous papers, the measurement that matches previous results most closely is selected and used for comparison and testing purpose.

1. Cash holdings, CASH, (CHE[1])] equals cash and cash equivalents (marketable securities) reported in the balance sheet of financial statements.

2. Debt capacity (DC) is measured as the maximum borrowing capacity of firm, estimated by the firm-level measure of expected asset liquidation value (less cash holdings) following Berger et al. (1996). Measurement of debt capacity implicitly assumes that it is in fact the tangibility of existing assets that matters because they provide collateral for total firm debt.

   Debt capacity, DC = Tangibility/Total assets
   = [0.715*Receivables (RECT[2]) + 0.547*Inventory (INVT[3]) + 0.535*PPE (PPENT[8]) / (AT[6])[11]

3. Unused debt capacity (UDC) is computed by netting leverage from debt capacity as follow.

   UDC = DC –BKDEBT
   = DC – [Long-term debt (DLTT[9]) + Long-term portion of current debt (DLC[34])]/(AT[6])

   UDC is computed only if value of DC is available. By construction, UDC has a minimum value of negative one and maximum value of one.

4. Industry cash flow volatility, INDSTDCF, measurement follows BKS and is computed as the standard deviation of industry cash flow to assets. First, standard deviation of cash flow to assets is computed for each firm-year observations with a minimum requirement of three observations up to the past ten years. Firms are then

[11] The initials beside each parenthesis represent the variable labels in CRSP/Compustat Fundamentals Annual database and its relevant item number in the square brackets. Many past papers used the *Industrial* Annual instead of *Fundamentals* Annual database, and represent data items using numbers, e.g. long term debt = Item 9 + Item 34 and total assets = item 6. The variable item number is no longer updated and used by CRSP and Compustat after fiscal year 2006 when the sample data are extracted from the Fundamentals Annual database in the Xpressfeed format. Relevant variable labels are documented alongside with their old data item numbers. It should be noted that after the change in variable identification, there are some variables which are no longer available as they are combined with other items in the financial statements. Similarly, there are additional new variables which were conventionally reported as part of the variable in the old format, now report separately as individual items.

divided into different industries using two-digit SIC code. Average of each firm's standard deviation of cash flow is taken each year in each industry group. Industry cash flow volatility is used to measure precautionary motive of cash holdings where firms with greater industry idiosyncratic risk hold more cash.

5. Cash flow to assets (earnings method), CFe, is predicted to have a negative relationship with cash because firms with greater cash flow require less cash on hand for payments and investments. Following BKS, CF is measured by the following

   CFe = [Earnings(EBITDA[13]) - Interest (XINT[15]) - Tax (TXT[16])
   - Common dividend (DVC[21])] / Total assets (AT[6])

6. Net cash flow to assets (CFcf) can be measured as follow using the cash flow method following Frank and Goyal (2003). There are variations to the measurement of cash flow in the literature and the most popular and commonly used two methods are chosen.

   CFcf = [Income before extraordinary items(IBC[123]) + Depreciation and amortization (DPC[125]) + Extra items and discontinued operations (XIDOC[124]) + Deferred tax (TXDC[126]) + Equity in net loss(earnings) (ESUBC[106]) + Gains (loss) from sale of property, plant and equipment, and investment (SSPIC[213]) + Other] / Total assets (AT[6])

7. Q ratio measures growth opportunities of firm. Firms with greater Q ratio have more growth opportunities and tend to keep more cash for investments. Q ratio is also the market-to-book value of assets ratio following Bates et al. (2009), computed as such.

   Q = [Total assets (AT[6]) – Book value equity (CEQ[60])
   + Market value equity (PRCC_F[199]*CSHO[25])] / Total assets (AT[6])

8. Firm size (LNAT) is computed as the natural logarithm of total assets (AT[6]). Larger firms may hold less cash since borrowing is easy for reputable and large

firms. However, larger firms have greater profitability and more ability to maintain a larger cash pool compared to smaller firms. The latter reason is similar to "economies of scale in holding cash" (Bates et al., 2009, p1999).

9. Net working capital, NWC, is predicted to have negative relationship with cash as working capital represents alternative to cash holdings and is readily convertible to cash. NWC is computed as follows.

   NWC = Working Capital (WCAD[179]) - Cash (CHE[1]) / Total assets (AT[6])

10. Capital expenditure, CAPEX, measures current period addition to firm's tangibility and may be used as collaterals for additional borrowings, thereby reducing the need to hold cash. The multiplier effect of new capital investment on a firm's debt capacity is proven in Almeida and Campello (2007) and Hahn and Lee (2009). On the other hand, cash in the current period may be used for investments and capital expenses, as Riddick and Whited (2009) found cash and capital expenses to be positively related. CAPEX is measured using capital expenditure (CAPX[128]) to total assets (AT[6]).

11. Similar to capital expenditure above, book value of debt (BKDEBT) may have both positive and negative relationship with cash depending on the current level of debt. BKDEBT is measured as follow,

    BKDEBT = Long term debt (DLTT[9]) + Debt in current liabilities (DLC[34])
    / Total assets (AT[6])

12. Acquisitions to assets (ACQUI) is measured by acquisitions (AQC[129]) to total assets (AT[6]). Predicted sign for acquisition may be positive or negative as cash may be kept for acquisition purpose in the near term or cash may be used up in the current period for acquisition.

13. Dividend dummy, DIVDUM, is set equal to one when a firm issues common dividend (DVC[21]), and zero otherwise. Dividend payers are generally larger firms with lower risk and greater ability to borrow, thereby tending to hold less cash. However, if dividends declared are due in cash, greater cash may be maintained.
14. Research and Development (RD_SALE) to sales is measured by research and development expenses (XRD) to total sales (SALE[12]). Similar to Q ratio above, R&D expenses have a predicted positive relationship with cash.
15. Net equity issues to total assets (ΔEQUITY) is measured by the sale of common and preferred equity (SSTK[108]) less purchase of common and preferred equity (PRSTKC[115]) divided by total assets.
16. Net debt issues (ΔDEBT) to total assets is measured by long-term debt issue (DLTIS[111]) less reduction in long-term debt (DLTR[114]) divided by total assets.
17. Gross investment (INVTMT) is computed as the ratio of investment in fixed assets (CAPX[128]) to beginning period capital stock (PPENT[8]) following Almeida and Campello (2007) and Marchica and Mura (2010).
18. Net investment (NINVTMT) is computed as the sum of capital expenditure (CAPX[128]), acquisitions (AQC[129]), increase in investment (IVCH[113]) less sale of property plant and equipment and sale of investment (SSPIV[213]) to beginning period total assets (AT[6]) following Lemmon and Roberts (2010).

CHAPTER A3. DESCRIPTIVE STATISTICS

A3.1 Summary statistics

As shown in Figure A1, from 1970 onwards cash holdings exhibit a continuous increasing trend until year 2008 where there is a slight dip in cash holdings, coinciding with the credit crisis. Campello et al. (2011) report significant use of cash by managers, especially for credit constrained firms, during the credit crunch. From 1950 to 1970, cash holdings decreased. At the same time, debt capacity remained at a fixed range until 1980, when debt capacity started to decrease significantly. When average cash holdings are computed for firms split into deciles of debt capacity, cash level monotonically decreases over each rank, where firms with the least debt capacity are found to hold the most cash, and vice versa. Figure A2 plots individual firm's cash and debt capacity ratios; a clear triangular region is formed across the graph. Figure 2 provides strong evidence for the substitution effect between the two internal flexibility components and shows that firms almost always lie in the black triangular region of the plot, trading off cash and debt capacity as few firms hold large amount of cash and debt capacity at the same time. To prevent masking important time effects when average cash holdings are computed by pooling together values over the whole sample period, Figure A3 reports cash holdings of firms in each debt capacity quintile for each financial year. Over the entire sample period, firms in the top debt capacity quintile hold the least cash, and the trend is the same in each year. Notably, the difference in average cash holdings of each quintile grows over time, indicating that firms are increasingly more dispersed in terms of their liquidity management.

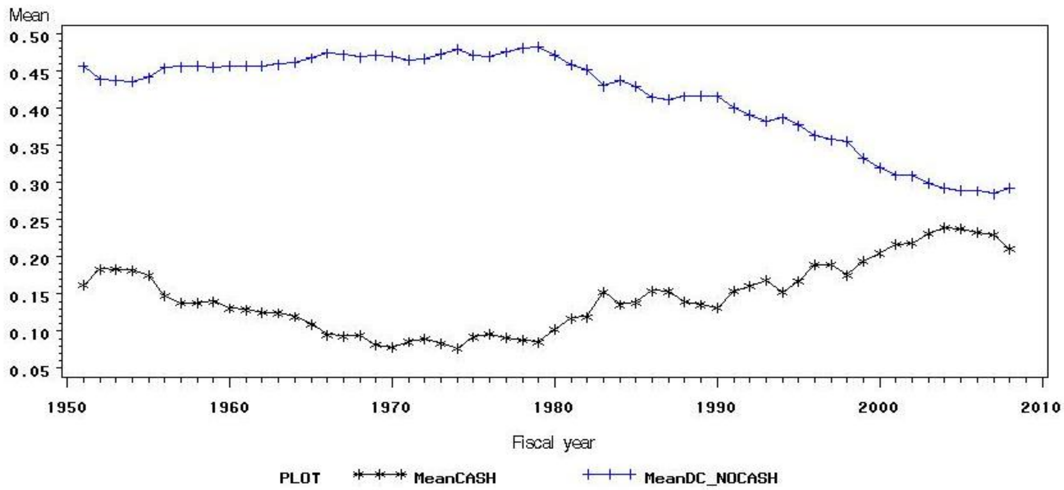


Figure A1 Average cash holdings and debt capacity to total assets, 1951-2008.

All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Cash is the ratio of cash holdings and marketable securities to total assets. Debt capacity is the ratio of the ratio of (0.715*Receivables + 0.547*Inventory + 0.535*PPE) to total assets; and unused debt capacity is debt capacity less debt only computed when firms report a positive debt capacity. Cash and debt capacity ratios are censored at [0,1] where ratio more than one is made equal to one.

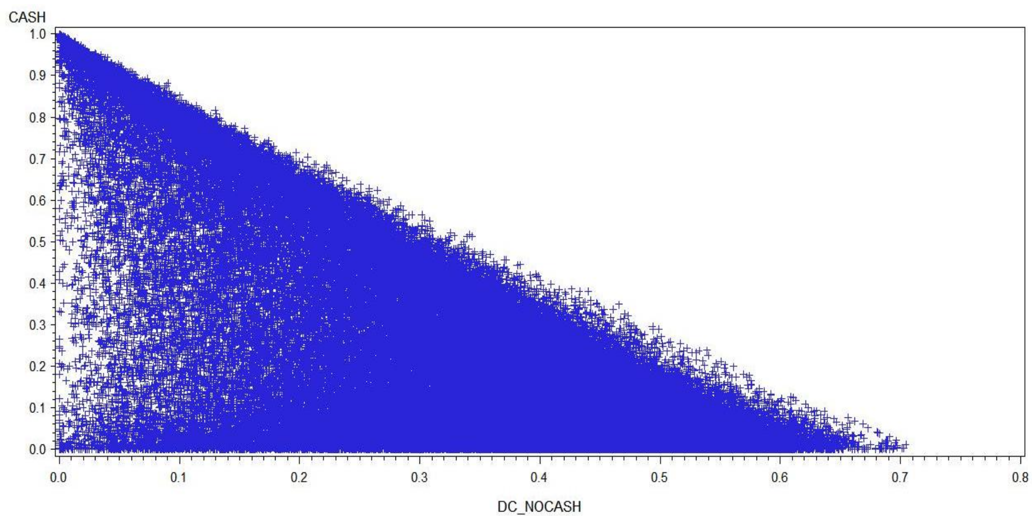
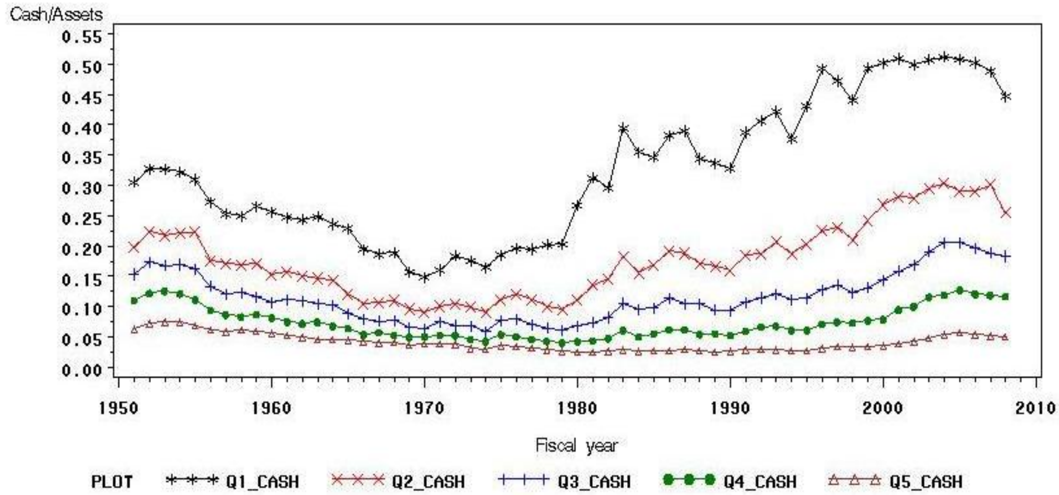


Figure A2

Figure A2 Cash holdings to assets against debt capacity to total assets across sample period, 1951-2008.

Figure A2 plots individual firm's cash to total assets ratio and debt capacity to total assets over the entire sample period. Sample and variable specifications are provided in Chapter A2.3.



[Q1_CASH and Q5_CASH are the average cash holdings at the lowest (Q1) and highest (Q5) DC quantile respectively]

Figure A3 Average cash holdings in each debt capacity quintile over time, 1951-2008.
The figure plots the average cash to total assets ratio for firms sorted by quintiles of debt capacity, with quintile 1 having the least debt capacity and quintile 5 having the most debt capacity. Average cash holdings are computed for every debt capacity quintile in each financial year. Sample and variable specifications are provided in Chapter A2.3.

To match our sample with BKS, we report cash to total assets and debt to total assets ratios from 1980 onwards in Table A1.[12] Both cash and debt levels are shown to follow an increasing and decreasing trend respectively. Cash holdings peak in 2004 and 2005 at 24%, while debt falls to its lowest level, to 19% over the same years. A comparable trend is shown in Figure A4 and A5, where yearly means and medians of cash and debt ratios are plotted along the same axis. BKS noted the trend of negative net debt in the recent years, where the amount of cash held by firms can more than repay the existing leverage. Here, negative net debt is observed from 2002 to 2007 and reverts back to positive in 2008 (due to the financial crisis). However, the prevalence of negative net debt does not, in practice, mean falling use of leverage because cash is not used to net off existing long-term obligations. Furthermore, net debt is seldom used to measure leverage in the literature because it might mask important differences between

[12] For comparison purposes, Table A1 and A2 only report statistics from 1980 to 2008. Statistics from 1950 to 1980 is reported in Appendix A-II and A-III for reference purposes.

debt and cash usage (Welch, 2008). While cash is used more for operations needs, debt is used more for investment purposes. Hence, the prevalence of negative net debt should not be alarming.

Average cash flow and debt capacities ratios are reported in Table A2. Cash flows are measured using two methods – earnings and cash flow methods following BKS and Frank and Goyal (2003) respectively. Both cash flows show a decreasing trend from 1980 to 2008. The lowest cash flow is recorded in 2001 and fluctuates thereafter. Both debt capacity and unused debt capacity show decreasing trends over the entire period – debt capacity falls from 47% to 29% while the unused portion falls more than two fold from 21% to 6%, indicating that the fall in leverage is more than the fall in debt capacity.

To identify if there is significant time varying trends, simple regressions are performed for cash and debt capacity with time variable as the single independent variable (see Table A3). In the regression of average debt capacity, the time variable has a significant coefficient of -0.68% and a very high R-squared of 97%, and results remain robust for median debt capacity. The unused portion of debt capacity also reports a statistically significant decreasing trend. The simple regression results show that the time series trend of both total and unused debt capacity over the sample period is statistically significant and even larger in magnitude than that of cash holdings. Finally, to test whether debt capacity has a significant influence over cash in the same period while controlling for time factor, cash is regressed against debt capacity and time. Results are summarised in Table A3. Debt capacity is an important determinant of cash holdings over time and the time variable measured in years remains significant at approximately similar coefficient values. R-squared increases for both mean and median cash holdings regressions. This shows the existence of (an)other important factor(s) influencing the level of cash holding kept by firms. Even though predictions are not to be made from these simple regressions, the results show that there exists an important relationship between debt capacity and cash holdings not subsumed by the time factor. Simple correlation coefficients reported in Table A4 confirm the highly negative relationship between cash and debt capacity of more than 60% - this is even larger than the relationship between total and unused debt capacity, and between debt capacity and leverage. Although debt capacity is an indication of the level of debt firms have, firms in normal times will not utilise all or even a substantial portion of the total capacity due to the fear of credit rating adjustments (Kisgen, 2006) and the intention of maintaining credit rating and spare capacity for use when opportunities arise (Graham and Harvey, 2001). Alternatively, the relationship between credit line and cash is more important because it affects firms' ability to invest, since firms with low credit capacity are forced to substitute cash savings for investments (Campello et al., 2011), which has an ultimate impact on future firm value. This partly explains the high negative correlation between cash and debt capacity as firms set the level of cash according to expected debt capacity in each period. On the other hand, total and unused debt capacities have positive correlations with both measures of cash flow, confirming the findings of Sufi (2009), where cash flow adds positively to firms' credit lines. As expected, debt capacity and cash holdings are highly correlated over time with correlation coefficients of more than 0.80 with their own lagged values. Whilst debt capacity and cash flows are correlated over time, the correlations are significantly lower compared to debt capacity and cash holdings, due to the high volatility of cash flow.

Table A1 Average cash and debt variables compared to Bates et al. (2009)

This table compares the CRSP/Compustat sample used in this work with Bates et al. (2009) Compustat sample. The number of observations and proportions are reported in a similar manner for ease of comparison. All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Cash holdings is the ratio of cash holdings and marketable securities to total assets; and debt is the sum of long term debt and debt in current liabilities to total assets. Cash and debt ratios are censored at [0,1] where ratio more than one is made equal to one.

	Bates et al. (2009) Compustat sample			CRSP/Compustat sample		
Year	N	Mean cash holdings	Mean debt	N	Mean cash holdings	Mean debt ratio
1980	3519	0.105	0.269	3394	0.103	0.2645
1981	3748	0.121	0.253	3599	0.118	0.2519
1982	3752	0.121	0.261	3661	0.119	0.2594
1983	4120	0.159	0.246	3945	0.153	0.2408
1984	4172	0.14	0.254	4018	0.136	0.2517
1985	4127	0.142	0.27	3985	0.139	0.2651
1986	4261	0.157	0.273	4092	0.155	0.269
1987	4407	0.156	0.273	4193	0.153	0.271
1988	4237	0.141	0.28	4065	0.140	0.275
1989	4095	0.138	0.286	3933	0.136	0.281
1990	4042	0.134	0.282	3885	0.132	0.276
1991	4137	0.155	0.259	3962	0.154	0.251
1992	4307	0.163	0.245	4107	0.161	0.232
1993	4713	0.171	0.225	4474	0.169	0.220
1994	4985	0.155	0.23	4757	0.153	0.224
1995	5165	0.171	0.23	4985	0.167	0.225
1996	5568	0.193	0.222	5344	0.189	0.217
1997	5605	0.191	0.236	5425	0.190	0.228
1998	5263	0.178	0.289	5102	0.176	0.247
1999	4971	0.194	0.247	4898	0.195	0.241
2000	4947	0.208	0.242	4698	0.205	0.227
2001	4540	0.214	0.268	4258	0.217	0.227
2002	4233	0.214	0.258	3925	0.218	0.216
2003	3992	0.227	0.235	3652	0.231	0.201
2004	3693	0.24	0.225	3583	0.239	0.189
2005	3549	0.237	0.219	3493	0.238	0.187
2006	3297	0.232	0.221	3404	0.233	0.193
2007	-	-	-	3256	0.230	0.203
2008	-	-	-	2568	0.210	0.232
Average	4350	0.172	0.252	4092	0.153	0.239

Table A2 Summary statistics of cash flow and debt capacities ratios

This table reports the summary statistics of cash flows and debt capacities. Cash flow computed using earnings method (CFe) is the ratio of the sum of earnings less interest, tax and common dividend to total assets computed according to Bates et al. (2009). Net cash flow computed based on cash flow method (CFcf) is the ratio of net cash flow to total assets, computed according to Frank and Goyal (2009). Debt capacity is the ratio of the ratio of (0.715*Receivables + 0.547*Inventory + 0.535*PPE) to total assets; and unused debt capacity is debt capacity less debt only computed when firms report a positive debt capacity. Cash flows (CFe and CFcf) are winsorized at the bottom 1%. Debt capacity ratio is censored at [0,1] where ratio more than one is made equal to one. Sample and variable specifications are provided in Chapter A2.3.

	CFe : Earnings method (Bates et al., 2009)			CFcf: Cash flow method (Frank and Goyal, 2009)			DC			UDC		
Year	Mean	Median	Std	Mean	Median	Std	Mean	Median	Std	Mean	Median	Std
1980	0.047	0.065	0.115	0.109	0.112	0.175	0.471	0.496	0.098	0.212	0.240	0.191
1981	0.032	0.059	0.134	0.095	0.110	0.154	0.459	0.488	0.106	0.212	0.237	0.189
1982	0.012	0.049	0.157	0.098	0.105	0.776	0.452	0.478	0.104	0.197	0.227	0.199
1983	0.016	0.052	0.146	0.092	0.104	0.407	0.430	0.462	0.119	0.194	0.230	0.203
1984	0.005	0.057	0.188	0.070	0.106	0.211	0.438	0.469	0.116	0.191	0.226	0.208
1985	-0.015	0.050	0.239	0.058	0.099	0.264	0.430	0.460	0.119	0.169	0.211	0.225
1986	-0.016	0.047	0.229	0.076	0.098	0.272	0.414	0.446	0.126	0.151	0.188	0.230
1987	-0.007	0.050	0.216	0.067	0.096	0.292	0.412	0.443	0.128	0.148	0.190	0.232
1988	-0.005	0.055	0.230	0.033	0.081	0.225	0.416	0.445	0.126	0.143	0.187	0.239
1989	-0.006	0.052	0.232	0.030	0.078	0.220	0.417	0.448	0.125	0.138	0.175	0.237
1990	0.002	0.054	0.231	0.038	0.079	0.229	0.416	0.447	0.125	0.141	0.179	0.239
1991	0.009	0.054	0.193	0.041	0.078	0.184	0.401	0.432	0.133	0.150	0.185	0.229
1992	0.014	0.064	0.203	0.043	0.085	0.192	0.391	0.423	0.135	0.160	0.192	0.221
1993	0.008	0.065	0.228	0.032	0.084	0.218	0.382	0.411	0.135	0.164	0.189	0.214
1994	0.007	0.071	0.240	0.033	0.090	0.230	0.387	0.413	0.131	0.164	0.196	0.218
1995	0.012	0.069	0.220	0.039	0.085	0.205	0.377	0.406	0.137	0.154	0.185	0.220
1996	-0.003	0.067	0.246	0.027	0.084	0.236	0.363	0.391	0.141	0.148	0.176	0.220
1997	-0.021	0.065	0.282	0.010	0.081	0.258	0.358	0.382	0.140	0.131	0.168	0.236
1998	-0.027	0.064	0.307	0.007	0.077	0.270	0.355	0.378	0.137	0.109	0.149	0.246
1999	-0.027	0.055	0.277	0.007	0.070	0.241	0.333	0.357	0.147	0.094	0.124	0.239

Table A2 Summary statistics of cash flow and debt capacities ratios (continued)

	CFe : Earnings method (Bates et al., 2009)			CFcf: Cash flow method (Frank and Goyal, 2009)			DC			UDC		
Year	Mean	Median	Std	Mean	Median	Std	Mean	Median	Std	Mean	Median	Std
2000	-0.060	0.049	0.330	-0.016	0.064	0.285	0.320	0.342	0.152	0.095	0.121	0.235
2001	-0.073	0.046	0.363	-0.036	0.060	0.326	0.310	0.325	0.148	0.083	0.117	0.243
2002	-0.041	0.052	0.302	-0.004	0.068	0.270	0.309	0.323	0.146	0.095	0.125	0.237
2003	0.000	0.059	0.231	0.035	0.077	0.200	0.299	0.307	0.146	0.099	0.126	0.231
2004	0.008	0.068	0.233	0.040	0.085	0.215	0.293	0.299	0.147	0.105	0.131	0.233
2005	0.001	0.065	0.244	0.032	0.084	0.224	0.289	0.292	0.145	0.103	0.134	0.235
2006	-0.014	0.063	0.277	0.035	0.088	0.228	0.289	0.292	0.146	0.096	0.126	0.239
2007	-0.018	0.059	0.267	0.033	0.086	0.223	0.285	0.286	0.146	0.083	0.121	0.245
2008	-0.029	0.064	0.330	0.021	0.087	0.288	0.293	0.295	0.143	0.061	0.106	0.259
Average	0.012	0.062	0.216	0.051	0.092	0.263	0.399	0.438	0.138	0.162	0.196	0.223

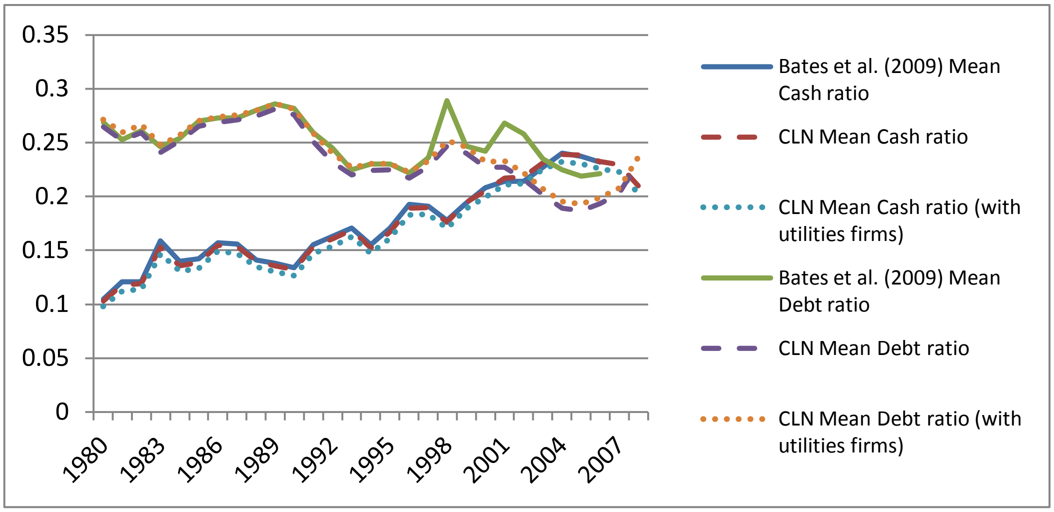


Figure A4 Mean cash and debt ratios compared with Bates et al. (2009).

The figure plots the mean statistics reported in Table A1 for cash holdings and debt ratio from 1980 to 2008 with the statistics from Bates et al. (2009). Sample and variable specifications are provided in Chapter A2.3.

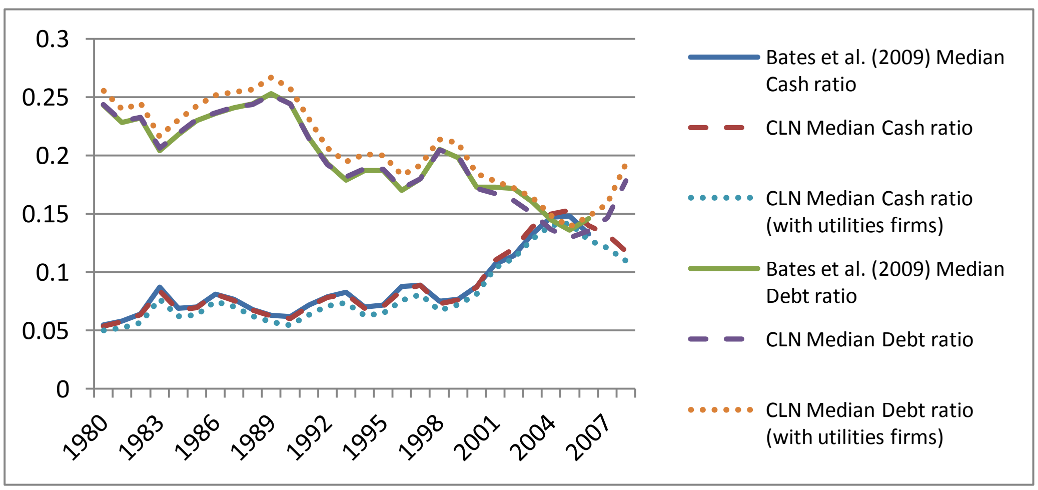


Figure A5 Median cash and debt ratios compared with Bates et al. (2009).

The figure plots the median statistics reported in Table A1 for cash holdings and debt ratio from 1980 to 2008 with the statistics from Bates et al. (2009). Sample and variable specifications are provided in Chapter A2.3.

Table A3 Summary results of regressions of cash against debt capacity and time

This table summarises the results of simple pooled OLS performed on cash and debt capacities with time variable measured in years from 1980 to 2008. Regressions are performed as follow: $Cash_{it} = Time_{it} + \varepsilon_{it}$, $Debt\ capacity_{it} = Time_{it} + \varepsilon_{it}$, and $Unused\ debt\ capacity_{it} = Time_{it} + \varepsilon_{it.}$ Mean and median of cash and debt capacity ratios are computed in each financial year before OLS regressions are performed. Sample and variable specifications are provided in Chapter A2.3.

Dependent variable	Coefficient of time variable	Coefficient of debt capacity	Adjusted R-squared
Mean of cash to total assets	0.0045***	-	89%
Median of cash to total assets	0.0029***	-	67%
Mean debt capacity to total assets	-0.0068***	-	97%
Median debt capacity to total assets	-0.0079***	-	96%
Mean unused debt capacity to total assets	-0.0045***	-	85%
Median unused debt capacity to total assets	-0.0046***	-	86%
Mean of cash to total assets	-0.0044***	-1.3015***	98%
Median of cash to total assets	-0.0058***	-1.1020***	90%
Cash to total assets	-0.0030***	-1.0864***	50%

*** Indicates significance at 1% level (p-value of less than 0.01)

Table A4 Correlations of key variables from 1980 to 2008

This table reports the Pearson and Spearman correlation coefficients of the key financial flexibility variables. Sample and variable specifications are provided in Chapter A2.3.All correlation coefficients exhibit statistical significance at 1% (two-tail) test level.

Panel A: Pearson Correlation Coefficients												
	DC	UDC	LAGDC	LAGUDC	BKDEBT	CASH	LAG CASH	Cfe	LAG CFe	CFcf	LAG CFcf	IND STDCF
DC	1											
UDC	0.408	1										
LAGDC	0.889	0.350	1									
LAGUDC	0.370	0.830	0.417	1								
BKDEBT	0.232	-0.794	0.204	-0.647	1							
CASH	-0.699	-0.048	-0.613	-0.036	-0.415	1						
LAGCASH	-0.607	-0.021	-0.710	-0.064	-0.373	0.844	1					
Cfe	0.260	0.220	0.290	0.170	-0.059	-0.280	-0.323	1				
LAGCFe	0.259	0.204	0.280	0.216	-0.048	-0.284	-0.302	0.705	1			
CFcf	0.194	0.176	0.223	0.116	-0.054	-0.201	-0.253	0.698	0.509	1		
LAGCFcf	0.227	0.190	0.245	0.202	-0.051	-0.245	-0.255	0.613	0.812	0.514	1	
INDSTDCF	-0.363	-0.107	-0.366	-0.110	-0.132	0.324	0.330	-0.200	-0.208	-0.164	-0.201	1
Panel B: Spearman Correlation Coefficients												
	DC	UDC	LAGDC	LAGUDC	BKDEBT	CASH	LAG CASH	Cfe	LAG CFe	CFcf	LAG CFcf	IND STDCF
DC	1											
UDC	0.416	1										
LAGDC	0.879	0.348	1									
LAGUDC	0.368	0.831	0.421	1								
BKDEBT	0.310	-0.673	0.281	-0.555	1							
CASH	-0.614	0.044	-0.527	0.045	-0.545	1						
LAGCASH	-0.523	0.070	-0.621	0.032	-0.497	0.809	1					
Cfe	0.201	0.296	0.199	0.241	-0.093	-0.137	-0.152	1				
LAGCFe	0.168	0.260	0.206	0.297	-0.092	-0.120	-0.139	0.750	1			
CFcf	0.170	0.297	0.173	0.231	-0.116	-0.072	-0.101	0.830	0.653	1		
LAGCFcf	0.145	0.265	0.173	0.298	-0.112	-0.066	-0.072	0.654	0.823	0.702	1	
INDSTDCF	-0.364	-0.088	-0.365	-0.090	-0.224	0.308	0.309	-0.132	-0.135	-0.166	-0.168	1

A3.2 Analysing the increasing cash holdings trend

A3.2.1 Firm size

As in BKS, we divide firms into quintiles of firm size and industry cash flow volatility, and IPO cohorts to examine whether the increase in cash holdings is pervasive across different characteristics of firms. Further analysis is performed to determine whether debt capacity influences the relationship between cash holdings and the three firm characteristics above, by dividing firms into five quintiles in each financial year according to their debt capacities.

First, firms are divided according to firm size measured by the book value of total assets at the close of each financial year. Small firms are expected to have higher cash-on-hand due to the greater difficulty faced in borrowing and issuing bonds or equity in the capital market. This is shown in Figure A6 where firms with the lowest total assets consistently have greater cash holdings over the sample period. Smaller firms (in the bottom two quintiles) increase cash holdings from approximately 10% cash to total assets in 1970 to more than 30% in 2008 (more than three-fold increase); the largest firms hold about 6% of cash to total assets in 1970 and gradually increase cash-on-hand to the peak of 12% in 2004 and 10% in 2008 (less than two-fold increase). This suggests that firms are increasingly more dispersed in their liquidity management, i.e. decreased herding behaviour over time. To find out whether the same trend is observed for firms with different levels of debt capacity, firms are then divided into five groups according to level of debt capacity. In each group, firms are ranked according to firm size in each financial year. Figure A7 reports the trends for five subsamples. The widening gap between cash holdings of large and small firms is observed for all five groups but with varying degree. Firms in the lowest debt capacity quintile (Q_DC=1) show greatest dispersion - from 10% cash for small firms to 25% cash for large firms in 1970, to 20% to 60% in 2008. This dispersion decreases monotonically and firms in the highest debt capacity quintile show only mild change in cash holdings ranging from 3% to 5% in the 1970s and 3% to 8% in 2000s. Even the smallest firm size quintile in the largest debt capacity group (Q_DC=5) had a peak of only 8% cash holdings in 2005. The trends observed in Figure A7 show that relationship between cash holdings and firm size varies when debt capacity changes.

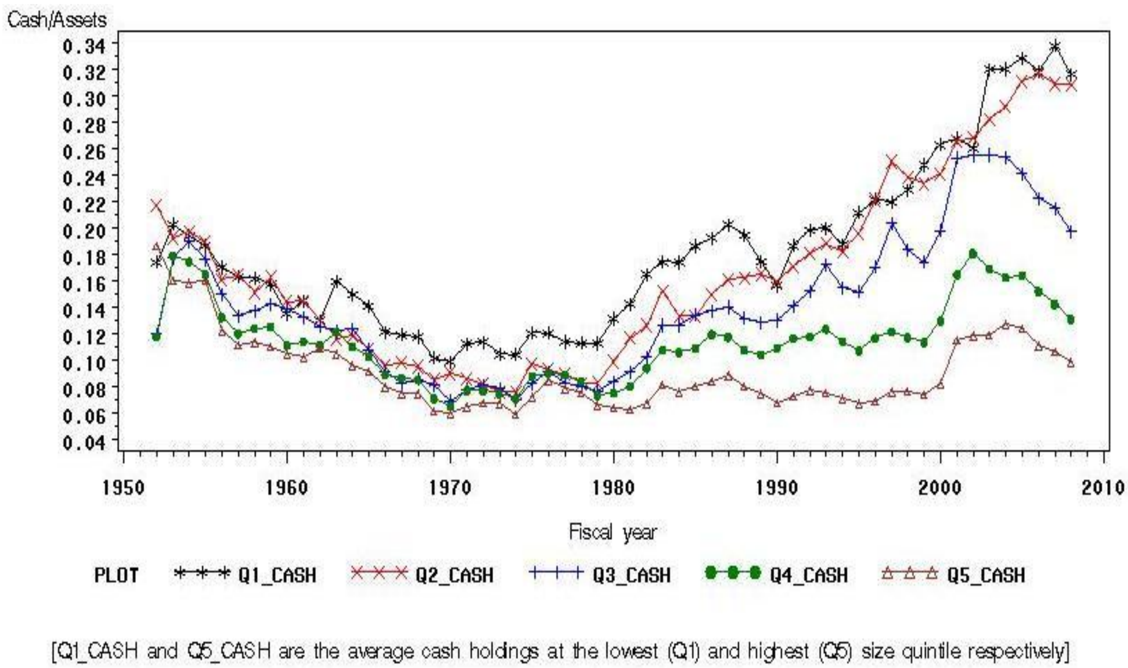
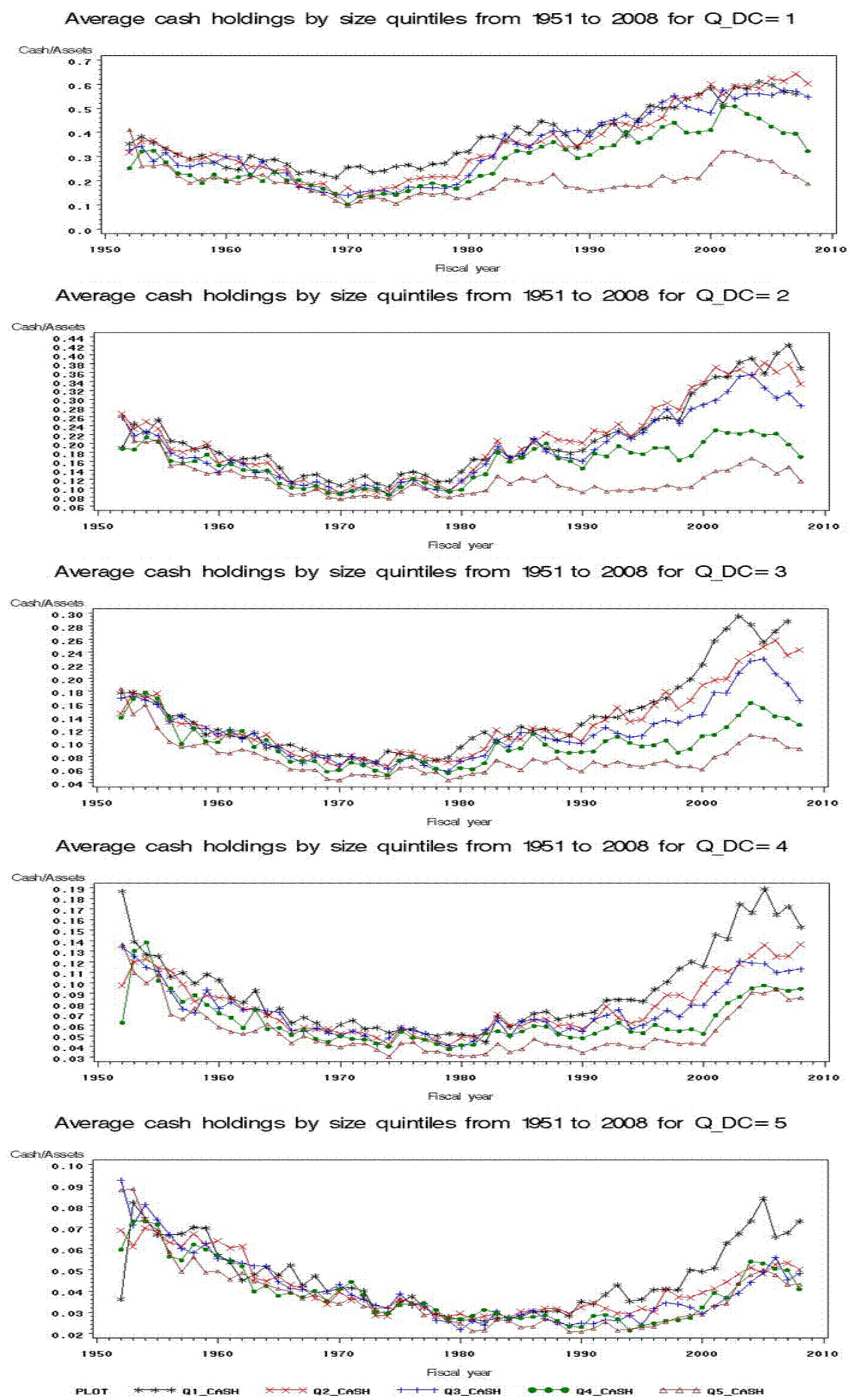


Figure A6 Average cash holdings in each size quintile, 1951-2008.
The figure plots the average cash to total assets ratio for firms sorted by firm size quintiles in each financial year, with quintile 1 having the lowest total assets and quintile 5 having the most total assets. Firm size is measured by the logarithm of book value of total assets in the previous financial year. Average cash holdings are computed for every size quintile in each financial year. Sample and variable specifications are provided in Chapter A2.3.



[Q1_CASH and Q5_CASH are the average cash holdings at the lowest (Q1) and highest (Q5) size quintile respectively]

Figure A7 Average cash holdings in each size quintile according to debt capacity groups, 1951-2008. The figure plots the average cash to total assets ratio for firms sorted by firm size quintiles in each debt capacity groups. Firms are first ranked and divided into five groups according to their current period debt capacity level. Debt capacity group 1 (Q_DC=1) represents firms with the lowest debt capacity and group 5 (Q_DC=5) represents firms with the highest debt capacity in each financial year. For each debt capacity group, average cash holdings are computed for every size quintile in each financial year, with quintile 1 having the lowest firm size and quintile 5 having the largest firm size. Sample and variable specifications are provided in Chapter A2.3.

A3.2.2 Idiosyncratic risk (the IPO effect)

Firms with varying level of idiosyncratic risks hold different amounts of cash for precautionary purposes. It is observed that the change in nature of newly listed firms has been a major factor in the increasing trend of cash holdings over time. To investigate whether newly listed firms have higher idiosyncratic risk (and pay fewer dividends) and hold more cash (Brown and Kapadia, 2007), firms are divided into different IPO cohorts according to their listing year.[13] As observed in BKS, firms in the more recent IPO cohorts are found to have greater average cash holdings and the increase in average cash holdings is monotonic to the listing date. While cash holdings increase gradually over the sample period, the increase is significantly sharper after year 2000. Cash holdings, however, peak at 2005 and fall sharply thereafter. The fall in cash holdings is more prominent for younger firms in the later cohorts. BKS noted that, at the same lifecycle stage, firms in the later cohorts hold more cash than firms in earlier cohorts. Firms in the later cohorts, however, use up much more cash than earlier cohorts, with the exception of the 1975 cohort. On the whole, younger firms in the later cohorts tend to have more fluctuations in their cash holdings – suggesting that younger firms in the later cohort utilise cash more than older firms in the earlier cohort, while older firms may rely more on cash flow, borrowings or equity issues for financing. Alternatively, differences in cash levels may also be due to greater investment opportunities for younger firms, and greater stability in cash flow for older firms.

[13] IPO cohort classification follows that of Bates et al. (2009). Firms with IPO listing before 1970 are classified under the 1960s cohort. 1970s cohort includes firms listed from 1970 to 1974, and 1975s cohort includes firms listed from 1975 to 1980, and henceforth for every 5-year period up to the 2000s cohort that includes firms listed from 2000 to 2005. Firms listed in the final three years of the sample are not considered as they are within the first three years of IPO and have more opportunity and access to greater cash holdings that potentially bias the cash holdings trend positively.

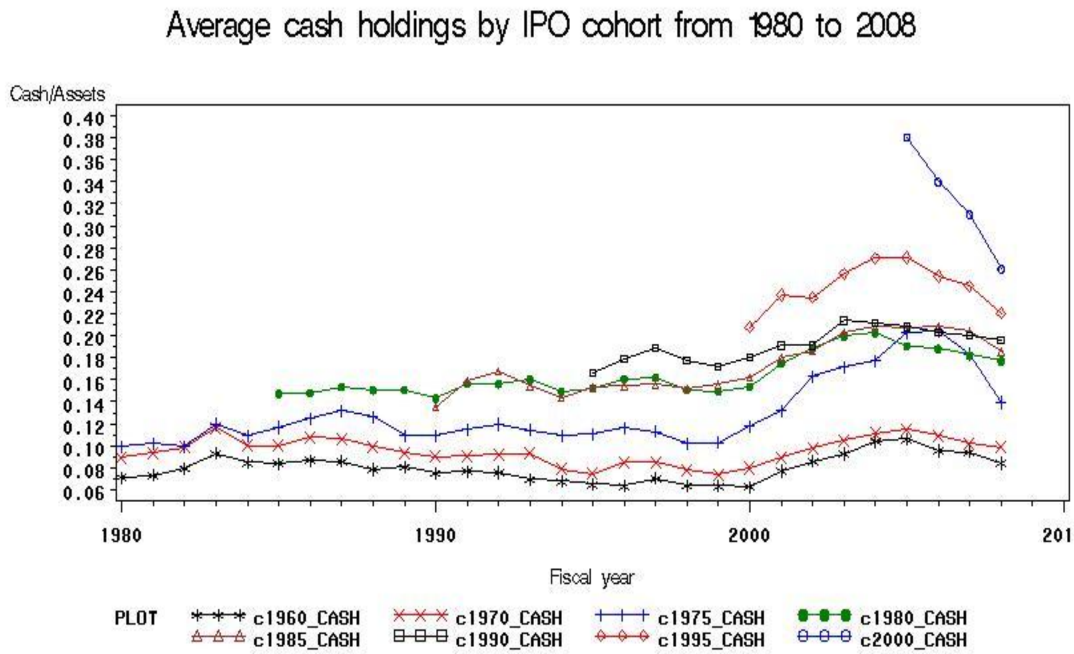


Figure A8 Average cash holdings in each IPO cohort, 1980-2008.
The figure plots the average cash to total assets ratio for firms sorted by IPO cohorts according to Bates et al. (2009). Average cash holdings are computed for each IPO cohort in each financial year. Sample and variable specifications are provided in Chapter A2.3.

The increasing trend in cash holdings may be due to a change in nature of newly listed firms and changing industry proportions over time. To identify whether the change in cash holdings is due to the changing nature of assets *within* firms (instead of across firms through IPO cohorts), firms are divided into five quintiles of debt capacity. In each debt capacity subsample, firms are then divided into different IPO cohorts according to their listing year and average cash holdings are computed for each cohort in each year. Figure A9 reports the IPO trend in the five subsamples of debt capacity. It is clear that the consistent trend observed in Figure A8 is no longer present after debt capacity is considered, and the relationship between idiosyncratic risks (measured using IPO listing date) and cash holdings breaks down. This suggests that increase in cash holdings is probably due to the changing nature of firms internally and across all industries, instead of the greater proportions of firms in specific industries. For instance, manufacturing firms now hold fewer fixed assets but rely more on leased assets compared to the past and the change in composition of assets within firms influences the level of cash holdings held by firms.

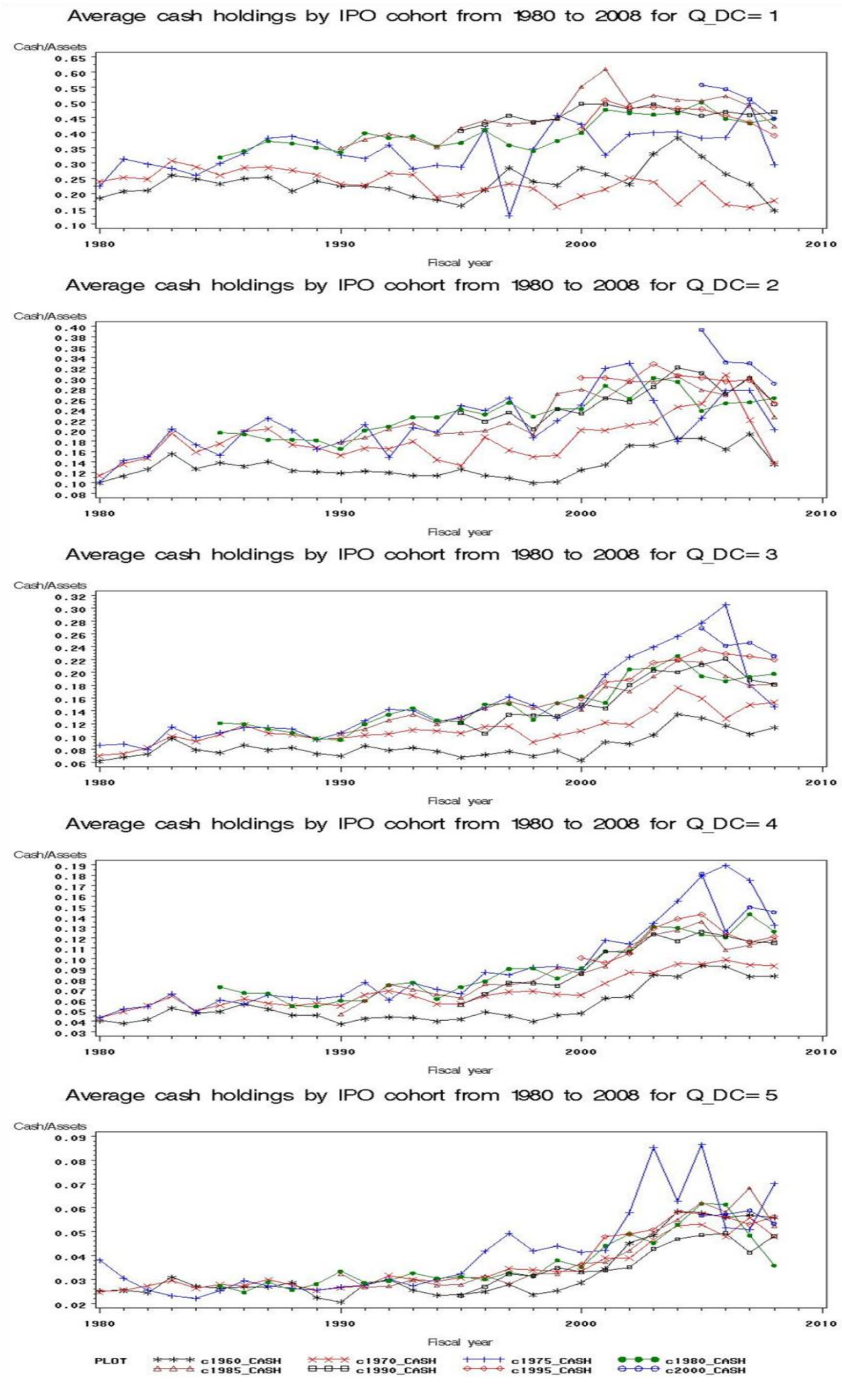


Figure A9 Average cash holdings in each IPO cohort according to debt capacity groups, 1951-2008.

The figure summarises the average cash to total assets ratio for firms sorted by IPO cohorts in each debt capacity groups. Firms are first ranked and divided into five groups according to their current period debt capacity level. Debt capacity group 1 (Q_DC=1) represents firms with the lowest debt capacity and group 5 (Q_DC=5) represents firms with the highest debt capacity in each financial year. For each debt capacity group, average cash are computed for each IPO cohort in each financial year. Sample and variable specifications are provided in Chapter A2.3.

A3.2.3 Industry effects

The increasing trend in cash holdings is attributed to the change in nature of newly listed firms, but the increase in proportion of technology firms is not the driving force of the increased cash holdings {and decreased leverage} (Bates et al., 2009). BKS divided the sample into two groups and examines only technology and non-technology firms broadly. To ensure no industry effect is influencing the trend of cash holdings (and debt capacity) over time, firms are split into ten industry groups following Campello et al. (2011). Proportions of the ten industries are charted in Figure A10 with the top graph showing the proportions of all ten industries for the entire sample period. Since manufacturing firms (IND=2) make up a substantial portion of the entire firm sample, these are taken out and plotted separately. The bottom two charts start from year 1952 as the small number (34) of firms in 1951 may be unrepresentative of firm proportions. Some important trends are noted. First, the proportion of manufacturing firms falls sharply from 78% to 48% from the 1950s to the 2000s. Second, the proportion of service and software/biotech firms increases sharply from 1960 and 1980 onwards. Third, there is a spike in the proportion of mining firms in the early 1980s but the percentage returns to its original level in the mid 1980s. While there are significant changes in industry proportions over time, the amounts of cash held in each industry are not known. Figures A11 and A12 then plot the average cash holdings and debt capacity of firms in each industry group for each year. Considerable increase in cash is noted for software and biotechnology firms from 10% in the 1980s to 45% in the 2000s. This coincides with the largest decrease (from 48% to 16% in the period 1980 to 2008) in debt capacity for the same industry group in Figure A12. For the other industries, a

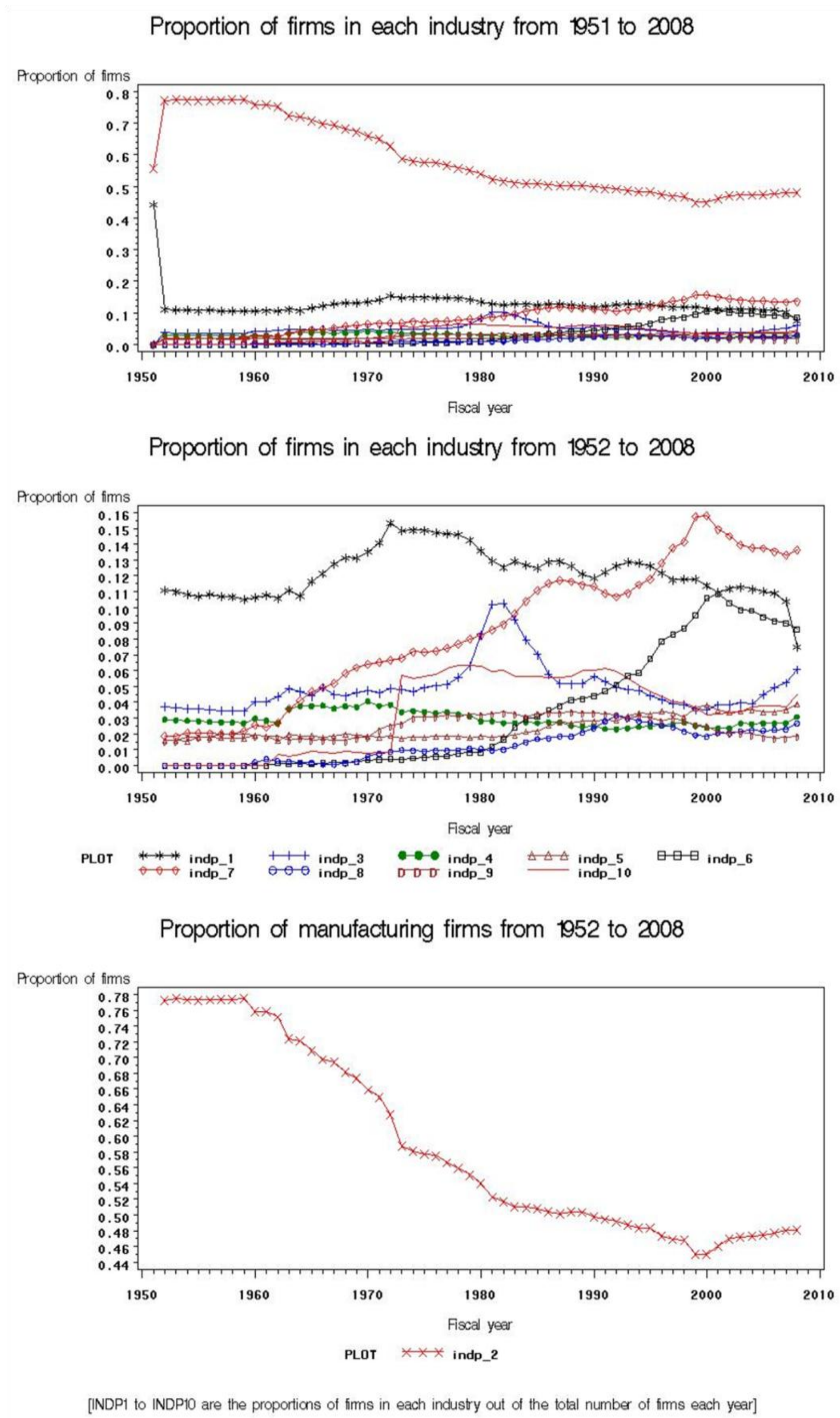


Figure A10 Industry proportions over time, 1951-2008.

The figure summarises the proportion of number of firms in each industry to total number of firms in each financial year. Firms are first sorted into ten industry groups adapted from Campello et al. (2010). Industry groups are sorted according to their SIC codes as follow: 1=Retail and wholesale, 2=Manufacturing, 3=Mining, 4=Transportation, 5=Communication, 6=Software and Biotech, 7=Services, 8=Healthcare, 9=Others, and 10=Utilities firms. Sample and variable specifications are provided in Chapter A2.3.

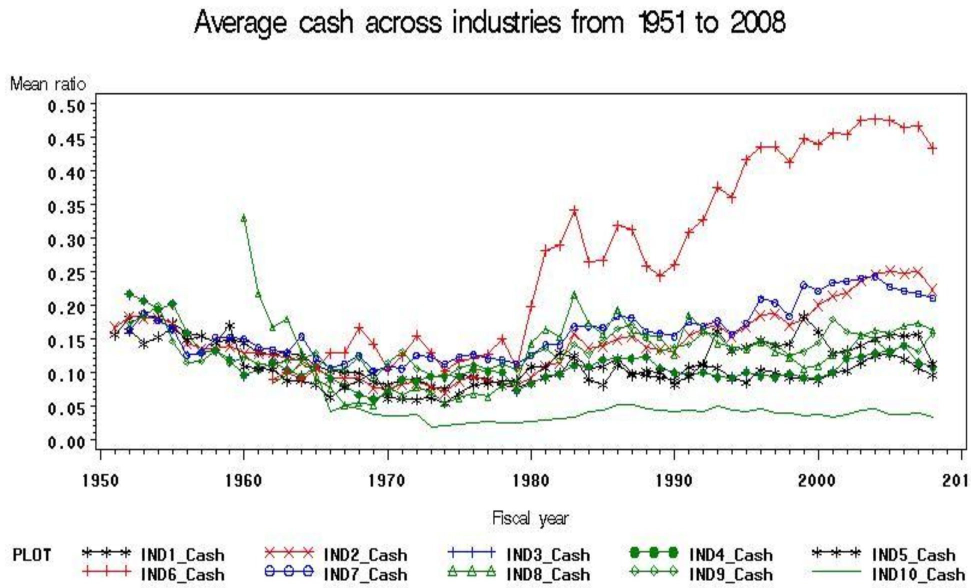


Figure A11 Average cash holdings in each industry group, 1951-2008.

The figure plots the average cash to total assets ratio for firms in each industry group in each financial year. Firms are first sorted into ten industry groups adapted from Campello et al. (2010). Industry groups are sorted according to their SIC codes as follow: 1=Retail and wholesale, 2=Manufacturing, 3=Mining, 4=Transportation, 5=Communication, 6=Software and Biotech, 7=Services, 8=Healthcare, 9=Others, and 10=Utilities firms. Cash holdings is the ratio of cash holdings and marketable securities to total assets. Sample and variable specifications are provided in Chapter A2.3.

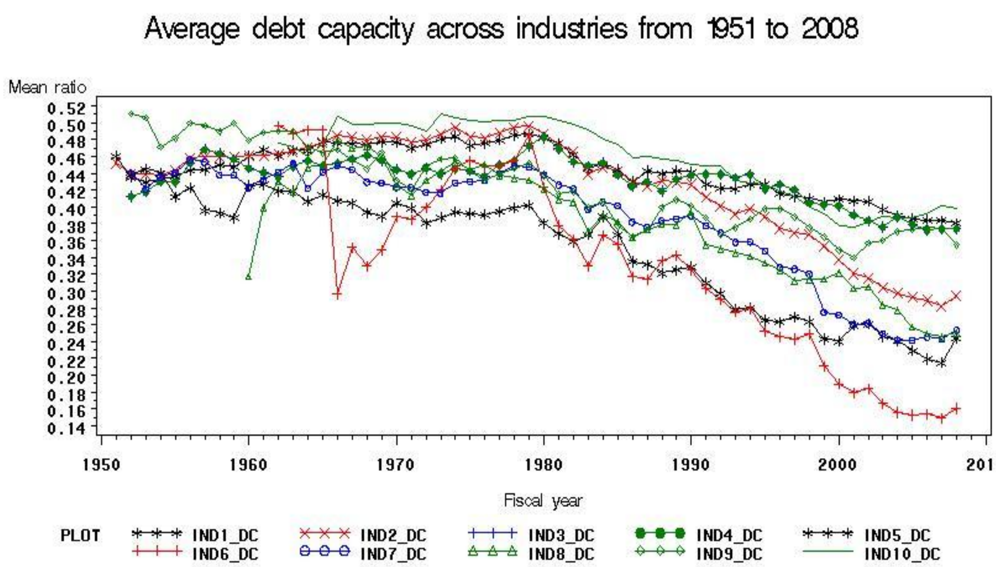


Figure A12 Average debt capacity in each industry group, 1951-2008.

The figure plots the average debt capacity to total assets ratio for firms in each industry group in each financial year. Firms are first sorted into ten industry groups adapted from Campello et al. (2010). Industry groups are sorted according to their SIC codes as follow: 1=Retail and wholesale, 2=Manufacturing, 3=Mining, 4=Transportation, 5=Communication, 6=Software and Biotech, 7=Services, 8=Healthcare, 9=Others, and 10=Utilities firms. Debt capacity is the ratio of the ratio of (0.715*Receivables + 0.547*Inventory + 0.535*PPE) to total assets. Sample and variable specifications are provided in Chapter A2.3.

general increase in cash and decrease in debt capacity is observed, and there is an additional trend of increased dispersion of firms in different industries. This increased dispersion is also noted when firms are divided into different debt capacity quintiles.

To ensure the increase in cash and decrease in debt capacity are not driven by software and biotechnology firms, Figure A13 shows the average cash and debt capacity computed every year for sample of firms without industry group 6. Averages of the entire sample are included for purpose of comparison. There is no significant difference in trends of both firm liquidity characteristics when industry group 6 is excluded. To investigate the significance of change in cash over time across industries, the mean of cash is regressed against time variable for each industry group and a positive significant estimate for time factor is reported only for half of the industry groups (not reported in detail here), i.e. increase in cash holdings is statistically significant for only half of the industry groups.[14] While BKS did not find industry effect the main driver of cash holdings over time, and all firms (industry group 1 to 9) can be pooled together for further tests, the same is not found here and consideration for fixed firm and industry effects is suggested for subsequent multivariate tests.

To understand better the industry influence on firms' liquidity management, Table A5 reports average statistics of key variables across the ten industries. A negative relationship between cash and debt capacity is evident in the statistics where utilities firms have the largest debt capacity and hold the least cash, and software and biotechnology firms have the least debt capacity and the most cash. The same trend is

[14] Mean of cash is computed yearly for each industry group. Time variable is measured as the number of years from the start of the sample period, 1980 (e.g. Financial year 1980 and 1981 will have Time variable equals to 0 and 1 respectively). Yearly means of cash are regressed against time variable for each industry group. Estimated coefficients for time variable are found to be insignificant in Industry 1, 8, 9 and 10, and negative in Industry 3. The proportion of firms in the above mentioned industries is about 35% of the total number of firms (43,605 out of 124,662).

reported for the other industries. Finally, to show that debt capacity used here is a good proxy for credit line (credit line is a subset of total debt capacity), statistics for year 2008 is reported in Table A6 to match with Campello et al. (2011) sample. Similar to Campello et al. (2011), substantial industry variations are identified in Table A6. Specifically, the previous authors highlighted that almost all (92%) the transportation firms have lines of credit while only half (52%) of healthcare firms have such committed credit, and the corresponding cash policies follow the level of lines of credit negatively.[15] Similar to the survey results, transportation firms are found to hold the least cash because they have one of the largest levels of unused debt capacity. Retailers and wholesalers are also found to exhibit similar liquidity policies as transport firms. Conversely, firms in the software and biotechnology sectors are found to hold significantly high levels of cash (44% of total assets) as they have the lowest debt capacities. Our results correspond to previous survey results where software and biotechnology sectors have the second largest cash savings and least credit lines. Debt capacity in our sample here may potentially be a good proxy for lines of credit because a similar trend and relationship with cash policy is observed. Substantial industry variation is evident and the substitution effect between cash and both debt capacities is present after controlling for industry. It is predicted that substitution effects between the two internal flexibility variables across industries may not be equal. Further multivariate tests and results are reported in Chapter A4 onwards.

[15] Transportation firms hold the least cash (5.7%) while healthcare firms have cash savings that are almost three-fold (16.9%) of the former.

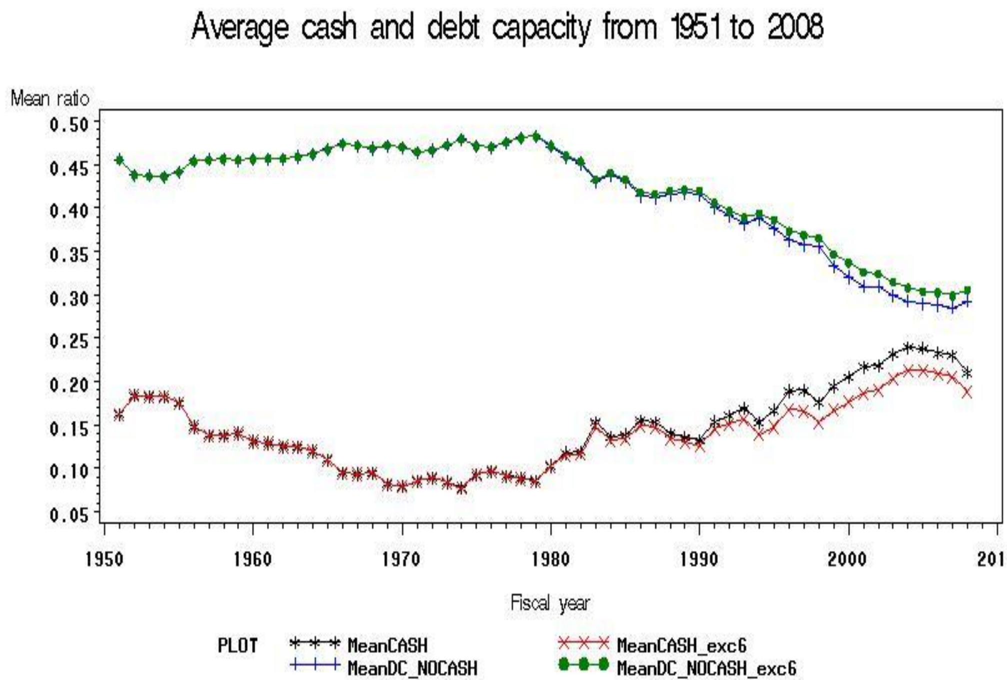


Figure A13 Average cash holdings and debt capacity over time with industry group 6 excluded, 1951-2008.

The figure plots the average cash to total assets ratio and average debt capacity to total assets ratio for firms all firms and sample with industry group 6 excluded. Industry group 6 includes firms in software and biotechnology sector. Sample and variable specifications are provided in Chapter A2.3.

Table A5 Descriptive statistics of key variables across industries

This table reports the summary statistics of key flexibility variables across ten industries. Sample and variable specifications are provided in Chapter A2.3.

FY1980-2008 Pooled statistics									
IND	TYPE	SIC Code	N	CASH	CFe	CFcf	DC	UDC	BKDEBT
1	Retail/Wholesale	4000-5999	14977	0.102	0.036	0.068	0.425	0.162	0.264
2	Manufacturing	2000-3999	60739	0.172	-0.005	0.034	0.386	0.166	0.220
3	Mining	1000-1499	6702	0.115	0.014	0.103	0.436	0.154	0.283
4	Transportation	4000-4799	3221	0.106	0.055	0.095	0.420	0.106	0.317
5	Communication	4800-4899	3712	0.131	-0.023	0.034	0.282	-0.125	0.407
6	Software/Biotech	5045, 5734, 7372, 8731, 2836	7895	0.406	-0.141	-0.085	0.232	0.111	0.121
7	Services	7000-8999	15287	0.193	-0.002	0.042	0.328	0.099	0.235
8	Healthcare	8000-8099	2630	0.149	0.024	0.070	0.332	0.024	0.307
9	Others	All others (0100-0999, 1500-1799)	3536	0.143	-0.054	0.021	0.385	0.115	0.293
10	Utilities	4900-4999	6002	0.041	0.032	0.073	0.440	0.076	0.365

Table A6 Comparison of descriptive statistics of key variables across industries for 2008

This table compares the CRSP/Compustat sample used in this thesis with Campello et al. (2009) Compustat sample. Sample and variable specifications are provided in Chapter A2.3.

		Campello et al. (2009) survey statistics before crisis*			Current sample			
IND		Proportion of firms with LC	Credit Lines	Cash	DC	UDC	Cash	SIC Code
1	Retail/Wholesale	83%	0.303	0.090	0.370	0.082	0.109	4000-5999
2	Manufacturing	87%	0.224	0.083	0.303	-0.393	0.216	2000-3999
3	Mining	78%	0.168	0.188	0.409	-0.130	0.156	1000-1499
4	Transportation	92%	0.207	0.057	0.382	0.020	0.103	4000-4799
5	Communication	60%	0.290	0.109	0.261	-0.289	0.129	4800-4899
6	Software/Biotech	54%	0.168	0.152	0.161	-0.475	0.444	5045, 5734, 7372, 8731, 2836
7	Services	78%	0.278	0.121	0.261	-1.071	0.215	7000-8999
8	Healthcare	52%	0.291	0.169	0.261	-0.071	0.155	8000-8099

*General trend of statistics is the same after crisis and thus not reported

A3.2.4 Idiosyncratic risk (industry cash flow volatility)

Using a more direct measure of idiosyncratic risk, Figure A14 plots the average cash holdings of firms sorted according to their specific industry cash flow volatilities. Firms with higher industry cash flow volatility are expected to hold more cash due to greater difficulty in estimating future cash flow and access to external funds. Following BKS, firms are sorted according to the level of industry cash flow volatility over the entire sample period 1980 to 2008 (i.e. sorting is not performed every financial year). However, as the volatility level varies substantially over the sample period[16], sorting is performed over two periods – before and after 1990. Firms in the top volatility quintile are reported to be more than half in proportion to the entire sample and comparable with BKS.[17] The cash holdings trend shown in Figure A14 is similar to BKS where firms with higher idiosyncratic risks (i.e. higher industry cash flow volatility) hold more cash, and this trend decreases monotonically across the five quintiles. To ensure the trend observed is not due to the way firms are divided, volatility quintiles are computed in each financial year, and average cash is computed for each quintile and plotted against time (see Figure A15). The overall trend remains where firms with greater idiosyncratic risk hold more cash, with the exception of years before 1985 and year 2002. Before 1985, the third and fourth quintile of firms hold more cash than the top (fifth) quintile, while in year 2002, the position of the third and fourth quintile is switched. Although the two exceptions do not affect the overall influence of idiosyncratic risk on cash holdings,

[16] Industry cash flow volatility in the top quintile (value at the 80th percentile is 5.0%) in 1980 belongs to the lowest quintile in 1990 (value at the 20th percentile is 5.9%).

[17] Average cash holdings according to industry cash flow volatility quintiles sorted over the entire sample (i.e. non-truncated criteria) are reported in Appendix A-I. General trend remains the same with the exception of the 1980s where there are no firms in the top volatility quintile before 1983. The cash holdings pattern before 1988 is disordered and not consistent with expectations.

it is important to note the sensitivity of the risk-cash relationship to sorting and sub-sampling.

To identify whether the relationship between idiosyncratic risk and cash is consistent over the other measure of flexibility, firms are divided into five groups according to their level of debt capacity. Average cash is plotted for each volatility quintile of firms over time in each debt capacity group (see Figure A16). While the bottom two quintiles of firms (firms with lower volatility) consistently hold the least cash over the five debt capacity groups, the trend for the rest of the quintiles is not obvious and the positive risk-cash relationship is not robust after debt capacity is taken into account.

On the whole, the analyses above show that the selected two important determinants of cash (firm size and idiosyncratic risk) exhibit positive influence on cash holdings. However, once debt capacity is considered, positive relationships do not hold for all firms in the sample. Furthermore, it is found that although industry affects the level of cash held by firms, no single industry is the main driver of the increasing trend in cash over time. Conversely, the negative relationship between cash and debt capacity is observed even when firms are divided into different industries. This supports the hypothesis that industries dictate the nature of assets held by firms; and the nature of assets determine the amount of debt capacity owned by firms and thereby directly control the amount of cash held.

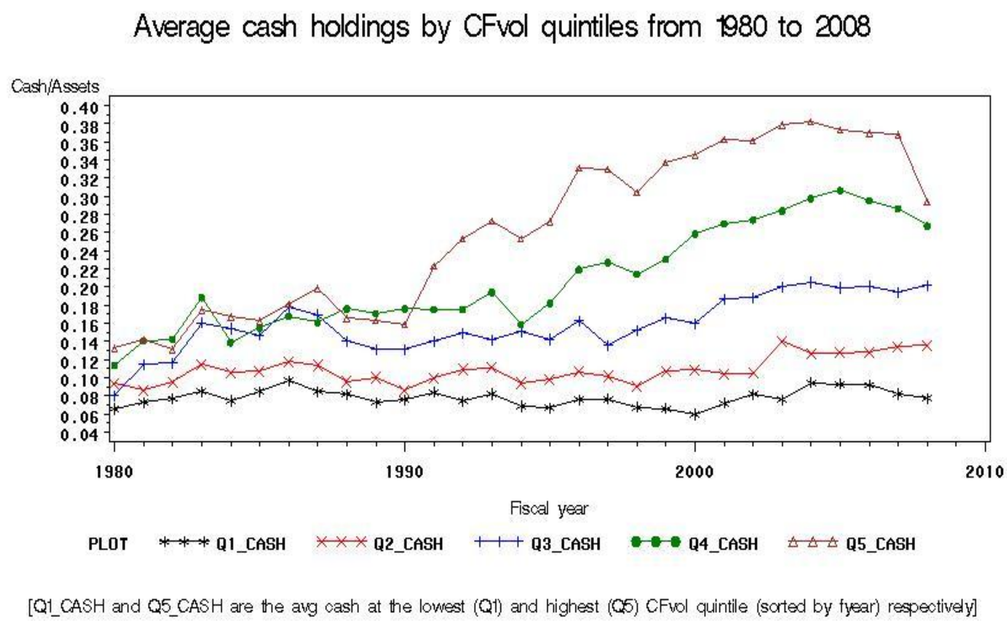


Figure A14 Average cash holdings in each industry cash flow volatility quintile, 1980-2008.

The figure plots the average cash to total assets ratio for firms sorted by industry cash flow volatility quintiles, with quintile 1 having the lowest volatility and quintile 5 having the highest volatility. Average cash holdings are computed for every volatility quintile in each financial year. Industry cash flow volatility is measured as the average of standard deviation of cash flow of firms for the past 3 to 10 years in each industry sorted by two digit SIC code. Sample and variable specifications are provided in Chapter A2.3.

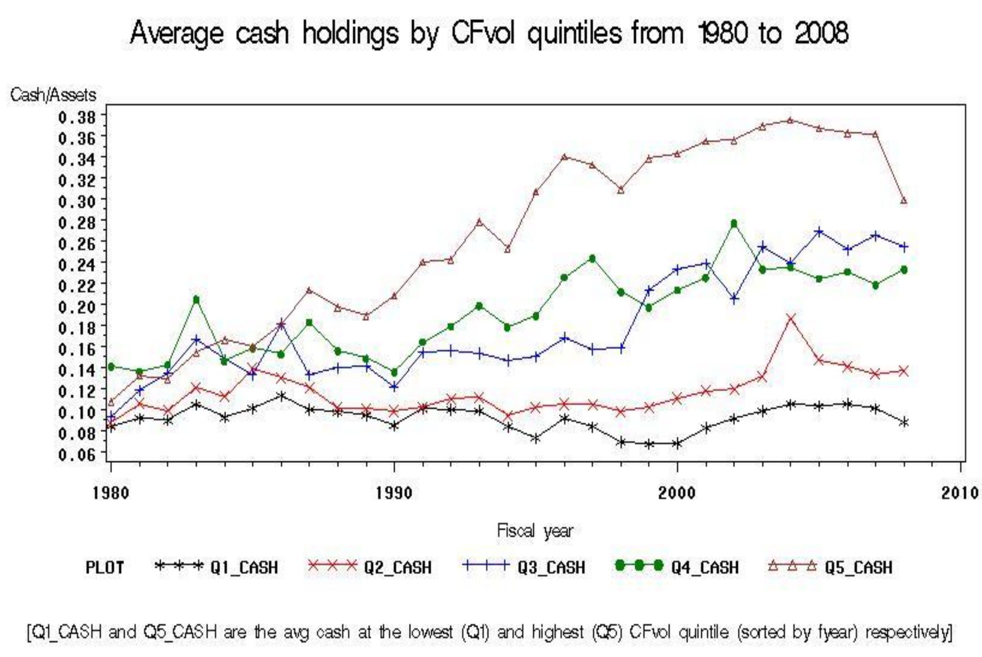


Figure A15 Average cash holdings by industry cash flow volatility quintiles sorted each financial year, 1980-2008.

The figure plots the average cash to total assets ratio for firms sorted by industry cash flow volatility quintiles in each financial year, with quintile 1 having the lowest volatility and quintile 5 having the highest volatility. Volatility sorting is done each financial year and firms are divided into 5 groups each year. Average cash holdings are computed for every volatility quintile in each financial year. Sample and variable specifications are provided in Chapter A2.3.

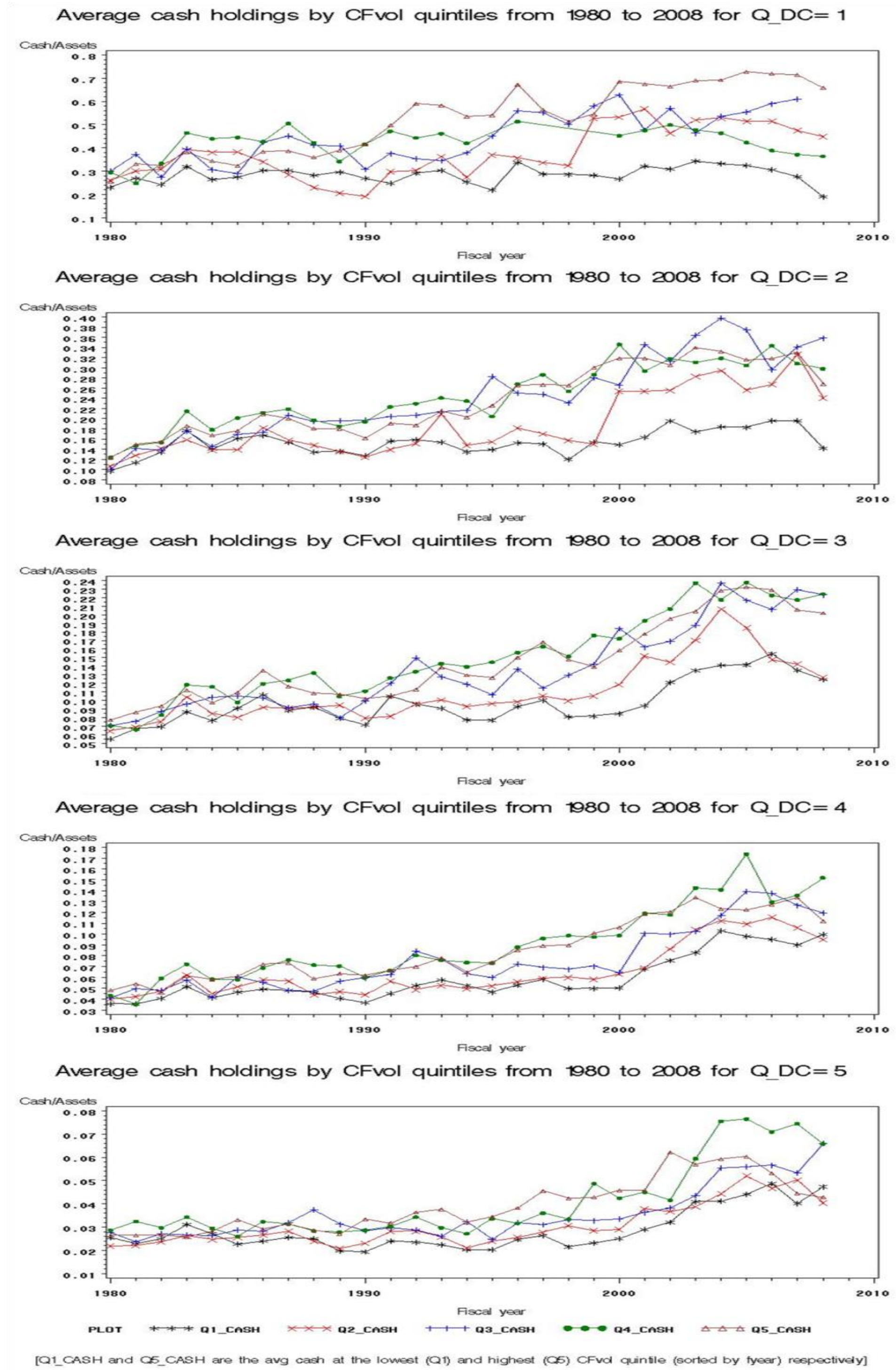


Figure A16 Average cash holdings in each industry cash flow quintile according to debt capacity groups, 1951-2008

The figure plots the average cash to total assets ratio for firms sorted by industry cash flow volatility quintiles, with quintile 1 having the lowest volatility and quintile 5 having the highest volatility. Firms are first ranked and divided into five groups according to their current period debt capacity level. Debt capacity group 1 (Q_DC=1) represents firms with the lowest debt capacity and group 5 (Q_DC=5) represents firms with the highest debt capacity. For each debt capacity group, average cash holdings are computed for each industry cash flow volatility quintile in each financial year. Sample and variable specifications are provided in Chapter A2.3.

CHAPTER A4. THE DETERMINANTS OF CASH HOLDINGS

A4.1 Cash model specifications

In order to examine the interaction between various firm characteristics and cash holdings, the following base cash model is adapted from Opler, Pinkowitz, Stulz and Williamson (1999). Potential determinants of cash are based on the transactional and precautionary theory of cash. BKS use the model to identify major determinants of cash holdings and to test whether there is a shift in the demand for cash holdings. Here, the model is adapted to measure the impact of debt capacity on cash holdings demand curve intercept and slope.

For comparability with previous results, the base model (*a*) is estimated from 1980 to 2006 using nine different regression models. Regression estimates are reported in Table A7. The rest of the models uses sample from 1980 to 2008.

$$\text{Cash}_{i,t} = c + \alpha_1\text{INDSTDCF}_{i,t} + \alpha_2\text{Q}_{i,t} + \alpha_3\text{LNAT}_{i,t} + \alpha_4\text{CFe}_{i,t} + \alpha_5\text{NWC}_{i,t} + \alpha_6\text{CAPEX}_{i,t} + \alpha_7\text{BKDEBT}_{i,t} + \alpha_8\text{RD\_SALE}_{i,t} + \alpha_9\text{DIVDUM}_{i,t} + \alpha_{10}\text{ACQUI}_{i,t} + \varepsilon_\text{i} \qquad (a)$$

In the modified cash model, debt capacity is added to the base model and estimated using the same period and same methods to compare the results with model (a) (results are reported in Table A7).

$$\text{Cash}_{i,t} = c + \alpha_1\text{DC}_{i,t} + \alpha_2\text{INDSTDCF}_{i,t} + \alpha_3\text{Q}_{i,t} + \alpha_4\text{LNAT}_{i,t} + \alpha_5\text{CFe}_{i,t} + \alpha_6\text{NWC}_{i,t} + \alpha_7\text{CAPEX}_{i,t} + \alpha_8\text{BKDEBT}_{i,t} + \alpha_9\text{RD\_SALE}_{i,t} + \alpha_{10}\text{DIVDUM}_{i,t} + \alpha_{11}\text{ACQUI}_{i,t} + \varepsilon_\text{i} \qquad (b)$$

To avoid potential multicollinearity problem, estimation is repeated with NWC and Capex excluded and subsequent industry cash flow volatility is excluded as follow.[18]

$$\text{Cash}_{i,t} = c + \alpha_1\text{DC}_{i,t} + \alpha_2\text{INDSTDCF}_{i,t} + \alpha_3\text{Q}_{i,t} + \alpha_4\text{LNAT}_{i,t} + \alpha_5\text{CFe}_{i,t} + \alpha_6\text{BKDEBT}_{i,t} + \alpha_7\text{RD\_SALE}_{i,t} + \alpha_8\text{DIVDUM}_{i,t} + \alpha_9\text{ACQUI}_{i,t} + \varepsilon_i \quad (c)$$

$$\text{Cash}_{i,t} = c + \alpha_1\text{DC}_{i,t} + \alpha_2\text{Q}_{i,t} + \alpha_3\text{LNAT}_{i,t} + \alpha_4\text{CFe}_{i,t} + \alpha_5\text{BKDEBT}_{i,t} + \alpha_6\text{RD\_SALE}_{i,t} + \alpha_7\text{DIVDUM}_{i,t} + \alpha_8\text{ACQUI}_{i,t} + \varepsilon_i \quad (d)$$

To test whether previous period industry cash flow volatility and debt capacity have significant impact on current period cash holdings, model (c) is repeated with all independent variable lagged one period. It is expected that the previous period debt capacity has similar negative impact on current period's cash holdings but of a lower magnitude.

$$\text{Cash}_{i,t} = c + \alpha_1\text{DC}_{i,t-1} + \alpha_2\text{INDSTDCF}_{i,t-1} + \alpha_3\text{Q}_{i,t-1} + \alpha_4\text{LNAT}_{i,t-1} + \alpha_5\text{CFe}_{i,t-1} + \alpha_6\text{BKDEBT}_{i,t-1} + \alpha_7\text{RD\_SALE}_{i,t-1} + \alpha_8\text{DIVDUM}_{i,t-1} + \alpha_9\text{ACQUI}_{i,t-1} + \varepsilon_i \quad (e)$$

As industry cash flow volatility and debt capacity are highly correlated with each other, the two computationally different ratios potentially measure a common factor and influence cash holdings in a similar respect, resulting in a positive bias in the above models (a), (b), (c) and (e). To control the effect of one variable on the other, the base model is orthogonalized to differentiate the influence of the two variables on cash holdings. The extent to which both variables are measuring the same component is

[18] To test the severity of multicollinearity problem, the variance inflation factor (VIF) is computed based on models (b) to (d) using OLS regression. A VIF of 1 means that there is no correlation among the x^{th} predictor and the remaining predictor variables. The largest VIF recorded from the modified cash model (b) is 1.81 (for DC), indicating no serious multicollinearity problem even though the standard error for the coefficient of DC is mildly inflated. Excluding NWC and CAPEX in model (c) reduces the VIF by a fair proportion to 1.45, and further exclusion of INDSTDCF in model (d) only reduces VIF to 1.38. Although multicolleanarity problem is not severe, models (c) and (d) are performed for robustness purpose.

netted off using orthogonalized regression. The first version of the orthogonalized regression extracts the debt capacity residuals, R_DC, in the following two-step regression.

The first step of the orthogonalized estimation regresses debt capacity against volatility in each financial year and obtains a debt capacity residual for each firm in each year. By construction, debt capacity residuals are uncorrelated with industry cash flow volatility. This resolves the potential multicollinearity problem between the two variables and allows each variable's net impact on cash holdings to be measurable. Debt capacity residuals are then put into the base model with other determinants of cash in the second step estimation.

First step: $DC_{i,t} = c + \alpha_1 INDSTDCF_{i,t} + R\_DC_{i,t}$

Second step: $Cash_{i,t} = c + \alpha_1 R\_DC_{i,t} + \alpha_2 INDSTDCF_{i,t} + \alpha_3 Q_{i,t} + \alpha_4 LNAT_{i,t} + \alpha_5 CFe_{i,t} + \alpha_6 BKDEBT_{i,t} + \alpha_7 RD\_SALE_{i,t} + \alpha_{10} DIVDUM_{i,t} + \alpha_{11} ACQUI_{i,t} + \varepsilon_i$ (*f*)

To cater for lagged effect as described before, the second step is repeated using lagged independent variables. Finally, the orthogonalized regression is repeated but uses industry cash flow volatility residuals instead of debt capacity residuals.

First step: $INDSTDCF_{i,t} = c + \alpha_1 DC_{i,t} + R\_INDSTDCF_{i,t}$

Second step: $Cash_{i,t} = c + \alpha_1 R\_INDSTDCF_{i,t} + \alpha_2 INDSTDCF_{i,t} + \alpha_3 Q_{i,t} + \alpha_4 LNAT_{i,t} + \alpha_5 CFe_{i,t} + \alpha_6 BKDEBT_{i,t} + \alpha_7 RD\_SALE_{i,t} + \alpha_{10} DIVDUM_{i,t} + \alpha_{11} ACQUI_{i,t} + \varepsilon_i$ (*g*)

Cash flow is found to have direct positive effect on access to lines of credit (Campello et al., 2010). Although this impact is not significant for firms with high cash holdings, the positive relationship between cash flow and borrowing capacity implies a negative relationship between cash flow risk and debt capacity, where firms with more volatile cash flow have lower debt capacity, all else being equal. To model the impact of cash flow risk on debt capacity and the impact of debt capacity on cash, an interaction term between volatility and debt capacity is added to cash model (b) as follows.

$$\begin{aligned}Cash_{i,t} = c &+ \alpha_1 DC_{i,t} + \alpha_2 INDSTDCF_{i,t} + \alpha_3 DC{*}INDSTDCF_{i,t} + \alpha_4 Q_{i,t} + \alpha_5 LNAT_{i,t} \\ &+ \alpha_6 CFe_{i,t} + \alpha_7 NWC_{i,t} + \alpha_8 CAPEX_{i,t} + \alpha_9 BKDEBT_{i,t} + \alpha_{10} RD\_SALE_{i,t} \\ &+ \alpha_{11} DIVDUM_{i,t} + \alpha_{12} ACQUI_{i,t} + \varepsilon_i \qquad (h)\end{aligned}$$

A4.2 Cash model regression results

A4.2.1 Base cash model regression results

The base cash model results are reported in Table A7. Regression estimates are similar BKS with the following exceptions: (1) industry cash flow volatility is insignificant in the 1980 Fama MacBeth regression (model 7) and the fixed effects regression (model 9), (2) logarithm of total assets (LNAT), net working capital (NWC) and capital expenditure (CAPEX) have lower coefficient estimates compared to BKS, (3) capital expenditure (CAPEX) is not sensitive to the measurement of cash holdings, and (4) indicator variables for 1990s and 2000s trends yield slightly different signs in estimates compared to BKS. These differences, however, do not alter the interpretation of the cash model that is based on transactional and precautionary motives.[19] First, notwithstanding the insignificance of the variable in model 7 and 9, industry cash flow volatility remains the most important determinant of cash holdings in the base cash model, supporting the precautionary motive of holding cash. Second, transactional motive is supported by the highly significant estimates for net working capital, capital

[19] The model used is adapted originally from Opler, Pinkowitz, Stulz and Williamson (1999). Bates, Kahle and Stulz (2009) used the OPSW model to test whether “cash holdings changed because firms moved along the demand curve for cash or because the demand curve shifted” overtime (Bates et al., 2009, p1987).

expenditure, and acquisition expense because these tangibility variables measures firms' economies of scale when converting noncash assets into cash.[20] Although the three measures have reduced importance in the models here compared to BKS, they are the most important determinants of cash along with volatility and debt. Furthermore, capital expenditure is insensitive to the measurement of cash holdings and is significant in all models. Together with the negative significance of cash flow (in all 9 models)[21] which suggests the importance of transaction motive of holding cash since greater cash flow generally indicates lower transactional costs due to less need in the conversion of noncash assets into cash, overall results provide evidence to support the transactional motive for cash.

Other than the difference above, the remaining results obtained are either similar to BKS or support the findings in the literature. First, models 3 and 6 provide evidence suggesting that the impact of firm characteristics on cash holdings is changing over time. The models measure the flow concept of cash and use changes in cash holdings as dependent variable. Total assets yield a positive but zero estimate, suggesting it is unimportant in determining changes in cash holdings. Cash flows in models 3 and 6 obtain a positive estimate, measuring the positive impact of cash flows to cash holdings in each period.

Second, there is higher cash holdings in the most recent period compared to the period before year 2000. Modifying the base cash model slightly, models 4 to 6 include dummy variables for 1990s and 2000s (Dummy1990 and Dummy2000) to measure

[20] Supporting the transactional motive of holding cash, Beltz and Frank (1996), Mulligan (1997), and Bover and Watson (2005) found evidence of economies of scale in cash holdings.
[21] The cash regressions results reported significance of cash flow in seven out of nine models. Cash flow is found to be insignificant determinant of year-to-year changes in cash holdings (Model 3 and 6).

changes in trend over two different periods (from 1990 to 2008 and 2000 to 2008 respectively). Estimates for both dummies (with the exception of Dummy2000 in model 5) support previous findings that cash holdings in the 2000s increased significantly compared to the period before 2000. Dummy2000 is positive for model 4 and 6 which indicates that there is a part of the variance (increase) of cash holdings not explained by firm characteristics in the 2000s period. Model 5 reports a negative coefficient for Dummy2000 but the variable is larger than the estimate for 1990s, again suggesting larger cash holdings in 2000s. The Fama-MacBeth regressions performed over two periods, before and after 1990 (model 7 and 8) support the findings of a change in intercept of cash holding model over time. Similar to BKS, the intercepts for regressions in the 1990s and 2000s have lower magnitude compared to the 1980s – supporting the claim that intercept of cash model changes over time and there may be predictors of cash holdings not included in the model. According to the internal flexibility hypothesis, the suggested missing predictor of cash holdings is debt capacity, which will be tested and analysed in Table A8.

Third, it is suggested that firms with IPOs within the last five years potentially affect the fixed effects regression results since new firms generally have higher idiosyncratic risks, thus influencing the amount of cash held. In addition, firms with recent IPOs may hold more cash. Thus, the fixed effects regression (model 9) excludes firms with IPOs in the last five years. The fixed effects model yield results that are comparable to BKS. Coefficient estimates for industry cash flow volatility and firm size become insignificant after controlling for firm and year fixed effects. Supporting the transactional motive of holding cash, all other independent variables remain significant but have lower estimated coefficients. A strong fixed effects impact is evident due to large and highly significant intercepts reported in models 1 to 8, suggesting that there may be an important cash holdings determinant excluded from the base model.

Finally, a robustness check is performed for the base cash model to ensure the accuracy of results reported. Whilst t-values of estimated coefficients are not reported in BKS, they are relatively large (i.e. estimates are highly significant) in the reported regressions. To ensure that the t-values obtained are appropriate, a portion of the sample is matched to Opler et al. (1999). The results obtained are comparable with Opler et al. (1999) and reported in Appendix A-IV. It is noted that t-values are sensitive to the measure of dependent variable and the type of regression – t-values obtained for the dependent variable is larger for cash to total assets compared to the logarithm of cash ratio and change in cash ratio; and t-values for simple OLS regressions are generally larger compared to Fama-MacBeth and fixed effects regression.

To sum up, the transaction motive of cash holdings is supported even after controlling for fixed effects because net working capital, capital expenditure, acquisition expenses and debt remain the most important determinants of cash holdings. The importance of these value-adding expenses in firms' cash decisions also supports the new cash holdings theory of firm-value and strategic motives as firms hold more cash to invest more efficiently and effectively (cost-effectiveness due to lower transaction costs) in profitable projects. On the other hand, the precautionary motive of cash measured using cash flow volatility is no longer an important factor of cash after fixed effects are considered. This also suggests that, after controlling for fixed effects, there is evidence in support of firms using cash holdings for upside opportunistic motives instead of serving as a cushion for downside risks as documented in the literature (e.g. Bates et al., 2009). However, it is noted that the fixed effects regression (Model 9) excludes firms with IPOs during the last five years (i.e. younger and smaller firms). It is expected that, after inclusion of these firms, volatility and cash flow will become important in determining the level of cash because these firms hold cash primarily for precautionary purposes to cushion any negative cash flow shocks. This expectation is confirmed in an extra regression (not reported in detail here) and it is found that cash flow volatility becomes significant when small and young firms are included. This suggests that volatility is an important determinant of cash holdings only for smaller or younger firms. Further analysis on the determinants of cash for constrained and unconstrained firms will be documented in Chapter A5.

A4.2.2 Modified cash model regression results

Table A8 reports the modified cash model (with debt capacity) for the period 1980 to 2008.[22] Inclusion of debt capacity as an additional explanatory variable for cash holdings generates important results. First, the coefficient estimates of industry cash flow volatility reduces significantly after debt capacity is included – a significant decrease from 0.387 to 0.094 for model 1. Furthermore, cash flow volatility becomes sensitive to whether debt capacity is included in the Fama-MacBeth and fixed effects regression. In the 1980s Fama-MacBeth estimation, cash flow volatility is significant only when debt capacity is included in the regression. In the fixed effects regression, the sign for the volatility estimate changes to negative when debt capacity is added. This

[22] The same modified cash model with debt capacity for the period from 1980 to 2006 yields similar results as regression using the sample period 1980 to 2008. As such the larger sample period will be used for subsequent tests. Table of coefficients for the sample period 1980 to 2006 is reported in Appendix A-V for reference and comparison purposes.

shows that cash flow volatility is sensitive to the estimation method when debt capacity is included in the model.

Second, after considering debt capacity, NWC no longer significantly predicts cash holdings in all the models, becoming insignificant in four (out of nine) models, and is sensitive to the estimation methods. Similarly, the coefficient estimate for NWC falls sharply for all models. While BKS found NWC the most important firm characteristic that contributed to the increase in cash holdings, it is found here that its importance is subjected to the consideration of debt capacity. Third, similar evidence is observed for Capex when debt capacity is considered. The coefficient estimate is not only sensitive to the measurement of cash holdings (as reported in the previous study), it is sensitive to the type of modelling. The sign for the Capex coefficient changes when there is a change in regression model and cash measurement. Fourth, lower coefficient estimates for Q, cash flow, debt, dividend and R&D ratios across all nine models indicate decreased importance of these variables when debt capacity is included. Cash flow ratio becomes insignificant for models 7 and 8, suggesting the instability of cash flow as an important determinant of cash holdings after debt capacity is accounted for. Fifth, year dummies do not show that intercepts of the models change over time. Both coefficients for dummy variables of 1990s and 2000s are negative, suggesting no shift in the intercepts. Furthermore, Dummy2000 has a lower magnitude than Dummy1990 in two out of the three models, suggesting that intercept for the more recent decade have not increased. The results imply that demand for cash may not have shifted over time. Finally, there is considerable increase in R-squared across all nine models (e.g. increase from 0.430 to 0.634 for model 1), suggesting an overall increase in model fit when debt capacity is taken into account.

On the whole, the results above indicate that debt capacity has the greater impact on cash holdings compared to industry cash flow volatility; while BKS showed that increased in cash holdings is due mainly to changes in NWC, cash flow volatility, Capex and R&D expense, these variables no longer significantly predict cash holdings once debt capacity is considered. The high negative coefficient estimate (e.g. -0.882 for model 1) provides evidence for the substitution between cash and debt capacity for precautionary purposes. Although cash and debt capacity are not perfect substitutes for each other in the imperfect capital market, they both serve the precautionary function in firms' liquidity management. Lins et al. (2010) provide evidence for different precautionary roles of cash and debt capacity – excess (non-operating purpose) cash holdings is used to cushion bad times when cash flow are inadequate, while credit lines are used to fund business opportunities in good times. Further evidence on the different precautionary functions for cash and debt capacity is given in subsequent models and results.

A4.2.3 Robustness tests

A4.2.3.1 Net working capital and capital expenditure

The sensitivities of variables reported in the previous table may be due to the high correlations between explanatory variables. To avoid a potential multicollinearity problem due to model specification, NWC and Capex are excluded from the regressions - results are reported in Table A9. The construction of debt capacity includes firms' receivables, inventory, and property plant and equipment (PPE) in pre-specified weights. The first two components of debt capacity are included in net working capital, and Capex measures single period capital expense that adds to the total amount of PPE. By construction, higher correlations are expected between NWC and debt capacity, and Capex and debt capacity – reported as 0.366 and 0.241 respectively.[23] Notwithstanding that there are no similar components in their construction, cash flow volatility is found to have high correlation with debt capacity (-0.363). This will be investigated further in Table A10 when volatility is excluded from the model.

The modified model in Table A9 (with NWC and Capex excluded) produces estimates that are very similar to results reported in Table A8. Furthermore, excluding the two variables (NWC and Capex) does not reduce the model fit. Thus, debt capacity can be used to replace the two variables with little impact on the model – supporting the findings from Table A8.

A4.2.3.2 Industry cash flow volatility

In the next modified cash model, industry cash flow volatility is excluded from the model (reported in Table A10). Contrary to previous findings and expectations, excluding industry cash flow volatility does not reduce the model fit; i.e. R-squared remains at the same level. Estimated coefficients for debt capacity increase slightly, while the other estimations are relatively similar to the previous reported tables. One noteworthy point is the evidence on the shift in demand for cash (i.e. change in intercept over time) from the Fama-MacBeth regressions. Intercepts for the 1980s and 1990s regression remain relatively the same with only an insignificant drop of less than 1%.

[23] Correlations between independent variables are reported in Appendix A-VI.

This gives further support to the supposition that the intercept of the model may not have changed over time, but the slope of the model has become steeper.

A4.2.3.3 Lagged independent variable effect

To examine whether cash holdings is influenced by previous year's volatility and firm characteristics, all determinants of cash holdings are lagged one period and reported in Table A11. The model examines whether previous period debt capacity and industry cash flow volatility has greater impact on current period's cash holdings. According to Lins et al. (2010), cash holdings are held to cushion bad times when cash flows are inadequate. Furthermore, there is evidence of firms artificially managing financial flexibility to prepare for recession (Ang and Smedema, 2011). Previous period cash flow and volatility may have greater explanatory power on current level of cash holdings because managers will adjust current cash level accordingly.

Accordingly, estimates from Table A11 provide evidence that previous period industry cash flow volatility has a greater impact on cash holdings, e.g. coefficient of volatility for model 1 increases from 0.091 (from Table A9) to 0.232. Although cash flow variable reports higher coefficient for some models, the increase is not significant and constant across different estimation techniques. Nevertheless, evidence from lagged industry cash flow volatility is consistent with Ang and Smedema (2011) and Lins et al. (2010) that cash holdings are used to hedge against idiosyncratic risk and unexpected negative shocks, even prior negative shocks are experienced.

Lagged variables representing investment opportunities (Q ratio, R&D expenses, acquisition expenses) are expected to have little or no change in their impact for cash holdings because investment opportunities are generally funded by lines of credit (proxied using debt capacity) instead of cash-on-hand. There is, however, no conclusive evidence since coefficient estimates of lagged Q ratio and R&D expenses are similar to those reported in Table A9. The lagged acquisition variable yields lower estimates compared to the current period estimate. This may be due to depletion of cash holdings in the previous period when acquisition activity has taken place, resulting in a lower level of cash held in the current period. Further evidence on debt capacity's precautionary role is documented in Chapter A7 for the debt capacity regressions.

On the whole, with the exception of debt capacity and volatility, the 'lagged model' does not perform as well as the 'current' cash model which implies that cash decisions are current decisions made by managers based on existing firm conditions. This is reasonable because we expect managers to have insider information and make decisions according to their expectations for the current period's requirements rather than the previous reported figures. Thus, a cash model with the current period's firm characteristics (not lagged in independent variables) may be more appropriate, with the exception of industry cash flow volatility which is not known in the current period when managers make cash decisions. Whilst managers make use of current (unreported) firm conditions and statistics in cash decisions, they can only look at previous the period's reported industry figures. Hence, it becomes intuitively reasonable to lag only the volatility variable while keeping the rest of the variables at the current period. Accordingly, the estimation performed with lagged volatility reports slightly higher coefficient estimates for volatility but does not differ significantly from Table A11 for other variables and model fit. Results are reported in Appendix A-VII for reference purposes. Although the robustness check does not indicate that the lagged volatility measure has much greater influence on cash compared to the current value of volatility, this presumption will be further tested in the orthogonalized regression in the next section.

Table A7 Regressions of base cash model (*a*) for period 1980 to 2006

This table reports the base cash model regression (following BKS) results using a CRSP/Compustat sample from 1980 to 2006. The results and models used are reported in a similar manner as BKS for ease of comparison. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Variable specifications are reported in Chapter A2.3. The final sample has 112,038 firm-year observations for the base cash model OLS regressions. Following Bates et al. (2009), firms with IPOs in the last 5 years are excluded in the fixed effects regression and the last model uses 67,247 observations. The dependent variable is cash holdings ratio computed as cash to total asset except for the following models: Models 2 and 5 use the natural logarithm of ratio cash to net asset (LNCASH_NETASSET), where net asset is computed as total asset less cash holdings; and Models 3 and 6 use the period-to-period change in cash holdings (DCASH) computed as $Cash_t$ – $Cash_{t-1}$. Models 1 to 6 report estimates from OLS regressions with heteroskedasticity adjusted standard errors. Models 4 to 6 includes dummy variables, DUMMY1990 and DUMMY2000, for observations from 1990 to 2006 and 2000 to 2006 respectively. Models 7 and 8 are based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. The final model controls for firm and year fixed effects. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	MODEL1 OLS	MODEL2 OLS	MODEL3 OLS	MODEL4 OLS	MODEL5 OLS	MODEL6 OLS	MODEL7 FM1980	MODEL8 FM1990	MODEL9 FE
Dependent	Cash	LnCash_ netasset	DCash	Cash	LnCash_ netasset	DCash	Cash	Cash	Cash
Intercept	0.261***	0.151***	0.074***	0.266***	0.153***	0.078***	0.283***	0.245***	
.	(141.28)	(41.24)	(57.44)	(141.29)	(40.97)	(59.05)	(30.48)	(32.85)	
LAGDCASH			-0.082***			-0.083***			
.			(-27.66)			(-27.93)			
LAGCASH			-0.284***			-0.285***			
.			(-145.98)			(-146.50)			
INDSTDCF	0.387***	0.423***	0.101***	0.391***	0.459***	0.099***	0.103	0.505***	0.016
.	(45.17)	(24.94)	(18.17)	(43.73)	(25.89)	(17.02)	(1.67)	(12.04)	(1.52)
Q	0.019***	0.017***	0.006***	0.019***	0.017***	0.006***	0.010***	0.020***	0.009***
.	(71.33)	(33.30)	(31.45)	(72.30)	(33.43)	(32.44)	(7.67)	(10.68)	(23.51)
LNAT	-0.005***	-0.004***	0.000**	-0.005***	-0.003***	0.000**	-0.010***	-0.005***	0.001
.	(-18.21)	(-7.99)	(2.04)	(-15.49)	(-4.71)	(1.97)	(-8.30)	(-3.97)	(1.22)
CFe	-0.046***	-0.053***	0.050***	-0.045***	-0.055***	0.050***	0.035*	-0.020	0.013***
.	(-18.93)	(-11.03)	(30.80)	(-18.69)	(-11.39)	(31.13)	(2.11)	(-1.07)	(4.34)
NWC	-0.171***	-0.198***	-0.071***	-0.172***	-0.200***	-0.071***	-0.171***	-0.189***	-0.158***
.	(-79.83)	(-46.50)	(-50.62)	(-79.83)	(-46.91)	(-50.47)	(-15.25)	(-10.92)	(-53.39)
CAPEX	-0.326***	-0.519***	-0.312***	-0.331***	-0.531***	-0.312***	-0.250***	-0.453***	-0.268***
.	(-51.43)	(-41.26)	(-72.45)	(-51.64)	(-41.86)	(-71.86)	(-15.81)	(-5.91)	(-31.94)
BKDEBT	-0.390***	-0.288***	-0.099***	-0.392***	-0.293***	-0.099***	-0.345***	-0.377***	-0.223***
.	(-163.05)	(-60.70)	(-58.22)	(-162.18)	(-61.12)	(-57.97)	(-53.94)	(-44.45)	(-72.56)
RD_SALE	0.027***	0.086***	0.009***	0.027***	0.086***	0.009***	0.216***	0.052***	0.006***
.	(73.95)	(118.00)	(35.59)	(73.90)	(118.11)	(35.51)	(8.41)	(2.97)	(10.98)
DIVDUM	-0.049***	-0.038***	-0.009***	-0.052***	-0.043***	-0.010***	-0.025***	-0.061***	0.004**
.	(-41.53)	(-16.31)	(-11.30)	(-41.95)	(-17.60)	(-11.98)	(-6.24)	(-9.19)	(2.28)
ACQUI	-0.210***	-0.275***	-0.369***	-0.205***	-0.273***	-0.366***	-0.102***	-0.271***	-0.160***
.	(-24.48)	(-16.15)	(-64.63)	(-23.92)	(-16.04)	(-64.10)	(-5.61)	(-7.08)	(-21.08)
DUMMY-1990				-0.015***	-0.012***	-0.009***			
.				(-13.23)	(-5.00)	(-11.63)			
DUMMY-2000				0.011***	-0.009***	0.009***			
.				(8.83)	(-3.68)	(11.27)			
R-Sq	0.430	0.263	0.272	0.431	0.263	0.274	0.358	0.469	
Adj R-Sq	0.430	0.263	0.272	0.431	0.263	0.274	0.357	0.468	
Obs	112038	112052	102832	112038	112052	102832	38528	73510	67247

Table A8 Regressions of base cash model (*b*) with debt capacity for period 1980 to 2008

This table reports the base cash model regression results after inclusion of debt capacity as additional independent variable from 1980 to 2008 in a similar manner as the previous table for ease of comparison. Sample and variable definitions are reported in Chapter A2.3. Refer to Table A7 for model specifications. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	MODEL1 OLS	MODEL2 OLS	MODEL3 OLS	MODEL4 OLS	MODEL5 OLS	MODEL6 OLS	MODEL7 FM1980	MODEL8 FM1990	MODEL9 FE
Dependent	Cash	LnCash_ netasset	DCash	Cash	LnCash_ netasset	DCash	Cash	Cash	Cash
Intercept	0.593***	0.537***	0.255***	0.605***	0.550***	0.264***	0.579***	0.559***	
.	(302.17)	(117.17)	(140.68)	(304.47)	(118.17)	(143.06)	(50.94)	(93.27)	
LAGDCASH			-0.053***			-0.051***			
.			(-19.50)			(-19.01)			
LAGCASH			-0.404***			-0.408***			
.			(-201.48)			(-203.27)			
DC	-0.882***	-1.025***	-0.393***	-0.897***	-1.052***	-0.402***	-0.883***	-0.851***	-0.824***
.	(-251.21)	(-125.06)	(-129.86)	(-254.71)	(-127.56)	(-131.63)	(-40.20)	(-41.67)	(-162.00)
INDSTDCF	0.094***	0.102***	0.014***	0.159***	0.210***	0.043***	0.142***	0.219***	-0.008
.	(13.88)	(6.49)	(2.87)	(22.88)	(12.87)	(8.24)	(3.26)	(9.07)	(-0.94)
Q	0.010***	0.007***	0.004***	0.010***	0.006***	0.004***	0.009***	0.012***	0.007***
.	(45.52)	(13.55)	(22.27)	(46.00)	(12.94)	(23.36)	(4.53)	(6.34)	(23.43)
LNAT	-0.014***	-0.015***	-0.005***	-0.011***	-0.010***	-0.004***	-0.012***	-0.013***	-0.015***
.	(-64.53)	(-30.17)	(-29.80)	(-46.40)	(-18.77)	(-20.30)	(-10.36)	(-11.40)	(-23.69)
CFe	-0.007***	-0.013***	0.051***	-0.010***	-0.019***	0.050***	0.021	0.004	0.031***
.	(-3.35)	(-2.77)	(34.15)	(-4.92)	(-4.13)	(33.35)	(1.60)	(0.31)	(11.71)
NWC	0.006***	0.010**	-0.011***	0.002	0.005	-0.012***	-0.007	-0.022	-0.034***
.	(2.80)	(2.16)	(-7.40)	(0.99)	(1.14)	(-8.54)	(-0.61)	(-1.70)	(-12.80)
CAPEX	0.047***	-0.089***	-0.141***	0.025***	-0.120***	-0.151***	0.028*	0.052***	-0.050***
.	(8.75)	(-7.08)	(-33.33)	(4.65)	(-9.53)	(-35.51)	(1.76)	(3.68)	(-6.82)
BKDEBT	-0.218***	-0.088***	-0.070***	-0.225***	-0.099***	-0.074***	-0.211***	-0.230***	-0.135***
.	(-107.83)	(-18.66)	(-44.93)	(-111.53)	(-20.88)	(-47.44)	(-19.58)	(-43.90)	(-51.22)
RD_SALE	0.016***	0.067***	0.007***	0.016***	0.067***	0.007***	0.064***	0.030***	0.004***
.	(59.26)	(108.35)	(32.80)	(59.45)	(108.61)	(32.96)	(3.24)	(3.10)	(8.50)
DIVDUM	-0.005***	0.015***	0.004***	-0.014***	0.002	-0.000	-0.016***	-0.020***	0.009***
.	(-5.09)	(6.49)	(6.19)	(-13.92)	(0.99)	(-0.15)	(-6.37)	(-12.51)	(6.85)
ACQUI	-0.466***	-0.574***	-0.458***	-0.465***	-0.579***	-0.456***	-0.436***	-0.491***	-0.231***
.	(-68.43)	(-36.16)	(-88.82)	(-68.67)	(-36.54)	(-88.73)	(-13.61)	(-20.74)	(-36.25)
DUMMY-1990				-0.027***	-0.024***	-0.015***			
.				(-28.02)	(-10.86)	(-21.39)			
DUMMY-2000				-0.016***	-0.044***	-0.004***			
.				(-16.42)	(-18.76)	(-5.66)			
R-Sq	0.634	0.351	0.372	0.639	0.354	0.376	0.641	0.639	0.837
Adj R-Sq	0.634	0.351	0.372	0.639	0.354	0.376	0.639	0.638	
Obs	115681	115692	106501	115681	115692	106501	115681	78147	66083

Table A9 Regressions of modified cash model (*c*) with debt capacity less NWC and CAPEX

This table reports the modified cash model regression results from 1980 to 2008 in a similar manner as the previous table for ease of comparison. . Sample and variable definitions are reported in Chapter A2.3. Refer to Table A7 for model specifications. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	MODEL1 OLS	MODEL2 OLS	MODEL3 OLS	MODEL4 OLS	MODEL5 OLS	MODEL6 OLS	MODEL7 FM1980	MODEL8 FM1990	MODEL9 FE
Dependent	Cash	LnCash_ netasset	DCash	Cash	LnCash_ netasset	DCash	Cash	Cash	Cash
Intercept	0.594***	0.536***	0.259***	0.606***	0.548***	0.268***	0.577***	0.557***	
.	(302.68)	(117.04)	(142.71)	(305.25)	(117.88)	(144.27)	(49.02)	(81.02)	
LAGDCASH			-0.050***			-0.049***			
.			(-18.30)			(-17.83)			
LAGCASH			-0.414***			-0.418***			
.			(-207.40)			(-208.85)			
DC	-0.873***	-1.031***	-0.425***	-0.893***	-1.064***	-0.435***	-0.879***	-0.854***	-0.849***
.	(-276.86)	(-140.10)	(-154.83)	(-280.31)	(-142.51)	(-155.36)	(-47.49)	(-52.36)	(-178.07)
INDSTDCF	0.091***	0.105***	0.022***	0.159***	0.211***	0.047***	0.140***	0.221***	-0.006
.	(13.43)	(6.71)	(4.47)	(22.80)	(12.97)	(9.06)	(3.10)	(8.46)	(-0.66)
Q	0.010***	0.006***	0.003***	0.010***	0.006***	0.003***	0.009***	0.012***	0.007***
.	(46.80)	(12.66)	(19.12)	(46.86)	(11.78)	(19.97)	(4.27)	(6.31)	(23.46)
LNAT	-0.014***	-0.016***	-0.005***	-0.011***	-0.011***	-0.004***	-0.011***	-0.013***	-0.016***
.	(-65.02)	(-30.69)	(-31.16)	(-46.44)	(-19.47)	(-22.69)	(-12.37)	(-13.47)	(-24.75)
CFe	-0.005**	-0.012***	0.046***	-0.009***	-0.019***	0.044***	0.020	0.000	0.024***
.	(-2.55)	(-2.60)	(31.33)	(-4.70)	(-4.24)	(30.29)	(1.29)	(0.00)	(9.35)
BKDEBT	-0.219***	-0.093***	-0.071***	-0.225***	-0.102***	-0.074***	-0.210***	-0.225***	-0.125***
.	(-114.93)	(-20.89)	(-47.60)	(-118.53)	(-22.91)	(-49.66)	(-24.59)	(-58.90)	(-49.38)
RD_SALE	0.016***	0.067***	0.007***	0.016***	0.067***	0.007***	0.065***	0.030***	0.004***
.	(59.61)	(108.47)	(32.34)	(59.66)	(108.63)	(32.42)	(3.20)	(3.08)	(8.07)
DIVDUM	-0.005***	0.015***	0.005***	-0.014***	0.004	0.001	-0.017***	-0.022***	0.008***
.	(-5.37)	(6.85)	(6.99)	(-14.22)	(1.63)	(1.51)	(-5.83)	(-11.18)	(6.44)
ACQUI	-0.468***	-0.566***	-0.450***	-0.466***	-0.570***	-0.449***	-0.439***	-0.498***	-0.231***
.	(-68.90)	(-35.71)	(-87.19)	(-69.04)	(-36.01)	(-87.00)	(-12.75)	(-19.69)	(-36.21)
DUMMY-1990				-0.027***	-0.022***	-0.013***			
.				(-28.51)	(-10.15)	(-18.92)			
DUMMY-2000				-0.017***	-0.043***	-0.003***			
.				(-16.64)	(-18.36)	(-4.15)			
R-Sq	0.634	0.350	0.366	0.638	0.354	0.368	0.639	0.637	0.837
Adj R-Sq	0.634	0.350	0.366	0.638	0.354	0.368	0.638	0.637	
Obs	115681	115692	106501	115681	115692	106501	115681	78147	66083

Table A10 Regressions of modified cash model (*d*) with debt capacity less INDSTDCF, NWC and CAPEX

This table reports the modified cash model regression results from 1980 to 2008 in a similar manner as the previous table for ease of comparison. Sample and variable definitions are reported in Chapter A2.3. Refer to Table A7 for model specifications. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	MODEL1 OLS	MODEL2 OLS	MODEL3 OLS	MODEL4 OLS	MODEL5 OLS	MODEL6 OLS	MODEL7 FM1980	MODEL8 FM1990	MODEL9 FE
Dependent	Cash	LnCash_ netasset	DCash	Cash	LnCash_ netasset	DCash	Cash	Cash	Cash
Intercept	0.606***	0.550***	0.262***	0.625***	0.573***	0.272***	0.599***	0.590***	
.	(350.34)	(136.36)	(154.14)	(344.75)	(135.22)	(153.28)	(88.30)	(112.46)	
LAG-DCASH			-0.050***			-0.050***			
.			(-18.51)			(-18.31)			
LAGCASH			-0.413***			-0.416***			
.			(-207.60)			(-208.82)			
DC	-0.883***	-1.042***	-0.427***	-0.905***	-1.080***	-0.438***	-0.893***	-0.874***	-0.849***
.	(-287.13)	(-145.36)	(-157.97)	(-287.43)	(-146.58)	(-157.19)	(-55.72)	(-57.65)	(-178.11)
Q	0.010***	0.006***	0.003***	0.010***	0.006***	0.004***	0.010***	0.013***	0.007***
.	(47.56)	(13.04)	(19.43)	(48.20)	(12.57)	(20.53)	(4.18)	(6.13)	(23.46)
LNAT	-0.014***	-0.015***	-0.005***	-0.011***	-0.011***	-0.004***	-0.012***	-0.013***	-0.016***
.	(-64.23)	(-30.31)	(-30.95)	(-47.39)	(-20.05)	(-23.05)	(-12.09)	(-14.11)	(-24.78)
CFe	-0.007***	-0.014***	0.045***	-0.011***	-0.022***	0.044***	0.018	-0.003	0.024***
.	(-3.55)	(-3.11)	(31.13)	(-5.91)	(-4.93)	(29.98)	(1.11)	(-0.16)	(9.36)
BKDEBT	-0.221***	-0.095***	-0.071***	-0.227***	-0.105***	-0.075***	-0.213***	-0.228***	-0.125***
.	(-116.19)	(-21.45)	(-47.88)	(-119.53)	(-23.56)	(-49.81)	(-23.58)	(-61.36)	(-49.39)
RD_SALE	0.016***	0.068***	0.007***	0.016***	0.068***	0.007***	0.066***	0.031***	0.004***
.	(61.46)	(109.90)	(32.92)	(62.39)	(110.64)	(33.37)	(3.28)	(3.15)	(8.07)
DIVDUM	-0.007***	0.013***	0.004***	-0.016***	0.001	0.001	-0.018***	-0.023***	0.008***
.	(-7.39)	(5.94)	(6.42)	(-15.98)	(0.64)	(0.87)	(-5.59)	(-10.51)	(6.44)
ACQUI	-0.468***	-0.566***	-0.450***	-0.466***	-0.570***	-0.449***	-0.439***	-0.498***	-0.231***
.	(-68.87)	(-35.71)	(-87.18)	(-68.88)	(-35.98)	(-86.96)	(-12.84)	(-20.29)	(-36.21)
DUMMY-1990				-0.024***	-0.019***	-0.013***			
.				(-25.60)	(-8.47)	(-17.88)			
DUMMY-2000				-0.012***	-0.037***	-0.002**			
.				(-12.56)	(-16.20)	(-2.55)			
R-Sq	0.633***	0.350***	0.366***	0.637***	0.353***	0.368***	0.637***	0.634***	0.837***
Adj R-Sq	0.633	0.350	0.366	0.637	0.353	0.368	0.636	0.633	
Obs	115681	115692	106501	115681	115692	106501	115681	78147	66083

Table A11 Regressions of modified cash model (*e*) with lagged independent variables

This table reports the modified cash model regression results from 1980 to 2008 in a similar manner as the previous table for ease of comparison. Sample and variable definitions are reported in Chapter A2.3. Refer to Table A7 for model specifications. All independent variables are lagged one period, except for Dummy1990 and Dummy2000. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6	MODEL7	MODEL8	MODEL9
Model	OLS	OLS	OLS	OLS	OLS	OLS	FM1980	FM1990	FE
Dependent	Cash	LnCash	DCash	Cash	LnCash	DCash	Cash	Cash	Cash
Intercept	0.478***	0.353***	0.031***	0.486***	0.359***	0.029***	0.458***	0.457***	
.	(212.32)	(78.43)	(13.35)	(212.77)	(78.60)	(12.18)	(43.30)	(29.64)	
LAGDCASH			-0.096***			-0.097***			
.			(-30.03)			(-30.57)			
LAGCASH			-0.256***			-0.252***			
.			(-96.99)			(-94.93)			
LAGDC	-0.669***	-0.685***	-0.021***	-0.678***	-0.698***	-0.010***	-0.658***	-0.667***	-0.445***
.	(-183.98)	(-94.29)	(-5.89)	(-183.89)	(-94.62)	(-2.86)	(-42.81)	(-36.34)	(-76.74)
LAG-INDSTDCF	0.232***	0.296***	0.179***	0.272***	0.346***	0.155***	0.228***	0.328***	0.018*
.	(29.35)	(18.74)	(29.92)	(32.96)	(20.96)	(24.83)	(3.79)	(11.40)	(1.65)
LAGQ	0.008***	0.002***	0.001***	0.008***	0.003***	0.001***	0.009***	0.012***	0.007***
.	(33.18)	(5.18)	(4.48)	(34.02)	(5.54)	(4.12)	(5.02)	(7.07)	(19.69)
LAGLNAT	-0.010***	-0.010***	0.000**	-0.009***	-0.008***	-0.001***	-0.009***	-0.010***	-0.018***
.	(-42.33)	(-20.53)	(2.18)	(-33.34)	(-15.14)	(-2.78)	(-10.05)	(-9.34)	(-23.55)
LAGCFe	-0.025***	-0.085***	-0.009***	-0.026***	-0.086***	-0.007***	0.019	-0.014	0.010***
.	(-10.56)	(-17.83)	(-4.82)	(-10.92)	(-18.19)	(-3.97)	(0.85)	(-0.70)	(3.08)
LAGBKDEBT	-0.201***	-0.075***	-0.036***	-0.203***	-0.079***	-0.034***	-0.186***	-0.204***	-0.085***
.	(-89.45)	(-16.85)	(-20.19)	(-90.61)	(-17.55)	(-18.81)	(-16.40)	(-23.35)	(-27.38)
LAGRD_ SALE	0.018***	0.065***	0.005***	0.018***	0.065***	0.005***	0.068***	0.035***	0.002***
.	(55.19)	(99.77)	(21.51)	(54.97)	(99.67)	(21.32)	(3.07)	(2.94)	(2.62)
LAG DIVDUM	-0.010***	0.012***	-0.006***	-0.015***	0.006***	-0.004***	-0.018***	-0.025***	0.000
.	(-9.18)	(5.42)	(-7.58)	(-13.49)	(2.73)	(-4.93)	(-4.25)	(-9.67)	(0.23)
LAGACQUI	-0.405***	-0.403***	-0.092***	-0.401***	-0.401***	-0.090***	-0.363***	-0.426***	-0.157***
.	(-52.11)	(-25.96)	(-15.15)	(-51.74)	(-25.84)	(-14.77)	(-9.38)	(-13.90)	(-20.06)
DUMMY1990				-0.021***	-0.016***	-0.002**			
.				(-19.49)	(-7.27)	(-2.19)			
DUMMY2000				-0.001	-0.012***	0.015***			
.				(-0.72)	(-5.35)	(17.71)			
R-Sq	0.513	0.288	0.165	0.515	0.289	0.168	0.491	0.535	0.762
Adj R-Sq	0.513	0.288	0.165	0.515	0.289	0.168	0.490	0.534	
Obs	106483	106516	106474	106483	106516	106474	106483	72471	66014

A4.3 Orthogonalized cash model regression results

As debt capacity and industry cash flow volatility are both significant determinants of cash holdings and have a relatively high correlation (see Appendix A-VI), this section uses the orthogonalized regression method to distinguish between the true effect of each determinant on cash. Table A12 reports orthogonalized cash model with debt capacity residuals computed yearly using OLS regression. To ensure the estimation technique in the first step of the orthogonalized regressions do not have any significant impact or bias on the final results, other techniques are used to estimate debt capacity residuals. Pooled OLS regression and fixed effects regression are used in the first level estimation. The final results are not affected by the first level estimation technique. Estimations based on residuals computed using pooled OLS regression are reported Appendix A-VIII and A-IX for reference purpose. Residuals of debt capacity measure the net effect of debt capacity on cash holdings after controlling for industry cash flow volatility.

Volatility remains an important variable when the uncorrelated debt capacity residual is included in the model. The orthogonalized model provides evidence that both debt capacity and industry cash flow volatility have important impact on cash holdings – very high and significant coefficient estimates, e.g. 0.87 for debt capacity and -0.77 for volatility. However, the volatility estimate falls significantly when firm and year fixed effects are taken into account in model 9. As this is consistent with previous estimates of volatility in fixed effects regressions, volatility is less important when specific firm characteristics are controlled for.

In another estimation (unreported in detail here), the model above is recast with volatility excluded. The impact of debt capacity on cash holdings is still highly significant (coefficient estimate=-0.81) and model fit remains high (R-squared=0.58). Results add to previous evidence in Table A9 and further show that the impact of debt capacity on cash holdings is not affected by the presence of industry cash flow volatility and the former remains an important determinant of cash even after volatility has been controlled for. Additionally, the high model fit shows debt capacity may be a greater determining factor affecting cash decisions compared to volatility, supporting the results in Table A9.

The orthogonalized estimations are repeated with the cash determinants lagged by one period (reported in Table A13). The lagged model increases the estimate for industry cash flow volatility but reduces that for debt capacity. Although both variables remain highly significant, this suggests reduced (increased) importance of debt capacity (industry cash flow volatility) in the previous period. This is consistent with earlier findings that (1) cash holdings depend more on the previous period's cash flow volatility because managers are unable to observe the current period industry performance (a low volatility in the previous period will result in lower expected negative shocks and hence less cash held in current period); and (2) cash decisions are made based on the current period's debt capacity rather than previous because managers with insider information make cash decisions promptly based on current unreported expectations. Other than the general increasing trend in volatility and decreasing trend in debt capacity, the rest of the variables in Table A13 do not appear to show significant variation from the original estimation. However, R-squared is noted to fall by more than 10% in model 1 when the variables are lagged, suggesting a fall in model fit which is consistent with earlier results that cash holdings are based more on the current period's firm statistics (and not the previous period) because managers make cash decisions with current private information that may not be reported and publicly available.

In the next stage of regression analysis, the orthogonalized estimation is repeated with industry cash flow volatility residuals, R_INDSTDCF, computed in the first level regression (see Table A14). R_INDSTDCF measures the residual effect of volatility after taking into account debt capacity and is uncorrelated with debt capacity by construction. While volatility and debt capacity residuals both have large coefficients in the previous orthogonalized estimation, this is not the case for volatility residuals. Although they remain significant, coefficients for volatility residuals are much lower compared to that of debt capacity. Similar findings are reported when the orthogonalized estimation is performed using different methods – (1) pooled OLS estimation (over the entire sample) in the first step regression, (2) pooled OLS estimation in the first step regression with lagged independent variables in the second step regression, and (3) yearly OLS estimation in the first step regression with lagged independent variables in the second step regression (reported in Appendix A-X to A-XII). Results are robust to different modelling and estimation methods. This means that volatility has reduced impact on cash holdings after controlling for debt capacity; suggesting that the impact of volatility on cash holdings is partially dependent on the level of debt capacity. To investigate this further, an interaction term between debt capacity and volatility is created and put into the model in the next section.

Table A12 Regressions of orthogonalized cash model (*f*) with debt capacity residuals (yearly OLS)

This table reports the orthogonalized cash model regression results from 1980 to 2008 in a similar manner as the previous table for ease of comparison. Sample and variable definitions are reported in Chapter A2.3. The first step of the orthogonalized estimation regresses debt capacity against industry cash flow volatility in each financial year to obtain debt capacity residuals, R_DC, for each firm-year observation. R_DC are then put into the regression models with other cash determinants in the second step estimation. Results from the second step estimation are reported as follow. Models 1 to 6 report estimates from OLS regressions with heteroskedasticity adjusted standard errors. Models 4 to 6 includes dummy variables, DUMMY1990 and DUMMY2000, for observations from 1990 to 2006 and 2000 to 2006 respectively. Models 7 and 8 are based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. The final model controls for firm and year fixed effects. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	MODEL1 OLS	MODEL2 OLS	MODEL3 OLS	MODEL4 OLS	MODEL5 OLS	MODEL6 OLS	MODEL7 FM1980	MODEL8 FM1990	MODEL9 FE
Dependent	Cash	LnCash	DCash	Cash	LnCash	DCash	Cash	Cash	Cash
Intercept	0.172***	0.037***	0.053***	0.175***	0.035***	0.056***	0.188***	0.190***	
.	(131.15)	(12.38)	(50.31)	(130.57)	(11.29)	(51.89)	(20.20)	(14.01)	
LAG-DCASH			-0.052***			-0.053***			
.			(-18.82)			(-19.27)			
LAG-CASH			-0.403***			-0.407***			
.			(-202.00)			(-204.27)			
R_DC	-0.866***	-1.032***	-0.413***	-0.873***	-1.039***	-0.419***	-0.879***	-0.854***	-0.825***
.	(-266.02)	(-137.49)	(-147.79)	(-268.72)	(-138.10)	(-149.99)	(-47.49)	(-52.36)	(-173.44)
IND-STDCF	0.769***	0.909***	0.342***	0.699***	0.854***	0.302***	0.733***	0.898***	0.287***
.	(114.17)	(58.59)	(66.55)	(99.52)	(52.57)	(56.85)	(7.46)	(16.93)	(31.25)
Q	0.011***	0.008***	0.004***	0.011***	0.008***	0.004***	0.009***	0.012***	0.007***
.	(52.81)	(15.87)	(23.10)	(53.16)	(15.36)	(23.41)	(4.27)	(6.31)	(23.16)
LNAT	-0.006***	-0.006***	-0.001***	-0.009***	-0.009***	-0.003***	-0.011***	-0.013***	-0.015***
.	(-28.24)	(-12.33)	(-7.60)	(-39.42)	(-16.13)	(-18.09)	(-12.37)	(-13.47)	(-23.57)
CFe	-0.022***	-0.031***	0.039***	-0.015***	-0.026***	0.043***	0.020	0.000	0.023***
.	(-11.67)	(-7.11)	(26.31)	(-7.71)	(-5.84)	(29.11)	(1.29)	(0.00)	(8.59)
BKDEBT	-0.246***	-0.124***	-0.082***	-0.237***	-0.116***	-0.077***	-0.210***	-0.225***	-0.128***
.	(-128.65)	(-28.11)	(-54.55)	(-123.05)	(-26.04)	(-51.17)	(-24.59)	(-58.90)	(-49.96)
RD_SALE	0.017***	0.068***	0.007***	0.017***	0.068***	0.007***	0.065***	0.030***	0.004***
.	(63.05)	(110.42)	(33.88)	(62.56)	(110.25)	(33.67)	(3.20)	(3.08)	(8.36)
DIVDUM	-0.027***	-0.010***	-0.006***	-0.019***	-0.002	-0.001	-0.017***	-0.022***	0.008***
.	(-27.61)	(-4.33)	(-7.86)	(-18.71)	(-0.81)	(-1.10)	(-5.83)	(-11.18)	(6.21)
ACQUI	-0.432***	-0.526***	-0.432***	-0.437***	-0.534***	-0.435***	-0.439***	-0.498***	-0.227***
.	(-62.82)	(-33.20)	(-83.11)	(-63.73)	(-33.68)	(-83.86)	(-12.75)	(-19.69)	(-35.30)
DUMMY-1990				0.009***	0.020***	0.004***			
.				(9.15)	(9.02)	(5.43)			
DUMMY-2000				0.030***	0.012***	0.019***			
.				(29.36)	(5.16)	(26.03)			
R-Sq	0.622	0.347	0.355	0.626	0.348	0.360	0.639	0.637	0.834
Adj R-Sq	0.622	0.347	0.355	0.626	0.348	0.360	0.638	0.637	
Obs	115681	115692	106501	115681	115692	106501	115681	78147	66083

Table A13 Regressions of lagged orthogonalized cash model (*f*) with debt capacity residuals (yearly OLS)

This table reports the orthogonalized cash model regression results from 1980 to 2008 in a similar manner as the previous table for ease of comparison. Sample and variable definitions are reported in Chapter A2.3. The first step of the orthogonalized estimation regresses debt capacity against industry cash flow volatility in each financial year to obtain debt capacity residuals, R_DC, for each firm-year observation. R_DC are then put into the regression models with other cash determinants in the second step estimation. All variables are lagged one period in the second step estimation. Results from the second step estimation are reported as specified in Table A12. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	MODEL1 OLS	MODEL2 OLS	MODEL3 OLS	MODEL4 OLS	MODEL5 OLS	MODEL6 OLS	MODEL7 FM1980	MODEL8 FM1990	MODEL9 FE
Dependent	Cash	LnCash	DCash	Cash	LnCash	DCash	Cash	Cash	Cash
Intercept	0.150***	0.017***	0.019***	0.157***	0.021***	0.023***	0.165***	0.168***	
.	(101.30)	(5.85)	(15.93)	(103.17)	(6.84)	(18.93)	(14.61)	(9.78)	
LAGDCASH			-0.096***			-0.097***			
.			(-30.16)			(-30.63)			
LAGCASH			-0.246***			-0.250***			
.			(-94.36)			(-95.73)			
LAGR_DC	-0.652***	-0.669***	0.001	-0.660***	-0.677***	-0.006	-0.658***	-0.666***	-0.429***
.	(-174.24)	(-90.41)	(0.35)	(-176.79)	(-91.19)	(-1.53)	(-43.36)	(-36.97)	(-70.48)
LAG INDSTDCF	0.775***	0.853***	0.184***	0.700***	0.786***	0.159***	0.665***	0.854***	0.168***
.	(98.38)	(54.68)	(29.53)	(84.80)	(47.89)	(24.65)	(6.18)	(14.90)	(14.63)
LAGQ	0.009***	0.004***	0.001***	0.009***	0.003***	0.001***	0.009***	0.012***	0.007***
.	(38.57)	(8.08)	(4.75)	(36.89)	(7.21)	(4.19)	(5.00)	(7.03)	(18.19)
LAGLNAT	-0.004***	-0.004***	0.001***	-0.008***	-0.007***	-0.001**	-0.009***	-0.010***	-0.018***
.	(-17.83)	(-8.06)	(4.11)	(-28.62)	(-12.76)	(-2.49)	(-10.13)	(-9.40)	(-21.98)
LAGCFe	-0.039***	-0.098***	-0.010***	-0.031***	-0.092***	-0.008***	0.019	-0.014	0.011***
.	(-16.11)	(-20.73)	(-5.71)	(-13.16)	(-19.43)	(-4.16)	(0.86)	(-0.69)	(3.04)
LAG BKDEBT	-0.223***	-0.098***	-0.036***	-0.214***	-0.090***	-0.034***	-0.187***	-0.205***	-0.087***
.	(-99.16)	(-22.02)	(-20.05)	(-95.02)	(-20.16)	(-18.77)	(-16.24)	(-22.96)	(-26.14)
LAGRD _SALE	0.019***	0.066***	0.005***	0.019***	0.066***	0.005***	0.068***	0.035***	0.002***
.	(57.99)	(101.35)	(21.30)	(57.64)	(101.18)	(21.28)	(3.07)	(2.95)	(2.66)
LAG DIVDUM	-0.027***	-0.006***	-0.007***	-0.019***	0.002	-0.004***	-0.018***	-0.025***	0.000
.	(-24.97)	(-2.64)	(-8.59)	(-17.01)	(0.81)	(-5.09)	(-4.24)	(-9.57)	(0.03)
LAGACQUI	-0.370***	-0.368***	-0.083***	-0.377***	-0.376***	-0.087***	-0.362***	-0.425***	-0.157***
.	(-47.26)	(-23.74)	(-13.76)	(-48.34)	(-24.21)	(-14.49)	(-9.41)	(-13.99)	(-19.21)
DUMMY1990				0.002**	0.008***	-0.001*			
.				(2.11)	(3.83)	(-1.82)			
DUMMY2000				0.036***	0.026***	0.016***			
.				(31.83)	(11.46)	(18.37)			
R-Sq	0.501	0.284	0.165	0.506	0.285	0.168	0.491	0.535	0.759
Adj R-Sq	0.501	0.284	0.165	0.506	0.285	0.168	0.490	0.534	
Obs	106483	106516	106474	106483	106516	106474	106483	72471	58724

Table A14 Regressions of orthogonalized cash model (*g*) with industry cash flow volatility residuals (yearly OLS)

This table reports the orthogonalized cash model regression results from 1980 to 2008 in a similar manner as the previous table for ease of comparison. Sample and variable definitions are reported in Chapter A2.3. The first step of the orthogonalized estimation regresses industry cash flow volatility against debt capacity in each financial year to obtain volatility residuals, R_INDSTDCF, for each firm-year observation. R_ INDSTDCF are then put into the regression models with other cash determinants in the second step estimation. Results from the second step estimation are reported as specified in Table A12. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	MODEL1 OLS	MODEL2 OLS	MODEL3 OLS	MODEL4 OLS	MODEL5 OLS	MODEL6 OLS	MODEL7 FM1980	MODEL8 FM1990	MODEL9 FE
Dependent	Cash	LnCash	DCash	Cash	LnCash	DCash	Cash	Cash	Cash
Intercept	0.606***	0.551***	0.263***	0.625***	0.574***	0.273***	0.601***	0.592***	
.	(351.31)	(136.52)	(154.50)	(345.86)	(135.43)	(153.66)	(92.39)	(121.23)	
LAGDCASH			-0.049***			-0.049***			
.			(-18.09)			(-17.87)			
LAGCASH			-0.415***			-0.418***			
.			(-207.76)			(-209.00)			
R_ INDSTCF	0.165***	0.187***	0.051***	0.170***	0.196***	0.053***	0.140***	0.221***	0.010
.	(23.03)	(11.16)	(9.56)	(23.77)	(11.70)	(9.88)	(3.10)	(8.46)	(1.08)
DC	-0.888***	-1.048***	-0.429***	-0.911***	-1.087***	-0.441***	-0.900***	-0.884***	-0.850***
.	(-288.70)	(-145.86)	(-158.19)	(-289.10)	(-147.13)	(-157.44)	(-60.21)	(-60.34)	(-176.04)
Q	0.010***	0.006***	0.003***	0.010***	0.006***	0.003***	0.009***	0.012***	0.007***
.	(46.08)	(12.30)	(18.77)	(46.66)	(11.78)	(19.86)	(4.27)	(6.31)	(23.46)
LNAT	-0.014***	-0.015***	-0.005***	-0.011***	-0.011***	-0.004***	-0.011***	-0.013***	-0.016***
.	(-62.77)	(-29.55)	(-30.40)	(-45.78)	(-19.22)	(-22.43)	(-12.37)	(-13.47)	(-24.79)
CFe	-0.005**	-0.012***	0.046***	-0.009***	-0.020***	0.044***	0.020	0.000	0.024***
.	(-2.55)	(-2.62)	(31.40)	(-4.94)	(-4.45)	(30.24)	(1.29)	(0.00)	(9.37)
BKDEBT	-0.219***	-0.093***	-0.071***	-0.225***	-0.102***	-0.074***	-0.210***	-0.225***	-0.125***
.	(-115.07)	(-20.84)	(-47.66)	(-118.46)	(-22.95)	(-49.62)	(-24.59)	(-58.90)	(-49.39)
RD_SALE	0.016***	0.067***	0.007***	0.016***	0.067***	0.007***	0.065***	0.030***	0.004***
.	(59.07)	(108.35)	(32.05)	(59.95)	(109.05)	(32.48)	(3.20)	(3.08)	(8.07)
DIVDUM	-0.006***	0.015***	0.005***	-0.014***	0.003	0.001	-0.017***	-0.022***	0.008***
.	(-6.01)	(6.60)	(6.94)	(-14.73)	(1.26)	(1.33)	(-5.83)	(-11.18)	(6.46)
ACQUI	-0.467***	-0.565***	-0.450***	-0.465***	-0.568***	-0.449***	-0.439***	-0.498***	-0.231***
.	(-68.88)	(-35.66)	(-87.18)	(-68.91)	(-35.94)	(-86.96)	(-12.75)	(-19.69)	(-36.21)
DUMMY-1990				-0.024***	-0.019***	-0.013***			
.				(-25.74)	(-8.51)	(-17.94)			
DUMMY-2000				-0.013***	-0.038***	-0.002***			
.				(-13.13)	(-16.47)	(-2.74)			
R-Sq	0.635	0.351	0.366	0.639	0.353	0.368	0.639	0.637	0.837
Adj R-Sq	0.635	0.351	0.366	0.639	0.353	0.368	0.638	0.637	
Obs	115681	115692	106501	115681	115692	106501	115681	78147	66083

A4.4 Cash model with interaction regression results

The final cash model includes an interaction term between debt capacity and industry cash flow volatility reported in Table A15. By construction, including the interaction term means that debt capacity and volatility are assumed to be conditional upon each other, which to some extent may be true due to (1) high negative correlation found between the two variables in the univariate tests, and (2) previous findings supporting the relationship between debt capacity and cash flow, and assuming that cash flow volatility has similar relationship to debt capacity (Campello et al., 2011). Table A15 shows that the estimates for cash flow volatility increase significantly and a large estimate is reported for the interaction term. In these models, the coefficients of volatility and debt capacity have to be interpreted together with the interaction term. For the first OLS regression, the impact of volatility and debt capacity on cash is high at 0.749 and -0.666 respectively, conditional upon the other variable being equal to zero. If a firm has no debt capacity at all, its cash flow volatility will play a significant role (up to 0.749) on the level of cash held. However, if the firm has sufficiently high debt capacity, volatility will play little or no role in affecting cash holdings. For instance, for a firm with debt capacity 38% of total assets, change in volatility will not lead to any change in cash holdings.[24] The average debt capacity over the period 1980 to 2008 is 38% of total assets which means that, on average, change in volatility minimally impact cash-on-hand over the sample period. However, debt capacity decreased during the sample period, and this may mean that cash flow volatility have increasing influence over cash holdings over time. To prevent any shocks in profitability in affecting a firm's

[24] At average debt capacity to total assets of 38%, impact of change in volatility on cash is computed as 0.749 - 1.979*0.38 = 0 – a zero impact of change in volatility on cash holdings.

liquidity, firms may choose to maintain a high debt capacity if at all possible. This, however, may not be critical because the impact of volatility on cash holdings is small. In the last two years, volatility increases 0.7% from 0.127 to 0.134. With the average debt capacity of 29% of total assets in 2008, actual increase in cash holdings from the change in volatility is only 0.12% – contributing to only 6% of the total increase in cash of 2% of total assets from 2007 to 2008.

On the other hand, for debt capacity to have net zero impact on cash holdings, volatility needs to be -0.337, which is not possible by construction because the mean of standard deviations of cash flow is always positive and at the minimum is equal to zero. At the minimum volatility, the least impact of debt capacity on cash is -0.666, and any increase in volatility will lead to a greater negative relationship between debt capacity and cash. The results remain largely similar for Models 1 to 8. For Model 9, much smaller coefficients are reported for volatility and interaction terms. The interpretation of results from Model 9 is, nevertheless, similar to the other models, where volatility plays little role in firms' cash management when a debt capacity is above 36% of total assets, the minimum effect of debt capacity on cash remains high at -0.769. The rest of the variables yield estimates that are similar to the previously reported results.

The findings above show that, whilst debt capacity is important in cash management, cash flow volatility may only be important under certain conditions, for instance lower debt capacity. Since debt capacity measures firms' ability to borrow when needed, the variable indirectly measures firms' debt constraints – where financially constrained firms have greater difficulty in obtaining loans. This implies that cash flow volatility may only have a positive impact on cash when firms are financially or debt constrained. Similar findings are found in Campello et al. (2011) where cash flows are found to impact positively credit lines (debt capacity) only when firms are cash constrained. Supporting the previous findings, the level of constraints faced by firms may play a significant role in determining the relationship between cash, debt capacity and cash flow volatility. To investigate this further, the following Chapter will perform analysis across firms with varying financial constraints.

To sum up the findings of this Chapter, previous studies and initial cash models found the impact of firm characteristics on cash and intercept of cash function change over time, and the presence of large fixed effects or unaccounted firm characteristics. These, however, are no longer present when debt capacity is introduced as an additional cash determinant. Debt capacity is found to have the greatest impact on level of cash. After considering the impact of debt capacity, (1) industry cash flow volatility has a lower significance and becomes unstable (i.e. sensitive to estimation methods), (2) net working capital is no longer a significant determinant of cash, (3) capital expenditure is sensitive to the estimation method and measurement of dependent variable, (4) all other cash determinants exhibit lower estimates, and (5) no evidence of change in the intercepts of cash function is found. In the robustness test, the modified cash model (with debt capacity) results further confirm that debt capacity can replace net working capital and capital expenditure in explaining the level of cash, and the cash function may not have shifted over time but its slope becomes steeper. Finally, managers are found to be using current period firm condition to make cash decisions rather than previous reported figures because they are assumed to have inside information that may not be publicly reported yet.

Table A15 Regressions of base cash model (*h*) with debt capacity and interaction effect for period 1980 to2008

This table reports the cash model regression results from 1980 to 2008 in a similar manner as the previous table for ease of comparison. Interaction term (DC*INDSTDCF) is computed as the product of debt capacity ratio and industry cash flow volatility for each firm-year observation. Sample and variable definitions are reported in Chapter A2.3. Refer to Table A7 for model specifications. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Variable	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6	MODEL7	MODEL8	MODEL9
Model	OLS	OLS	OLS	OLS	OLS	OLS	FM1980	FM1990	FE
Dependent	Cash	LnCash	DCash	Cash	LnCash	DCash	Cash	Cash	Cash
Intercept	0.516***	0.788***	0.221***	0.529***	1.014***	0.231***	0.485***	0.430***	
.	(204.22)	(29.95)	(104.11)	(205.81)	(37.96)	(106.35)	(15.80)	(41.51)	
LAG-DCASH			-0.051***			-0.049***			
.			(-18.72)			(-18.24)			
LAG-CASH			-0.412***			-0.415***			
.			(-204.62)			(-206.10)			
DC	-0.666***	-6.342***	-0.292***	-0.687***	-6.636***	-0.306***	-0.625***	-0.492***	-0.769***
.	(-115.95)	(-106.08)	(-65.55)	(-119.55)	(-111.12)	(-68.21)	(-8.47)	(-16.50)	(-99.44)
INDSTDCF	0.749***	2.618***	0.336***	0.793***	2.762***	0.348***	0.938***	1.290***	0.172***
.	(48.84)	(16.39)	(28.91)	(51.47)	(17.26)	(29.72)	(4.38)	(10.36)	(8.07)
DC* INDSTDCF	-1.979***	-5.083***	-0.958***	-1.918***	-3.576***	-0.911***	-2.278***	-3.125***	-0.479***
.	(-47.47)	(-11.71)	(-30.63)	(-46.00)	(-8.25)	(-29.03)	(-4.63)	(-13.00)	(-8.74)
Q	0.010***	0.074***	0.004***	0.010***	0.078***	0.004***	0.009***	0.012***	0.008***
.	(46.45)	(33.86)	(23.01)	(46.49)	(35.57)	(23.81)	(4.56)	(6.45)	(25.73)
LNAT	-0.015***	-0.113***	-0.005***	-0.011***	-0.080***	-0.004***	-0.012***	-0.013***	-0.017***
.	(-67.17)	(-50.31)	(-31.56)	(-49.17)	(-33.17)	(-22.16)	(-10.48)	(-12.19)	(-27.33)
CFe	-0.003	0.080***	0.052***	-0.006***	0.055***	0.051***	0.022*	0.006	0.030***
.	(-1.35)	(3.96)	(35.06)	(-3.06)	(2.75)	(34.17)	(1.83)	(0.53)	(11.66)
NWC	0.003	-0.043**	-0.012***	-0.000	-0.084***	-0.013***	-0.005	-0.018	-0.033***
.	(1.51)	(-2.14)	(-8.22)	(-0.12)	(-4.16)	(-9.22)	(-0.45)	(-1.61)	(-12.52)
CAPEX	0.055***	0.937***	-0.135***	0.034***	0.682***	-0.145***	0.040**	0.072***	-0.046***
.	(10.28)	(16.89)	(-32.06)	(6.38)	(12.30)	(-34.14)	(2.25)	(5.72)	(-6.37)
BKDEBT	-0.216***	-2.473***	-0.071***	-0.223***	-2.551***	-0.075***	-0.207***	-0.225***	-0.136***
.	(-108.17)	(-118.68)	(-45.85)	(-111.66)	(-122.81)	(-48.17)	(-20.61)	(-45.38)	(-52.88)
RD_SALE	0.013***	0.064***	0.005***	0.013***	0.066***	0.005***	0.059***	0.023**	0.004***
.	(46.20)	(22.75)	(25.22)	(46.69)	(23.52)	(25.69)	(2.90)	(2.87)	(10.77)
DIVDUM	-0.006***	0.008	0.003***	-0.014***	-0.092***	-0.001	-0.015***	-0.019***	0.010***
.	(-6.61)	(0.77)	(4.95)	(-14.77)	(-9.06)	(-0.85)	(-6.67)	(-12.11)	(7.67)
ACQUI	-0.452***	-3.536***	-0.451***	-0.453***	-3.498***	-0.451***	-0.424***	-0.474***	-0.232***
.	(-67.03)	(-50.34)	(-87.84)	(-67.48)	(-50.16)	(-87.89)	(-13.82)	(-18.35)	(-37.97)
DUMMY-1990				-0.022***	-0.387***	-0.013***			
.				(-23.39)	(-39.49)	(-18.28)			
DUMMY-2000				-0.019***	-0.051***	-0.006***			
.				(-19.40)	(-4.94)	(-7.51)			
Adj R-Sq	0.641	0.518	0.378	0.645	0.526	0.381	0.647	0.649	
Obs	115681	115692	106501	115681	115692	106501	115681	78147	70552

CHAPTER A5. DEBT CAPACITY, CASH HOLDINGS AND FINANCIAL CONSTRAINTS

Campello, Giambona, Graham and Harvey (2011) find that firms with more internal liquidity (cash and credit line) have greater ability to invest and are subjected to lower costs of debt (commitment fee and actual fees). The survey observed the following interaction between internal flexibility and investment. First, at low level of lines of credit, firms choose to save cash rather than invest. This suggests that firms with high levels of lines of credit can avoid giving up valuable investment opportunities for cash savings.[25] In other words, financially constrained firms will prefer saving cash to investing. Second, firms' investment and lines of credit are positively related to each other only at high level of cash holdings, i.e. lines of credit are value-adding to firms only when their cash holdings are sufficiently high. Finally, the interactions between cash and credit line are dependent on whether firms are financially constrained. The substitution effect between cash and lines of credit is higher for constrained firms. Firms are classified as credit constrained if they are small, private, of non-investment grade, have limited access to credit lines and have negative cash flow (Campello et al., 2011). Constrained firms are found to use more (42%-64% compared to 21%-33% of unconstrained firms) of their committed credit lines during the crisis. They face greater difficulties when renewing or initiating new lines of credit and, when they do so successfully, the terms of credit change unfavourably.

Flannery and Lockhart (September 2009) find opposite evidence such that cash and credit lines are not good substitutes for constrained firms. In view of imperfect capital

[25] This relationship is not observed when the opportunity cost of investment is large. In such circumstances, firms will still opt to invest rather than save, regardless of the level of credit and cash savings.

market and transaction costs, cash and debt capacity are not perfect substitutes for each other (Gamba and Triantis, 2008). Here, a perfect trade-off between cash and debt capacity is not found; rather some form of substitution between the two instruments is evident (supporting evidence in Chapter A4). This is further analysed to determine whether the trade-off varies for firms with different financial constraints.

In Table A16, the Compustat firm sample is matched with Campello et al. (2011) and similar trends are reported for year 2008. The difference in reported proportion is due to the difference in numbers of firms and slight variation in variable measurement. Campello et al. (2011) report 5000 firms at the end of fiscal year 2008 and these firms are required to be active in the first quarter of 2009. Due to the time frame, the previous Compustat sample reported only consists of firms with fiscal year-end in December 2008. Our sample consists of 5,460 firms, including firms with fiscal year-end other than December 2008. Whilst cash flow is measured using return on assets, an income statement method of computation in Campello et al. (2011), it is measured here as net cash flow – a cash-flow statement method of computation following Frank and Goyal (2003) (see Chapter A2.3 Sample and variable specifications for details). The proportion of firms classified as constrained (i.e. small, non-investment grade, non-dividend payer and negative cash flow) is larger in our sample because we need not require firms to be active in the next fiscal year. Notwithstanding the above minor differences, the general trend is similar and, accordingly, firms are classified into constrained and unconstrained groups for further analyses.

The last two columns report proportions and statistics for firms from 1980 to 2008. Taking the entire sample as a whole, smaller firms form a greater proportion possibly because a larger number of firms is considered. The proportion of firms of investment grade is higher, suggesting that recent firms may have lower credit rating compared to the past. The proportions of firms paying dividends and reporting negative cash flows remain similar to year 2008. Ironically, average returns to assets are considerably larger (69%) compared to year 2008 (6%) – this is possibly due to two factors: (1) greater profitability of firms in past years, and (2) the recent credit crunch. Taking the entire sample as a whole, debt capacity, unused debt capacity and leverage increase, while cash holdings and net cash flow decrease. For comparability, private firms are included in the computation of sample proportions in Table A17.[26] However, since private firms have different disclosure requirements, and statistics are not entirely available over the entire sample, they are excluded from the sample in subsequent tests.

The classification criteria are modified from Campello et al. (2011) for the Compustat sample of public firms (see Table A17). There are four constraint criteria used to classify firms as 'small', 'non-investment graded', 'unprofitable', and 'non-dividend payer'. Division of firms into credit constrained and unconstrained allows for the analysis on whether constraints affect interaction between cash and debt capacity. For comparability, Panel A in Table A18 reports the Compustat/CRSP sample of public firms for financial year 2008. The survey sample includes both private and public firms, and firms have lower cash holdings and debt capacity, and are smaller in size compared to our sample of public firms. Since the number of firms is significantly smaller in the survey, it is more insightful to compare the median statistics rather than the mean figures. The other statistics are largely similar with median values of net cash flow,

[26] Private firms have missing share code (SHRCD) in the Compustat/CRSP database. The sample includes only firms with share code 11and 12.

investment grading and bank dependence reporting the same median statistics. Panel B reports the same firm characteristics for the entire sample from 1980 to 2008. Similar figures are obtained when computation of statistics is done by pooling the entire sample or by averaging yearly. As expected, after taking into account the entire sample, firms in the earlier sample period hold less cash, are larger in size, and have greater debt capacities, debt and bank dependence.

After the initial matching to ensure the comparability of sample with Campello et al. (2011), firms are then divided into constrained and unconstrained according to the four criteria listed in Table A17. OLS and fixed effects regressions of base cash model (a) and model with debt capacity (c) are performed for the two groups of firms. The purpose of separating firms into constrained and unconstrained categories is to examine the use of cash and debt capacity for the two groups of firms and determine whether the negative relationship between cash and debt capacity is different across firms. In an unreported two-sample means test, means of cash and debt capacity ratios are significantly different between constrained and unconstrained firms for all constraint criteria. There is significant difference in the use of cash and debt capacity for firms with varying constraints. It is expected that constrained firms will have a higher negative cash-DC relationship because of greater need to substitute any drop in cash or debt capacity with another instrument. Results will be used to support the findings of Campello et al. (2010), and confirm the possibility that debt capacity may be a good proxy for credit line and thus a good alternative to measuring financial constraint.[27]

[27] Campello et al. (July 2010) finds (1) substitution between cash savings and investments when firms have low debt capacity (i.e. lines of credit), (2) cash is used to substitute credit lines when credit is unavailable, and (3) greater credit line allow firms to invest more only when there are sufficient cash on hand.

Table A16 FY2008 sample proportion breakdown according constraints criteria

This table compares the CRSP/Compustat sample used in this thesis with the Compustat sample of Campello et al. (2009). The number of observations and proportions are reported in a similar manner for ease of comparison. Basic descriptive statistics on cash holdings, return on assets, net cash flow, debt capacity and unused debt capacity are reported with the former two compared to Campello et al. (2009). All firms are included with the exception of financial (SIC=69000-6999) and government (SIC=9100) firms. The last two columns report firms in CRSP/Compustat from 1980 to 2008 with the exception of investment grade which is only reported from 1985 to 2008 due to data unavailability. Small firms have total sales of less than $1billion, and large firms have total sales equal or more than $1billion. Investment grade firms are as defined in Campello et al. (2009) as firms with S&P long-term credit rating of BBB- or higher. Dividend is the total (common and preferred) dividend declared by firms in each financial year. Net cash flow is the ratio of net cash flow to total assets, computed according to Frank and Goyal (2009); and cash holdings is the ratio of cash holdings and marketable securities to total assets. Return on assets is the earnings before interest, taxes, depreciation and amortization (EBITDA) to total assets. Debt capacity is the ratio of the ratio of (0.715*Receivables + 0.547*Inventory + 0.535*PPE) to total assets; and unused debt capacity is debt capacity less debt only computed when firms report a positive debt capacity. Debt is the sum of long term debt and debt in current liabilities to total assets. Cash, debt and debt capacity ratios are censored at [0,1] where ratio more than one is made equal to one. Cash flow and return on assets ratios are winsorized at its top and bottom three interquartile range. Winsorisation method is different because both private and public firms are included, and taking arbitrary 1% or 5% away may distort sample statistics.

	Campello et al. (2009) Compustat sample		Sample for FY2008		Sample for FY1980-2008	
Firm types	N	Frequency	N	Frequency	N	Frequency
Small	3647	68%	3772	69%	161011	85%
Large	1698	32%	1688	31%	29486	15%
	5345		5460		190497	
Non-investment grade	997	52%	1050	55%	16156	46%
Investment grade	907	48%	845	45%	19070	54%
	1904		1895		35226	
Non-dividend payer	2667	55%	3472	64%	114141	60%
Dividend payer	2173	45%	1988	36%	76356	40%
	4840		5460		190497	
Negative cash flow (CFcf)	1152	23%	977	19%	51179	27%
Positive cash flow (CFcf)	3875	77%	4086	81%	139305	73%
	5027		5063		190484	
Negative unused debt capacity	-	-	1828	33%	48839	26%
Positive unused debt capacity	-	-	3632	67%	137280	74%
			5460		186119	
	Mean	Median	Mean	Median	Mean	Median
Cash holdings	0.178	0.078	0.185	0.095	0.157	0.065
ROA	0.044	0.082	0.049	0.063	0.044	0.058
Net cash flow (CFcf)	-	-	0.072	0.086	0.070	0.086
Debt capacity	-	-	0.316	0.331	0.380	0.415
Unused debt capacity	-	-	0.054	0.104	0.102	0.146
Debt	-	-	0.263	0.211	0.280	0.240

Table A17 Key constraint criteria comparison

Constraint criteria	Campello et al. (2009)	Modified criteria used
Small firms	Sales less than $1billion	Sales less than $1billion
Non-public firms	Private firms with the exception of financial and non-profitable organisation	NIL (sample only public firms with the exception of financial and non-profitable organisations firms)
Non-investment grade	S&P Long-term credit rating below BBB- or unrated	S&P Long-term credit rating below BBB- or unrated
Limited access to lines of credit	Firms at the bottom 30% lines of credit from the survey data	NIL (Firms at the bottom 30% of unused debt capacity may be used as a criteria, but because debt capacity is used as an explanatory variable in subsequent cash regressions, this classification is omitted to prevent problem of biasness)
Unprofitable (negative cash flow)	Negative return on assets	Negative net cash flow (CFcf) following Frank and Goyal (2009)
Non-dividend payer	NIL	Zero common dividend issued

Table A18 Descriptive statistics of internal flexibility and constraint variables in comparison with Campello et al. (2009)

This table compares the summary statistics of flexibility and constraint variables with Campello et al. (2009). All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999) and government (SIC=9100) firms. Firms with missing or negative total assets and total sales are excluded. Cash holdings is the ratio of cash holdings and marketable securities to total assets; and net cash flow (CFcf) is the ratio of net cash flow to total assets, computed according to Frank and Goyal (2009). Debt capacity is the ratio of the ratio of (0.715*Receivables + 0.547*Inventory + 0.535*PPE) to total assets; and unused debt capacity is debt capacity less debt only computed when firms report a positive debt capacity. Debt is the sum of long term debt and debt in current liabilities to total assets. Large variable equals to one when total sales is larger than $1billion; investment grade variable equals to one when firms have long-term credit rating of BBB- and above; and bank dependent variable equals to one when firm is reported to have a rating. Cash, debt and debt capacity ratios are censored at [0,1] where ratio more than one is made equal to one. Net cash flow is winsorized at the bottom 1%.

Panel A

	Campello et al. (2009) survey sample for 2008						Sample for FY2008 (for public firms only)					
Variables	Mean	Std. Dev.	Q1	Q2 (Median)	Q3	N	Mean	Std. Dev.	Q1	Q2 (Median)	Q3	N
Cash holdings	0.122	0.157	0.020	0.055	0.160	334	0.202	0.225	0.033	0.110	0.298	2689
Net cash flow	0.090	0.171	0.030	0.080	0.150	338	0.023	0.284	0.028	0.085	0.136	2689
Debt capacity	0.239	0.210	0.100	0.200	0.330	287	0.297	0.142	0.185	0.303	0.415	2652
Unused debt capacity	-	-	-	-	-	-	0.060	0.255	-0.061	0.100	0.234	2644
Debt	-	-	-	-	-	-	0.237	0.235	0.018	0.192	0.368	2681
Large	0.220	0.420	0.000	0.000	0.000	397	0.340	0.474	0.000	0.000	1.000	2689
Investment grade	0.180	0.390	0.000	0.000	0.000	397	0.000	0.000	0.000	0.000	0.000	2689
Bank dependent	0.720	0.450	0.000	1.000	1.000	397	0.711	0.453	0.000	1.000	1.000	2689

Panel B

	FY1980-2008 Pooled statistics						FY1980-2008 Average (by year) statistics					
Variables	Mean	Std. Dev.	Q1	Q2 (Median)	Q3	N	Mean	Std. Dev.	Q1	Q2 (Median)	Q3	N
Cash holdings	0.167	0.210	0.021	0.076	0.234	124662	0.168	0.203	0.023	0.082	0.242	4299
Net cash flow	0.039	0.274	0.019	0.085	0.138	124701	0.041	0.254	0.018	0.085	0.137	4300
Debt capacity	0.376	0.143	0.281	0.409	0.491	122344	0.375	0.131	0.291	0.398	0.476	4219
Unused debt capacity	0.135	0.228	0.025	0.164	0.294	122112	0.134	0.224	0.025	0.163	0.289	4211
Debt	0.243	0.217	0.049	0.212	0.374	124461	0.243	0.215	0.054	0.208	0.371	4292
Large	0.166	0.372	0.000	0.000	0.000	124701	0.171	0.368	0.000	0.000	0.172	4300
Investment grade	0.000	0.000	0.000	0.000	0.000	124701	0.000	0.000	0.000	0.000	0.000	4300
Bank dependent	0.829	0.377	1.000	1.000	1.000	124701	0.828	0.335	0.793	1.000	1.000	4300

Base cash model regressions for constrained and unconstrained firms are reported in Table A19. Results show that industry cash flow volatility has reduced importance in its effect on cash holdings for unconstrained firms – magnitude of coefficient estimate for volatility falls dramatically for all four subsamples of unconstrained firms (e.g. from 0.433 to 0.038 for non-investment graded and investment graded firms respectively). Industry cash flow volatility has greater impact on cash holdings only when firms are financially constrained. This supports the precautionary motive of saving cash (Keynes, 1936) as firms increase cash holdings in face of greater cash flow risks that are undiversifiable. Han and Qiu (2007) find a significant relationship between cash and cash flow volatility for constrained firms, while the same relationship for unconstrained firms is insignificant. There may be a herding effect where constrained firms monitor the cash flow volatility of their peers when deciding how much cash to retain because constrained firms are more prone to credit rejection and managers tend not to put their source of external financing at risk by falling below the industry mean. The herding behaviour may be more apparent in competitive industries for strategic reasons (Lins et al., 2010). Previous studies (e.g. Bates et al., 2009, Froot et al., 1993, Minton and Schrandb, 1999, Smith and Stulz, 1985) show that deadweight costs of financial distress increase with cash flow volatility. As constrained firms have higher probability of distress, these costs matter much more to them; resulting in greater impact of volatility on cash holdings where an increase in volatility will lead to a significantly larger increase in cash. Furthermore, cash flow is insignificant for investment graded firms, where addition to cash holdings from cash flow is of little impact to total amount of cash held because these firms have little difficulty in sourcing alternative financing.

The rest of the variables show the expected trend for firms with varying levels of constraints. Leverage, net working capital and capital expenditure have larger impact on cash holdings for constrained firms – an increase in leverage, net working capital or capital expenditure will lead to a larger decrease in cash holdings of constrained firms. Larger coefficient for leverage implies constrained firms treat financing from leverage and cash as substitutes for each other more than their unconstrained counterparts; possibly due to greater difficulty in sourcing funds. Thus, financing used for operations and investment purpose are not clearly distinguished and firms utilise funds wherever sourced as long as they are available when needed. This is further supported by the larger coefficient estimates for net working capital (operation purpose) and capital expenditure (investment purpose) for constrained firms, where (1) the same increase in inventory and account receivables leads to a larger fall in cash; and (2) the same amount of capital investment made is funded proportionally more by cash when firms are financially constrained. This is partially supported by Faulkender and Wang (2006) where cash has a greater marginal value for constrained firms because these firms make greater use of cash for investment purposes. On the other hand, investment in research and development are largely funded by cash when firms are less constrained, i.e. unconstrained research intensive firms hold greater cash when research expenses increase. Since constrained firms have less capability to keep aside cash for investment purposes, the reported positive relationship between cash and research expenses is much lower. The results support Campello et al. (2009) where constrained firms invest less (and save more in terms of cash), and a weaker relationship between cash and investment is expected.

Table A20 reports regression estimates with debt capacity included as additional independent variable. Results further support findings from the base cash model, and show that industry cash flow volatility is a significant cash determinant only for constrained firms. When debt capacity is considered, coefficient estimate for volatility of unconstrained firms falls significantly and becomes statistically insignificant. For unconstrained firms sorted by credit rating and dividends, the estimate for volatility becomes unstable and estimated relationship changes from negative to positive.

Although debt capacity has a larger estimated coefficient for constrained firms, it remains a significant and important cash determinant for unconstrained firms. The smallest coefficient magnitude for unconstrained firms is 0.162 (investment graded firms), where a unit increase in debt capacity will lead to a 16.2% fall in cash holdings. This is comparatively larger compared to other coefficients, showing that debt capacity remains important in cash management for both constrained and unconstrained firms. For research and development expenses, results correspond to findings in Table A19 where unconstrained research intensive firms hold significantly more cash to finance such expenses.

In Table A19, leverage, net working capital and capital expenditure are found to have greater impact on cash holdings for constrained firms. This finding is, however, not supported after debt capacity is included in Table A20. The impact of leverage, net working capital and capital expenditure on cash holdings are no longer dependent on the level of constraints faced by firms. Furthermore, the relationship between net working capital and cash, and capital expenditure and cash are no longer stable with coefficients reporting both positive and negative relationship, and coefficients magnitude decreasing significantly. Supporting the initial findings in Table A8, industry cash flow volatility, net working capital and capital expenditure no longer remain important cash determinants after debt capacity is included. While debt capacity, and research and development expenses continue to predict cash holdings across firms with varying level of financial constraints. Firms with lower debt capacity tend to hold greater cash; this effect is greater for small size, non-investment graded, unprofitable and non-dividend paying firms, i.e. financial constrained firms. The opposite is reported for research and development expenses where firms keep more cash if research and development expenses are higher, and that unconstrained research-intensive firms hold greater cash compared to their constrained counterparts.

The last part of this Chapter sums up the findings of the cash models performed across firms with varying financial constraints. First, industry cash flow volatility is a more important cash determinant for constrained firms because of herding behaviour in competitive industries (Lins et al., 2010) and the increased intensity of deadweight costs of financial distress for constrained firms (e.g. Bates et al., 2009, Froot et al., 1993, Minton and Schrandb, 1999, Smith and Stulz, 1985). Second, constrained firms consider funding from leverage and cash as substitutes of each other more than unconstrained firms. This indicates that funding used for operations and investments might not be clearly distinguished all the time. Third, supporting Faulkender and Wang (2006), cash has a higher marginal value because it is used proportionately more in funding investments of constrained firms. Finally and most importantly, in the modified cash model (when debt capacity is included as additional determinant), previous important cash determinants – cash flow volatility, net working capital, and capital expenditure are no longer significant in explaining cash level of unconstrained firms, while debt capacity and research and development expenses remain significant (although of different magnitude) for both constrained and unconstrained firms. The substitution effect between debt capacity and cash is larger when firms have greater financial constraints. On the other hand, research and development expenses increase the level of cash holdings and even more so for unconstrained firms.

Table A19 Regressions of base cash model (*a*) for constrained and unconstrained firms for period 1980 to2008

This table reports the base cash model results for constrained and unconstrained firms for period 1980 to 2008. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Firms are sorted according to four financial constraint criteria – firm size, cash flow, investment grade and dividend. Constrained firms have sales less than US$1billion, report negative net cash flow, are not of investment grade (rating below BBB- or unrated), and do not pay common dividends in the applicable financial year; and conversely for unconstrained firms. Variable specifications are reported in Chapter A2.3. The dependent variable is cash holdings ratio computed as cash to total asset. The first model (OLS) is estimated using OLS regression with heteroskedasticity adjusted standard errors. The second model (FM) is based on Fama-MacBeth regressions performed yearly from 1980 to 2008 using Newey and West (1987) standard errors controlling for autocorrelation. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Panel A								
	Small size		Large size		Negative CFcf		Positive CFcf	
Model	OLS	FM	OLS	FM	OLS	FM	OLS	FM
Intercept	0.234***	0.225***	0.200***	0.191***	0.189***	0.199***	0.271***	0.268***
.	(109.55)	(14.79)	(42.29)	(38.39)	(39.83)	(6.79)	(149.96)	(47.55)
INDSTDCF	0.433***	0.429***	0.074***	0.068*	0.708***	0.585***	0.213***	0.141***
.	(44.71)	(4.38)	(7.63)	(1.91)	(31.82)	(3.05)	(26.75)	(5.36)
Q	0.019***	0.017***	0.022***	0.028***	0.017***	0.013***	0.026***	0.025***
.	(67.98)	(7.97)	(36.15)	(7.86)	(32.91)	(6.36)	(81.30)	(9.71)
LNAT	0.004***	0.003	-0.010***	-0.010***	0.021***	0.013**	-0.010***	-0.012***
.	(11.95)	(1.05)	(-18.24)	(-17.82)	(24.08)	(2.26)	(-42.35)	(-24.21)
CFe	-0.063***	-0.018	-0.019***	-0.026**	-0.034***	0.016	-0.099***	-0.085***
.	(-24.35)	(-0.94)	(-3.04)	(-2.68)	(-7.07)	(0.89)	(-22.75)	(-6.67)
NWC	-0.190***	-0.201***	-0.093***	-0.102***	-0.148***	-0.155***	-0.181***	-0.187***
.	(-79.53)	(-14.22)	(-29.81)	(-7.26)	(-26.30)	(-13.70)	(-87.70)	(-17.10)
CAPEX	-0.357***	-0.436***	-0.168***	-0.179***	-0.269***	-0.337***	-0.329***	-0.344***
.	(-52.43)	(-5.82)	(-13.93)	(-5.81)	(-16.03)	(-4.11)	(-54.06)	(-9.41)
BKDEBT	-0.415***	-0.388***	-0.167***	-0.165***	-0.455***	-0.402***	-0.341***	-0.315***
.	(-159.16)	(-36.30)	(-44.47)	(-26.71)	(-82.83)	(-27.77)	(-140.75)	(-59.87)
RD_SALE	0.022***	0.104***	0.547***	0.451***	0.019***	0.121**	0.145***	0.402***
.	(65.78)	(3.18)	(37.52)	(8.56)	(42.39)	(2.67)	(47.16)	(10.47)
DIVDUM	-0.045***	-0.045***	-0.037***	-0.037***	-0.089***	-0.068***	-0.033***	-0.029***
.	(-32.58)	(-6.83)	(-27.51)	(-14.84)	(-12.39)	(-6.12)	(-32.03)	(-7.60)
ACQUI	-0.262***	-0.265***	-0.165***	-0.145***	-0.347***	-0.290***	-0.179***	-0.189***
.	(-27.51)	(-4.97)	(-15.12)	(-7.08)	(-11.62)	(-4.24)	(-23.89)	(-6.76)
Adj R-Sq	0.431	0.424	0.369	0.337	0.433	0.425	0.398	0.415
Obs	99470	65131	18370	14181	26585	19395	91255	59917

Table A19 (continued)

	Panel B							
	Non-investment graded		Investment graded		Non-dividend paying		Dividend paying	
Model	OLS	FM	OLS	FM	OLS	FM	OLS	FM
Intercept	0.244***	0.242***	0.183***	0.187***	0.231***	0.229***	0.288***	0.287***
.	(124.72)	(18.54)	(29.44)	(9.68)	(100.39)	(16.54)	(115.03)	(49.86)
INDSTDCF	0.433***	0.410***	0.038***	0.099	0.478***	0.473***	0.127***	0.082***
.	(48.90)	(4.41)	(3.05)	(1.60)	(45.75)	(4.18)	(11.70)	(4.76)
Q	0.019***	0.017***	0.016***	0.021***	0.019***	0.017***	0.024***	0.025***
.	(71.79)	(7.51)	(19.93)	(10.33)	(63.97)	(7.99)	(44.11)	(11.87)
LNAT	-0.000	-0.002	-0.008***	-0.009***	0.002***	0.000	-0.019***	-0.019***
.	(-1.41)	(-1.09)	(-13.24)	(-8.52)	(5.76)	(0.12)	(-62.45)	(-22.54)
CFe	-0.056***	-0.010	-0.013*	-0.019	-0.056***	-0.008	-0.121***	-0.129***
.	(-22.64)	(-0.55)	(-1.65)	(-1.01)	(-20.21)	(-0.53)	(-21.28)	(-7.64)
NWC	-0.184***	-0.195***	-0.072***	-0.081***	-0.187***	-0.199***	-0.164***	-0.167***
.	(-81.94)	(-13.68)	(-18.59)	(-5.42)	(-69.05)	(-12.39)	(-59.30)	(-13.58)
CAPEX	-0.349***	-0.411***	-0.192***	-0.206***	-0.335***	-0.391***	-0.360***	-0.383***
.	(-53.61)	(-6.24)	(-12.63)	(-6.23)	(-43.94)	(-5.80)	(-37.58)	(-14.91)
BKDEBT	-0.398***	-0.372***	-0.156***	-0.158***	-0.412***	-0.383***	-0.280***	-0.274***
.	(-163.37)	(-38.83)	(-25.62)	(-12.13)	(-144.06)	(-47.04)	(-77.59)	(-57.74)
RD_SALE	0.023***	0.105***	0.456***	0.394***	0.023***	0.106***	0.035***	0.300***
.	(69.57)	(3.20)	(22.04)	(4.78)	(63.21)	(3.15)	(6.75)	(7.07)
DIVDUMMY	-0.045***	-0.044***	-0.030***	-0.041***	0.000***	-0.000**	0.000***	-0.000**
.	(-35.54)	(-6.70)	(-13.96)	(-3.49)	(.)	(-2.70)	(.)	(-2.70)
ACQUI	-0.240***	-0.237***	-0.135***	-0.131***	-0.265***	-0.255***	-0.148***	-0.162***
.	(-27.06)	(-5.43)	(-9.54)	(-5.33)	(-24.79)	(-5.49)	(-14.00)	(-9.01)
Adj R-Sq	0.431	0.427	0.291	0.321	0.423	0.424	0.367	0.386
Obs	108785	71921	9055	7391	82331	59482	35509	19830

Table A20 Regressions of cash model (*c*) for constrained and unconstrained firms for period 1980 to2008

This table reports results from modified cash model with debt capacity for constrained and unconstrained firms for period 1980 to 2008. Sample and variable specifications are reported in Chapter A2.3. Refer to Table A19 for model specifications. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Panel A								
	Small size		Large size		Negative CFcf		Positive CFcf	
Model	OLS	FM	OLS	FM	OLS	FM	OLS	FM
Intercept	0.598***	0.576***	0.339***	0.337***	0.598***	0.565***	0.556***	0.547***
.	(264.26)	(47.15)	(61.19)	(25.73)	(124.28)	(40.53)	(268.79)	(26.45)
DC_NOCASH	-0.940***	-0.933***	-0.282***	-0.316***	-1.080***	-1.039***	-0.742***	-0.761***
.	(-241.49)	(-65.44)	(-42.48)	(-9.26)	(-132.37)	(-28.40)	(-198.58)	(-14.99)
INDSTDCF	0.109***	0.186***	0.014	-0.010	0.236***	0.268***	0.003	0.015
.	(13.88)	(3.82)	(1.48)	(-0.27)	(13.35)	(3.24)	(0.49)	(0.60)
Q	0.010***	0.009***	0.016***	0.020***	0.007***	0.005***	0.014***	0.014***
.	(42.40)	(4.81)	(26.97)	(7.94)	(18.75)	(3.23)	(53.69)	(4.73)
LNAT	-0.010***	-0.007***	-0.015***	-0.013***	-0.000	0.001	-0.017***	-0.014***
.	(-33.23)	(-11.46)	(-27.09)	(-11.94)	(-0.12)	(0.91)	(-80.27)	(-11.86)
CFe	-0.009***	0.015	-0.019***	0.007	-0.011***	0.001	-0.039***	-0.012
.	(-4.20)	(1.13)	(-2.76)	(0.42)	(-3.04)	(0.11)	(-9.92)	(-0.64)
NWC	0.015***	0.001	-0.066***	-0.068***	0.059***	0.048***	-0.033***	-0.035**
	(6.81)	(0.19)	(-20.39)	(-4.86)	(12.37)	(6.57)	(-15.93)	(-2.22)
CAPEX	0.041***	0.024*	0.029**	-0.024	0.090***	0.088***	0.004	-0.012
	(7.08)	(1.71)	(2.30)	(-0.86)	(6.69)	(4.83)	(0.73)	(-1.04)
BKDEBT	-0.213***	-0.214***	-0.159***	-0.145***	-0.181***	-0.178***	-0.225***	-0.209***
.	(-94.98)	(-20.01)	(-43.92)	(-15.44)	(-38.04)	(-17.42)	(-105.65)	(-21.24)
RD_SALE	0.014***	0.062***	0.468***	0.400***	0.011***	0.065**	0.093***	0.264***
.	(52.27)	(3.14)	(33.30)	(9.87)	(29.82)	(2.63)	(36.21)	(9.20)
DIVDUM	-0.000	-0.012***	-0.025***	-0.028***	-0.022***	-0.024***	-0.002*	-0.009***
.	(-0.00)	(-6.93)	(-18.46)	(-12.28)	(-3.82)	(-5.34)	(-1.74)	(-5.55)
ACQUI	-0.509***	-0.482***	-0.233***	-0.212***	-0.600***	-0.522***	-0.396***	-0.380***
.	(-66.55)	(-11.17)	(-22.10)	(-11.55)	(-25.84)	(-10.42)	(-62.26)	(-19.53)
Adj R-Sq	0.646	0.643	0.428	0.416	0.659	0.644	0.587	0.611
Obs	97625	64220	18056	13927	26212	19157	89469	58990

Table A20 (continued)

	Panel B							
	Non-investment graded		Investment graded		Non-dividend paying		Dividend paying	
Model	OLS	FM	OLS	FM	OLS	FM	OLS	FM
Intercept	0.594***	0.576***	0.256***	0.258***	0.598***	0.575***	0.525***	0.517***
.	(283.34)	(47.06)	(36.84)	(8.27)	(239.99)	(47.88)	(173.29)	(22.52)
DC_NOCASH	-0.916***	-0.911***	-0.189***	-0.203***	-0.941***	-0.934***	-0.594***	-0.619***
.	(-248.91)	(-50.32)	(-22.51)	(-4.21)	(-216.65)	(-46.74)	(-109.88)	(-11.75)
INDSTDCF	0.102***	0.164***	-0.004	0.025	0.136***	0.213***	-0.031***	-0.005
.	(14.17)	(3.38)	(-0.36)	(0.54)	(16.02)	(4.36)	(-3.32)	(-0.21)
Q	0.010***	0.009***	0.014***	0.017***	0.010***	0.009***	0.013***	0.014***
.	(44.52)	(4.60)	(17.44)	(8.76)	(40.34)	(4.96)	(25.98)	(6.19)
LNAT	-0.011***	-0.009***	-0.010***	-0.009***	-0.012***	-0.008***	-0.020***	-0.018***
.	(-46.02)	(-10.81)	(-16.50)	(-12.64)	(-39.78)	(-4.55)	(-75.20)	(-20.84)
CFe	-0.008***	0.017	-0.014	-0.005	-0.002	0.020*	-0.092***	-0.073***
.	(-4.21)	(1.30)	(-1.44)	(-0.21)	(-1.05)	(1.74)	(-17.36)	(-4.24)
NWC	0.010***	-0.004	-0.052***	-0.054***	0.014***	0.001	-0.055***	-0.058***
	(4.56)	(-0.36)	(-13.26)	(-4.40)	(5.69)	(0.06)	(-19.81)	(-4.58)
CAPEX	0.042***	0.022	-0.030*	-0.065*	0.058***	0.042**	-0.040***	-0.064***
	(7.60)	(1.55)	(-1.79)	(-1.97)	(9.02)	(2.68)	(-4.47)	(-3.22)
BKDEBT	-0.216***	-0.212***	-0.140***	-0.136***	-0.212***	-0.209***	-0.217***	-0.207***
.	(-103.05)	(-19.61)	(-23.39)	(-10.44)	(-85.63)	(-22.28)	(-67.80)	(-17.10)
RD_SALE	0.015***	0.063***	0.426***	0.392***	0.015***	0.061***	0.013***	0.185***
.	(55.43)	(3.17)	(21.20)	(5.28)	(49.77)	(3.20)	(2.92)	(5.97)
DIVDUM	-0.000	-0.012***	-0.019***	-0.028***	0.000***	-0.000**	0.000***	-0.000**
.	(-0.22)	(-6.80)	(-8.92)	(-3.06)	(.)	(-2.70)	(.)	(-2.70)
ACQUI	-0.490***	-0.458***	-0.180***	-0.177***	-0.517***	-0.479***	-0.303***	-0.302***
.	(-68.48)	(-12.46)	(-12.96)	(-8.91)	(-59.97)	(-12.73)	(-32.78)	(-20.62)
Adj R-Sq	0.642	0.643	0.330	0.364	0.636	0.642	0.536	0.556
Obs	106778	70868	8903	7279	80750	58604	34931	19543

CHAPTER A6. CAN DEBT CAPACITY PREDICT CASH HOLDINGS LEVEL

To determine which firm characteristics contribute most to the more than two-fold increase in cash holdings, the following model is first estimated using Fama-MacBeth regressions performed yearly from 1980 to 1989 (1980s). [28] The model assembled for predicted cash holdings includes net equity issue and net debt issue to take into account any increase in cash from external financing. The coefficient estimates are comparable to the estimates obtained in BKS.[29]

Predicted Cash, $Cash_P$ = 0.326 + 0.361 Industry cash flow volatility + 0.026 Q ratio - 0.009 Log size - 0.007 Cash flow/Assets - 0.163 Net working capital/Assets - 0.404 CAPEX - 0.253 Leverage/Assets + 0.109 RD/Sales + 0.005 Dividend dummy - 0.243 Acquisitions/Assets + 0.148 Net equity/Assets + 0.134 Net debt/Assets

Using the estimates above, predicted cash holdings ($Cash_P$) are first computed yearly from 1990 to 2008 and compared with the actual cash ratio ($Cash_A$) reported in Table A21. Second, the actual and predicted comparison is performed for constrained and unconstrained firms to determine if there is any difference in predictability of cash across different subsamples of firms. Third, differences in the average firm characteristics between the 1980s and 2000s are reported and multiplied by the regression coefficient estimates to determine which firm features contribute most to the increase in cash holdings. Averages of each firm ratio are computed yearly (e.g. 1980 to

[28] The model estimated for predicted cash holdings computation uses industry cash flow volatility computed using the mean of standard deviations of cash flow to total assets over ten years. This is to ensure the coefficient estimates reflect the true long-term relationship between cash holdings and industry cash flow volatility without any influence of short-term links in the short-run. To prevent any extreme firm characteristics from biasing the estimates, regressions are performed only for firms with non-missing standard deviations of cash flow and reasonable changes in equity holdings (i.e. net equity issue equals or between zero and one).

[29] Appendix A-XIII reports details of the coefficient estimates and comparison with BKS.

1989) and the mean of each year's average is taken to compute the average firm characteristic value of each period (e.g. 1980s). Fourth, the breakdown of determinants of changes in predicted cash is reported for constrained and unconstrained firms to identify differences in impact from each determinant over time.

Table A21 reports the actual and predicted cash ratios for the whole sample. The difference in the fourth column is computed as the actual less predicted ratio. Except for year 2002 and 2003, the model consistently over predicts cash holdings from 1990 to 2008. Predicted cash ratio matches the actual ratio for year 2002; and for year 2003, the difference between actual and predicted cash holdings is relatively small at 0.4% of assets. The model predicts cash holdings better in the 2000s as the difference between actual and predicted ratio is not found to be significantly more than zero in most years of the 2000s period. The largest difference is recorded in 1999 when the model over predicts cash ratio by 3.1% of assets.[30] To examine whether constraints affect the model's performance in predicting cash ratio, Table A22 reports the predicted cash ratio and difference (actual less predicted ratio) for constrained and unconstrained firms sorted according to the four constraint criteria.

[30] Deviation between predicted and actual cash holdings is close to that previously reported. The difference between the largest (actual less predicted) deviation reported in this paper and BKS is 0.6% of total assets.

Table A21 Comparison of actual and predicted cash holdings from 1990 to 2008 using BKS model

This table summarizes the actual ($Cash_A$) and predicted cash ratios ($Cash_p$), and the difference between the two ratios of sample firms from 1990 through 2008. Predicted cash ratio for each firm is computed from the following Fama-MacBeth regression estimates. $Cash_P$ = 0.326 + 0.361 Industry cash flow volatility + 0.026 Q ratio - 0.009 Log size - 0.007 Cash flow/Assets - 0.163 Net working capital/Assets - 0.404 CAPEX - 0.253 Leverage/Assets + 0.109 RD/Sales + 0.005 Dividend dummy - 0.243 Acquisitions/Assets + 0.148 Net equity/Assets + 0.134 Net debt/Assets. Average $Cash_p$ is then computed yearly and reported by year for the sample of 67,203 firms. t-value, degrees of freedom (DF) and probability reported are test results from the independent t-test performed for the actual and predicted ratios yearly. Detailed variable definitions can be found in Chapter A2.3.

FYEAR	Average $Cash_A$	Average $Cash_P$	Difference ($Cash_A$ - $Cash_P$)	tValue	DF	Probt
1990	0.133	0.152	-0.019	-5.180	6800	0.042
1991	0.155	0.177	-0.022	-5.383	7066	0.009
1992	0.160	0.183	-0.023	-5.411	7380	0.003
1993	0.169	0.194	-0.024	-5.634	8018	0.000
1994	0.154	0.181	-0.027	-6.722	8524	0.000
1995	0.166	0.190	-0.024	-5.696	8760	0.000
1996	0.182	0.207	-0.024	-4.736	8872	0.003
1997	0.180	0.193	-0.013	-2.854	8746	0.273
1998	0.168	0.176	-0.008	-1.778	8276	0.668
1999	0.183	0.213	-0.031	-5.589	7826	0.000
2000	0.192	0.204	-0.012	-2.286	7462	0.812
2001	0.211	0.229	-0.019	-2.690	6768	0.848
2002	0.212	0.208	0.004	0.738	6326	0.002
2003	0.219	0.219	0.000	-0.002	5974	0.030
2004	0.227	0.233	-0.006	-0.842	5854	0.763
2005	0.228	0.233	-0.005	-0.616	5834	0.993
2006	0.219	0.237	-0.018	-1.982	5752	0.095
2007	0.219	0.226	-0.007	-0.855	5622	0.574
2008	0.205	0.210	-0.005	-0.483	4484	0.977

Table A22 Comparison of actual and predicted cash holdings for firms sorted by constraints (BKS model)

This table summarizes the predicted cash ratio ($Cash_p$), and difference ($Cash_A$ - $Cash_p$) between the actual and predicted ratios of sample firms from 1990 through 2008. Predicted cash ratio for each firm is computed from the following Fama-MacBeth regression estimates. $Cash_P$ = 0.326 + 0.361 Industry cash flow volatility + 0.026 Q ratio - 0.009 Log size - 0.007 Cash flow/Assets - 0.163 Net working capital/Assets - 0.404 CAPEX - 0.253 Leverage/Assets + 0.109 RD/Sales + 0.005 Dividend dummy - 0.243 Acquisitions/Assets + 0.148 Net equity/Assets + 0.134 Net debt/Assets. Average $Cash_p$ is then computed yearly and reported by year for eight subsamples of firms sorted according to four financial constraint criteria – firm size, cash flow, investment grade and dividend. Constrained firms have sales less than US$1billion, report negative net cash flow, are not of investment grade (rating below BBB- or unrated), and do not pay common dividends in the applicable financial year; and conversely for unconstrained firms. Detailed variable definitions can be found in Chapter A2.3.

Panel A								
	Small size		Large size		Negative CFcf		Positive CFcf	
FYEAR	$Cash_P$	Difference	$Cash_P$	Difference	$Cash_P$	Difference	$Cash_P$	Difference
1990	0.159	-0.017	0.097	-0.033	0.229	-0.051	0.128	-0.009
1991	0.186	-0.019	0.110	-0.042	0.269	-0.051	0.149	-0.013
1992	0.193	-0.020	0.110	-0.042	0.311	-0.058	0.147	-0.013
1993	0.205	-0.021	0.111	-0.047	0.345	-0.069	0.150	-0.012
1994	0.191	-0.024	0.106	-0.047	0.329	-0.083	0.139	-0.012
1995	0.203	-0.021	0.106	-0.048	0.340	-0.072	0.149	-0.011
1996	0.222	-0.021	0.108	-0.047	0.410	-0.094	0.149	-0.005
1997	0.207	-0.007	0.111	-0.047	0.343	-0.043	0.146	-0.004
1998	0.189	-0.001	0.109	-0.043	0.310	-0.026	0.134	-0.002
1999	0.234	-0.027	0.113	-0.046	0.402	-0.082	0.148	-0.013
2000	0.224	-0.005	0.114	-0.042	0.346	-0.018	0.143	-0.009
2001	0.254	-0.014	0.128	-0.039	0.380	-0.036	0.159	-0.011
2002	0.229	0.011	0.124	-0.021	0.355	-0.001	0.153	0.006
2003	0.246	0.006	0.129	-0.021	0.396	-0.033	0.171	0.009
2004	0.267	-0.003	0.134	-0.014	0.515	-0.091	0.172	0.012
2005	0.271	-0.002	0.130	-0.012	0.500	-0.097	0.169	0.017
2006	0.283	-0.020	0.126	-0.012	0.571	-0.176	0.163	0.017
2007	0.275	-0.006	0.115	-0.010	0.537	-0.126	0.154	0.020
2008	0.260	-0.007	0.105	0.000	0.531	-0.157	0.132	0.032

Table A22 Comparison of actual and predicted cash holdings for firms sorted by constraints (BKS model) (continued)

Panel B								
	Non-investment grade		Investment grade		Non-dividend paying		Dividend paying	
FYEAR	$Cash_P$	Difference	$Cash_P$	Difference	$Cash_P$	Difference	$Cash_P$	Difference
1990	0.157	-0.017	0.099	-0.041	0.167	-0.019	0.117	-0.018
1991	0.183	-0.019	0.115	-0.052	0.196	-0.020	0.133	-0.028
1992	0.189	-0.020	0.114	-0.054	0.202	-0.020	0.137	-0.030
1993	0.201	-0.021	0.115	-0.062	0.214	-0.022	0.141	-0.030
1994	0.187	-0.024	0.110	-0.060	0.199	-0.024	0.131	-0.035
1995	0.198	-0.021	0.108	-0.061	0.210	-0.020	0.133	-0.037
1996	0.216	-0.021	0.108	-0.059	0.231	-0.020	0.134	-0.037
1997	0.201	-0.008	0.113	-0.062	0.211	-0.006	0.137	-0.036
1998	0.183	-0.002	0.112	-0.061	0.192	0.002	0.124	-0.038
1999	0.224	-0.027	0.115	-0.064	0.239	-0.029	0.122	-0.036
2000	0.213	-0.006	0.117	-0.064	0.225	-0.004	0.124	-0.043
2001	0.240	-0.014	0.131	-0.064	0.253	-0.013	0.137	-0.042
2002	0.218	0.010	0.126	-0.046	0.226	0.014	0.139	-0.035
2003	0.230	0.005	0.133	-0.041	0.241	0.006	0.150	-0.019
2004	0.244	-0.002	0.137	-0.040	0.262	-0.002	0.156	-0.016
2005	0.244	-0.001	0.134	-0.038	0.266	-0.002	0.150	-0.012
2006	0.249	-0.015	0.131	-0.041	0.276	-0.020	0.142	-0.013
2007	0.238	-0.004	0.125	-0.038	0.263	-0.005	0.137	-0.012
2008	0.220	-0.002	0.119	-0.029	0.241	-0.002	0.131	-0.013

Table A22 shows that the BKS model consistently over predicts the cash ratio for both constrained and unconstrained firms.[31] The model, however, predicts cash holdings better for constrained firms than unconstrained firms – the difference between actual and predicted ratio is smaller for constrained firms compared to their counterparts. The largest difference recorded for constrained firms is between 2.4% and 2.7%, while that of unconstrained firms is between 4.3% and 6.8%. The trend is evident for all constraints criteria except for cash flow where the opposite is reported. For firms sorted using cash flow, predicted cash ratio is closer to actual ratios for unconstrained firms. The results are expected, as cash ratio is directly related to cash flow to the extent that cash flow add to cash holdings in each financial period. As such, firms with negative cash flow have no ability to accumulate cash holdings even though they ought to do so theoretically. Predicted cash for negative cash flow firms is more than 50% of total assets in the last five years of the sample. The actual cash to assets in the last five years is about 40%; and this is almost double the average cash holdings for the period 2000 to 2008 of 21.5%. There is evidence that constrained firms with negative cash flow hold significantly greater cash in practice but the lack of ability to increase cash holdings to the 'ideal' predicted level results in a shortfall in the actual cash held.

Predictions for cash holdings are more accurate for constrained firms. This means that the original BKS determinants model cash holdings better for constrained firms – this corresponds to the evidence in previous Chapter where the main driver of cash holdings – industry cash flow volatility has significant influence on cash ratio only for constrained firms.

[31] The model over predicts cash ratio for all subsample of firms sorted according to four constraint criteria, with the exception of firms with positive cash flow where the model under predicts cash ratio for the later sample period from 2002 to 2008.

In addition, cash holdings are predicted to increase significantly (from 1990 to 2008) for constrained firms only, while the estimated maximum increase in cash for unconstrained is only 2% of total assets. The maximum increase in predicted cash is 30% of total assets for firms reporting negative cash flow, followed by a 10% increase for small firms. The difference found for constrained and unconstrained firms are subjected to the extent that model predicts cash holdings accurately for these firms; therefore actual cash holdings are compared. The maximum increase in actual cash holdings from 1990 to 2008 for constrained firms is 20% of total assets; while that for unconstrained firms is only 4.5% – this means actual cash holdings for constrained firms increase more than four times compared with unconstrained firms.[32]

Next, determinants of changes in predicted cash are reported in Table A23. The first two columns report the average firm characteristics in 1980s and 2000s. The third column reports contribution of each firm characteristic to the increase in cash holdings by multiplying the coefficient estimates with the difference between the 1980s and 2000s mean values.[33] Industry cash flow volatility almost doubles from the 1980s to the 2000s. Net working capital falls more than three times, average cash flow changes from positive to negative, and research and development expense increases dramatically about five times over two decades. Supporting BKS findings, these four variables contribute significantly to the increase in cash holdings. Additionally, firm size and leverage are found to contribute significantly to the increase in cash; however, this is attributed to the large coefficient estimates rather than actual changes in the firm

[32] The overall results support BKS findings where non-dividend paying firms are found to have significantly larger increase in cash compared to dividend paying firms

[33] For example, estimated contribution from industry cash flow volatility is computed as coefficient estimate*(2000s average – 1980s average) = 0.361*(0.130-0.074).

characteristics. Together, the six variables explain the increase in cash holdings significantly. The sum of the estimated contribution from the determinants (5.8%) shortfalls the actual increase in average cash level of 7.9% of total assets. This shortfall will be subsequently rectified in the modified model when debt capacity is included as one of the determinants of cash.

The same determinants of changes in predicted cash are examined across subsamples of firms sorted according to different financial constraint criteria in Table A24. According to the trend observed in Table A22, the increase in cash level from the 1980s to 2000s is expected to be significantly higher for constrained firms compared to their unconstrained counterparts. Accordingly, the sum of estimated contribution from the cash determinants is reported to be higher for all four subsamples of constrained firms – ranging from 5.4% to 11.1%; while that of unconstrained firms has a mean of 3.5%. The six determinants (industry volatility, net working capital, capital expenditure, size, research and development expenses and leverage) remain important determinants of cash for constrained firms, while the last two variables do not contribute to change in cash significantly for unconstrained firms. For instance, change in leverage explains up to 2% of change in cash for constrained firms, but only explains up to 0.7% for unconstrained firms. A similar trend is noted for research and development expenses, where there is a differential of 1 percentage point – equivalent to 13% of the actual change in average cash from 1980s to 2000s. The greater impact of change in leverage on cash level for constrained firms may be due to changes in debt capacity. For all four constraint criteria, constrained firms experienced a greater fall in debt capacity relative to unconstrained firms (unreported in detail here). A larger decrease in debt capacity naturally leads to greater fall in debt use because constrained firms now have less capacity to extend or take new borrowing when existing debt matures.

For intangible expenses such as research and development, securing external debt and equity is difficult for constrained firms. These firms rely heavily on cash holdings for research and development expenses, and this explains the greater cash level kept when such expenses are required. Therefore, cash holdings grow more for constrained firms due to greater fall in debt use and greater increase in research and development expenses – both of which can be attributed to the fall in debt capacity over time because lower borrowing capacity restricts the amount of debt held by firm and intangible expenses are then funded by cash-on-hand.

In the second half of this section, predicted cash level is re-estimated using the modified BKS model with debt capacity included as additional cash determinant. This helps to identify whether debt capacity is a major or better explanatory variable of cash, and at the same time confirm our findings in the first half of this section about debt capacity effect on leverage and intangible expenses changes on the changes in cash holdings. The modified model yield the following coefficient estimates that are used to compute the new predicted cash level, denoted by $Cash_{P\_DC}$.

$Cash_{P\_DC}$ = 0.639 – 0.749 Debt capacity/Assets + 0.249 Industry cash flow volatility + 0.011 Q ratio - 0.009 Log size + 0.044 Cash flow/Assets - 0.022 Net working capital - 0.156 Capex - 0.151 Leverage/Assets + 0.070 RD/Sales + 0.007 Dividend dummy - 0.344 Acquisitions/Assets + 0.059 Net equity/Assets + 0.073 Net debt/Assets

For comparison purposes, Tables A25 and A26 report results in a similar manner to Table A21 and A23. The new model predicts cash holdings better as the maximum difference between actual and predicted cash (1.4% of total assets) is less than half of the maximum difference (3.1%) reported in Table A21 and almost half of the maximum difference (2.7%) found in BKS. The sum of estimated contribution from the cash determinants computed in the last row includes only determinants that are found significant in the Fama MacBeth model above. Industry cash flow volatility, net working capital, research and development expenses and dividend dummy becomes insignificant after debt capacity is included in the yearly Fama MacBeth regressions; and the four determinants are not included in the computation. The final sum of the estimated contribution from the determinants (8.7%) is closer to the actual change in cash of 7.9%. This difference of 0.8% is significantly lower than the shortfall of 2.1% reported in Table A23. This means that not only does the modified model predicts cash better but also it tracks changes in cash determinants better than the original model.

Average debt capacity falls by 13% of total assets and this contributes to 9.8% of the increase in cash holdings. Other than firm size, the other variables contribute to less than 1% change in cash. This is contrasted with Table A23 where changes in cash are attributed to changes in six determinants in the range of 1.1% to 2.1% each. Changes in cash are more evenly spread across the top six determinants in the original BKS model, whereas the changes in cash are largely explained by changes in debt capacity in the modified model. Three out of the six top determinants (industry cash flow volatility, net working capital, research and development expenses) are insignificant once debt capacity is included. The remaining two variables (leverage and capital expenditure) contribute marginally to changes in cash over time, and the final determinant (firm size) has an estimated contribution that remains similar to the previous model. Supporting the findings in previous Chapters, results from Tables A25 and A26 prove that debt capacity is an important determinant of cash and has the ability to replace previous cash determinants in explaining changes in firms' cash holdings over time.

To sum up, the previous BKS model is found consistently to over-predict cash ratio, and predicts cash holdings better for constrained firms. The modified BKS model (with debt capacity included as additional determinant) performs better than the original model and reports predicted cash holdings that are closer to actual ratios. Second, in predicting cash holdings for firms with varying constraints, both the predicted and actual cash holdings for constrained firms increase significantly more over the period 1980 to 2008. Third, the original BKS model identifies six cash determinants that contribute collectively to the increase in cash holdings over time. Half of the six important cash determinants, however, become insignificant after taking into account debt capacity. Fourth, the estimated contribution from determinants in the modified BKS model matches the actual change in cash better. Change in cash over time is largely explained by corresponding change in debt capacity alone. The results confirmed that debt capacity is an important determinant of cash, helps predict cash holdings better, and has the ability to replace previous determinants and explain substantial variance in cash holdings.

Table A23 Breakdown of determinants of changes in $Cash_p$ from 1980s to 2000s (BKS model)

This table summarizes the determinants of the change in predicted cash between the 1980s and 2000s period. The change in cash ratio is measured as the difference between average cash ratio from 2000 to 2008 and the average cash ratio from 1980 to 1989. The estimated determinants of the cash ratio are computed using coefficient estimates from the following Fama MacBeth regression model. $Cash_P$ = 0.326 + 0.361 Industry cash flow volatility + 0.026 Q ratio - 0.009 Log size - 0.007 Cash flow/Assets - 0.163 Net working capital/Assets - 0.404 CAPEX - 0.253 Leverage/Assets + 0.109 RD/Sales + 0.005 Dividend dummy - 0.243 Acquisitions/Assets + 0.148 Net equity/Assets + 0.134 Net debt/Assets. Detailed variable definitions can be found in Chapter A2.3. For each variable, its average values for the period 1980s and 2000s are reported. The 1980s (2000s) average is computed as the mean value of the average firm characteristics computed for each financial year from 1980 to 1989 (2000 to 2008). Difference between the 1980s average and 2000s average is then multiplied by the relevant coefficient estimate to derive the estimated determinant reported in column four. Standard error, t-value, and probability reported are test results from the independent t-test performed for the estimated determinant using Delta method (Greene, 2008).

Variable	1980s Average	2000s Average	Estimate	Standard Error	tValue	Probt
INDSTDCF	0.074	0.130	0.021	0.0073	2.799	0.005
Q	1.756	2.020	0.007	0.0078	0.860	0.390
LNAT	17.183	19.364	-0.019	0.0038	-5.070	0.000
CFe	0.007	-0.012	0.000	0.0002	-0.548	0.583
NWC	0.142	0.040	0.017	0.0051	3.236	0.001
CAPEX	0.087	0.053	0.014	0.0063	2.183	0.029
BKDEBT	0.258	0.210	0.012	0.0054	2.262	0.024
RD_SALE	0.025	0.124	0.011	0.0015	6.960	0.000
DIVDUM	0.410	0.252	-0.001	0.0005	1.546	0.122
ACQUI	0.013	0.024	-0.003	0.0018	-1.437	0.151
ΔEQUITY	0.062	0.046	-0.002	0.0051	-0.471	0.638
ΔDEBT	0.011	0.009	0.000	0.0012	-0.187	0.852

Table A24 Breakdown of determinants of changes in $Cash_p$ for firms sorted by constraints (BKS model)

This table summarizes the determinants of the change in predicted cash between the 1980s and 2000s period for eight subsamples of firms sorted according to four financial constraint criteria – firm size, cash flow, investment grade and dividend. Constrained firms have sales less than US$1billion, report negative net cash flow, are not of investment grade (rating below BBB- or unrated), and do not pay common dividends in the applicable financial year; and conversely for unconstrained firms. The change in cash ratio is measured as the difference between average cash ratio from 2000 to 2008 and the average cash ratio from 1980 to 1989. The estimated determinants of the cash ratio are computed using coefficient estimates from the following Fama MacBeth regression model. $Cash_P$ = 0.326 + 0.361 Industry cash flow volatility + 0.026 Q ratio - 0.009 Log size - 0.007 Cash flow/Assets - 0.163 Net working capital/Assets - 0.404 CAPEX - 0.253 Leverage/Assets + 0.109 RD/Sales + 0.005 Dividend dummy - 0.243 Acquisitions/Assets + 0.148 Net equity/Assets + 0.134 Net debt/Assets. Detailed variable definitions can be found in Chapter A2.3. For each variable, the 1980s (2000s) average is computed as the mean value of the average firm characteristics computed for each financial year from 1980 to 1989 (2000 to 2008). Difference between the 1980s average and 2000s average is then multiplied by the relevant coefficient estimate to derive the estimated determinant reported here.

	Small firms	Large firms	Negative CFcf	Positive CFcf	Non-invest-ment grade	Invest-ment grade	Non-dividend paying	Dividend paying
Variable	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
INDSTDCF	0.022	0.019	0.029	0.018	0.021	0.015	0.021	0.016
Q	0.007	0.014	-0.004	0.009	0.007	0.013	0.001	0.010
LNAT	-0.015	-0.008	-0.020	-0.020	-0.017	-0.014	-0.023	-0.019
CFe	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
NWC	0.017	0.012	0.014	0.016	0.016	0.011	0.013	0.018
CAPEX	0.014	0.012	0.016	0.013	0.014	0.013	0.016	0.011
BKDEBT	0.018	-0.006	0.033	0.007	0.014	0.001	0.020	0.000
RD_SALE	0.014	0.001	0.040	0.003	0.012	0.001	0.014	0.001
DIVDUM	-0.001	-0.002	0.000	-0.001	-0.001	-0.001	0.000	0.000
ACQUI	-0.002	-0.002	-0.001	-0.003	-0.003	-0.001	-0.003	-0.002
ΔEQUITY	0.000	-0.002	0.000	-0.004	-0.002	-0.003	-0.005	-0.003
ΔDEBT	0.000	0.000	0.002	-0.001	0.000	-0.001	0.000	-0.001
TOTAL	0.073	0.037	0.111	0.036	0.061	0.034	0.054	0.032

Table A25 Comparison of actual and predicted cash holdings from 1990 to 2008 (modified BKS model with DC)

This table summarizes the actual ($Cash_A$) and predicted cash ratios ($Cash_{P\_DC}$), and the difference between the two ratios of sample firms from 1990 through 2008. Predicted cash ratio for each firm is computed from the following Fama-MacBeth regression estimates. $Cash_{P\_DC}$ = 0.639 – 0.749 Debt capacity/Assets + 0.249 Industry cash flow volatility + 0.011 Q ratio - 0.009 Log size + 0.044 Cash flow/Assets - 0.022 Net working capital - 0.156 Capex - 0.151 Leverage/Assets + 0.070 RD/Sales + 0.007 Dividend dummy - 0.344 Acquisitions/Assets + 0.059 Net equity/Assets + 0.073 Net debt/Assets. Average $Cash_p$ is then computed yearly and reported by year for the sample of 66,216 firms. t-value, degrees of freedom (DF) and probability reported are test results from the independent t-test performed for the actual and predicted ratios yearly. Detailed variable definitions can be found in Chapter A2.3.

FYEAR	Average $Cash_A$	Average $Cash_{P\_DC}$	Difference ($Cash_A$ – $Cash_{P\_DC}$)	tValue	DF	Probt
1991	0.155	0.150	0.005	1.228	6954	0.220
1992	0.160	0.156	0.004	1.002	7254	0.317
1993	0.170	0.166	0.004	1.022	7888	0.307
1994	0.154	0.156	-0.002	-0.449	8392	0.653
1995	0.166	0.166	0.000	0.098	8606	0.922
1996	0.183	0.172	0.012	2.878	8718	0.004
1997	0.180	0.169	0.011	2.800	8602	0.005
1998	0.168	0.161	0.007	1.815	8154	0.070
1999	0.183	0.190	-0.006	-1.374	7708	0.170
2000	0.193	0.190	0.003	0.731	7366	0.465
2001	0.211	0.200	0.011	2.151	6686	0.031
2002	0.213	0.199	0.014	3.009	6250	0.003
2003	0.220	0.214	0.006	1.176	5904	0.240
2004	0.227	0.218	0.010	1.954	5780	0.051
2005	0.228	0.218	0.009	1.869	5758	0.062
2006	0.219	0.213	0.006	1.193	5680	0.233
2007	0.219	0.213	0.007	1.304	5544	0.192
2008	0.205	0.196	0.009	1.607	4428	0.108

Table A26 Breakdown of determinants of changes in $Cash_{P\_DC}$ from 1980s to 2000s (modified BKS model with DC)

This table summarizes the determinants of the change in predicted cash between the 1980s and 2000s period. The change in cash ratio is measured as the difference between average cash ratio from 2000 to 2008 and the average cash ratio from 1980 to 1989. The estimated determinants of the cash ratio are computed using coefficient estimates from the following Fama MacBeth regression model. $Cash_{P\_DC}$ = 0.639 – 0.749 Debt capacity/Assets + 0.249 Industry cash flow volatility + 0.011 Q ratio - 0.009 Log size + 0.044 Cash flow/Assets - 0.022 Net working capital - 0.156 Capex - 0.151 Leverage/Assets + 0.070 RD/Sales + 0.007 Dividend dummy - 0.344 Acquisitions/Assets + 0.059 Net equity/Assets + 0.073 Net debt/Assets. Detailed variable definitions can be found in Chapter A2.3. For each variable, its average values for the period 1980s and 2000s are reported. The 1980s (2000s) average is computed as the mean value of the average firm characteristics computed for each financial year from 1980 to 1989 (2000 to 2008). Difference between the 1980s average and 2000s average is then multiplied by the relevant coefficient estimate to derive the estimated determinant reported in column four. Standard error, t-value, and probability reported are test results from the independent t-test performed for the estimated determinant using Delta method (Greene, 2008).

Variable	1980s Average	2000s Average	Estimate	Standard Error	tValue	Probt
DC	0.434	0.303	0.098	0.018	5.483	0.000
INDSTDCF	0.074	0.130				
Q	1.756	2.020	0.003	0.003	0.860	0.390
LNAT	17.183	19.364	-0.021	0.004	-5.070	0.000
CFe	0.007	-0.012	-0.001	0.002	-0.548	0.583
NWC	0.142	0.040				
CAPEX	0.087	0.053	0.005	0.002	2.183	0.029
BKDEBT	0.258	0.210	0.007	0.003	2.262	0.024
RD_SALE	0.025	0.124				
DIVDUM	0.410	0.252				
ACQUI	0.013	0.024	-0.004	0.003	-1.437	0.151
ΔEQUITY	0.062	0.046	-0.001	0.002	-0.471	0.638
ΔDEBT	0.011	0.009	0.000	0.001	-0.187	0.852
TOTAL			0.087			

CHAPTER A7. THE REVERSE CAUSALITY RELATIONSHIP BETWEEN DEBT CAPACITY AND CASH HOLDINGS

A7.1 Debt capacity model specifications

After examining the importance of debt capacity on cash holdings and assessing their relationship for constrained and unconstrained firms, a reverse causality test is performed in this Chapter using a series of debt capacity models (1) to confirm the substitution effect (negative relationship) between cash and debt capacity reported in Campello et al. (2011), (2) to confirm the positive effect of cash flow on debt capacity reported in Sufi (2009), and finally (3) to assess the importance of cash flow sensitivity of cash in explaining debt capacity. To support the reverse causality relationship between cash and debt capacity, a Granger causality test is performed prior to the actual debt capacity models using one lag of change in cash ratio and two lags of change in debt capacity ratio.[34] The bivariate Granger test shows that there is a significant feedback relationship between cash and debt capacity where change in cash Granger cause change in debt capacity, and vice versa.[35]

Further continuing the internal flexibility analysis, interactions between cash, cash flow and debt capacity are examined using adapted models from Sufi (2009) and Campello et al. (2011) as follow.

[34] Taking the change in debt capacity and cash ratio from one period to the previous period eliminates the time series effect and converts the ratios into stationary variables. One lag of change in cash ratio and two lags of change in debt capacity ratio are used in the Granger causality test because the respective lags are found to yield the lowest Akaike Information Criterion (AIC) for the regressions individually.

[35] Regressions performed in the Granger causality test reports large t-values and p-value of 0.000 for all respective regressions. At a p-value of 0.000, null hypothesis of no relationship between the change in cash and the change in debt capacity is rejected.

$$DC/(DC + Cash)_{i,t} = DC/IF_{i,t} = c + \alpha_1 CFe_{i,t} + \alpha_4 Ln(AT)_{i,t} + \alpha_2 Credit_{i,t} + \alpha_3 Q_{i,t} + \varepsilon_i \qquad (i)$$

$$DC/Assets_{i,t} = c + \alpha_1 CFe_{i,t} + \alpha_2 Cash_{i,t} + \alpha_3 Ln(AT)_{i,t} + \alpha_4 Credit_{i,t} + \alpha_5 Q_{i,t} + \varepsilon_i \qquad (j)$$

$$DC/Assets_{i,t} = c + \alpha_1 CFe_{i,t} + \alpha_2 Cash_{i,t} + \alpha_3 (Cash\ flow{*}Cash)_{i,t} + \alpha_4 Ln(AT)_{i,t} + \alpha_5 Credit_{i,t} + \alpha_6 Q_{i,t} + \varepsilon_i \qquad (k)$$

where internal flexibility (IF) is computed as the sum of debt capacity and cash; independent variables are firm characteristics that control for firm size, credit rating, and investment growth prospect following Campello et al. (2011).[36] The Campello's modified model is next adapted, where the effect of cash holdings on credit is explicitly modelled, allowing for nonlinearities by using a different scaling factor in the dependent variable and including cash and its interaction as independent variables. The interaction term helps assess the effect of cash flow sensitivity of cash on debt capacity. Inclusion of the interaction term makes cash and cash flow conditional upon each other which, in practice, is true to a certain extent in the cash model regressions. Interpretation of estimated coefficients for cash and cash flow become different; and model (k) will be interpreted in a different manner compared to model (i) and (j). Model (k) investigates the use of cash and credit lines when cash flow are assumed to give firms greater access to credit facilities, i.e. positive relationship between credit lines and cash flow documented in Sufi (2009). The final debt capacity model includes industry cash flow volatility and additional control variables from Bates et al. (2009) and Opler (1999). Cash flow is found to add positively to firms' borrowing capacity (Campello et al., 2011); as such it is expected that cash flow risk has a negative impact on firms' debt

[36] Total internal flexibility (liquidity) is computed as the sum of lines of credit (LC) and cash in Sufi (2009). In this paper, debt capacity is used to replace lines of credit in the computation of total internal flexibility. Firm characteristics are defined as such – Large is a dummy variable for firm size taking value of one if firm's sale revenue is equal or more than $1billion; credit is a dummy variable equals to one if firm has rating BBB- or higher; and investment growth prospect is measured using Q ratio.

capacity, where firms with volatile cash flow have lower debt capacity, or else being equal. Negative correlation between volatility and debt capacity is found in the univariate tests. The actual impact of volatility on debt capacity is derived from the following regression model.

$$DC/Assets_{i,t} = c + \alpha_1 CFe_{i,t} + \alpha_2 Cash_{i,t} + \alpha_3 (Cash\ flow{*}Cash)_{i,t} + \alpha_4 INDSTDCF_{i,t} + \alpha_5 Ln(AT)_{i,t} + \alpha_6 Credit_{i,t} + \alpha_7 Q_{i,t} + \varepsilon_i \qquad (l)$$

The Granger causality test performed prior the debt capacity models indicated a feedback relationship between the two variables. The relationship between cash holdings and debt capacity is subjected to a "reverse-causality story" (Campello et al., 2011). Greater cash holdings may be due to firms utilizing their credit lines in the same period, resulting in higher cash holdings and lower levels of credit lines. The authors test this reverse-causality using the level of drawdowns made by firms because when firms have higher cash holdings and use less of their credit lines, the consequent lower level of drawdown will not lead to greater cash holdings.

Here, this is tested using firms' unused debt capacity and actual debt usage. First, the level of drawdown is low when firms' unused debt capacity is high (i.e. firms preserving their existing capacity), during which low drawdown should not add to cash holdings. If cash holdings are high when unused debt capacity is high, the substitution effect between cash holdings and debt capacity will be supported while eliminating the possibility that higher cash holdings are due to higher debt use from firms' higher debt capacity. However, using the unused debt capacity ratio denominated by total assets to determine its relationship with cash may be subjected to bias since firms may naturally have higher or lower unused debt capacity depending on its size. Ratio is scaled by debt capacity for models (i) to (l) because it is the unused portion out of total capacity that is the most important and relevant. Second, the reverse-cycle is further tested using actual debt usage out of the total debt capacity. Actual debt usage is measured using (1) long-term debt scaled by debt capacity to measure the proportion of debt used out of total borrowing capacity, (2) net debt issuance scaled by debt capacity to measure actual debt use in each period more accurately predict the actual addition to cash from new debt issuance, (3) long-term debt scaled by total assets, and (4) net debt issuance scaled by total assets, where the latter two are generic measurement that serves as a robustness test for the first two measures scaled by debt capacity, As greater debt usage (due to higher debt capacity) cannot lead to firms having less cash, a negative relationship between debt use and cash holdings implies that firms have greater cash-on-hand not due to greater debt usage from larger borrowing capacity. Rather, cash holdings are carefully managed to maximise firm's internal flexibility according to existing borrowing capacity level. Together, the results from unused debt capacity and actual debt usage will support the trade-off between cash and debt capacity, and the active management of total internal financial flexibility by firms.

A7.2 Debt capacity model regression results

Table A27 reports results of the adapted debt capacity model. The previous model (Sufi, 2009) uses lines of credit obtained from the Dealscan database that includes mainly large firms with publicly published details on bank debt. Here, debt capacity is a derived estimate using coefficient estimates from Berger et al. (1996). Although the two measures are not directly comparable, they represent a portion of a firm's borrowing capacity and are expected to have similar trends in the regression models. Accordingly, all variables are found to enter the debt capacity model with the same sign as Campello et al. (2011).[37]

First, cash flow positively impacts debt capacity over the entire sample, where increase in cash flow improves the firm's borrowing capacity. While higher profits reduce the probability of firms violating the covenants and increase the use of credit lines (Sufi, 2009), increased profitability also contributes positively to firms' generic measure of debt capacity. The magnitude of the coefficient estimate of cash flow is, however, much smaller than with the previous model, indicating that cash flow may be a less important variable in explaining total debt capacity compared to committed lines of credit. Supporting this further, cash flows have much lower estimate after the firm fixed effect is taken into account (in Model 6) and after cash holdings is included as additional determinant in Models 3, 7 and 11. The latter implies that cash ratio has variance that partly subsumes the effect of cash flow on debt capacity. Second, cash is found to have a highly significant and negative relationship with debt capacity, supporting the trade-off

[37] Campello et al. (2011) perform the credit line regression for financial year 2008 sample clustered by industry. To better compare the results with Campello et al. (2011), Appendix A-XIV reports the debt capacity model (k) performed for year 2008 and the entire sample using industry fixed effects.

practice between the two variables. As mentioned, the most important variable (cash flow) for credit line no longer reports high coefficient after cash is taken into account. More importantly, the fit of the model increases more than four times. This suggests that cash is a more important determinant of debt capacity compared to cash flow.

Third, the interaction effect between cash and cash flow is negative and significant in Models 4, 8 and 12. Compared to the previous model, the estimate for the interaction term is small because cash flow enters the debt capacity model with a very small coefficient. From the Fama-MacBeth yearly regression (Model 12), the largest coefficient of interaction term (0.095) is further interpreted as follows. If a firm does not keep cash on hand, the impact of any change in cash flow on debt capacity is 7.6%, e.g. an arbitrary ten percent change in cash flow will increase debt capacity only by less than a percentage point (76 basis points). In practice, change in cash flow to total assets is, on average, 30 basis points from 1980 to 2008, implying that the actual impact of cash flow on debt capacity is minimal and, on average, 2 basis points of total assets. Taking the last two financial years as an example, for a firm holding the average level of cash at 21% of total assets and cash flow to total assets decreasing at average rate 1.1% from 2007 to 2008, the year-to-year decrease in cash flow contributes 0.06 basis point to the total increase in debt capacity to total assets of 80 basis points. This effect is equivalent to nil impact of cash flow on debt capacity from 2007 to 2008. As the year-to-year change in cash flow is comparably smaller than the change in debt capacity, results show that cash flow may not have significant impact on debt capacity. On the other hand, if a firm has median cash flow (6.4% of total assets) in 2008 and a decrease in average cash holdings of 2% from 2007 to 2008, the fall in cash holdings contribute to almost all of the consequent increase in debt capacity of 80 basis points. Finally, except for Model 1 and firm size, most of the control variables enter the regression model with the same sign as in the previous study. The positive relationship between firm size and debt capacity is reported in Models 1, 2 and 10, while the rest of the models report a negative relationship. Theoretically, a positive relationship is expected as larger firms have greater capacity to borrow. However, it is noted that Campello et al. (2011) report a similar negative relationship for firm size in their credit lines regression using a Compustat sample.

BKS identified cash flow volatility as a major determinant of cash holdings, and previous Chapters found significant relationship between volatility and debt capacity; henceforth, the variable is included in the modified debt capacity model to test its impact on debt capacity. Results are reported in Models 5, 9 and 13 in Table A27. Fit of the model improves only slightly when cash flow volatility is included. Industry cash flow volatility is highly significant even with cash holdings present in the model. There is a strong negative relationship between volatility and debt capacity, where firms with increased cash flow risk have lower debt capacity. However, addition of the volatility variable does not change the relationship of existing variables on debt capacity.

To sum up the findings in Table A27, cash flows are found to have little impact on debt capacity when cash and cash flow risk are considered, since the bulk of the variance is explained by the latter two variables. The interaction term of cash flow and cash holdings shows that even when consideration is made to the extent cash flow adds to cash holdings in each period, cash flow exhibits minimal impact on debt capacity. Instead, cash is a significantly more important variable of debt capacity, followed by cash flow risk. Results obtained are not entirely in line with Campello et al. (2011) and Sufi (2009), where cash flow is a significant explanatory variable of credit lines even when cash holdings are accounted for. The difference in results is attributed to (1) difference in dependent variable used – the previous study used direct measure of credit lines, while a generic measure of debt capacity is adapted here; and (2) difference in firm sample.

First, debt capacity and credit lines encompass different components that should be interpreted differently. The estimated debt capacity is a more generic measure of the total borrowing capacity of firms while credit lines should be a subset of debt capacity. Debt capacity ratio is a firm-level measure of expected asset liquidation value from Berger et al. (1996), and used in Almeida and Campello (2007) and Hahn and Lee (2009). Subject to lenders accurately predicting asset liquidation value of firms and extending loans accordingly, the generic measure provides a fair measure of the general level of borrowing capacity in firms. From the previous chapters, debt capacity has important relationship with cash holdings for the entire sample and across firms with varying levels of financial constraints. Debt capacity is an important component in total internal flexibility and a form of substitute for cash. Second, the sample of firms used in the previous study may consist mainly of larger firms with reported information on bank credit commitments. This is supported by results in the fourth and fifth columns in Table A28 Panel A. For the debt capacity model performed on a sample of large firms, cash flow is found to exhibit greater explanatory power, 0.255 compared to 0.069 for the sample of small firms using the Fama MacBeth regression model. The estimates obtained for large firm subsample are comparable to previous studies. This shows that the difference in results may be due to difference in samples of firms used and fundamental difference in dependent variable used.

Moving on, to analyse whether the relationships between cash and debt capacity are consistent across all firms, the modified debt capacity model is utilised over different subsamples of firms sorted according to several financial constraints criteria. Table A28 shows that the impact of cash holdings on debt capacity is similar for constrained and unconstrained firms. Regardless of the level of constraints, cash holdings remain an important driver of debt capacity. The other variables report a similar trend as there is no significant difference in their relationship with debt capacity over different firm subsamples. This means that variables influencing debt capacity do not vary for firms with different levels of financial constraints, which either implies that an important variable is omitted from the model or that debt capacity is a more stable variable that may not change as much as cash holdings (reported in Chapter A5) when financial constraints and other firm variables vary.[38]

The latter supports our hypothesis that debt capacity is the first-level variable that exhibits less periodic change compared to the second-level variable cash which can be monitored and adjusted in each period. The debt capacity models suggest lines of credit to be dependent on the level of cash flow and amount of cash savings firms have but our hypothesis is slightly different in terms of cause-and-effect. We presume firms' cash policies to be first dependent on the level of debt capacities firms have and, depending on the changes in credit capacities, firms adjust their cash savings accordingly in each period. This is because cash policies are generally more flexible and

[38] The problem of omission of important variables is reduced as regressions are performed with constant terms and firm and year fixed effects.

subject to less restriction, while debt capacity generally depends on many factors such as the nature of assets, nature of business and bank relationships. As managers in practice may not have total control over debt capacity, they adjust cash-on-hand periodically to cater for their financial flexibility needs, while both debt capacity and cash add to total financial flexibility, cash holdings can be managed more easily and is in practice varied more often compared to debt capacity.

Table A27 Regressions of debt capacity models (*i*) to (*l*) for period 1980 to 2008

This table reports the debt capacity models (*i*) to (*l*) results using the CRSP/Compustat sample from 1980 to 2008. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The interaction term between cash flow and cash holdings is computed as the product of cash flow to total assets and cash holdings to total assets for each firm-year observation. Variable definitions are reported in Chapter A2.3. The dependent variable is debt capacity ratio computed as debt capacity to the sum of debt capacity and cash (internal flexibility) for Model 1 and debt capacity to total asset for the rest of the models. Large is a dummy variable taking a value of 1 if firm has sales revenue equal or more than US$1billion, and zero otherwise. Credit is a dummy variable with value 1 if firm has a S&P long-term credit rating of BBB- and higher, and zero otherwise. OLS model reports estimates from OLS regressions with heteroskedasticity adjusted standard errors. FE model controls for firm and year fixed effects. FM model is based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. All regressions include a constant term (not reported). The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6	MODEL7	MODEL8	MODEL9	MODEL10	MODEL11	MODEL12	MODEL13
Model	OLS					FE				FM			
Dependent	DC_IF	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT
CFe	0.186***	0.113***	0.043***	0.067***	0.062***	0.001	0.013***	0.024***	0.023***	0.105***	0.053***	0.076***	0.074***
.	(54.68)	(62.24)	(29.71)	(30.66)	(28.85)	(0.45)	(9.86)	(13.61)	(12.79)	(15.52)	(5.95)	(9.11)	(8.53)
CASH			-0.458***	-0.467***	-0.443***		-0.375***	-0.380***	-0.382***		-0.438***	-0.445***	-0.435***
.			(-265.04)	(-252.82)	(-236.70)		(-209.32)	(-204.07)	(-205.73)		(-34.25)	(-38.36)	(-29.62)
CASH_CFe				-0.091***	-0.107***			-0.050***	-0.049***			-0.095***	-0.095***
.				(-14.56)	(-17.31)			(-9.39)	(-9.32)			(-7.03)	(-7.39)
LARGE	0.072***	0.001	-0.027***	-0.028***	-0.030***	-0.034***	-0.040***	-0.040***	-0.037***	0.019***	-0.011***	-0.011***	-0.013***
.	(27.13)	(0.36)	(-24.27)	(-24.90)	(-26.48)	(-25.11)	(-34.40)	(-34.47)	(-32.00)	(5.82)	(-6.64)	(-7.24)	(-7.61)
CREDIT	0.060***	-0.006***	-0.026***	-0.027***	-0.024***	-0.032***	-0.038***	-0.038***	-0.034***	-0.003	-0.018***	-0.018***	-0.018***
.	(16.71)	(-3.10)	(-17.15)	(-17.69)	(-15.87)	(-21.36)	(-29.68)	(-29.79)	(-27.18)	(-1.20)	(-5.05)	(-5.03)	(-5.00)
Q	-0.039***	-0.016***	-0.001***	-0.001***	-0.001***	-0.001***	0.004***	0.004***	0.004***	-0.015***	-0.001	-0.001	-0.000
.	(-91.60)	(-71.95)	(-7.65)	(-7.10)	(-3.70)	(-4.27)	(26.29)	(26.54)	(24.71)	(-21.31)	(-1.13)	(-1.08)	(-0.18)
INDSTDCF					-0.327***				-0.178***				-0.158***
.					(-57.84)				(-31.30)				(-4.89)
Adj R-Sq	0.142	0.098	0.435	0.436	0.451					0.093	0.412	0.413	0.418
Obs	118079	118079	118064	118064	118064	118079	118064	118064	118064	118079	118064	118064	118064

Table A28 Regressions of debt capacity models (*l*) for constrained and unconstrained firms for period 1980 to 2008

This table reports the debt capacity model (*l*) results using the CRSP/Compustat sample from 1980 to 2008. The dependent variable is debt capacity ratio computed as debt capacity to total asset. Sample and variable definitions are reported in Chapter A2.3. The dependent variable is debt capacity ratio computed as debt capacity to total assets. Large is a dummy variable taking a value of 1 if firm has sales revenue equal or more than US$1billion, and zero otherwise. Credit is a dummy variable with value 1 if firm has a S&P long-term credit rating of BBB- and higher, and zero otherwise. OLS model reports estimates from OLS regressions with heteroskedasticity adjusted standard errors. FM model is based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Panel A								
	Small size		Large size		Negative CFcf		Positive CFcf	
Model	OLS	FM	OLS	FM	OLS	FM	OLS	FM
Dependent	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT
Intercept	0.482***	0.459***	0.453***	0.446***	0.465***	0.447***	0.483***	0.457***
.	(621.09)	(39.70)	(236.45)	(32.22)	(276.68)	(41.39)	(551.52)	(37.93)
Cfe	0.059***	0.069***	0.164***	0.255***	0.027***	0.018**	0.099***	0.139***
.	(26.58)	(7.99)	(15.92)	(5.60)	(8.27)	(2.10)	(20.18)	(5.87)
CASH	-0.446***	-0.437***	-0.361***	-0.344***	-0.440***	-0.429***	-0.435***	-0.426***
.	(-229.86)	(-30.19)	(-34.56)	(-22.47)	(-113.32)	(-26.11)	(-164.13)	(-27.37)
CASH_Cfe	-0.103***	-0.088***	-0.233***	-0.341	-0.082***	-0.056**	-0.092***	-0.135***
.	(-16.24)	(-7.14)	(-3.35)	(-1.55)	(-8.75)	(-2.38)	(-4.52)	(-3.25)
LARGE	0.000***	-0.000**	0.000***	-0.000**	-0.022***	-0.006	-0.031***	-0.014***
.	(.)	(-2.70)	(.)	(-2.70)	(-4.17)	(-0.84)	(-27.33)	(-6.71)
CREDIT	-0.030***	-0.045**	-0.019***	-0.014***	-0.034***	-0.023*	-0.024***	-0.018***
.	(-8.70)	(-2.44)	(-11.69)	(-4.09)	(-2.72)	(-1.72)	(-15.79)	(-5.20)
Q	-0.000**	0.000	-0.010***	-0.012***	-0.001**	-0.001	-0.002***	-0.002***
.	(-1.99)	(0.13)	(-12.61)	(-7.62)	(-2.05)	(-1.52)	(-8.60)	(-2.89)
INDSTDCF	-0.327***	-0.154***	-0.328***	-0.229***	-0.312***	-0.173***	-0.328***	-0.151***
.	(-51.54)	(-4.26)	(-26.36)	(-7.37)	(-27.32)	(-3.36)	(-50.18)	(-5.22)
Adj R-Sq	0.479	0.442	0.203	0.165	0.568	0.517	0.353	0.335
Obs	99656	99656	18408	18408	26628	26628	91436	91436

Table A28 Regressions of debt capacity models (*l*) for constrained and unconstrained firms for period 1980 to 2008 (continued)

	Panel B							
	Non-investment graded		Investment graded		Non-dividend paying		Dividend paying	
Model	OLS	FM	OLS	FM	OLS	FM	OLS	FM
Dependent	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT
Intercept	0.483***	0.459***	0.449***	0.384***	0.470***	0.451***	0.504***	0.469***
.	(648.68)	(39.63)	(105.57)	(9.51)	(525.47)	(46.55)	(389.46)	(33.82)
Cfe	0.059***	0.070***	0.158***	0.380***	0.049***	0.061***	0.136***	0.150***
.	(27.02)	(7.81)	(10.36)	(3.15)	(20.54)	(7.76)	(19.15)	(7.07)
CASH	-0.443***	-0.435***	-0.431***	-0.357***	-0.436***	-0.429***	-0.437***	-0.425***
.	(-234.06)	(-29.98)	(-21.10)	(-5.00)	(-204.85)	(-31.00)	(-95.07)	(-19.63)
CASH_Cfe	-0.103***	-0.089***	0.530***	-0.239	-0.078***	-0.072***	-0.156***	-0.133**
.	(-16.50)	(-6.89)	(2.98)	(-0.46)	(-11.62)	(-4.70)	(-5.53)	(-2.53)
LARGE	-0.030***	-0.014***	-0.022***	0.019	-0.044***	-0.013***	-0.029***	-0.016***
.	(-25.75)	(-6.95)	(-6.17)	(0.96)	(-25.59)	(-3.47)	(-21.10)	(-8.93)
CREDIT	0.000***	-0.000**	0.000***	0.000***	-0.045***	-0.036***	-0.034***	-0.022***
.	(.)	(-2.70)	(.)	(.)	(-13.15)	(-4.68)	(-21.11)	(-5.29)
Q	-0.001***	-0.000	-0.009***	-0.011***	0.000	0.000	-0.007***	-0.005***
.	(-3.45)	(-0.33)	(-7.63)	(-4.74)	(0.06)	(0.28)	(-13.27)	(-7.79)
INDSTDCF	-0.334***	-0.160***	-0.260***	-0.180***	-0.289***	-0.114*	-0.313***	-0.146***
.	(-56.20)	(-4.64)	(-14.19)	(-9.51)	(-42.56)	(-2.02)	(-29.94)	(-7.18)
Adj R-Sq	0.467	0.432	0.152	0.153	0.467	0.435	0.307	0.274
Obs	109006	109006	9058	9058	82509	82509	35555	35555

Table A29 Regressions of unused debt capacity (out of debt capacity) models for period 1980 to 2008

This table reports the unused debt capacity models results using the CRSP/Compustat sample from 1980 to 2008. Sample and variable definitions and model specifications are reported in Chapter A2.3 and Table A28 respectively. The dependent variable is unused debt capacity ratio computed as unused debt capacity to the sum of debt capacity and cash (internal flexibility) for Model 1 and unused debt capacity to debt capacity for the rest of the models. Large is a dummy variable taking a value of 1 if firm has sales revenue equal or more than US$1billion, and zero otherwise. Credit is a dummy variable with value 1 if firm has a S&P long-term credit rating of BBB- and higher, and zero otherwise. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	OLS					FE				FM			
	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6	MODEL7	MODEL8	MODEL9	MODEL10	MODEL11	MODEL12	MODEL13
Dependent	UDC_IF	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC
Cfe	0.418***	0.752***	0.819***	0.506***	0.486***	0.579***	0.566***	0.567***	0.557***	0.811***	0.875***	0.638***	0.632***
.	(50.31)	(48.56)	(52.12)	(21.50)	(20.65)	(35.78)	(34.96)	(26.00)	(25.58)	(8.94)	(9.94)	(7.51)	(7.27)
CASH			0.443***	0.570***	0.676***		0.376***	0.375***	0.366***		0.598***	0.678***	0.705***
.			(23.77)	(28.60)	(33.11)		(17.01)	(16.35)	(15.98)		(9.91)	(14.86)	(18.98)
CASH_Cfe				1.195***	1.127***			-0.004	-0.000			0.749**	0.740**
.				(17.77)	(16.78)			(-0.06)	(-0.01)			(2.66)	(2.67)
LARGE	-0.077***	-0.169***	-0.141***	-0.131***	-0.137***	-0.151***	-0.144***	-0.144***	-0.126***	-0.099*	-0.060	-0.051	-0.053
.	(-11.76)	(-13.88)	(-11.54)	(-10.78)	(-11.29)	(-10.65)	(-10.19)	(-10.19)	(-8.89)	(-1.98)	(-1.21)	(-1.11)	(-1.10)
CREDIT	0.027***	0.009	0.028*	0.039**	0.052***	-0.120***	-0.115***	-0.115***	-0.094***	0.041	0.060*	0.068**	0.070**
.	(3.01)	(0.56)	(1.68)	(2.34)	(3.16)	(-7.68)	(-7.36)	(-7.36)	(-6.00)	(1.30)	(1.97)	(2.08)	(2.11)
Q	0.011***	0.033***	0.019***	0.017***	0.020***	0.036***	0.032***	0.032***	0.030***	0.040***	0.020**	0.019**	0.020**
.	(10.37)	(17.23)	(9.36)	(8.69)	(10.08)	(20.50)	(17.75)	(17.74)	(16.77)	(4.46)	(2.53)	(2.40)	(2.75)
INDSTDCF					-1.416***				-1.110***				-0.155
.					(-22.97)				(-15.81)				(-0.63)
Adj R-Sq	0.022	0.021	0.025	0.028	0.032					0.031	0.047	0.049	0.050
Obs	118079	118079	118064	118064	118064	118079	118064	118064	118064	118079	118064	118064	118064

Table A30 Regressions of leverage models for period 1980 to 2008

This table reports the leverage models results using the CRSP/Compustat sample from 1980 to 2008. The interaction term between cash flow and cash holdings is computed as the product of cash flow to total assets and cash holdings to total assets for each firm-year observation. Sample and variable definitions are reported in Chapter A2.3. The dependent variable is long-term debt to debt capacity (BKDEBT_DC) and long-term debt to total assets (BKDEBT_AT) in Panel A, and net issuance of debt to debt capacity (ΔDEBT_DC) and net issuance of debt to total assets (ΔDEBT_AT) in Panel A. Large is a dummy variable taking a value of 1 if firm has sales revenue equal or more than US$1billion, and zero otherwise. Credit is a dummy variable with value 1 if firm has a S&P long-term credit rating of BBB- and higher, and zero otherwise. All models are estimated using fixed effects regression that controls for firm and year fixed effects. All regressions include a constant term (not reported). The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Panel A								
Dependent	BKDEBT_DC				BKDEBT_AT			
VARIABLE	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6	MODEL7	MODEL8
CFe	-0.586***	-0.573***	-0.578***	-0.569***	-0.176***	-0.166***	-0.209***	-0.208***
.	(-44.34)	(-43.40)	(-32.10)	(-31.62)	(-67.37)	(-65.85)	(-61.92)	(-61.68)
CASH		-0.400***	-0.397***	-0.389***		-0.312***	-0.293***	-0.292***
.		(-22.49)	(-21.50)	(-21.09)		(-90.96)	(-82.42)	(-82.21)
CASH_CFe			0.022	0.017			0.195***	0.195***
.			(0.42)	(0.32)			(19.31)	(19.29)
LARGE	0.088***	0.082***	0.082***	0.066***	0.002	-0.002	-0.002	-0.003
.	(7.66)	(7.20)	(7.20)	(5.74)	(0.96)	(-1.03)	(-0.89)	(-1.57)
CREDIT	0.127***	0.121***	0.121***	0.102***	0.018***	0.013***	0.014***	0.012***
.	(10.05)	(9.63)	(9.63)	(8.10)	(7.07)	(5.53)	(5.74)	(5.02)
Q	-0.034***	-0.029***	-0.029***	-0.027***	-0.007***	-0.003***	-0.003***	-0.003***
.	(-23.63)	(-20.01)	(-20.02)	(-18.88)	(-24.26)	(-11.34)	(-11.85)	(-11.33)
INDSTDCF				1.014***				0.091***
.				(18.01)				(8.40)
Obs	114787	114776	114776	114776	117855	117840	117840	117840

Table A30 Regressions of leverage models for period 1980 to 2008 (continued)

Panel B								
Dependent	ΔDEBT_DC				ΔDEBT_AT			
VARIABLE	MODEL9	MODEL10	MODEL11	MODEL12	MODEL13	MODEL14	MODEL15	MODEL16
CFe	-0.052***	-0.052***	-0.086***	-0.088***	-0.032***	-0.031***	-0.049***	-0.049***
.	(-5.59)	(-5.49)	(-6.80)	(-6.93)	(-11.59)	(-11.22)	(-13.09)	(-13.27)
CASH		-0.051***	-0.036***	-0.038***		-0.032***	-0.025***	-0.025***
.		(-3.99)	(-2.73)	(-2.84)		(-8.71)	(-6.42)	(-6.57)
CASH_CFe			0.154***	0.154***			0.078***	0.078***
.			(4.07)	(4.08)			(7.13)	(7.16)
LARGE	-0.011	-0.011	-0.011	-0.008	-0.001	-0.001	-0.001	0.000
.	(-1.32)	(-1.38)	(-1.36)	(-0.98)	(-0.24)	(-0.44)	(-0.40)	(0.10)
CREDIT	0.041***	0.040***	0.041***	0.044***	0.008***	0.008***	0.008***	0.009***
.	(4.51)	(4.44)	(4.48)	(4.85)	(3.10)	(2.94)	(3.02)	(3.48)
Q	0.002**	0.003***	0.003***	0.003***	-0.001**	-0.000	-0.000	-0.000
.	(2.41)	(2.97)	(2.86)	(2.58)	(-2.17)	(-0.85)	(-1.05)	(-1.43)
INDSTDCF				-0.186***				-0.072***
.				(-4.55)				(-6.13)
Obs	118079	118064	118064	118064	110959	110946	110946	110946

A7.3 Unused debt capacity model regression results

In the final part of this Chapter, the reverse-cycle effect between cash and debt capacity is tested and reported in Table A29 to A30. The positive relationship between cash and unused debt capacity found in Table A29 shows that firms have higher unused debt capacity when cash holdings are higher. Unused debt capacity is measured as the actual unused portion of debt capacity out of total estimated borrowing capacity. The positive relationship between cash and unused debt capacity supports the trade-off between cash and debt capacity as firms use less of their borrowing capacity (and have higher unused debt capacity) when cash holdings are higher. The unused debt capacity regression model is not subjected to a reverse-causality critique as less use of debt capacity cannot cause firms to have greater cash on hand (Campello et al., 2011).

In the regression of unused debt capacity, cash flow ratio is found to have increased importance in its impact on the dependent variable. This is contrasted with the previous results where cash flow does not play a significant role in explaining changes in debt capacity. While cash flow may not dictate the level of debt capacity, it affects the amount of debt capacity preserved. Cash flow risk affects unused debt capacity in negative manner. Firms utilise more debt capacity when cash flow risks are higher because more cash will be kept when risks are higher (subject to the extent cash flow add to cash holdings). As cash flow has a greater impact on unused debt capacity, the interaction term between cash and cash flow report a significant and large estimate. The rest of the variables exhibit similar estimates as for previous model and Campello et al. (2011).

In the debt capacity models, changes in cash holdings contribute to almost all of the actual changes in debt capacity, while changes in cash flow have little actual impact on debt capacity. For unused debt capacity, change in average cash holdings is found to contribute 59% of the actual change in debt capacity over the recent two years (2007 to 2008); and change in average cash flow contribute about 36% to the change in average debt capacity – both changes in cash and cash flow contribute to almost all of the average change unused debt capacity.[39] In the decision to preserve borrowing capacity, firms take into account not only the level of cash on hand, but also cash flow level and cash flow risk. While total debt capacity dictates the level of cash holdings firms maintain in each period, the level of unused debt capacity is partially dependent on cash holdings and cash flow. This partially explains the Granger feedback relationship between cash and debt capacity found in the earlier part of the Chapter.[40] Nevertheless, it is noted that the interaction effect becomes insignificant and has lower estimated magnitude in the fixed effect and Fama MacBeth regression respectively. This means the impact of cash flow sensitivity of cash on the usage of debt capacity falls when firm and time effects are considered.

Table A30 reports four variations of leverage models to support the findings in Table A29. Both the stock and flow variable of leverage (total long-term debt and net debt issuance) regressions produce negative and significant estimates with cash holdings. As greater debt usage (due to higher debt capacity) cannot lead to firms having less cash, a negative relationship between debt use and cash holdings implies that firms have greater cash-on-hand not due to greater debt usage from larger borrowing capacity. Rather, it implies that cash holdings are carefully managed to maximise firm's internal flexibility according to existing borrowing capacity level.

[39] Average cash holdings and cash flow in year 2008 are 21% and -2.9% of total assets. Average decrease in cash flow is 1.1% of total assets and estimated average decrease in unused debt capacity due to changes in cash flow is 0.8%. This amounts to about 36% when scaled by the actual decrease in average unused debt capacity ratio of 2.2%. In a similar respect, average cash holdings to total assets decrease 2% from 2007 to 2008, and this contributed to an estimated 1.3% decrease in unused debt capacity ratio. This amounts to about 59% of the actual decrease in average unused debt capacity of 2.2%.

[40] In an unreported test, Granger feedback relationship is found between cash holdings and unused debt capacity where changes in cash Granger cause changes in unused debt capacity, and vice versa.

In contrast with the unused debt capacity regressions, cash flow has a negative relationship with leverage, where increase in cash flow decreases the amount of debt held and issued by firms.

Having proven that results from unused debt capacity model and different variations of leverage models are consistent, unused debt capacity is used to model firms' artificial preservation of borrowing capacity in the next regression model where firms are divided according to level of financial constraints. Financially constrained firms are expected to have less ability to preserve capacity and the relationship between cash and unused debt capacity will either be lower in magnitude if positive, or become negative or insignificant. The use of debt capacity (lower unused portion of debt capacity) is more likely to add positively to cash holdings and contribute to the reverse-causality effect between debt capacity and cash for constrained firms. Accordingly, Table A31 shows cash holdings being insignificant in explaining unused debt capacity of small, unprofitable and non-investment graded firms. For non-dividend payers, cash holdings have a smaller estimated coefficient compared to dividend payers. Results are in line with expectations, with the exception of investment graded firms reporting a negative coefficient for cash holdings. The results obtained are robust to different measures of unused debt capacity. The same regressions are performed using unused debt capacity scaled by debt capacity as the dependent variable and results are reported in Appendix A-XV. Cash is a more important explanatory variable for unused debt capacity for small, unprofitable and non-dividend paying firms. With the exception of constraints measured by long-term credit rating, estimated coefficient of cash holdings has a lower magnitude for constrained firms.

To sum up, the regressions of unused debt capacity models support the trade-off between cash and debt capacity as firms use less of their borrowing capacity when cash holdings are higher; since less use of debt capacity cannot cause firms to have greater cash on hand, reverse-causality is eliminated. Second, cash flows are found to have positive impact on unused debt capacity as firms with higher cash flow preserve greater debt capacity. Cash flow risk affects unused debt capacity in the opposite and negative manner, where riskier firms use greater portions of their borrowing capacity. Third, the extent that cash flow adds to cash holdings measured by the interaction term is more important in explaining the level of unused debt capacity than total borrowing capacity. Finally, reverse causality problem is more prominent for constrained firms as the use of debt capacity is more likely to add positively to cash holdings because constrained firms have less ability to preserve capacity without restrictions.

Table A31 Regressions of unused debt capacity models for constrained and unconstrained firms for period 1980 to 2008

This table reports the debt capacity models (i) to (k) results using the CRSP/Compustat sample from 1980 to 2008. Sample and variable definitions and model specifications are reported in Chapter A2.3 and Table A28 respectively. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Panel A								
	Small size		Large size		Negative CFcf		Positive CFcf	
Model	OLS	FM	OLS	FM	OLS	FM	OLS	FM
Dependent	UDC_AT	UDC_AT	UDC_AT	UDC_AT	UDC_AT	UDC_AT	UDC_AT	UDC_AT
Intercept	0.164***	0.130***	0.113***	0.075***	0.109***	0.091***	0.154***	0.113***
.	(103.84)	(15.24)	(31.08)	(5.28)	(28.51)	(4.18)	(91.16)	(13.87)
Cfe	0.237***	0.275***	0.477***	0.658***	0.082***	0.111***	0.481***	0.532***
.	(51.55)	(7.17)	(21.64)	(5.03)	(10.93)	(7.46)	(46.97)	(15.85)
CASH	-0.004	0.003	0.212***	0.178**	-0.008	-0.027**	0.066***	0.068***
.	(-0.97)	(0.32)	(10.72)	(2.71)	(-0.89)	(-2.40)	(12.94)	(3.56)
CASH_Cfe	-0.084***	-0.091**	-0.406***	0.020	-0.027	-0.170***	-0.419***	-0.403***
.	(-6.48)	(-2.37)	(-3.03)	(0.03)	(-1.26)	(-3.15)	(-10.42)	(-7.41)
LARGE	0.000***	-0.000**	0.000***	-0.000**	-0.098***	-0.067***	-0.044***	-0.024**
.	(.)	(-2.70)	(.)	(-2.70)	(-8.23)	(-3.10)	(-20.17)	(-2.19)
CREDIT	-0.058***	-0.066***	0.006*	0.018***	0.027	0.002	-0.016***	-0.002
.	(-8.16)	(-2.96)	(1.94)	(3.23)	(0.92)	(0.12)	(-5.58)	(-0.37)
Q	0.004***	0.006***	-0.002	0.002	-0.001**	-0.003	0.004***	0.004***
.	(10.80)	(3.44)	(-1.54)	(0.44)	(-2.31)	(-1.63)	(7.23)	(2.99)
INDSTDCF	-0.248***	0.063	-0.492***	-0.128**	-0.195***	0.092	-0.318***	0.057
.	(-19.25)	(0.73)	(-21.29)	(-2.18)	(-7.55)	(0.60)	(-25.59)	(0.79)
Adj R-Sq	0.061	0.067	0.062	0.094	0.018	0.028	0.053	0.060
Obs	97625	97625	18056	18056	26212	26212	89469	89469

Table A31 Regressions of unused debt capacity models for constrained and unconstrained firms for period 1980 to 2008 (continued)

Panel B								
	Non-investment graded		Investment graded		Non-dividend paying		Dividend paying	
Model	OLS	FM	OLS	FM	OLS	FM	OLS	FM
Dependent	UDC_AT	UDC_AT	UDC_AT	UDC_AT	UDC_AT	UDC_AT	UDC_AT	UDC_AT
Intercept	0.166***	0.127***	0.125***	0.048	0.130***	0.096***	0.204***	0.161***
.	(108.71)	(14.53)	(19.70)	(1.40)	(70.43)	(9.07)	(87.60)	(24.17)
Cfe	0.242***	0.283***	0.224***	0.598***	0.197***	0.237***	0.497***	0.549***
.	(53.14)	(7.28)	(8.71)	(3.46)	(39.97)	(7.77)	(35.24)	(8.57)
CASH	0.005	0.011	-0.100***	-0.006	0.018***	0.019**	0.096***	0.111***
.	(1.26)	(1.25)	(-3.17)	(-0.05)	(4.01)	(2.35)	(11.61)	(4.07)
CASH_Cfe	-0.087***	-0.091**	1.896***	0.938	-0.013	-0.044	-0.551***	-0.553***
.	(-6.81)	(-2.22)	(6.84)	(1.16)	(-0.97)	(-1.26)	(-10.63)	(-3.71)
LARGE	-0.047***	-0.030**	0.009*	0.047***	-0.088***	-0.066***	-0.039***	-0.029***
.	(-19.53)	(-2.42)	(1.71)	(3.17)	(-25.15)	(-9.56)	(-15.76)	(-3.46)
CREDIT	0.000***	-0.000**	0.000***	0.000***	-0.005	-0.009	-0.061***	-0.037***
.	(.)	(-2.70)	(.)	(.)	(-0.76)	(-0.58)	(-20.93)	(-3.71)
Q	0.004***	0.006***	-0.004**	-0.005	0.005***	0.006***	0.004***	0.007**
.	(11.45)	(3.70)	(-2.26)	(-0.91)	(10.99)	(3.34)	(4.34)	(2.55)
INDSTDCF	-0.287***	0.065	-0.327***	-0.191***	-0.150***	0.228	-0.344***	-0.029
.	(-23.56)	(0.72)	(-12.21)	(-6.37)	(-10.75)	(1.69)	(-18.48)	(-0.40)
Adj R-Sq	0.061	0.067	0.047	0.071	0.052	0.061	0.101	0.095
Obs	106778	106778	8903	8903	80750	80750	34931	34931

CHAPTER A8. DEBT CAPACITY, CASH HOLDINGS AND INDUSTRY EFFECT

A8.1 Cash holdings and industry effect

While financial flexibility has been highlighted in liquidity management and capital structure literature, few papers in the existing literature discuss industry impact on financial flexibility directly. Many papers consider industry factor as a fixed effect and control it statistically in multivariate analysis (e.g. Almeida and Campello, 2007, Bates et al., 2009, Campello et al., 2011). Nevertheless, there is empirical evidence indicating the effect of industry on firms' liquidity management. Firms may make liquidity choices based on competitors' internal flexibility positions, and even more so in more competitive industries because of the strategic benefits of flexibility from both cash and debt capacity (Lins et al., 2010).

In Chapter A3.2.3, univariate analysis shows significant variation in the level of cash and debt capacity held by firms across different industries. The time trend analysis of average cash over time shows cash increase at a significant rate only for certain industries.[41] In this Chapter, the relationship between cash and debt capacity across different industries is analysed to determine (1) whether trade-off between the two instruments is evident across industries and, if so, how different is the degree of substitution and (2) whether other cash determinants affect cash holdings equally across industries. According to the trade-off hypothesis, the substitution effect should be apparent in all industries; however, the effect may be stronger in two

[41] Yearly mean of cash is regressed against time variable for each industry group and a positive significant estimate for time factor is reported only for half of the industry. Mean of cash is computed yearly for each industry group. Time variable is measured as the number of years from the start of the sample period, 1980 (e.g. financial year 1980 and 1981 will have time variable equals to 0 and 1 respectively). Estimated coefficients for time variable are found to be insignificant in Industry 1, 8, 9 and 10, and negative in Industry 3. Industry groups are sorted according to their SIC codes as follow: 1=Retail and wholesale, 2=Manufacturing, 3=Mining, 4=Transportation, 5=Communication, 6=Software and Biotech, 7=Services, 8=Healthcare, and 9=Others.

opposite scenarios – (1) more stable or less risky industries because firms in such industries have greater ability to borrow and are less constrained in the external debt market; this effect is substantiated by herding behaviour of firms in highly competitive industries; (2) risky and high growth firms because these firms have greater need to grow but have difficulty sourcing external funds and, thus, cash has to be maintained at sufficiently high level.

The cash model with debt capacity included is performed using Fama-MacBeth regressions across the nine industries (reported in Table A32). Only debt capacity and leverage remains significant across all industries. All the other cash determinants are insignificant in at least one industry group. This suggests that debt capacity and leverage are robust cash determinants across all industry groups.

First, industry cash flow volatility is a significant cash determinant only in manufacturing and transportation. Volatility reports insignificant or zero coefficient estimates in all other industries. Results support findings in previous chapters that industry cash flow volatility may not be a robust cash determinant as it only proves significant for certain firms. Manufacturing and transportation industries have the largest proportion of lines of credit (Campello et al., 2011). As manufacturing and transportation firms have higher lines of credit and are less constrained in seeking external debt, average cash holdings are, on average, not high in the two industries.[42] With less cash held mostly for operations purpose (rather than investment purpose), manufacturing and transportation firms may have higher cash flow to cash sensitivity, and keep more cash when cash flow risks are higher, thereby explaining the significance of industry cash flow volatility in these two industries.

[42] Average cash holdings from 1980 to 2008 are 17% and 11% of total assets for manufacturing and transportation firms respectively. This is relatively low compared to the highest cash holdings reported for software and biotechnology firms (41%).

Second, the acquisition variable reports interesting results. Acquisition has a relatively high, negative and significant estimate for all other industries (except for the residual industry). The largest estimate magnitude (0.714) is reported in software and biotechnology, implying that acquisition activities in high technology industries is largely funded by cash, probably because other sources of funding are difficult to access or are much more costly. Supporting this, the mining industry with high tangibility reports a significantly lower estimate magnitude (0.090), implying that, while mining firms use cash for acquisitions, they are likely to depend on other sources of financing and overall cash level is not significantly affected by the level of acquisition. The results are supported by Harford (1999) where cash-rich firms were found to engage in acquisition activities more than their counterparts. On average, software and biotechnology firms hold the largest average cash (41% of total assets over the sample period), while mining firms have a low cash average of 12%. The large cash holdings enable cash-rich high technology firms to acquire more. Using a reverse-causality explanation, acquisition activities are then found to have greater impact on cash level of cash-rich industries such as software and biotechnology.

Third, the substitution effect is the greatest in software, biotechnology and manufacturing, where the coefficient estimate for debt capacity is greater than one, such that any decrease in debt capacity will result in a more than proportional increase in cash holdings. For software and biotechnology firms, cash is an important source of funding because of low borrowing capacity. Large intangibles and research and development activities contribute little to firms' borrowing capacity in high technology industry. The evidence above shows that high technology firms rely substantially on cash even for acquisition activities. An increase in debt capacity for these firms means freeing up the cash for other purposes. As such, any change in debt capacity is likely to impact cash level because cash is used extensively for various purposes, e.g. acquisitions, investment and operations. As mentioned, cash in the software and biotechnology industries are held consistently at a sufficiently high level for these firms. The importance of cash in high technology firms is supported by empirical evidence in Brown and Petersen (2011) where cash is used for smoothing investment in intangibles. Furthermore, the marginal value of cash holdings is higher in high technology firms compared to other firms (Zhou, 2011), supporting the results obtained here that the value of substituting a drop in debt capacity with greater cash holdings is greater for high technology firms.

On the other hand, the substitution effect is higher for manufacturing firms, possibly due to strategic reasons. For competitive reasons, Haushalter et al. (2007) found that firm's competition with its industry rivals for valuable investment is dependent on the level of cash held – to prevent losing valuable investment opportunities and market share, firms hold greater cash holdings (at least greater than the rivals) whenever possible. High substitution effect for manufacturing firms support previous empirical results where firms hold greater debt capacity and/or cash for strategic reasons (Lins et al., 2010, Maksimovic, 1990). Any change in debt capacity is "replaced" quickly by adjusting the level of cash held to prevent losing strategically to rivals.

A8.2 Debt capacity and industry effect

To examine the impact of industry on debt capacity, the debt capacity model is performed for the nine industry groups and results are reported in Table A33. Similar to the cash model results, industry cash flow volatility is not a significant determinant of debt capacity in most of the industries. Volatility is found significant in the software and biotechnology industries possibly because high technology firms have greater risks and less stable cash flow compared to other firms with more tangible investments.

Debt capacity is the most important determinant of cash in Table A32. The same is found on the reverse side, where cash reports the largest estimate that is significant across all industry groups. This reinforces the substitution effect between cash and debt capacity across different industries, and shows that the relationship between cash and debt capacity is robust even when there are substantial industry effects.

Cash flow is insignificant in about half the industries (retail and wholesale, manufacturing, mining, transportation and communication industries); while the interaction term is significant only in retail and wholesale and manufacturing industries. In Chapter A5, cash flow and the interaction between cash holdings and cash flow are more important determinants of debt capacity for constrained firms. Both sets of results may tell the same story if industries listed above are made up more of constrained firms with difficulty sourcing for external funds. However, this is not the case. Except for the communication industry, the above industries have higher borrowing capacity compared to the other industries. This implies they have little difficulty sourcing for external borrowing with existing tangible assets as collaterals. As such, results in Table A33 are attributed to industry difference rather than the level of constraints faced by specific industries. Contrary to Campello et al. (2011), cash flow and cash flow sensitivity of cash may not impact debt capacity in the same manner when industry effects considered.

To sum up, Table A32 shows that there is substantial industry effect in determining the level of cash holdings and debt capacity. Regardless of the magnitude of estimates reported, the number and type of cash determinants are found to be significant across all nine industries. Only debt capacity is a consistent significant cash determinant for all industries. Contrary to expectations, the greatest substitution effect is found in manufacturing, software and biotechnology firms. Even when the other cash determinants are significant, their impact on cash varies substantially in magnitude, e.g. acquisition variable has a negative 0.714 estimate for software and biotechnology firms but only a negative 0.090 estimate for mining firms – implying greater proportion of cash used for acquisition activities for high technology firms. The previous important cash determinant (found in Bates et al., 2009), industry cash flow volatility, is no longer a robust explanatory variable once industry effects are considered – it is important only for low debt capacity industries such as manufacturing and transportation. For debt capacity, Table A33 shows similar important industry effects. Only cash has an important relationship with debt capacity across all industries, while cash flow and cash flow sensitivity of cash are insignificant in industries with lower tangibles and borrowing capacity. While cash flow variable is an insignificant debt capacity determinant in high technology firms, cash flow volatility is remained important in determining the level of debt capacity.

Table A32 Regressions of cash model (*b*) for period 1980 to 2008 across industries

This table reports cash model (b) regression results using the CRSP/Compustat sample from 1980 to 2006. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Industry groups are sorted according to their SIC codes as follow: 1=Retail and wholesale, 2=Manufacturing, 3=Mining, 4=Transportation, 5=Communication, 6=Software and Biotech, 7=Services, 8=Healthcare, and 9=Others. Variable definitions are reported in Chapter A2.3. The dependent variable is cash holdings ratio computed as cash to total asset. All estimates are reported based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	FM								
Industry	IND=1	IND=2	IND=3	IND=4	IND=5	IND=6	IND=7	IND=8	IND=9
Dependent	CASH	CASH	CASH	CASH	CASH	CASH	CASH	CASH	CASH
Intercept	0.485***	0.648***	0.560***	0.438***	0.386***	0.738***	0.518***	0.445***	0.520***
.	(26.26)	(96.72)	(22.96)	(16.62)	(17.42)	(26.70)	(22.89)	(7.92)	(21.65)
DC_NOCASH	-0.723***	-1.006***	-0.938***	-0.787***	-0.462***	-1.236***	-0.742***	-0.681***	-0.677***
.	(-13.99)	(-69.95)	(-38.90)	(-15.19)	(-7.63)	(-27.61)	(-24.10)	(-5.25)	(-13.74)
INDSTDCF	-0.085	0.178***	-0.038	0.368***	-0.000**	0.031	0.093*	-0.000**	0.250
.	(-1.18)	(7.06)	(-0.16)	(3.65)	(-2.70)	(0.15)	(1.92)	(-2.70)	(1.18)
Q	0.015***	0.007***	-0.001	0.032***	0.011*	0.005***	0.012***	0.022***	0.002
.	(4.22)	(4.94)	(-0.25)	(6.00)	(1.96)	(3.15)	(4.05)	(3.70)	(0.47)
LNAT	-0.008***	-0.014***	-0.006***	-0.005**	-0.014***	-0.005	-0.012***	-0.012***	-0.014***
.	(-5.79)	(-11.79)	(-3.24)	(-2.72)	(-7.68)	(-1.20)	(-8.79)	(-7.52)	(-5.45)
Cfe	-0.019*	0.033**	0.036***	0.111***	-0.050	0.025***	0.011	-0.009	0.047**
.	(-1.81)	(2.41)	(3.58)	(5.91)	(-1.43)	(3.72)	(0.69)	(-0.22)	(2.13)
NWC	0.003	-0.015	-0.003	-0.072***	0.046**	0.019	-0.025**	-0.007	-0.052***
.	(0.21)	(-1.16)	(-0.17)	(-3.22)	(2.62)	(1.43)	(-2.29)	(-0.23)	(-2.99)
CAPEX	-0.110***	0.033*	0.085***	0.006	0.273***	-0.007	0.109**	0.136**	0.032
.	(-3.46)	(1.86)	(4.81)	(0.26)	(3.37)	(-0.13)	(2.17)	(2.74)	(0.58)
BKDEBT	-0.168***	-0.213***	-0.099***	-0.117***	-0.179***	-0.214***	-0.239***	-0.133***	-0.224***
.	(-11.87)	(-14.04)	(-7.76)	(-9.50)	(-8.26)	(-8.75)	(-29.33)	(-5.60)	(-11.55)
RD_SALE	0.233**	0.058***	-0.127	-4.051	0.346**	0.036**	0.040*	0.293***	0.032
.	(2.69)	(2.84)	(-1.12)	(-1.42)	(2.11)	(2.76)	(1.89)	(4.72)	(0.18)
DIVDUM	0.010***	-0.024***	-0.016***	0.008	-0.025***	-0.026**	-0.008**	0.022**	0.006
.	(3.84)	(-4.49)	(-3.04)	(0.94)	(-4.35)	(-2.57)	(-2.61)	(2.38)	(0.60)
ACQUI	-0.308***	-0.388***	-0.090***	-0.318***	-0.332***	-0.714***	-0.490***	-0.433***	-0.233*
.	(-12.63)	(-15.52)	(-4.05)	(-6.14)	(-5.66)	(-10.98)	(-16.08)	(-11.57)	(-2.02)
Adj R-Sq	0.551	0.690	0.582	0.607	0.460	0.682	0.515	0.541	0.537
Obs	14656	60062	6406	3117	3557	7702	14579	2538	3064

Table A33 Regressions of debt capacity model (*l*) for period 1980 to 2008 across industries

This table reports debt capacity model (*l*) regression results using the CRSP/Compustat sample from 1980 to 2006. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Industry groups are sorted according to their SIC codes as follow: 1=Retail and wholesale, 2=Manufacturing, 3=Mining, 4=Transportation, 5=Communication, 6=Software and Biotech, 7=Services, 8=Healthcare, and 9=Others. Variable definitions are reported in Chapter A2.3. The dependent variable is debt capacity scaled by total asset. All estimates are reported based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	FM								
Industry	IND=1	IND=2	IND=3	IND=4	IND=5	IND=6	IND=7	IND=8	IND=9
Dependent	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT
Intercept	0.475***	0.471***	0.487***	0.456***	0.278***	0.515***	0.372***	0.374***	0.367***
.	(139.92)	(36.51)	(34.73)	(37.04)	(15.79)	(17.67)	(31.53)	(16.32)	(11.96)
CFe	0.089***	0.066***	0.102***	0.203***	0.109**	0.003	0.015	0.003	0.125*
.	(4.48)	(7.83)	(5.93)	(7.44)	(2.59)	(0.19)	(1.51)	(0.12)	(1.89)
CASH	-0.494***	-0.464***	-0.480***	-0.495***	-0.233***	-0.369***	-0.352***	-0.344***	-0.366***
.	(-37.53)	(-27.23)	(-41.62)	(-13.26)	(-7.30)	(-11.07)	(-25.38)	(-9.87)	(-11.13)
CASH_CFe	-0.184***	-0.068***	-0.041	-0.217	-0.239*	0.025	0.085	0.050	-0.141
.	(-3.75)	(-5.41)	(-0.53)	(-1.61)	(-1.84)	(0.62)	(1.66)	(0.74)	(-0.96)
LARGE	-0.004	-0.031***	-0.035***	0.008	0.032	-0.022	-0.015**	0.008	0.009
.	(-1.51)	(-15.16)	(-3.07)	(1.12)	(1.60)	(-0.97)	(-2.57)	(1.01)	(0.29)
CREDIT	-0.005	-0.022***	0.004	-0.016	0.014	0.025	-0.024***	0.021	-0.039**
.	(-1.04)	(-5.33)	(0.66)	(-1.25)	(0.64)	(1.47)	(-3.58)	(1.25)	(-2.35)
Q	-0.001	-0.000	-0.000	0.003	0.008	-0.002	0.001	0.003*	0.006
.	(-1.09)	(-0.85)	(-0.10)	(0.89)	(1.54)	(-1.63)	(0.70)	(1.77)	(1.15)
INDSTDCF	-0.095	-0.003	-0.248	-0.185*	0.000**	-0.786***	0.186*	0.000***	0.298
.	(-0.63)	(-0.05)	(-1.35)	(-1.80)	(2.70)	(-5.07)	(1.73)	(.)	(1.44)
Adj R-Sq	0.334	0.553	0.312	0.322	0.138	0.600	0.225	0.269	0.186
Obs	14896	60436	6643	3215	3686	7858	15207	2610	3513

CHAPTER A9. DEBT CAPACITY, CASH HOLDINGS AND INVESTMENT

A9.1 Investment model specifications

Firms with greater untapped borrowing capacity are found to perform better in the long-run because of their greater ability to invest more in better projects (Denis and McKeon, March 2012, Marchica and Mura, 2010). In the face of positive shocks, firms with greater spare debt capacity are able to seize opportunities better than their counterparts by using their preserved debt capacity as a ‘transitory financing vehicle’ and minimizing the total cost of funding (DeAngelo et al., 2011). Firms with greater cash are also found to invest better in good times, and the greater investment made adds positively to future firm value (Simutin, 2010). Also, in the face of negative shocks, firms with greater financial flexibility are able to withstand external shocks and perform better during crises with the greater pool of cash on hand (Campello et al., 2011, Harford et al., April 2003) and unused debt capacity (Arslana et al., 2011). In addition, there is evidence of firms managing financial flexibility to prepare for recession; this, however, is applicable only for unconstrained firms who are able to maintain adequate flexibility in normal times (Ang and Smedema, 2011). Han and Qiu (2007) found a negative relationship between investment and cash flow risks, and positive relationship between cash holdings and cash flow risks for financially constrained firms.

The literature provides evidence that cash and debt capacity contribute to better investment and greater firm value in the long-run. However, it is important to understand how the two instruments together impact investment activities and firm value. To examine the real impact of internal flexibility, the following investment model is adapted from previous studies (Almeida and Campello, 2007, Brown and Petersen, 2011, Campello et al., 2011, Marchica and Mura, 2010).

Gross or Net Investment, $INVTMT_{it}$ / $NINVTMT_{it}$

$$= c + \alpha_1 Cash_{it} + \alpha_2 DC_{it} + \alpha_3 (Cash{*}DC)_{it} + \alpha_4 Q_{it} + \alpha_5 CFe_{it} + \varepsilon_i \qquad (m)$$

In the previous survey study (Campello et al., 2011), the authors use planned expenditure, planned technology spending and planned employment as the independent variables because they measure ex-ante investment decisions (from data obtained in surveys) rather than ex-post. However, to measure the actual impact on firms, we use the actual investment variable measured in two ways: (i) Investment (INVTMT) computed as the ratio of investment in fixed assets to beginning period capital stock following Almeida and Campello (2007) and Marchica and Mura (2010), and (ii) net investment (NINVTMT) computed as the sum of capital expenditure, acquisitions, increase in investment less sale of property plant and equipment and sale of investment to beginning period total assets following Lemmon and Roberts (2010).[43] Following Almeida and Campello (2007), firms with capital stock less than USD 5million, real asset or sale growth more than 100%, negative Q or Q larger than 10 is excluded from the final sample for investment regression. Excluding these firms avoids potential bias from extreme value of investments due to young and developing firms making initial start-up investments and mature firm making major change to the nature of business or investment portfolio.

Evidence from the literature suggests that both cash and debt capacity are important in liquidity management, especially in times of crisis. Recent surveys also highlight better performance of firms with greater internal liquidity during the financial crisis. To measure the effect of cash and debt capacity on investment during a crisis period, a recession dummy is created. The recession dummy equals 1 during

[43] Detailed variable definitions are reported in Chapter A-4.

a recession period and zero otherwise. Recession periods are recorded based on NBER Business Cycle Dates – a financial year is recorded as a recession year when more than half of the year is in a contraction period. Using this formula, years 1980, 1981, 1982, 1990, 1991, 2001, 2008 and 2009 are recorded as recession years. Following Leary's (2009) event study method, recession dummy and additional interaction terms between each independent variable and recession dummy is put into the model. By construction, the interaction term between each independent variable and recession dummy is equal to zero in normal non-recessionary years. In addition, a pre-recession variable is constructed for the year prior the start of recession year. The pre-recession variable represents the peak before the start of contraction, and a positive relationship between pre-recession indicator and investment is expected.

According to the literature, internal liquidity has a role to play in both positive and negative times; thus, it is important to test the effect of internal liquidity when firms face positive shocks. Here, positive period is identified as the post-recession years when recovery takes place and firms are faced with valuable investment opportunities, their ability to recover and seize valuable investments becomes important in the period after recession. The number of years of post-recession years equals the number of years of recession on the assumption that the economy takes an equal amount of time (as it contracted previously) to recover.[44]

[44] The arbitrary selection of post-recession years is tested for robustness by taking just one period after recession as the post-recession year. Although unreported, results obtained are qualitatively and quantitatively similar.

A9.2 Investment model results

A9.2.1 Base Investment model results

Table A34 reports the results of the investment function (with and without cash and debt capacity interaction term) performed using three regression techniques. Panels A and B report results using investment ratio and net investment ratio respectively. The inclusion of an interaction term between cash and debt capacity makes little difference to the model estimation except that the interpretation of coefficients is different.

First, according to expectations, both cash and debt capacity add positively to investment and net investment. Greater cash and debt capacity increase investment capacity and actual investment made by firms. The largest estimates recorded are for the OLS regression of gross investment ratio where a unit change in cash and debt capacity increase investment by more than four times each. The latter evidence of debt capacity supports Almeida and Campello's (2007) credit multiplier effect where investments in tangible assets generate greater capacity for further investments as tangible assets are used as collateral for additional investment. Investment ratio has greater coefficient estimate compared to net investment because the former measures gross investment of firms without considering any sale of existing investments, and a different scaling variable is used for gross investment. Difference in scaling variable results in larger investment ratios and the subsequent larger coefficient estimates (robustness checks in the latter part of this section show that results are robust to different scaling variable). Net investment measures new investments made by firms using cash-on-hand, bank debt, or new debt and equity issues. Panel A shows that, after fixed and year effects are considered, increase in cash adds less than proportionately to increase in investment; while increase in debt capacity increases investment proportionately more (i.e. credit multiplier effect).

Second, the interaction term between cash and debt capacity enters the investment model with an expected negative coefficient supporting the trade-off between cash and debt capacity as funding instrument for investments. As the level of cash holdings increases, the impact of debt capacity on investment falls as the final coefficient estimate of debt capacity is reduced by the negative interaction term. Firms with greater cash holdings will rely less on debt capacity to fund investments. This applies for cash holdings in a similar respect, where the cash effect on investment falls when debt capacity increases. As explained above, net investment regressions report lower coefficients compared to gross investment models.

To interpret the results in another way, the impact of debt capacity on investment is 1.73 for a firm with average cash holdings of 21%; while the impact of cash on investment is 0.52 for a firm owning average debt capacity of 29% in the final year of sample.[45] The estimates show that it is not possible for cash and debt capacity to have zero impact on investment.[46] The minimum effect of debt capacity on investment is 1.404, while the minimum cash effect is 0.26. Debt capacity has greater impact on investment compared to cash. The positive minimum effect of both liquidity instruments proves the importance of cash and debt capacity in firm's investment behaviour.

[45] Impact of debt capacity on net investment at average cash level for FY2008 is 1.795 – 0.332*0.21 = 1.73
Impact of cash on net investment at average debt capacity for FY2008 is 0.614- 0.332*0.293 = 0.52

[46] For debt capacity to have zero impact on net investment, cash needs to be 5.25 of total assets which is not possible because the maximum value of cash ratio is 1. Similarly, it is not feasible for cash to have zero impact on net investment because debt capacity has to be 1.788 of total assets. By construction, the debt capacity ratio is capped at value 1 because it measures the liquidation value of firm's assets and is a proxy for total borrowing capacity firm is able to obtain if lenders are willing to extend the funds when required. Unless debt capacity measures a component that is not included in the balance sheet (which is not considered in this study), the maximum value of debt capacity ratio is taken to be 1.

Third, cash flow is significant in determining gross investment only. The variable becomes insignificant when interaction term and fixed effects are taken into account. Similar to Almeida and Campello (2007) and Marchica and Mura (2010), cash flow enters the fixed effect model with the correct positive estimate – cash flows and investment are positively correlated. The estimate of cash flow is smaller for net investment regression possibly because the sale of investment and capital stock is considered in net investment ratio, and these sales contribute to investment funding while cash flows contribute more to funding for operational needs. Fourth, consistent with previous estimates, Q ratio has a significant positive impact on gross investment. The positive relationship is expected as Q ratio is a proxy for future investment opportunities. However, this is not the case for net investment where Q ratio is insignificant when firm and year fixed effects are considered, and found to have negative coefficient in the OLS regressions. Inconsistent estimates of Q ratio are possibly due to the measurement of net investment ratio which includes the sale of existing investments.

A9.2.2 Robustness tests

The following are carried out to test the robustness of the investment model and results. First, correlations coefficients between debt capacity and the two investment ratios are checked to avoid any bias problems due to variable design because capital stock is included in the estimation of debt capacity and a main component in investment ratios. Results are reported in Appendix A-XVIII. Correlations between debt capacity and the two investment ratios are relatively small (largest correlation of 0.111 is reported between debt capacity and net investment using Spearman rank correlations tests). Low correlations between the two internal flexibility instruments and investment ratios indicate that high coefficient estimates found in the investment regressions are not due to variable construction or design but actual underlying strong relationship between investment behaviour and internal liquidity.

Second, to ensure results are robust to the construction of variables, independent variables are scaled by beginning capital stock (instead of total assets) for the regression of gross investment because investment ratio is computed as capital expenditure scaled by beginning period capital stock. Following Almeida and Campello (2007) and Marchica and Mura (2010), cash flows are scaled by capital stock for each firm-year. For consistency, the same scaling variable is used for debt capacity and cash ratios. Appendix A-XIX reports the regression of gross investment with independent variables scaled by capital stock. Results obtained are similar to previous studies. As expected, coefficient estimates for cash and debt capacity falls significantly due to the difference in value of ratio. Cash and debt capacity scaled by net assets have values greater than the original ratios scaled by total assets. Lower coefficients together with larger independent variable values produce similar quantitative results as that reported in Table A34. For example, the impact of changes in cash on gross investment from 2007 to 2008 is similar for both measurements of cash (cash ratio scaled by total assets and capital stock) for a firm with average debt capacity. When a firm with average debt capacity to total assets of 29.3% in 2008 experiences a decrease in cash holdings of 2% (fall in average cash holdings to total assets from 2007 to 2008), gross investment of the firm will fall 7.56%. This is about 27% of the total decrease in actual average gross investment from 2007 to 2008. In a similar respect, for a firm with average debt capacity to capital stock ratio of 2.037, a fall in average cash holdings to capital stock of 18.4% will result in a decrease of 7.48% in gross investment. The decrease in gross investment from changes in average cash to total assets and changes in average cash to capital stock is almost equivalent (7.56% vs 7.48%) – indicating the similarity of quantitative and qualitative results of Table A34 and Appendix A-XIX. This further proves that results are robust to the construction of independent variables when scaling variable is different.

Third, to ensure results are not due to the winsorisation method used for the sample, further results are reported in Appendix A-XX for investment ratios winsorized at the top and bottom 1%. The estimates obtained are qualitatively similar to Table A34, but are quantitatively much larger than the initial estimates. This is due to the large values of investment ratios for some firm-year observations. To normalize the investment ratios and prevent extreme large value of investment ratios from biasing the results, Table A33 reports results of the dependent variable winsorized at the 5% top and bottom tails. In an unreported regression, dependent variable is winsorized by 10% at the top and bottom tails, and results obtained are similar to that for 5% winsorisation. The final regression models used 5% winsorisation method because it is not subject to extreme values biasness.

A9.2.3 Investment and recession

In the final stage of investment behaviour analysis, recessionary impact on the relationship between internal liquidity and investment is examined. Table A35 Panel A reports the investment model with recession variable and interaction of independent variables with recession. Recession is important in dictating the level of investments for Model 1 to 3. With the exception of net investment fixed effects regression, recession variable enters all other models with an expected negative and significant estimate – suggesting that there are fewer investments made during a recessionary period. Insignificance of recession variable in net investment regression with fixed effects may suggest that firm effects and/or sales of previous investments and existing tangibles during recession are better able to explain the difference in net investments made by firms. First, firm fixed effects measure inert firm characteristics that are not picked up in the model specification, and some firms are possibly more greatly hit by recession than others (e.g. the automobile manufacturing and airline transportation industries were greatly affected by the 2007-2008 financial crisis). Second, net investments includes sale of previous investments and these sales generate cash flows for operational and investment use during recessionary years. The sales activities are expected to be greater in recessionary period because firms may have difficulty renewing existing credit lines or initiating new source of funding (Campello et al., 2011). Nevertheless, the models show the effect of negative shocks on gross investments as hypothesized.

As the interaction term between debt capacity and recession has positive coefficients, debt capacity is more likely to be used in recessionary times. The same is, however, not found for cash since the interaction term between cash and recession is mildly significant for net investments. The same regressions are repeated excluding debt capacity and its interaction with recession (unreported) but results confirm findings in Panel A of Table A35. Results indicate that firms use more debt capacity for both gross and net investments but there is only partial evidence of greater use of cash for net investments during recessionary periods. This suggests that the use of cash for new investment (not including replacement) is curbed because managers are more cautious and build up precautionary cash savings as risk increases. Debt capacity, on the other hand, may be drawn down during recession times as managers try to draw down whatever credit that is available to avoid restriction on borrowing – this is more apparent for unprofitable firms (Campello et al., 2011). Evidence found in the previous study suggests that firms spend and invest more only when they have sufficient cash holdings – therefore, investments are made out of cash and debt capacity during recessions only when enough cash is held within the firm.

Finally, growth opportunities have positive relationships with both investment measures but cash flow only reports a positive relationship with gross investments. However, greater growth opportunities and increased cash flow are not found to impact positively gross investment during recession as the variables' interaction term with recession are insignificant. Growth opportunities proxied by Q ratio remain an unimportant variable during recession whilst cash flow is positively related to net investment *only* during recession.

Panel B of Table A35 repeats Panel A regressions with an additional two variables for pre-recession and post-recession period. Estimates for the explanatory variables in Panel B are largely similar to those reported in Panel A. First, similar to Panel A, the recession variable enters the model with a negative and significant estimate (except for the net investment fixed effects model) – suggesting firms significantly reduce investment during recession years. Second, during the year prior to recession, firms are also found to reduce investments. This negative relationship is expected because the year prior to recession is usually the peak where investments saturation is high and new investments are relatively lower compared to the growth before the peak. This negative effect is, however, not significant when firms' fixed effects are considered. Finally, the post-recession variable enters all the models with significant and positive estimates. This indicates significantly larger investment activities during the right period after recession. The estimates for the three recession variables are encouraging because they show a decrease in investments before and during recession, and an increase in investments after recession. This not only supports our investment model using cash and debt capacity as main determinants but also supports the use of the three recession dummy variables for modelling purposes.

Summing up the findings from the investment models, cash and debt capacity are found to explain most of the changes in investment, leaving other variables with trivial impact. Results are robust to the consideration of fixed firm and time effects. The results support the credit multiplier effect of Almeida and Campello (2007); and debt capacity is found to have greater impact on investment compared to cash. Results are extended to the model with recessionary impact because debt capacity is found to impact positively investment during recession, but cash is not found to influence positively investment during recession. Whilst growth opportunities and cash flows enter the investment model according to hypothesis, the relationships of investment and the two variables do not change significantly over the recessionary period. Recessionary variables constructed are found to model external shocks on investment relatively well as investments are found to decline slightly prior to recession, decline by a larger portion during recession, and increase after the recession. On the whole, results suggest that debt capacity increases firm value by increasing firms' ability to invest during recession, while cash takes a more precautionary purpose, supporting operational requirement rather than investment need, by cushioning the drop in cash flows during recession.

Table A34 Regressions of investment model (model *m*) for period 1980 to 2008

This table reports the investment models results using the CRSP/Compustat sample from 1980 to 2008. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Following Almeida and Campello (2007), firms with the following characteristics are eliminated from the sample: (1) capital stock less than USD5million, (2) real asset or sale growth more than 100%, and (3) negative Q or Q more than 10. The interaction term between cash holdings and debt capacity is computed as the product of cash holdings to total assets and debt capacity to total assets for each firm-year observation. Variable definitions are reported in Chapter A2.3. The dependent variable is investment ratio computed as capital investment to lagged capital stock for Panel A and net investment computed as the sum of capital investment, acquisitions and change in investments less sale in property plant and equipment and investment to lagged total assets for Panel B. Both investment and net investment ratios are winsorised at top and bottom 5% due to large extreme values. OLS model reports estimates from OLS regressions with heteroskedasticity adjusted standard errors. FE model controls for firm and year fixed effects. FM model is based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. All regressions include a constant term (not reported). The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in parentheses.

Panel A

VARIABLE	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6
Model	OLS		FE		FM	
Dependent	NINVTMT	NINVTMT	NINVTMT	NINVTMT	NINVTMT	NINVTMT
CASH	1.214***	1.114***	0.706***	0.614***	1.386***	1.229***
.	(13.64)	(12.13)	(6.89)	(6.11)	(3.95)	(4.22)
DC	2.399***	2.366***	1.887***	1.795***	1.647***	1.646***
.	(22.16)	(21.06)	(14.02)	(13.48)	(5.21)	(5.42)
CASH*DC		-0.980***		-0.332***		-6.204***
.		(-8.63)		(-4.23)		(-5.12)
Q	-0.040***	-0.036***	0.019*	0.018*	-0.021	-0.009
.	(-3.82)	(-3.32)	(1.95)	(1.91)	(-1.40)	(-0.65)
Cfe	-0.008	-0.115	0.164**	0.090	-0.030	-0.273
.	(-0.11)	(-1.42)	(2.15)	(1.20)	(-0.16)	(-1.41)
Adj R-Sq	0.007	0.008			0.005	0.015
Obs	75457	66972	75457	66972	75457	66972

Panel B

VARIABLE	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6
Model	OLS		FE		FM	
Dependent	INVTMT	INVTMT	INVTMT	INVTMT	INVTMT	INVTMT
CASH	4.365***	4.544***	3.947***	4.060***	4.610***	4.576***
.	(14.01)	(13.39)	(11.06)	(10.82)	(7.42)	(8.63)
DC	4.204***	4.502***	4.858***	5.468***	2.164***	2.242***
.	(11.09)	(10.85)	(10.37)	(11.00)	(2.83)	(3.07)
CASH*DC		-3.870***		-0.948***		-24.448***
.		(-9.22)		(-3.24)		(-7.92)
Q	0.181***	0.183***	0.423***	0.436***	0.345***	0.361***
.	(4.92)	(4.60)	(12.32)	(12.07)	(3.08)	(3.12)
Cfe	-1.085***	-1.391***	0.604**	0.446	-1.679***	-2.186***
.	(-3.97)	(-4.64)	(2.28)	(1.59)	(-3.59)	(-3.86)
Adj R-Sq	0.004	0.005			0.007	0.016
Obs	75457	66972	75457	66972	75457	66972

Table A35 Regressions of investment model (*m*) with recession variables for period 1980 to 2008
This table reports the investment models results using the CRSP/Compustat sample from 1980 to 2008. The interaction terms between recession dummy and cash holdings and debt capacity is computed as the product of recession dummy and cash holdings to total assets and debt capacity to total assets respectively for each firm-year observation. Recession, Prerecession and Postrecession are dummy variables that equal one (and zero otherwise) during recessionary period, the year prior the start of recessionary period, the period after the last year of recessionary period respectively. The Postrecession period duration follows number of years of recession. Sample and variable definitions are reported in Chapter A2.3 and Table A34. Regressions are performed with firm and year fixed effects and include a constant term (not reported). The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in parentheses.

Panel A				
VARIABLE	MODEL1	MODEL2	MODEL3	MODEL4
Model	OLS		FE	
Dependent	INVTMT	NINVTMT	INVTMT	NINVTMT
RECESSION	**-1.667*** **	-0.516***	**-0.718** **	**-0.154**
.	(-3.44)	(-3.72)	(-2.13)	(-1.59)
CASH	**4.233*** **	1.116***	**3.740*** **	**0.628*** **
.	(12.31)	(11.37)	(10.04)	(5.87)
CASH*RECESSION	0.617	0.439*	0.686	**0.290* **
.	(0.76)	(1.89)	(1.19)	(1.75)
DC	**3.509*** **	2.115***	**4.263*** **	**1.715*** **
.	(8.23)	(17.38)	(8.66)	(12.13)
DC*RECESSION	**3.305*** **	1.213***	**1.952*** **	**0.522*** **
.	(3.49)	(4.49)	(2.96)	(2.76)
Q	0.156***	-0.042***	0.429***	0.026**
.	(3.85)	(-3.61)	(11.74)	(2.49)
Q*RECESSION	0.147	0.031	0.036	-0.017
.	(1.50)	(1.12)	(0.52)	(-0.87)
Cfe	-1.285***	-0.102	0.489*	0.109
.	(-4.15)	(-1.16)	(1.69)	(1.31)
Cfe*RECESSION	0.879	0.446**	0.521	0.247*
.	(1.33)	(2.36)	(1.05)	(1.74)
Obs	75457	75457	75457	75457

Table A35 Regressions of investment model (*m*) with recession variables for period 1980 to 2008 (continued)

	Panel B			
Dependent	INVTMT	NINVTMT	INVTMT	NINVTMT
PRERECESSION	-0.318**	-0.076**	-0.095	-0.017
.	(-2.50)	(-2.08)	(-1.09)	(-0.66)
RECESSION	-1.737***	-0.526***	-0.754**	-0.161*
.	(-3.57)	(-3.79)	(-2.23)	(-1.65)
POSTRECESSION	0.181*	0.184***	0.252***	0.071***
.	(1.82)	(6.50)	(3.62)	(3.54)
CASH	4.155***	1.059***	3.574***	0.584***
.	(12.04)	(10.76)	(9.54)	(5.42)
CASH*RECESSION	0.695	0.497**	0.785	0.316*
.	(0.85)	(2.13)	(1.36)	(1.91)
DC	3.320***	1.984***	3.983***	1.640***
.	(7.71)	(16.14)	(8.02)	(11.49)
DC*RECESSION	3.494***	1.344***	2.209***	0.591***
.	(3.69)	(4.97)	(3.34)	(3.10)
Q	0.161***	-0.036***	0.438***	0.029***
.	(3.97)	(-3.06)	(11.95)	(2.74)
Q*RECESSION	0.141	0.025	0.029	-0.019
.	(1.45)	(0.89)	(0.41)	(-0.98)
Cfe	-1.302***	-0.105	0.492*	0.110
.	(-4.20)	(-1.19)	(1.70)	(1.33)
Cfe*RECESSION	0.896	0.449**	0.529	0.248*
.	(1.35)	(2.37)	(1.07)	(1.75)
Obs	75457	75457	75457	75457

CHAPTER A10. CONCLUSION

Supporting the trade-off between cash and debt capacity, cash is found to decrease monotonically over the sample ranked according to debt capacity. The negative relationship between the two internal flexibility instruments is apparent even when firm size, idiosyncratic risks and industry effects are accounted for. In addition, cash and debt capacity levels of firms are found to be increasingly dispersed, indicating a larger difference in the liquidity management. Evidence supports previous studies (Bates et al., 2009, Brown and Kapadia, 2007) and shows that firm size and idiosyncratic risk exhibit positive influence on cash holdings; but the relationship is weakened once debt capacity is considered. In addition, no single industry is the main driver of the increasing trend in cash holdings over time. This supports the hypothesis that industries dictate the nature of assets held by firms; and the nature of assets will determine the amount of debt capacity owned by firms and thereby directly impact the amount of cash held. Results suggest that increase in cash holdings is probably due to the changing nature of firms internally rather than change in proportion of firms in specific industries.

Multivariate analyses show that debt capacity is found to have the greatest impact on level of cash. After considering the impact of debt capacity, previous important cash determinants may no longer be important or significant in explaining the variance of cash. Debt capacity is found to replace net working capital and capital expenditure in explaining level of cash, and the cash function may not have shifted over time but its slope becomes steeper.

When varying financial constraints are considered, the evidence is that industry cash flow volatility is a more important cash determinant only for constrained firms because of herding behaviour in competitive industries (Lins et al., 2010) and the increased intensity of deadweight costs of financial distress for constrained firms (e.g. Bates et al., 2009, Froot et al., 1993, Minton and Schrandb, 1999, Smith and Stulz, 1985). Constrained firms also consider funding from leverage and cash as substitutes of each other more than unconstrained firms. This indicates that funding used for operations and investments might be not clearly distinguished all the time, as evidence suggests that investments are funded proportionately more by cash in constrained firms. Finally and most importantly, in the modified cash model (when debt capacity is included as additional determinant), previous important cash determinants – cash flow volatility, net working capital, and capital expenditure are no longer significant in explaining cash level of unconstrained firms, while debt capacity and research and development expenses remain significant (although of different magnitude) for both constrained and unconstrained firms. The substitution effect between debt capacity and cash is larger when firms have greater financial constraints. On the other hand, research and development expenses increase the level of cash holdings and even more so for unconstrained firms.

In predicting cash holdings, the modified model performs better than the original model and reports predicted cash holdings that are closer to actual ratios. Both the predicted and actual cash holdings for constrained firms increase significantly more over the sample period (e.g. change in actual cash holdings for constrained firms is more than four times that of unconstrained firms). The original BKS model identifies six cash determinants (industry volatility, net working capital, capital expenditure, size, research and development expenses and leverage) that contribute collectively to the increase in cash holdings over time; but half of these determinants become insignificant after considering debt capacity. Not only does the modified BKS model predicts cash holdings better, estimated contribution from the determinants in the modified model matches the actual change in cash better. Change in cash over time is largely explained by corresponding change in debt capacity alone, while change in cash in the original model is explained collectively by the six determinants. The results confirm that debt capacity is an important determinant of cash, helps predict cash holdings better, and has the ability to replace previous determinants and explain substantial variance in cash level.

On the reverse side for debt capacity models, contrary to previous studies, cash flow has little impact on debt capacity, but cash and cash flow risk are able to explain the bulk of the variance in debt capacity. The interaction term of cash flow and cash holdings shows that even when consideration is made to the extent cash flow add to cash holdings in each period, cash flow exhibits minimal impact on debt capacity. The unused debt capacity models resolve the reverse-causality issue by providing evidence for the trade-off between cash and debt capacity as firms use less borrowing capacity when cash holdings are higher; while less use of debt capacity cannot cause firms to have greater cash on hand. The reverse causality problem is more prominent for constrained firms as the use of debt capacity is more likely to add positively to cash holdings because constrained firms have less ability to preserve capacity without restrictions.

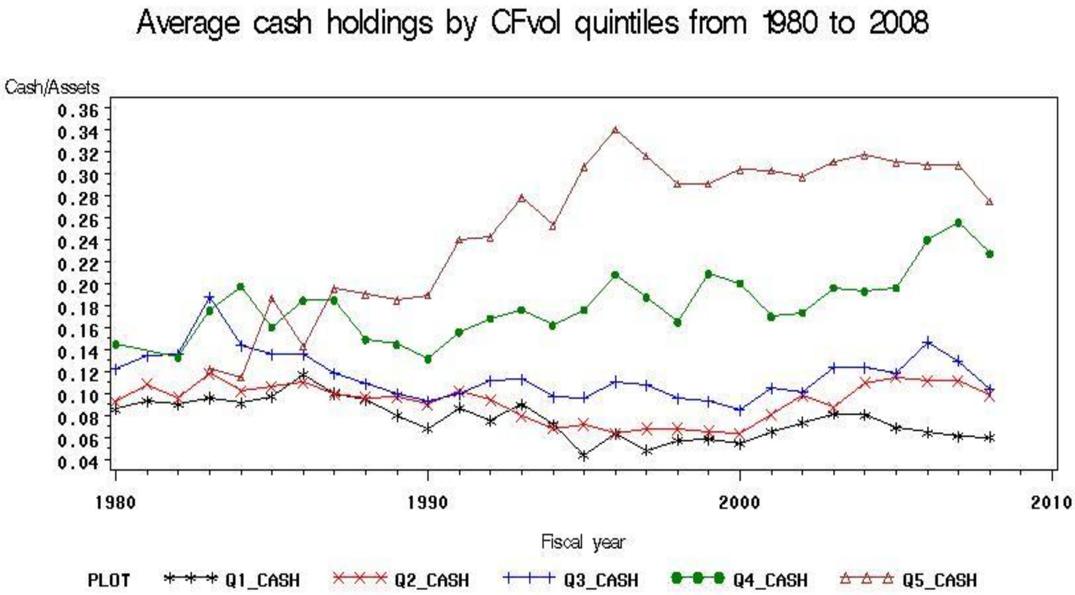
The relationship between cash and debt capacity is proven robust even across different industry groups. Only debt capacity and leverage are consistent and significant in determining cash when firms are split according to industries. Manufacturing and software and biotechnology firms experience the largest substitution effect. Greater proportion of cash is used for acquisition activities for high technology firms. Lastly, industry cash flow volatility is an important cash determinant only for low debt capacity industries.

The hypothesis that debt capacity is the first-level variable that exhibits less periodic changes compared to the second-level variable, cash, which can be monitored and adjusted in each period is supported. While the original debt capacity models (Bates et al., 2009, Campello et al., 2011) suggest lines of credit are dependent on the level of cash flow and amount of cash savings firms have, the hypothesis is slightly different in terms of cause-and-effect here. Firms' cash policies are presumed to be first dependent on the levels of debt capacities firms have, and firms adjust their cash savings accordingly in each period. This is because cash policies are generally more flexible and subject to less restriction, while debt capacity generally depends on many factors such as the nature of assets, nature of business and bank relationships. While both debt capacity and cash add to total financial flexibility, cash holdings can be managed more easily and is in practice varied more often compared to debt capacity.

In the investment regressions, cash and debt capacity are found to explain most of the changes in investment, leaving other variables with trivial impact. Results are robust to the consideration of fixed firm and time effects. Results support the credit multiplier effect of Almeida and Campello (2007) and debt capacity is found to have greater impact on investment compared to cash. Furthermore, debt capacity is found to impact positively investment even during recession, but cash does not. Therefore, debt capacity increases firm value by increase firms' ability to invest during recession, while cash takes a more precautionary purpose for operational requirement rather than investment need by cushioning the drop in cash flows during recession.

APPENDIX A

Appendix A-I Average cash holdings by industry cash flow volatility quintiles sorted by sample period 1980 to 2008



[Q1_CASH and Q5_CASH are the average cash holdings at the lowest (Q1) and highest (Q5) CFvol quintile respectively]

The figure summarises the average cash to total assets ratio for firms sorted by industry cash flow volatility quintiles over the entire sample (i.e. non-truncated criteria), with quintile 1 having the lowest volatility and quintile 5 having the highest volatility. Average cash holdings are computed for every volatility quintile over the entire sample. Industry cash flow volatility is measured as the average of standard deviation of cash flow of firms for the past 3 to 10 years in each industry sorted by two digit SIC code. Cash holdings is the ratio of cash holdings and marketable securities to total assets. Cash ratio is censored at [0,1] where ratio more than one is made equal to one. Industry cash flow volatility is winsorized at the bottom 1% level. All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded.

Appendix A-II Average cash and debt variables compared to Bates et al. (2009) from 1951 to 2008

This table compares the CRSP/Compustat sample used in this thesis with Bates et al. (2009) Compustat sample. The number of observations and proportions are reported in a similar manner for ease of comparison. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. All statistics are computed conditional upon cash and debt ratios being nonmissing. Cash, debt and debt capacity ratios are censored at [0,1] where ratio more than one is made equal to one. Cash sflow are winsorized at the bottom 1%.

	Bates et al. (2009) Compustat sample			CRSP/Compustat sample			CRSP/Compustat sample with utilities (SIC 4900-4999) firms		
Year	N	Mean cash holdings	Mean debt	N	Mean cash holdings	Mean debt	N	Mean cash holdings	Mean debt
1951	-	-	-	34	0.162	0.1664	34	0.162	0.166
1952	-	-	-	378	0.184	0.1518	378	0.184	0.200
1953	-	-	-	382	0.183	0.1502	382	0.183	0.200
1954	-	-	-	388	0.182	0.1417	388	0.182	0.192
1955	-	-	-	392	0.175	0.1382	392	0.175	0.188
1956	-	-	-	397	0.148	0.1523	397	0.148	0.199
1957	-	-	-	402	0.138	0.164	402	0.138	0.210
1958	-	-	-	403	0.138	0.1651	403	0.138	0.214
1959	-	-	-	409	0.140	0.1607	409	0.140	0.209
1960	-	-	-	471	0.131	0.1638	471	0.131	0.206
1961	-	-	-	493	0.129	0.1625	493	0.129	0.206
1962	-	-	-	703	0.125	0.1622	708	0.125	0.198
1963	-	-	-	861	0.124	0.1712	866	0.124	0.202
1964	-	-	-	972	0.120	0.1801	979	0.120	0.208
1965	-	-	-	1106	0.110	0.1983	1116	0.110	0.223
1966	-	-	-	1331	0.095	0.2222	1342	0.095	0.243
1967	-	-	-	1432	0.094	0.2349	1443	0.093	0.255
1968	-	-	-	1560	0.095	0.2439	1574	0.094	0.263
1969	-	-	-	1682	0.082	0.2571	1696	0.081	0.276
1970	-	-	-	1760	0.079	0.2768	1774	0.078	0.293
1971	-	-	-	1860	0.086	0.269	1876	0.085	0.286
1972	-	-	-	2423	0.090	0.2566	2444	0.089	0.271
1973	-	-	-	3064	0.084	0.2634	3248	0.080	0.276
1974	-	-	-	3478	0.077	0.2794	3680	0.074	0.291
1975	-	-	-	3443	0.092	0.2661	3648	0.088	0.277
1976	-	-	-	3410	0.096	0.2561	3618	0.092	0.267
1977	-	-	-	3343	0.091	0.2625	3562	0.087	0.272
1978	-	-	-	3269	0.088	0.2668	3489	0.084	0.276
1979	-	-	-	3313	0.086	0.2741	3537	0.082	0.282
1980	3519	0.105	0.269	3394	0.103	0.2645	3620	0.098	0.272
1981	3748	0.121	0.253	3599	0.118	0.2519	3828	0.112	0.260
1982	3752	0.121	0.261	3661	0.119	0.2594	3896	0.114	0.267
1983	4120	0.159	0.246	3945	0.153	0.2408	4181	0.146	0.248
1984	4172	0.14	0.254	4018	0.136	0.2517	4257	0.130	0.257
1985	4127	0.142	0.27	3985	0.139	0.2651	4224	0.133	0.271
1986	4261	0.157	0.273	4092	0.155	0.269	4334	0.149	0.274
1987	4407	0.156	0.273	4193	0.153	0.271	4440	0.148	0.276
1988	4237	0.141	0.28	4065	0.140	0.275	4308	0.135	0.280
1989	4095	0.138	0.286	3933	0.136	0.281	4184	0.130	0.286

Appendix A-II Average cash and debt variables compared to Bates et al. (2009) from 1951 to 2008 (continued)

1990	4042	0.134	0.282	3885	0.132	0.276	4134	0.127	0.281
1991	4137	0.155	0.259	3962	0.154	0.251	4220	0.147	0.259
1992	4307	0.163	0.245	4107	0.161	0.232	4366	0.154	0.240
1993	4713	0.171	0.225	4474	0.169	0.220	4736	0.163	0.227
1994	4985	0.155	0.23	4757	0.153	0.224	5011	0.147	0.230
1995	5165	0.171	0.23	4985	0.167	0.225	5230	0.161	0.230
1996	5568	0.193	0.222	5344	0.189	0.217	5587	0.183	0.223
1997	5605	0.191	0.236	5425	0.190	0.228	5654	0.184	0.233
1998	5263	0.178	0.289	5102	0.176	0.247	5311	0.170	0.252
1999	4971	0.194	0.247	4898	0.195	0.241	5084	0.189	0.246
2000	4947	0.208	0.242	4698	0.205	0.227	4854	0.200	0.232
2001	4540	0.214	0.268	4258	0.217	0.227	4402	0.211	0.233
2002	4233	0.214	0.258	3925	0.218	0.216	4060	0.212	0.222
2003	3992	0.227	0.235	3652	0.231	0.201	3780	0.225	0.207
2004	3693	0.24	0.225	3583	0.239	0.189	3722	0.232	0.196
2005	3549	0.237	0.219	3493	0.238	0.187	3630	0.231	0.193
2006	3297	0.232	0.221	3404	0.233	0.193	3538	0.225	0.199
2007	-	-	-	3256	0.230	0.203	3382	0.223	0.208
2008	-	-	-	2568	0.210	0.232	2689	0.202	0.237
Avg	4350	0.172	0.252	2790	0.153	0.239	2921	0.148	0.248

Appendix A-III Summary statistics of cash flow and debt capacities ratios from 1951 to 2008

All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Cash flow computed using earnings method (CFe) is the ratio of the sum of earnings less interest, tax and common dividend to total assets computed according to Bates et al. (2009). Net cash flow computed based on cash flow method (CFcf) is the ratio of net cash flow to total assets, computed according to Frank and Goyal (2009). Debt capacity is the ratio of the ratio of (0.715*Receivables + 0.547*Inventory + 0.535*PPE) to total assets; and unused debt capacity is debt capacity less debt only computed when firms report a positive debt capacity. Cash flow (CFe and CFcf) are winsorized at the bottom 1%. Debt capacity ratio is censored at [0,1] where ratio more than one is made equal to one.

	CFe : Earnings method (Bates et al., 2009)			CFcf: Cash flow method (Frank and Goyal, 2009)			DC			UDC		
Year	Mean	Median	Std	Mean	Median	Std	Mean	Median	Std	Mean	Median	Std
1951	0.035	0.048	0.051	.	.	.	0.456	0.463	0.068	0.289	0.314	0.091
1952	0.056	0.053	0.036	.	.	.	0.438	0.449	0.078	0.286	0.292	0.122
1953	0.061	0.058	0.038	.	.	.	0.437	0.448	0.076	0.286	0.299	0.118
1954	0.062	0.060	0.044	.	.	.	0.436	0.446	0.076	0.294	0.305	0.115
1955	0.073	0.070	0.042	.	.	.	0.441	0.451	0.078	0.303	0.319	0.118
1956	0.071	0.067	0.040	.	.	.	0.454	0.466	0.075	0.301	0.323	0.121
1957	0.067	0.063	0.035	.	.	.	0.456	0.470	0.075	0.292	0.305	0.124
1958	0.059	0.056	0.034	.	.	.	0.457	0.471	0.073	0.291	0.302	0.122
1959	0.067	0.064	0.034	.	.	.	0.455	0.470	0.076	0.294	0.306	0.122
1960	0.055	0.055	0.040	.	.	.	0.456	0.475	0.080	0.293	0.310	0.136
1961	0.054	0.053	0.035	.	.	.	0.457	0.473	0.080	0.295	0.312	0.135
1962	0.064	0.063	0.039	.	.	.	0.457	0.476	0.085	0.295	0.315	0.141
1963	0.063	0.062	0.041	.	.	.	0.459	0.477	0.086	0.288	0.308	0.149
1964	0.069	0.068	0.045	.	.	.	0.462	0.477	0.086	0.282	0.303	0.158
1965	0.074	0.073	0.044	.	.	.	0.467	0.485	0.086	0.269	0.289	0.166
1966	0.076	0.074	0.048	.	.	.	0.474	0.493	0.084	0.252	0.277	0.179
1967	0.068	0.068	0.053	.	.	.	0.472	0.489	0.082	0.237	0.265	0.178
1968	0.066	0.064	0.046	.	.	.	0.469	0.488	0.082	0.225	0.249	0.177
1969	0.062	0.062	0.046	.	.	.	0.472	0.491	0.083	0.215	0.243	0.185
1970	0.052	0.053	0.050	.	.	.	0.470	0.490	0.082	0.193	0.212	0.188
1971	0.056	0.058	0.054	0.083	0.093	0.095	0.465	0.483	0.082	0.196	0.217	0.188
1972	0.069	0.067	0.050	0.099	0.103	0.085	0.467	0.487	0.086	0.210	0.233	0.188
1973	0.073	0.071	0.053	0.111	0.108	0.091	0.473	0.493	0.087	0.210	0.231	0.186
1974	0.063	0.066	0.072	0.102	0.104	0.114	0.480	0.500	0.084	0.204	0.225	0.192
1975	0.065	0.067	0.070	0.114	0.105	0.205	0.471	0.489	0.081	0.209	0.237	0.194
1976	0.070	0.075	0.070	0.117	0.113	0.170	0.470	0.488	0.083	0.218	0.247	0.190

Appendix A-III Summary statistics of cash flow and debt capacities ratios from 1951 to 2008 (continued)

	CFe : Earnings method (Bates et al., 2009)			CFcf: Cash flow method (Frank and Goyal, 2009)			DC			UDC		
Year	Mean	Median	Std	Mean	Median	Std	Mean	Median	Std	Mean	Median	Std
1977	0.068	0.074	0.074	0.120	0.114	0.261	0.476	0.494	0.084	0.217	0.244	0.192
1978	0.072	0.076	0.067	0.123	0.118	0.116	0.481	0.499	0.084	0.218	0.242	0.183
1979	0.064	0.072	0.087	0.117	0.117	0.117	0.482	0.502	0.087	0.213	0.235	0.187
1980	0.047	0.065	0.115	0.109	0.112	0.175	0.471	0.496	0.098	0.212	0.240	0.191
1981	0.032	0.059	0.134	0.095	0.110	0.154	0.459	0.488	0.106	0.212	0.237	0.189
1982	0.012	0.049	0.157	0.098	0.105	0.776	0.452	0.478	0.104	0.197	0.227	0.199
1983	0.016	0.052	0.146	0.092	0.104	0.407	0.430	0.462	0.119	0.194	0.230	0.203
1984	0.005	0.057	0.188	0.070	0.106	0.211	0.438	0.469	0.116	0.191	0.226	0.208
1985	-0.015	0.050	0.239	0.058	0.099	0.264	0.430	0.460	0.119	0.169	0.211	0.225
1986	-0.016	0.047	0.229	0.076	0.098	0.272	0.414	0.446	0.126	0.151	0.188	0.230
1987	-0.007	0.050	0.216	0.067	0.096	0.292	0.412	0.443	0.128	0.148	0.190	0.232
1988	-0.005	0.055	0.230	0.033	0.081	0.225	0.416	0.445	0.126	0.143	0.187	0.239
1989	-0.006	0.052	0.232	0.030	0.078	0.220	0.417	0.448	0.125	0.138	0.175	0.237
1990	0.002	0.054	0.231	0.038	0.079	0.229	0.416	0.447	0.125	0.141	0.179	0.239
1991	0.009	0.054	0.193	0.041	0.078	0.184	0.401	0.432	0.133	0.150	0.185	0.229
1992	0.014	0.064	0.203	0.043	0.085	0.192	0.391	0.423	0.135	0.160	0.192	0.221
1993	0.008	0.065	0.228	0.032	0.084	0.218	0.382	0.411	0.135	0.164	0.189	0.214
1994	0.007	0.071	0.240	0.033	0.090	0.230	0.387	0.413	0.131	0.164	0.196	0.218
1995	0.012	0.069	0.220	0.039	0.085	0.205	0.377	0.406	0.137	0.154	0.185	0.220
1996	-0.003	0.067	0.246	0.027	0.084	0.236	0.363	0.391	0.141	0.148	0.176	0.220
1997	-0.021	0.065	0.282	0.010	0.081	0.258	0.358	0.382	0.140	0.131	0.168	0.236
1998	-0.027	0.064	0.307	0.007	0.077	0.270	0.355	0.378	0.137	0.109	0.149	0.246
1999	-0.027	0.055	0.277	0.007	0.070	0.241	0.333	0.357	0.147	0.094	0.124	0.239
2000	-0.060	0.049	0.330	-0.016	0.064	0.285	0.320	0.342	0.152	0.095	0.121	0.235
2001	-0.073	0.046	0.363	-0.036	0.060	0.326	0.310	0.325	0.148	0.083	0.117	0.243
2002	-0.041	0.052	0.302	-0.004	0.068	0.270	0.309	0.323	0.146	0.095	0.125	0.237
2003	0.000	0.059	0.231	0.035	0.077	0.200	0.299	0.307	0.146	0.099	0.126	0.231
2004	0.008	0.068	0.233	0.040	0.085	0.215	0.293	0.299	0.147	0.105	0.131	0.233
2005	0.001	0.065	0.244	0.032	0.084	0.224	0.289	0.292	0.145	0.103	0.134	0.235
2006	-0.014	0.063	0.277	0.035	0.088	0.228	0.289	0.292	0.146	0.096	0.126	0.239
2007	-0.018	0.059	0.267	0.033	0.086	0.223	0.285	0.286	0.146	0.083	0.121	0.245
2008	-0.029	0.064	0.330	0.021	0.087	0.288	0.293	0.295	0.143	0.061	0.106	0.259
Average	0.012	0.062	0.216	0.051	0.092	0.263	0.399	0.438	0.138	0.162	0.196	0.223

Appendix A-IV Regressions to match to Opler et al. (1999) for period 1971 to 1994

This table compares the cash model regression results reported in this thesis with Compustat sample from 1971 to 1994. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variable in all regressions is the natural logarithm of ratio cash to net assets, where net asset is total assets less cash holdings. All independent variables are denominated with net assets (instead of total assets), with the exception for industry cash flow volatility (INDSTDCF), research and development expenses to sales (RD_SALE) and common dividend dummy (DIVDUM). Variable definitions are reported in Section 4. Fama-MacBeth regression is performed cross-sectionally for each financial year using Newey and West (1987) standard errors to control for autocorrelation. Fixed effects regression control for both firm and year fixed effects. Following Opler et al. (1999), R-squared for fixed effects model is computed without the fixed effects and intercept. OLS regression is estimated with heteroskedasticity adjusted standard errors. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

	Opler et al. (1999, pp. 25)			Current sample		
Model	FM	FE	OLS	FM	FE	OLS
Dependent variable	LnCash_netasset	LnCash_ netasset	LnCash_ netasset	LnCash_ netasset	LnCash_ netasset	LnCash_ netasset
Intercept	-2.017			-2.267***		
.	(-19.53)			(-29.39)		
INDSTDCF	0.4533	1.1636	-0.8903	1.272	0.147	2.764***
.	(1.98)	(14.92)	(-12.51)	(1.12)	(0.80)	(16.93)
Q_NETASSET	0.1515	0.1422	0.0998	0.152***	0.009***	0.023***
.	(16.47)	(27.60)	(-18.1)	(2.96)	(18.84)	(42.60)
LNNETASSET	-0.0439	-0.0402	-0.0826	-0.142***	-0.508***	-0.191***
.	(-6.79)	(-13.37)	(-10.14)	(-9.40)	(-72.36)	(-66.10)
CF2_NETASSET	0.6601	0.1618	0.0742	0.782***	0.063***	0.164***
.	(3.71)	(4.44)	(-1.93)	(2.84)	(10.61)	(24.26)
NWC_NETASSET	-0.9713	-0.8136	-0.556	-0.572***	-0.132***	-0.479***
.	(-11.71)	(-13.24)	(-16.95)	(-5.39)	(-9.66)	(-34.04)
CAPEX_NETASSET	0.0703	0.4850	0.6524	0.450	1.233***	1.381***
.	(0.32)	(7.38)	(-10.52)	(0.82)	(24.91)	(27.28)
BKDEBT_NETASSET	-2.8145	-3.0234	-2.3395	-1.274***	-0.269***	-0.911***
.	(-29.16)	(-101.61)	(-65.80)	(-10.10)	(-16.87)	(-53.76)
RD_SALE	1.2783	1.1636	0.7631	-0.088	0.147***	0.538***
.	10.03	(14.92)	(-9.04)	(-0.18)	(8.22)	(42.97)
DIVDUM	-0.1001	-0.1275	0.0403	0.156***	0.251***	0.252***
.	(-2.67)	(-11.35)	(-3.1)	(4.73)	(17.63)	(20.80)
R-Sq	0.223	0.219	0.101	0.231	0.175	0.179
Adj R-Sq				0.229		
Obs	86955	86955	86955	85509	85509	85509

Appendix A-V Regressions of base cash model with debt capacity (b) for period 1980 to 2006

This table reports the base cash model regression results after inclusion of debt capacity as additional independent variable from 1980 to 2006. Sample and variable definitions are reported in Chapter A2.3. Following Bates et al. (2009), firms with IPO in the last 5 years are excluded in the fixed effects regression. The dependent variable is cash holdings ratio computed as cash to total asset except for the following models: Model 2 and 5 use the natural logarithm of ratio cash to net asset (LNCASH_NETASSET), where net asset is computed as total asset less cash holdings; and Model 3 and 6 use the period-to-period change in cash holdings (DCASH) computed as $Cash_t – Cash_{t-1}$. Model 1 to 6 report estimates from OLS regressions with heteroskedasticity adjusted standard errors. Model 4 to 6 includes dummy variables, DUMMY1990 and DUMMY2000, for observations from 1990 to 2006 and 2000 to 2006 respectively. Model 7 and 8 are based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. The final model controls for firm and year fixed effects. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	MODEL1 OLS	MODEL2 OLS	MODEL3 OLS	MODEL4 OLS	MODEL5 OLS	MODEL6 OLS	MODEL7 FM1980	MODEL8 FM1990	MODEL9 FE
Dependent	Cash	LnCash	DCash	Cash	LnCash	DCash	Cash	Cash	Cash
Intercept	0.597***	0.540***	0.263***	0.608***	0.552***	0.272***	0.617***	0.562***	
.	(298.12)	(116.31)	(140.64)	(300.60)	(117.14)	(142.98)	(59.16)	(106.98)	
LAGDCASH			-0.052***			-0.050***			
.			(-18.72)			(-18.24)			
LAGCASH			-0.415***			-0.418***			
.			(-200.48)			(-202.18)			
DC	-0.891***	-1.030***	-0.406***	-0.905***	-1.053***	-0.415***	-0.944***	-0.863***	-0.824***
.	(-248.61)	(-123.86)	(-130.27)	(-252.03)	(-125.97)	(-131.86)	(-45.79)	(-53.92)	(-162.00)
INDSTDCF	0.072***	0.047***	0.006	0.139***	0.152***	0.034***	-0.006	0.204***	-0.008
.	(10.27)	(2.92)	(1.10)	(19.26)	(9.04)	(6.26)	(-0.13)	(11.74)	(-0.94)
Q	0.009***	0.006***	0.004***	0.010***	0.006***	0.004***	0.003***	0.011***	0.007***
.	(43.90)	(13.00)	(21.98)	(44.64)	(12.67)	(23.26)	(3.44)	(6.09)	(23.43)
LNAT	-0.014***	-0.014***	-0.005***	-0.011***	-0.010***	-0.003***	-0.009***	-0.013***	-0.015***
.	(-61.27)	(-27.93)	(-28.12)	(-44.63)	(-17.98)	(-19.54)	(-27.12)	(-12.51)	(-23.69)
CFe	-0.003	-0.003	0.052***	-0.005**	-0.008*	0.052***	0.053***	0.010	0.031***
.	(-1.27)	(-0.73)	(34.13)	(-2.55)	(-1.81)	(33.56)	(4.56)	(0.75)	(11.71)
NWC	0.009***	0.012**	-0.009***	0.005**	0.007	-0.011***	0.021***	-0.016	-0.034***
.	(4.31)	(2.52)	(-6.39)	(2.47)	(1.50)	(-7.52)	(4.84)	(-1.42)	(-12.80)
CAPEX	0.046***	-0.097***	-0.141***	0.023***	-0.128***	-0.150***	-0.019***	0.055***	-0.050***
.	(8.40)	(-7.73)	(-32.60)	(4.29)	(-10.10)	(-34.72)	(-4.47)	(3.62)	(-6.82)
BKDEBT	-0.216***	-0.083***	-0.072***	-0.223***	-0.093***	-0.076***	-0.174***	-0.229***	-0.135***
.	(-104.75)	(-17.42)	(-44.81)	(-108.26)	(-19.39)	(-47.16)	(-16.71)	(-39.83)	(-51.22)
RD_SALE	0.018***	0.075***	0.008***	0.018***	0.075***	0.008***	0.129***	0.032***	0.004***
.	(58.91)	(107.96)	(33.57)	(59.24)	(108.26)	(33.80)	(5.34)	(3.21)	(8.50)
DIVCUMMY	-0.005***	0.014***	0.004***	-0.013***	0.002	-0.000	-0.008***	-0.020***	0.009***
.	(-4.74)	(6.12)	(6.09)	(-13.35)	(1.03)	(-0.03)	(-6.82)	(-11.30)	(6.85)
ACQUI	-0.464***	-0.569***	-0.457***	-0.464***	-0.574***	-0.455***	-0.332***	-0.495***	-0.231***
.	(-66.40)	(-35.06)	(-85.33)	(-66.66)	(-35.46)	(-85.18)	(-35.22)	(-18.51)	(-36.25)
DUMMY1990				-0.027***	-0.024***	-0.015***			
.				(-28.27)	(-10.90)	(-21.83)			
DUMMY2000				-0.016***	-0.041***	-0.003***			
.				(-15.35)	(-16.84)	(-3.89)			
R-Sq	0.637	0.353	0.380	0.641	0.356	0.384	0.644	0.642	0.837

Appendix A-VI Pearson and Spearman correlation coefficients of independent variables

All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Variable definitions are provided in Chapter A2.3. All correlation coefficients exhibit statistical significance at 1% (two-tail) test level.

Pearson Correlation Coefficients

	DC	INDSTDCF	Q	LNAT	CFe	NWC	CAPEX	BKDEBT	RD_SALE	DIVDUM	ACQUI
DC	1										
INDSTDCF	-0.363	1									
Q	-0.288	0.190	1.000								
LNAT	-0.017	-0.047	-0.187	1							
CF2	0.260	-0.200	-0.294	0.341	1						
NWC	0.366	-0.151	-0.128	-0.053	0.283	1					
CAPEX	0.241	-0.107	0.035	-0.015	0.067	-0.144	1				
BKDEBT	0.232	-0.132	-0.155	0.119	-0.059	-0.263	0.086	1			
RD_SALE	-0.255	0.228	0.180	-0.084	-0.358	-0.110	-0.046	-0.062	1		
DIVDUM	0.212	-0.206	-0.144	0.422	0.204	0.123	0.011	-0.039	-0.093	1	
ACQUI	-0.113	0.017	-0.032	0.126	0.067	-0.017	-0.076	0.101	-0.036	0.002	1

Spearman Correlation Coefficients

	DC	INDSTDCF	Q	LNAT	CFe	NWC	CAPEX	BKDEBT	RD_SALE	DIVDUM	ACQUI
DC	1										
INDSTDCF	-0.364	1									
Q	-0.319	0.268	1.000								
LNAT	-0.042	-0.102	-0.097	1							
CF2	0.201	-0.132	0.090	0.311	1						
NWC	0.426	-0.159	-0.157	-0.053	0.240	1					
CAPEX	0.281	-0.181	0.065	0.098	0.276	-0.059	1				
BKDEBT	0.310	-0.224	-0.244	0.166	-0.093	-0.156	0.076	1			
RD_SALE	-0.313	0.421	0.311	-0.118	-0.184	0.030	-0.131	-0.307	1		
DIVDUM	0.192	-0.264	-0.116	0.413	0.212	0.144	0.129	0.019	-0.152	1	
ACQUI	-0.128	0.023	0.016	0.289	0.125	-0.002	-0.042	0.104	-0.063	0.094	1

Note: All correlations coefficients exhibit statistical significance at 1% (two-tail) test level

Appendix A-VII Regressions of modified cash model (with debt capacity and lagged INDSTDCF less NWC and CAPEX)

This table reports the modified cash model regression results from 1980 to 2008 in a similar manner as the previous table for ease of comparison. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Variable definitions are reported in Chapter A2.3. Industry cash flow volatility variable is lagged one period in the model. Following Bates et al. (2009), firms with IPO in the last 5 years are excluded in the fixed effects regression. The dependent variable is cash holdings ratio computed as cash to total asset except for the following models: Model 2 and 5 use the natural logarithm of ratio cash to net asset (LNCASH_NETASSET), where net asset is computed as total asset less cash holdings; and Model 3 and 6 use the period-to-period change in cash holdings (DCash) computed as $Cash_t - Cash_{t-1}$. Model 1 to 6 report estimates from OLS regressions with heteroskedasticity adjusted standard errors. Model 4 to 6 includes dummy variables, DUMMY1990 and DUMMY2000, for observations from 1990 to 2006 and 2000 to 2006 respectively. Model 7 and 8 are based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. The final model controls for firm and year fixed effects. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6	MODEL7	MODEL8	MODEL9
Model	OLS	OLS	OLS	OLS	OLS	OLS	FM1980	FM1990	FE
Dependent	Cash	LnCash	DCash	Cash	LnCash	DCash	Cash	Cash	Cash
Intercept	0.560***	0.447***	0.260***	0.573***	0.459***	0.268***	0.545***	0.529***	
.	(272.96)	(100.16)	(142.44)	(276.08)	(101.35)	(144.18)	(56.34)	(74.13)	
LAGDCASH			-0.050***			-0.049***			
.			(-18.39)			(-17.94)			
LAGCASH			-0.414***			-0.418***			
.			(-207.41)			(-208.89)			
DC	-0.821***	-0.864***	-0.425***	-0.839***	-0.888***	-0.435***	-0.826***	-0.808***	-0.849***
.	(-251.71)	(-121.81)	(-154.55)	(-253.96)	(-123.21)	(-155.15)	(-61.30)	(-59.61)	(-178.07)
LAGINDSTDCF	0.112***	0.176***	0.018***	0.181***	0.262***	0.049***	0.138**	0.228***	-0.013
.	(15.82)	(11.45)	(3.51)	(24.72)	(16.38)	(9.01)	(2.76)	(9.65)	(-1.51)
Q	0.010***	0.002***	0.003***	0.010***	0.002***	0.003***	0.009***	0.012***	0.007***
.	(40.82)	(4.87)	(19.18)	(41.60)	(4.69)	(19.98)	(3.99)	(5.60)	(23.46)
LNAT	-0.013***	-0.013***	-0.005***	-0.010***	-0.009***	-0.004***	-0.010***	-0.012***	-0.016***
.	(-57.84)	(-26.34)	(-31.12)	(-42.37)	(-17.83)	(-22.64)	(-10.74)	(-10.19)	(-24.74)
CFe	-0.010***	-0.028***	0.045***	-0.013***	-0.032***	0.044***	0.017	-0.004	0.024***
.	(-5.12)	(-6.49)	(31.25)	(-6.69)	(-7.57)	(30.14)	(1.09)	(-0.22)	(9.36)
BKDEBT	-0.212***	-0.081***	-0.071***	-0.218***	-0.088***	-0.074***	-0.202***	-0.218***	-0.125***
.	(-110.56)	(-19.38)	(-47.60)	(-113.68)	(-20.96)	(-49.62)	(-21.27)	(-54.71)	(-49.37)
RD_SALE	0.016***	0.066***	0.007***	0.016***	0.065***	0.007***	0.060***	0.031***	0.004***
.	(58.11)	(106.85)	(32.45)	(57.89)	(106.80)	(32.45)	(3.64)	(3.19)	(8.07)
DIVDUM	-0.005***	0.014***	0.005***	-0.013***	0.005**	0.001	-0.016***	-0.021***	0.008***
.	(-5.09)	(6.73)	(6.88)	(-13.38)	(2.25)	(1.50)	(-4.72)	(-11.02)	(6.44)
ACQUI	-0.441***	-0.477***	-0.450***	-0.439***	-0.478***	-0.449***	-0.412***	-0.475***	-0.231***
.	(-62.94)	(-31.30)	(-87.19)	(-62.90)	(-31.39)	(-87.01)	(-11.01)	(-15.10)	(-36.22)
DUMMY1990				-0.028***	-0.023***	-0.014***			
.				(-29.30)	(-10.94)	(-19.18)			
DUMMY2000				-0.011***	-0.025***	-0.003***			
.				(-10.53)	(-11.55)	(-4.15)			
R-Sq	0.610	0.327	0.366	0.615	0.330	0.368	0.609	0.617	0.837
Obs	106513	106524	106501	106513	106524	106501	106513	72431	66083

Appendix A-VIII Regressions of orthogonalized cash model with debt capacity residuals (*f*) (pooled OLS)

This table reports the orthogonalized cash model regression results from 1980 to 2008 in a similar manner as the previous table for ease of comparison. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Variable definitions are reported in Chapter A2.3. Refer to Table A7 for dependent variable specifications. The first step of the orthogonalized estimation regresses debt capacity against industry cash flow volatility over the entire sample period (1980-2008) to obtain debt capacity residuals, R_DC, for each firm-year observation. R_DC are then put into the regression models with other cash determinants in the second step estimation. Results from the second step estimation are reported as follow. Model 1 to 6 report estimates from OLS regressions with heteroskedasticity adjusted standard errors. Model 4 to 6 includes dummy variables, DUMMY1990 and DUMMY2000, for observations from 1990 to 2006 and 2000 to 2006 respectively. Model 7 and 8 are based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. The final model controls for firm and year fixed effects. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6	MODEL7	MODEL8	MODEL9
Model	OLS	OLS	OLS	OLS	OLS	OLS	FM1980	FM1990	FE
Dependent	Cash	LnCash	DCash	Cash	LnCash	DCash	Cash	Cash	Cash
Intercept	0.194***	0.063***	0.065***	0.197***	0.061***	0.068***	0.174***	0.166***	
.	(150.30)	(21.09)	(61.27)	(149.32)	(19.72)	(63.08)	(36.08)	(52.64)	
LAGDCASH			-0.050***			-0.049***			
.			(-18.30)			(-17.83)			
LAGCASH			-0.414***			-0.418***			
.			(-207.40)			(-208.85)			
R_DC	-0.873***	-1.031***	-0.425***	-0.893***	-1.064***	-0.435***	-0.879***	-0.854***	-0.849***
.	(-276.86)	(-140.10)	(-154.83)	(-280.31)	(-142.51)	(-155.36)	(-47.49)	(-52.36)	(-178.07)
INDSTDCF	0.830***	0.979***	0.382***	0.915***	1.112***	0.415***	0.885***	0.943***	0.631***
	(124.54)	(62.93)	(74.20)	(130.14)	(67.53)	(75.99)	(25.40)	(41.51)	(65.77)
Q	0.010***	0.006***	0.003***	0.010***	0.006***	0.003***	0.009***	0.012***	0.007***
.	(46.80)	(12.66)	(19.12)	(46.86)	(11.78)	(19.97)	(4.27)	(6.31)	(23.46)
LNAT	-0.014***	-0.016***	-0.005***	-0.011***	-0.011***	-0.004***	-0.011***	-0.013***	-0.016***
.	(-65.02)	(-30.69)	(-31.16)	(-46.44)	(-19.47)	(-22.69)	(-12.37)	(-13.47)	(-24.75)
CFe	-0.005**	-0.012***	0.046***	-0.009***	-0.019***	0.044***	0.020	0.000	0.024***
.	(-2.55)	(-2.60)	(31.33)	(-4.70)	(-4.24)	(30.29)	(1.29)	(0.00)	(9.35)
BKDEBT	-0.219***	-0.093***	-0.071***	-0.225***	-0.102***	-0.074***	-0.210***	-0.225***	-0.125***
.	(-114.93)	(-20.89)	(-47.60)	(-118.53)	(-22.91)	(-49.66)	(-24.59)	(-58.90)	(-49.38)
RD_SALE	0.016***	0.067***	0.007***	0.016***	0.067***	0.007***	0.065***	0.030***	0.004***
.	(59.61)	(108.47)	(32.34)	(59.66)	(108.63)	(32.42)	(3.20)	(3.08)	(8.07)
DIVDUM	-0.005***	0.015***	0.005***	-0.014***	0.004	0.001	-0.017***	-0.022***	0.008***
.	(-5.37)	(6.85)	(6.99)	(-14.22)	(1.63)	(1.51)	(-5.83)	(-11.18)	(6.44)
ACQUI	-0.468***	-0.566***	-0.450***	-0.466***	-0.570***	-0.449***	-0.439***	-0.498***	-0.231***
.	(-68.90)	(-35.71)	(-87.19)	(-69.04)	(-36.01)	(-87.00)	(-12.75)	(-19.69)	(-36.21)
DUMMY1990				-0.027***	-0.022***	-0.013***			
.				(-28.51)	(-10.15)	(-18.92)			
DUMMY2000				-0.017***	-0.043***	-0.003***			
.				(-16.64)	(-18.36)	(-4.15)			
R-Sq	0.634	0.350	0.366	0.638	0.354	0.368	0.639	0.637	0.837
Obs	115681	115692	106501	115681	115692	106501	115681	78147	66083

Appendix A-IX Regressions of lagged orthogonalized cash model with debt capacity residuals (*f*) (pooled OLS)

This table reports the lagged orthogonalized cash model regression results from 1980 to 2008 in a similar manner as the previous table for ease of comparison. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Variable definitions are reported in Chapter A2.3. Refer to Table A7 for dependent variable specifications. The first step of the orthogonalized estimation regresses debt capacity against industry cash flow volatility over the entire sample period (1980-2008) to obtain debt capacity residuals, R_DC, for each firm-year observation. R_DC are then put into the regression models with other cash determinants in the second step estimation. All explanatory variables are lagged one period in the second step regression. Results from the second step estimation are reported as follow. Model 1 to 6 report estimates from OLS regressions with heteroskedasticity adjusted standard errors. Model 4 to 6 includes dummy variables, DUMMY1990 and DUMMY2000, for observations from 1990 to 2006 and 2000 to 2006 respectively. Model 7 and 8 are based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. The final model controls for firm and year fixed effects. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	MODEL1 OLS	MODEL2 OLS	MODEL3 OLS	MODEL4 OLS	MODEL5 OLS	MODEL6 OLS	MODEL7 FM1980	MODEL8 FM1990	MODEL9 FE
Dependent	Cash	LnCash	DCash	Cash	LnCash	DCash	Cash	Cash	Cash
Intercept	0.170***	0.037***	0.020***	0.174***	0.037***	0.023***	0.156***	0.151***	
.	(112.96)	(12.14)	(15.90)	(112.14)	(11.96)	(17.34)	(24.75)	(18.28)	
LAGDCASH			-0.096***			-0.097***			
.			(-29.68)			(-30.24)			
LAGCASH			-0.256***			-0.252***			
.			(-95.87)			(-93.76)			
LAGR_DC	-0.672***	-0.694***	-0.022***	-0.680***	-0.706***	-0.011***	-0.662***	-0.667***	-0.445***
.	(-181.78)	(-93.51)	(-6.00)	(-181.56)	(-93.75)	(-2.89)	(-46.06)	(-36.33)	(-72.43)
LAGINDSTDCF	0.808***	0.892***	0.201***	0.850***	0.946***	0.167***	0.793***	0.893***	0.354***
.	(101.98)	(56.10)	(31.59)	(101.11)	(56.03)	(24.54)	(12.48)	(31.70)	(29.16)
LAGQ	0.008***	0.002***	0.001***	0.008***	0.003***	0.001***	0.009***	0.012***	0.007***
.	(32.88)	(5.14)	(4.28)	(33.62)	(5.44)	(3.89)	(4.88)	(7.07)	(18.20)
LAGLNAT	-0.010***	-0.010***	0.001***	-0.009***	-0.008***	-0.000**	-0.009***	-0.010***	-0.019***
.	(-40.72)	(-19.88)	(3.10)	(-32.37)	(-14.91)	(-2.10)	(-9.72)	(-9.34)	(-22.60)
LAGCFe	-0.026***	-0.084***	-0.010***	-0.026***	-0.086***	-0.008***	0.017	-0.014	0.012***
.	(-10.71)	(-17.53)	(-5.26)	(-11.01)	(-17.86)	(-4.38)	(0.76)	(-0.70)	(3.27)
LAGBKDEBT	-0.202***	-0.077***	-0.037***	-0.205***	-0.080***	-0.034***	-0.188***	-0.204***	-0.085***
.	(-88.54)	(-16.74)	(-20.08)	(-89.58)	(-17.37)	(-18.62)	(-17.11)	(-23.32)	(-25.67)
LAGRD_SALE	0.018***	0.065***	0.005***	0.018***	0.065***	0.005***	0.071***	0.035***	0.002***
.	(54.30)	(98.13)	(21.14)	(54.17)	(98.07)	(20.96)	(2.89)	(2.94)	(2.62)
LAGDIVDUM	-0.011***	0.011***	-0.007***	-0.016***	0.006**	-0.004***	-0.018***	-0.025***	0.000
.	(-9.98)	(4.79)	(-7.84)	(-13.75)	(2.47)	(-5.03)	(-4.38)	(-9.67)	(0.16)
LAGACQUI	-0.404***	-0.403***	-0.092***	-0.402***	-0.402***	-0.089***	-0.368***	-0.426***	-0.159***
.	(-51.51)	(-25.60)	(-14.96)	(-51.22)	(-25.53)	(-14.58)	(-9.70)	(-13.90)	(-19.56)
DUMMY1990				-0.020***	-0.013***	-0.001			
.				(-18.01)	(-6.05)	(-1.14)			
DUMMY2000				-0.001	-0.013***	0.015***			
.				(-1.01)	(-5.52)	(17.26)			
R-Sq	0.513	0.289	0.166	0.515	0.289	0.168	0.497	0.535	0.760
Obs	103482	103515	103473	103482	103515	103473	103482	72469	58724

Appendix A-X Regressions of orthogonalized cash model with industry cash flow volatility residuals (*g*) (pooled OLS)

This table reports the orthogonalized cash model regression results from 1980 to 2008 in a similar manner as the previous table for ease of comparison. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Variable definitions are reported in Chapter A2.3. Refer to Table A7 for dependent variable specifications. The first step of the orthogonalized estimation regresses industry cash flow volatility against debt capacity over the entire sample period (1980-2008) to obtain volatility residuals, R_INDSTDCF, for each firm-year observation. R_ INDSTDCF are then put into the regression models with other cash determinants in the second step estimation. Model 1 to 6 report estimates from OLS regressions with heteroskedasticity adjusted standard errors. Model 4 to 6 includes dummy variables, DUMMY1990 and DUMMY2000, for observations from 1990 to 2006 and 2000 to 2006 respectively. Model 7 and 8 are based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. The final model controls for firm and year fixed effects. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	MODEL1 OLS	MODEL2 OLS	MODEL3 OLS	MODEL4 OLS	MODEL5 OLS	MODEL6 OLS	MODEL7 FM1980	MODEL8 FM1990	MODEL9 FE
Dependent	Cash	LnCash	DCash	Cash	LnCash	DCash	Cash	Cash	Cash
Intercept	0.608***	0.553***	0.263***	0.631***	0.582***	0.275***	0.599***	0.592***	
.	(350.51)	(136.47)	(153.91)	(344.85)	(135.68)	(152.78)	(97.24)	(126.20)	
LAGDCASH			-0.050***			-0.049***			
.			(-18.30)			(-17.83)			
LAGCASH			-0.414***			-0.418***			
.			(-207.40)			(-208.85)			
R_INDSTCF	0.091***	0.105***	0.022***	0.159***	0.211***	0.047***	0.140***	0.221***	-0.006
.	(13.43)	(6.71)	(4.47)	(22.80)	(12.97)	(9.06)	(3.10)	(8.46)	(-0.66)
DC	-0.887***	-1.048***	-0.428***	-0.918***	-1.097***	-0.442***	-0.901***	-0.888***	-0.848***
.	(-287.12)	(-145.26)	(-157.49)	(-287.67)	(-146.72)	(-156.35)	(-64.27)	(-60.22)	(-170.89)
Q	0.010***	0.006***	0.003***	0.010***	0.006***	0.003***	0.009***	0.012***	0.007***
.	(46.80)	(12.66)	(19.12)	(46.86)	(11.78)	(19.97)	(4.27)	(6.31)	(23.46)
LNAT	-0.014***	-0.016***	-0.005***	-0.011***	-0.011***	-0.004***	-0.011***	-0.013***	-0.016***
.	(-65.02)	(-30.69)	(-31.16)	(-46.44)	(-19.47)	(-22.69)	(-12.37)	(-13.47)	(-24.75)
CFe	-0.005**	-0.012***	0.046***	-0.009***	-0.019***	0.044***	0.020	0.000	0.024***
.	(-2.55)	(-2.60)	(31.33)	(-4.70)	(-4.24)	(30.29)	(1.29)	(0.00)	(9.35)
BKDEBT	-0.219***	-0.093***	-0.071***	-0.225***	-0.102***	-0.074***	-0.210***	-0.225***	-0.125***
.	(-114.93)	(-20.89)	(-47.60)	(-118.53)	(-22.91)	(-49.66)	(-24.59)	(-58.90)	(-49.38)
RD_SALE	0.016***	0.067***	0.007***	0.016***	0.067***	0.007***	0.065***	0.030***	0.004***
.	(59.61)	(108.47)	(32.34)	(59.66)	(108.63)	(32.42)	(3.20)	(3.08)	(8.07)
DIVDUM	-0.005***	0.015***	0.005***	-0.014***	0.004	0.001	-0.017***	-0.022***	0.008***
.	(-5.37)	(6.85)	(6.99)	(-14.22)	(1.63)	(1.51)	(-5.83)	(-11.18)	(6.44)
ACQUI	-0.468***	-0.566***	-0.450***	-0.466***	-0.570***	-0.449***	-0.439***	-0.498***	-0.231***
.	(-68.90)	(-35.71)	(-87.19)	(-69.04)	(-36.01)	(-87.00)	(-12.75)	(-19.69)	(-36.21)
DUMMY1990				-0.027***	-0.022***	-0.013***			
.				(-28.51)	(-10.15)	(-18.92)			
DUMMY2000				-0.017***	-0.043***	-0.003***			
.				(-16.64)	(-18.36)	(-4.15)			
R-Sq	0.634	0.350	0.366	0.638	0.354	0.368	0.639	0.637	0.837
Adj R-Sq	0.634	0.350	0.366	0.638	0.354	0.368	0.638	0.637	
Obs	115681	115692	106501	115681	115692	106501	115681	78147	66083

Appendix A-XI Regressions of lagged orthogonalized cash model with industry cash flow volatility residuals (*g*) (pooled OLS)

This table reports the lagged orthogonalized cash model regression results from 1980 to 2008 in a similar manner as the previous table for ease of comparison. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Variable definitions are reported in Chapter A2.3. Refer to Table A7 for dependent variable specifications. The first step of the orthogonalized estimation regresses industry cash flow volatility against debt capacity over the entire sample period (1980-2008) to obtain volatility residuals, R_INDSTDCF, for each firm-year observation. R_ INDSTDCF are then put into the regression models with other cash determinants in the second step estimation. All explanatory variables are lagged one period in the second step regression. Model 1 to 6 report estimates from OLS regressions with heteroskedasticity adjusted standard errors. Model 4 to 6 includes dummy variables, DUMMY1990 and DUMMY2000, for observations from 1990 to 2006 and 2000 to 2006 respectively. Model 7 and 8 are based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. The final model controls for firm and year fixed effects. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	MODEL1 OLS	MODEL2 OLS	MODEL3 OLS	MODEL4 OLS	MODEL5 OLS	MODEL6 OLS	MODEL7 FM1980	MODEL8 FM1990	MODEL9 FE
Dependent	Cash	LnCash	DCash	Cash	LnCash	DCash	Cash	Cash	Cash
Intercept	0.515***	0.403***	0.059***	0.529***	0.416***	0.052***	0.496***	0.509***	
.	(254.95)	(99.28)	(26.39)	(245.90)	(96.15)	(22.27)	(40.22)	(38.16)	
LAGDCASH			-0.096***			-0.097***			
.			(-29.68)			(-30.24)			
LAGCASH			-0.256***			-0.252***			
.			(-95.87)			(-93.76)			
LAGR_ INDSTCF	0.239***	0.304***	0.182***	0.274***	0.349***	0.158***	0.232***	0.329***	0.020*
.	(29.76)	(18.91)	(30.12)	(32.86)	(20.82)	(25.01)	(3.87)	(11.39)	(1.73)
LAGDC	-0.709***	-0.741***	-0.050***	-0.723***	-0.760***	-0.035***	-0.698***	-0.718***	-0.449***
.	(-195.67)	(-101.89)	(-13.88)	(-192.61)	(-100.79)	(-9.39)	(-37.62)	(-41.06)	(-70.29)
LAGQ	0.008***	0.002***	0.001***	0.008***	0.003***	0.001***	0.009***	0.012***	0.007***
.	(32.88)	(5.14)	(4.28)	(33.62)	(5.44)	(3.89)	(4.88)	(7.07)	(18.20)
LAGLNAT	-0.010***	-0.010***	0.001***	-0.009***	-0.008***	-0.000**	-0.009***	-0.010***	-0.019***
.	(-40.72)	(-19.88)	(3.10)	(-32.37)	(-14.91)	(-2.10)	(-9.72)	(-9.34)	(-22.60)
LAGCFe	-0.026***	-0.084***	-0.010***	-0.026***	-0.086***	-0.008***	0.017	-0.014	0.012***
.	(-10.71)	(-17.53)	(-5.26)	(-11.01)	(-17.86)	(-4.38)	(0.76)	(-0.70)	(3.27)
LAGBKDEBT	-0.202***	-0.077***	-0.037***	-0.205***	-0.080***	-0.034***	-0.188***	-0.204***	-0.085***
.	(-88.54)	(-16.74)	(-20.08)	(-89.58)	(-17.37)	(-18.62)	(-17.11)	(-23.32)	(-25.67)
LAGRD_SALE	0.018***	0.065***	0.005***	0.018***	0.065***	0.005***	0.071***	0.035***	0.002***
.	(54.30)	(98.13)	(21.14)	(54.17)	(98.07)	(20.96)	(2.89)	(2.94)	(2.62)
LAGDIVDUM	-0.011***	0.011***	-0.007***	-0.016***	0.006**	-0.004***	-0.018***	-0.025***	0.000
.	(-9.98)	(4.79)	(-7.84)	(-13.75)	(2.47)	(-5.03)	(-4.38)	(-9.67)	(0.16)
LAGACQUI	-0.404***	-0.403***	-0.092***	-0.402***	-0.402***	-0.089***	-0.368***	-0.426***	-0.159***
.	(-51.51)	(-25.60)	(-14.96)	(-51.22)	(-25.53)	(-14.58)	(-9.70)	(-13.90)	(-19.56)
DUMMY1990				-0.020***	-0.013***	-0.001			
.				(-18.01)	(-6.05)	(-1.14)			
DUMMY2000				-0.001	-0.013***	0.015***			
.				(-1.01)	(-5.52)	(17.26)			
R-Sq	0.513	0.289	0.166	0.515	0.289	0.168	0.497	0.535	0.760
Adj R-Sq	0.513	0.289	0.166	0.515	0.289	0.168	0.496	0.534	
Obs	103482	103515	103473	103482	103515	103473	103482	72469	58724

Appendix A-XII Regressions of lagged orthogonalized cash model with industry cash flow volatility residuals (*g*) (yearly OLS)

This table reports the lagged orthogonalized cash model regression results from 1980 to 2008 in a similar manner as the previous table for ease of comparison. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Variable definitions are reported in Chapter A2.3. Refer to Table A7 for dependent variable specifications. The first step of the orthogonalized estimation regresses industry cash flow volatility against debt capacity in each financial year to obtain volatility residuals, R_INDSTDCF, for each firm-year observation. R_ INDSTDCF are then put into the regression models with other cash determinants in the second step estimation. All explanatory variables are lagged one period in the second step regression. Model 1 to 6 report estimates from OLS regressions with heteroskedasticity adjusted standard errors. Model 4 to 6 includes dummy variables, DUMMY1990 and DUMMY2000, for observations from 1990 to 2006 and 2000 to 2006 respectively. Model 7 and 8 are based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. The final model controls for firm and year fixed effects. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	MODEL1 OLS	MODEL2 OLS	MODEL3 OLS	MODEL4 OLS	MODEL5 OLS	MODEL6 OLS	MODEL7 FM1980	MODEL8 FM1990	MODEL9 FE
Dependent	Cash	LnCash	DCash	Cash	LnCash	DCash	Cash	Cash	Cash
Intercept	0.509***	0.393***	0.056***	0.518***	0.399***	0.046***	0.492***	0.506***	
.	(257.35)	(99.33)	(25.46)	(248.28)	(95.76)	(20.21)	(35.78)	(29.80)	
LAGDCASH			-0.096***			-0.098***			
.			(-30.18)			(-30.80)			
LAGCASH			-0.257***			-0.252***			
.			(-97.05)			(-94.58)			
LAGR_ INDSTCF	0.256***	0.300***	0.139***	0.256***	0.302***	0.134***	0.229***	0.328***	0.034***
.	(30.03)	(17.63)	(21.43)	(30.11)	(17.71)	(20.83)	(3.84)	(11.32)	(2.97)
LAGDC	-0.702***	-0.726***	-0.045***	-0.707***	-0.734***	-0.026***	-0.686***	-0.707***	-0.448***
.	(-197.73)	(-102.33)	(-12.75)	(-193.77)	(-100.58)	(-7.09)	(-32.76)	(-29.72)	(-72.17)
LAGQ	0.008***	0.002***	0.001***	0.008***	0.003***	0.001***	0.009***	0.012***	0.007***
.	(33.02)	(5.17)	(4.95)	(33.65)	(5.42)	(3.95)	(5.01)	(7.07)	(18.19)
LAGLNAT	-0.009***	-0.009***	0.001***	-0.009***	-0.008***	-0.000**	-0.009***	-0.010***	-0.019***
.	(-38.13)	(-17.94)	(5.69)	(-32.55)	(-14.76)	(-2.34)	(-10.06)	(-9.35)	(-22.58)
LAGCFe	-0.027***	-0.087***	-0.011***	-0.027***	-0.088***	-0.008***	0.019	-0.014	0.012***
.	(-11.29)	(-18.36)	(-5.84)	(-11.44)	(-18.57)	(-4.39)	(0.85)	(-0.70)	(3.28)
LAGBKDEBT	-0.202***	-0.078***	-0.039***	-0.204***	-0.080***	-0.034***	-0.186***	-0.204***	-0.085***
.	(-90.35)	(-17.42)	(-21.47)	(-90.83)	(-17.79)	(-18.98)	(-16.39)	(-23.35)	(-25.66)
LAGRD_SALE	0.018***	0.065***	0.006***	0.018***	0.065***	0.006***	0.068***	0.035***	0.002***
.	(55.70)	(100.31)	(22.82)	(55.77)	(100.38)	(22.02)	(3.07)	(2.94)	(2.63)
LAGDIVDUM	-0.013***	0.007***	-0.009***	-0.016***	0.004**	-0.005***	-0.018***	-0.025***	0.000
.	(-12.24)	(3.51)	(-11.19)	(-14.56)	(1.99)	(-5.81)	(-4.24)	(-9.68)	(0.17)
LAGACQUI	-0.403***	-0.400***	-0.092***	-0.400***	-0.399***	-0.089***	-0.363***	-0.426***	-0.159***
.	(-51.87)	(-25.81)	(-15.04)	(-51.51)	(-25.72)	(-14.63)	(-9.38)	(-13.90)	(-19.56)
DUMMY1990				-0.015***	-0.008***	0.002**			
.				(-14.14)	(-3.78)	(2.05)			
DUMMY2000				0.005***	-0.004**	0.019***			
.				(4.64)	(-1.98)	(22.09)			
R-Sq	0.513	0.288	0.162	0.514	0.288	0.166	0.491	0.535	0.760
Adj R-Sq	0.513	0.288	0.162	0.514	0.288	0.166	0.490	0.534	
Obs	106483	106516	106474	106483	106516	106474	106483	72471	58724

Appendix A-XIII Regression of modified OPWS cash model following Bates for predicted cash holdings computation

This table reports and compares coefficient estimates used to compute predicted cash level. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Variable definitions are reported in Chapter A2.3. The dependent variable is cash holdings ratio computed as cash to total asset. Estimates are derived from Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation.

	BKS predicted cash model	CRSP/Compustat Sample			
Variable	Estimate	Estimate	StdErr	tValue	Probt
Intercept	0.307	0.326	0.031	10.46	0.0000
INDSTDCF_10	0.230	0.361	0.092	3.93	0.0035
Q	0.006	0.026	0.002	16.29	0.0000
LNATgdp	-0.009	-0.009	0.002	-4.70	0.0011
CFe	0.077	-0.007	0.011	-0.60	0.5635
NWC	-0.238	-0.163	0.012	-13.87	0.0000
CAPEX	-0.372	-0.404	0.011	-36.63	0.0000
BKDEBT	-0.360	-0.253	0.005	-47.69	0.0000
RD_SALE	0.048	0.109	0.043	2.52	0.0328
DIVDUM	-0.024	0.005	0.005	0.89	0.3980
ACQUI	-0.233	-0.243	0.023	-10.43	0.0000
ΔEQUITY	0.158	0.148	0.010	15.20	0.0000
ΔDEBT	0.190	0.134	0.017	7.94	0.0000
Adj R-Sq		0.290			

Appendix A-XIV Regressions of debt capacity models (*k*) for FY2008 and FY1980-2008

This table compares previous results from Campello et al. (2011) and the debt capacity model (k) results using CRSP/Compustat sample from 1980 to 2008. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The interaction term between cash flow and cash holdings is computed as the product of cash flow to total assets and cash holdings to total assets for each firm-year observation. Variable definitions are reported in Chapter A2.3. Following previous model, two dummy variables are used – (1) Large takes a value of 1 if the firm's sales revenue is equal to or more than US$1billion, and (2) Credit takes a value of 1 if the firm has a long-term credit rating of -BBB or above. The dependent variable is debt capacity to total asset. The first column reports the coefficient estimates of Campello et al. (2011). Column (2) reports OLS regression results on sample for financial year 2008 with heteroskedasticity adjusted standard errors clustered by industry. Column (3) reports OLS regression results on the entire sample with heteroskedasticity adjusted standard errors. All regressions include a constant term (not reported). The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

	Campello et al. (2011)	CRSP/Compustat Sample	
	FY2008	FY2008	FY1980-2008
VARIABLE	(1)	(2)	(3)
CFe	0.371***	0.004	0.067***
.	(6.37)	(0.32)	(30.66)
CASH	-0.288***	-0.382***	-0.467***
.	(-10.53)	(-30.14)	(-252.82)
CASH_CFe	-0.761***	-0.008	-0.091***
.	(-6.88)	(-0.23)	(-14.56)
LARGE	-0.044***	-0.009	-0.028***
.	(2.64)	(-1.60)	(-24.90)
CREDIT	-0.017	-0.021**	-0.027***
.	(-0.89)	(-2.43)	(-17.69)
Q	-0.007**	-0.007***	-0.001***
.	(-2.50)	(-3.26)	(-7.10)
R-Sq	0.27	0.362	0.436
Obs	1,908	2567	118064

Appendix A-XV Regressions of unused debt capacity models for constrained and unconstrained firms for period 1980 to 2008

This table reports the debt capacity models (i) to (k) results using CRSP/Compustat sample from 1980 to 2008. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variable is unused debt capacity ratio computed as unused debt capacity to total assets. Variable definitions and model specifications are reported in Chapter A2.3 and Table A28 respectively. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Panel A								
	Small size		Large size		Negative CFcf		Positive CFcf	
Model	OLS	FM	OLS	FM	OLS	FM	OLS	FM
Dependent	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC
Intercept	0.215***	0.088***	-0.011	-0.075	0.253***	0.138	0.143***	0.010
.	(25.36)	(3.42)	(-0.52)	(-0.97)	(10.92)	(1.27)	(16.51)	(0.24)
Cfe	0.419***	0.562***	2.033***	2.292***	0.196***	0.369***	0.931***	1.110***
.	(17.16)	(5.94)	(18.54)	(6.89)	(4.33)	(4.39)	(19.23)	(10.45)
CASH	0.681***	0.706***	1.062***	0.960***	0.497***	0.381***	0.825***	0.871***
.	(32.07)	(18.95)	(9.56)	(3.23)	(9.29)	(3.94)	(31.61)	(11.48)
CASH_Cfe	1.256***	0.857***	-1.930***	0.093	0.709***	-0.126	0.949***	0.744**
.	(18.13)	(3.02)	(-2.61)	(0.03)	(5.47)	(-0.65)	(4.73)	(2.20)
LARGE	0.000***	0.000***	0.000***	0.000***	-0.370***	-0.259**	-0.133***	-0.043
.	(.)	(.)	(.)	(.)	(-5.09)	(-2.63)	(-11.80)	(-0.98)
CREDIT	-0.231***	-0.343**	0.120***	0.125***	0.083	-0.021	0.040***	0.061*
.	(-6.09)	(-2.38)	(6.79)	(3.46)	(0.48)	(-0.15)	(2.70)	(1.75)
Q	0.021***	0.022***	-0.041***	-0.043	0.006	-0.003	0.016***	0.013
.	(9.94)	(2.98)	(-4.78)	(-1.40)	(1.61)	(-0.27)	(6.05)	(1.56)
INDSTDCF	-1.496***	-0.309	-1.151***	0.048	-2.485***	-0.674	-1.061***	0.075
.	(-21.55)	(-0.99)	(-8.70)	(0.30)	(-15.80)	(-0.83)	(-16.45)	(0.60)
Adj R-Sq	0.034	0.050	0.034	0.080	0.020	0.032	0.034	0.054
Obs	99656	99656	18408	18408	26628	26628	91436	91436

Appendix A-XV Regressions of unused debt capacity models for constrained and unconstrained firms for period 1980 to 2008 (continued)

	Panel B							
	Non-investment graded		Investment graded		Non-dividend paying		Dividend paying	
Model	OLS	FM	OLS	FM	OLS	FM	OLS	FM
Dependent	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC	UDC_DC
Intercept	0.224***	0.085***	-0.116***	-0.473*	0.117***	-0.012	0.266***	0.141***
.	(27.09)	(3.27)	(-3.29)	(-2.05)	(11.36)	(-0.44)	(23.11)	(3.28)
Cfe	0.450***	0.598***	1.191***	1.812***	0.331***	0.489***	1.473***	1.339***
.	(18.53)	(6.50)	(9.40)	(3.68)	(12.15)	(6.46)	(23.23)	(6.79)
CASH	0.690***	0.720***	-0.393**	-0.197	0.716***	0.729***	1.033***	1.088***
.	(32.83)	(19.57)	(-2.32)	(-0.45)	(29.26)	(18.19)	(25.22)	(8.49)
CASH_Cfe	1.180***	0.800***	10.129***	8.165**	1.380***	0.908***	-1.231***	-0.811
.	(17.10)	(2.89)	(6.88)	(2.28)	(17.93)	(3.92)	(-4.90)	(-1.33)
LARGE	-0.169***	-0.082	0.154***	0.405**	-0.292***	-0.162***	-0.115***	-0.068*
.	(-13.04)	(-1.62)	(5.14)	(2.73)	(-14.90)	(-3.93)	(-9.25)	(-1.85)
CREDIT	0.000***	0.000***	0.000***	0.000***	-0.017	-0.051	-0.093***	-0.028
.	(.)	(.)	(.)	(.)	(-0.44)	(-0.92)	(-6.46)	(-0.67)
Q	0.019***	0.018**	0.003	0.019*	0.021***	0.019**	0.014***	0.021**
.	(9.05)	(2.25)	(0.30)	(1.72)	(8.97)	(2.52)	(2.87)	(2.25)
INDSTDCF	-1.558***	-0.232	-0.277*	0.084	-1.172***	0.287	-1.035***	-0.150
.	(-23.62)	(-0.79)	(-1.82)	(0.58)	(-15.00)	(0.65)	(-11.10)	(-1.01)
Adj R-Sq	0.033	0.050	0.048	0.077	0.031	0.051	0.053	0.078
Obs	109006	109006	9058	9058	82509	82509	35555	35555

Appendix A-XVI Regressions of cash model (*b*) for period 1980 to 2008 across industries

This table reports cash model (b) regression results using CRSP/Compustat sample from 1980 to 2006. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Industry groups are sorted according to their SIC codes as follow: 1=Retail and wholesale, 2=Manufacturing, 3=Mining, 4=Transportation, 5=Communication, 6=Software and Biotech, 7=Services, 8=Healthcare, and 9=Others. Variable definitions are reported in Chapter A2.3. The dependent variable is cash holdings ratio computed as cash to total asset. All estimates are reported based on OLS regressions with heteroskedasticity adjusted standard errors. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	OLS								
Industry	IND=1	IND=2	IND=3	IND=4	IND=5	IND=6	IND=7	IND=8	IND=9
Dependent	CASH	CASH	CASH	CASH	CASH	CASH	CASH	CASH	CASH
Intercept	0.503***	0.665***	0.576***	0.458***	0.356***	0.754***	0.533***	0.544***	0.540***
.	(100.34)	(247.42)	(83.25)	(45.72)	(16.47)	(73.41)	(93.54)	(31.76)	(48.40)
DC_NOCASH	-0.723***	-0.993***	-0.947***	-0.723***	-0.459***	-1.248***	-0.732***	-0.643***	-0.731***
.	(-84.17)	(-200.17)	(-71.56)	(-40.37)	(-22.23)	(-72.11)	(-70.31)	(-26.47)	(-36.80)
INDSTDCF	-0.277***	0.054***	0.012	0.182***	0.252	-0.017	-0.000	-1.003***	-0.023
.	(-8.33)	(5.46)	(0.46)	(6.21)	(1.01)	(-0.43)	(-0.03)	(-7.49)	(-0.68)
Q	0.013***	0.008***	0.000	0.016***	0.011***	0.007***	0.011***	0.019***	-0.003*
.	(19.02)	(26.59)	(0.06)	(7.85)	(7.41)	(11.03)	(18.83)	(10.63)	(-1.90)
LNAT	-0.011***	-0.017***	-0.007***	-0.010***	-0.012***	-0.013***	-0.015***	-0.014***	-0.011***
.	(-24.02)	(-58.65)	(-9.11)	(-11.10)	(-9.70)	(-10.13)	(-19.50)	(-8.67)	(-8.24)
Cfe	-0.024***	0.001	0.027***	0.107***	-0.084***	0.016**	0.002	-0.022	0.018
.	(-4.50)	(0.19)	(3.66)	(8.03)	(-6.60)	(2.32)	(0.34)	(-1.55)	(1.54)
NWC	0.014***	0.002	0.005	-0.090***	0.052***	0.051***	-0.016***	0.019	-0.039***
.	(3.41)	(0.59)	(0.59)	(-8.51)	(4.10)	(4.47)	(-2.69)	(1.20)	(-4.64)
CAPEX	-0.067***	0.092***	0.085***	0.020	0.260***	0.150***	0.091***	0.136***	0.040
.	(-5.75)	(9.74)	(8.04)	(1.15)	(7.86)	(3.81)	(5.65)	(3.36)	(1.12)
BKDEBT	-0.164***	-0.222***	-0.111***	-0.118***	-0.173***	-0.205***	-0.239***	-0.164***	-0.210***
.	(-38.86)	(-78.46)	(-17.53)	(-12.66)	(-18.72)	(-18.58)	(-38.46)	(-12.07)	(-15.91)
RD_SALE	0.042***	0.013***	0.012***	0.258***	0.024***	0.009***	0.018***	0.013**	0.077***
.	(9.39)	(38.01)	(3.37)	(5.23)	(5.98)	(16.56)	(11.28)	(2.14)	(15.37)
DIVDUM	0.019***	-0.012***	-0.015***	0.018***	-0.029***	-0.017**	0.002	0.020**	0.003
.	(10.40)	(-10.24)	(-4.18)	(4.57)	(-4.32)	(-2.02)	(0.63)	(2.50)	(0.53)
ACQUI	-0.325***	-0.416***	-0.105***	-0.344***	-0.342***	-0.822***	-0.498***	-0.468***	-0.388***
.	(-20.76)	(-45.50)	(-4.45)	(-9.86)	(-11.06)	(-23.28)	(-25.56)	(-14.32)	(-7.29)
Adj R-Sq	0.522	0.684	0.569	0.543	0.372	0.642	0.495	0.470	0.539
Obs	14656	60062	6406	3117	3557	7702	14579	2538	3064

Appendix A-XVII Regressions of debt capacity model (*l*) for period 1980 to 2008 across industries

This table reports debt capacity model (*l*) regression results using CRSP/Compustat sample from 1980 to 2006. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Industry groups are sorted according to their SIC codes as follow: 1=Retail and wholesale, 2=Manufacturing, 3=Mining, 4=Transportation, 5=Communication, 6=Software and Biotech, 7=Services, 8=Healthcare, and 9=Others. Variable definitions are reported in Chapter A2.3. The dependent variable is debt capacity scaled by total asset. All estimates are reported based on OLS regressions with heteroskedasticity adjusted standard errors. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	OLS								
Industry	IND=1	IND=2	IND=3	IND=4	IND=5	IND=6	IND=7	IND=8	IND=9
Dependent	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT	DC_AT
Intercept	0.493***	0.509***	0.479***	0.473***	0.366***	0.500***	0.413***	0.526***	0.366***
.	(196.78)	(601.83)	(115.35)	(105.93)	(18.88)	(140.70)	(167.81)	(47.13)	(62.56)
Cfe	0.070***	0.057***	0.083***	0.132***	0.063***	0.034***	0.014**	-0.027	0.123***
.	(9.78)	(22.57)	(8.95)	(7.07)	(4.02)	(5.77)	(2.13)	(-1.64)	(8.16)
CASH	-0.495***	-0.471***	-0.472***	-0.486***	-0.236***	-0.362***	-0.364***	-0.350***	-0.394***
.	(-77.22)	(-219.81)	(-49.61)	(-31.19)	(-14.97)	(-70.34)	(-62.08)	(-24.12)	(-22.44)
CASH_Cfe	-0.141***	-0.091***	-0.078*	-0.198**	-0.100*	-0.102***	0.024	0.112*	-0.159**
.	(-4.69)	(-12.92)	(-1.65)	(-2.29)	(-1.82)	(-7.49)	(1.14)	(1.89)	(-2.54)
LARGE	-0.014***	-0.045***	-0.025***	-0.001	0.022***	-0.014**	-0.044***	-0.012	0.008
.	(-6.20)	(-34.89)	(-4.21)	(-0.11)	(3.01)	(-2.53)	(-9.95)	(-1.49)	(0.87)
CREDIT	-0.004	-0.030***	-0.011*	-0.024***	0.007	0.006	-0.023***	0.033**	-0.062***
.	(-1.22)	(-17.93)	(-1.75)	(-3.72)	(0.82)	(0.62)	(-3.48)	(2.43)	(-4.69)
Q	-0.002**	-0.001***	-0.002*	-0.004*	0.006***	-0.001*	-0.001	0.004**	0.007***
.	(-2.36)	(-2.66)	(-1.92)	(-1.78)	(4.25)	(-1.75)	(-1.08)	(2.13)	(4.05)
INDSTDCF	-0.338***	-0.345***	0.004	-0.168***	-1.002***	-0.757***	-0.167***	-1.610***	0.218***
.	(-10.06)	(-47.11)	(0.15)	(-4.93)	(-4.21)	(-36.54)	(-12.28)	(-14.77)	(5.44)
Adj R-Sq	0.327	0.580	0.318	0.305	0.097	0.604	0.256	0.257	0.174
Obs	14896	60436	6643	3215	3686	7858	15207	2610	3513

Appendix A-XVIII Pearson and Spearman correlation coefficients for investment model variables

This table reports the Pearson and Spearman correlation coefficients for variables in the investment model. The sample is taken from CRSP/Compustat from 1980 to 2008. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Following Almeida and Campello (2007), firms with the following characteristics are eliminated from the sample: (1) capital stock less than USD5million, (2) real asset or sale growth more than 100%, and (3) negative Q or Q more than 10. Variable definitions are reported in Chapter A2.3. Investment ratio (INVTMT) computed as capital investment to lagged capital stock and net investment (NINVTMT) is computed as the sum of capital investment, acquisitions and change in investments less sale in property plant and equipment and investment to lagged total assets Both investment and net investment ratios are winsorized at top and bottom 5% due to large extreme values.

Pearson Correlation Coefficients

	NINVTMT	INVTMT	CASH	LAGCASH	DC	LAGDC	Cfe	LAGCFe	Q
NINVTMT	1								
INVTMT	0.651	1							
CASH	-0.005	0.044	1						
LAGCASH	0.007	0.057	0.875	1					
DC	0.067	0.001	-0.623	-0.562	1				
LAGDC	0.061	-0.003	-0.571	-0.632	0.929	1			
Cfe	0.007	-0.013	-0.180	-0.190	0.159	0.172	1		
LAGCFe	0.006	-0.008	-0.153	-0.163	0.144	0.168	0.660	1	
Q	-0.021	0.029	0.371	0.352	-0.295	-0.292	0.047	0.044	1

Spearman Correlation Coefficients

	NINVTMT	INVTMT	CASH	LAGCASH	DC	LAGDC	Cfe	LAGCFe	Q
NINVTMT	1								
INVTMT	0.817	1							
CASH	0.001	0.072	1						
LAGCASH	0.036	0.088	0.820	1					
DC	0.115	0.010	-0.538	-0.464	1				
LAGDC	0.092	0.004	-0.471	-0.540	0.909	1			
Cfe	-0.011	-0.046	-0.006	-0.013	0.075	0.070	1		
LAGCFe	-0.014	-0.036	0.001	0.002	0.059	0.084	0.747	1	
Q	-0.080	-0.001	0.307	0.289	-0.317	-0.312	0.336	0.291	1

Appendix A-XIX Regressions of investment model (*m*) for period 1980 to 2008 (different scaling variable)

This table reports the investment models results using CRSP/Compustat sample from 1980 to 2008. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Following Almeida and Campello (2007), firms with the following characteristics are eliminated from the sample: (1) capital stock less than USD5million, (2) real asset or sale growth more than 100%, and (3) negative Q or Q more than 10. Cash, debt capacity and cash flow are scaled by capital stock (PPENT) and winsorized at the top and bottom 1%. The interaction term between cash holdings and debt capacity is computed as the product of cash holdings to capital stock and debt capacity to capital stock for each firm-year observation. Variable definitions are reported in Chapter A2.3. The dependent variable is investment ratio computed as capital investment to lagged capital stock OLS model reports estimates from OLS regressions with heteroskedasticity adjusted standard errors. FE model controls for firm and year fixed effects. FM model is based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. All regressions include a constant term (not reported). The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

VARIABLE	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6
Model	OLS		FE		FM	
Dependent	INVTMT	INVTMT	INVTMT	INVTMT	INVTMT	INVTMT
CASH_PPENT	0.030**	0.096***	0.024	0.040**	0.169***	0.322***
.	(2.28)	(6.35)	(1.57)	(2.49)	(3.31)	(4.38)
DC_PPENT	0.113***	0.205***	0.037**	0.061***	0.310***	0.584***
.	(8.20)	(12.55)	(2.21)	(3.35)	(3.70)	(3.89)
CASH*DC_PPENT		-1.187***		-0.458***		-3.201***
.		(-12.88)		(-6.23)		(-3.49)
Q	0.254***	0.247***	0.490***	0.497***	0.436***	0.428***
.	(7.35)	(6.59)	(14.55)	(14.07)	(4.09)	(3.99)
Cfe_PPENT	0.006	-0.000	0.018	0.004	-0.017	-0.101
.	(0.23)	(-0.02)	(0.88)	(0.17)	(-0.27)	(-1.48)
Adj R-Sq	0.002	0.004			0.006	0.012
Obs	75457	66972	75457	66972	75457	66972

Appendix A-XX Regressions of investment model (*m*) for period 1980 to 2008 (different winsorisation method)

This table reports the investment models results using CRSP/Compustat sample from 1980 to 2008. All firms are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Following Almeida and Campello (2007), firms with the following characteristics are eliminated from the sample: (1) capital stock less than USD5million, (2) real asset or sale growth more than 100%, and (3) negative Q or Q more than 10. The interaction term between cash holdings and debt capacity is computed as the product of cash holdings to total assets and debt capacity to total assets for each firm-year observation. Variable definitions are reported in Chapter A2.3. The dependent variable is investment ratio computed as capital investment to lagged capital stock for Panel A and net investment computed as the sum of capital investment, acquisitions and change in investments less sale in property plant and equipment and investment to lagged total assets for Panel B. Both investment and net investment ratios are winsorised at top and bottom 1%. OLS model reports estimates from OLS regressions with heteroskedasticity adjusted standard errors. FE model controls for firm and year fixed effects. FM model is based on Fama-MacBeth regressions using Newey and West (1987) standard errors controlling for autocorrelation. All regressions include a constant term (not reported). The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Panel A

VARIABLE	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6
Model	OLS		FE		FM	
Dependent	NINVTMT	NINVTMT	NINVTMT	NINVTMT	NINVTMT	NINVTMT
CASH	4.349***	3.708***	2.228***	2.525***	5.693***	5.116***
.	(8.98)	(8.03)	(3.77)	(4.40)	(3.07)	(2.86)
DC	7.623***	6.781***	5.692***	4.798***	6.594***	6.310***
.	(12.94)	(12.00)	(7.33)	(6.32)	(3.71)	(3.52)
CASH*DC		-1.985***		-0.779*		-12.513***
.		(-3.48)		(-1.74)		(-5.26)
Q	-0.137**	-0.150***	0.015	0.009	-0.063	-0.087
.	(-2.41)	(-2.77)	(0.26)	(0.17)	(-0.90)	(-1.44)
Cfe	0.242	-0.426	0.793*	0.385	0.139	-1.235
.	(0.57)	(-1.04)	(1.80)	(0.90)	(0.19)	(-1.33)
Adj R-Sq	0.002	0.003			0.003	0.006
Obs	75457	66972	75457	66972	75457	66972

Panel B

VARIABLE	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6
Model	OLS		FE		FM	
Dependent	INVTMT	INVTMT	INVTMT	INVTMT	INVTMT	INVTMT
CASH	7.732***	7.808***	7.523***	7.839***	7.575***	7.116***
.	(7.02)	(6.46)	(5.15)	(4.82)	(3.82)	(3.55)
DC	6.811***	7.512***	9.674***	11.066***	1.878	2.020
.	(5.08)	(5.08)	(5.05)	(5.14)	(0.77)	(0.79)
CASH*DC		-7.061***		-1.739		-44.309***
.		(-4.72)		(-1.37)		(-6.80)
Q	0.614***	0.670***	1.077***	1.112***	1.010***	1.109***
.	(4.73)	(4.72)	(7.65)	(7.11)	(3.10)	(3.29)
Cfe	-2.941***	-3.571***	1.390	1.383	-4.912***	-5.835***
.	(-3.04)	(-3.34)	(1.28)	(1.14)	(-2.94)	(-3.07)
Adj R-Sq	0.001	0.002			0.004	0.006
Obs	75457	66972	75457	66972	75457	66972

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PART B

Financial Flexibility and Capital Structure

ABSTRACT B

Using a sample of public US firms over the period 1980 to 2008, the role of financial flexibility in capital structure decisions is examined. Financial flexibility is measured internally as cash and debt capacity, and externally as equity liquidity using a novel external equity flexibility index based on common equity liquidity measures. The increasing trend in financing deficit is largely funded by equity rather than debt. Results suggest that the amount of debt issued to finance the deficit no longer depends solely on the size of deficit a firm faces but depends on the amount of the deficit relative to the firm's borrowing capacity. In tests of capital structure, the pecking order theory is contingent upon firms' ability to borrow. Firms with greater debt capacity issue less equity to fund deficits but firms with greater equity flexibility may not issue less debt, and equity is not used as a substitute for debt. Although there is weak evidence for substitution between debt and equity use, firms have the tendency to choose the financing source which provides them the best funding capacity. Finally, in the conventional trade-off model tests, debt capacity and external equity flexibility are shown to be the most important determinants of leverage - supporting the notion that financial flexibility is the most important consideration in financing decisions.

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Abbreviation List

ADJ R-SQ	Adjusted R Squared statistics
AMEX	American stock exchange
BKDEBT	Book value of debt to total assets ratio
BMA	Basic market-adjusted model's modified roll estimate
CAPEX	Capital expenditure to total assets ratio
CASH	Cash to total assets ratio
CF	Cash flow after interest and taxes
CFe	Cash flow to total assets ratio (computed using earnings method)
CFcf	Net cash flow to total assets ratio (computed using income method)
CPI	Consumer Price Index
CREDIT	Dummy variable for long-term credit rating
CRSP	The Center for Research in Security Prices
DC	Debt capacity to total assets ratio
DEF	Financing deficit to total assets ratio
DEF_NA	Financing deficit to net assets ratio
DIV	Cash dividend issued
DIVT	Total dividend issued
EEF	External equity flexibility index
EEF10	Scaled external equity flexibility index (division by 10)
FE	Fixed effects regression
FF	Financial flexibility
FM	Fama McBeth regression
I	Net investment
IPO	Initial public offering
LAG(var)	Lagged variable by one period, e.g. LAGCASH, LAGDC
LM12	Liu's (2006) trading discontinuity measure
LM12_SQRT	Square root of Liu's (2006) trading discontinuity measure
LNAT	Natural logarithm of total assets
LNSALE	Natural logarithm of total sales
LTRATING	Numeritized long-term S&P credit rating following Byoun (2008)
LTRATING_ALT	Numeritized long-term S&P credit rating (alternative measure)
MKTDEBT	Market value of debt to total assets ratio
MTB	Market to book asset ratio
NASDAQ	National Association of Securities Dealers Automated Quotations stock exchange
NYSE	New York stock exchange
OBS	Observations (in number)
OLS	Ordinary least square regression
RTOV12	Amihud's (2002) price impact measure

RTOV12_SQRT	Square root of Amihud's (2002) price impact measure
PIN	Probability of informed trading
PROFIT	Profitability
SEO	Secondary equity offering
SIC	Standard industry classification code
SIC_MEDIAN _BKDEBT	Industry median book value of debt to total assets ratio
SIZE	Firm size
STDEBT	Short-term debt to total assets ratio
STRATING	Short-term (commercial paper) S&P credit rating
R-SQ	R squared statistics
TANG	Tangibility ratio
TDEBT	True value of debt to total assets ratio
TO12	Turnover ratio
Q	Q ratio (also known as market-to-book assets ratio)
UDC	Unused debt capacity to total assets ratio
WCCHANGE	Change in working capital
ΔLTDEBT	Net debt issues to total assets ratio
ΔEQUITY	Net equity issues to total assets ratio

The following abbreviation follows the variable labels in CRSP/Compustat Fundamentals Annual database for items reported in the financial statements of firms.

AJEX	Split-adjusted average stock price
APALCH	Increase (Decrease) in accounts payable and accrued liabilities
AOLOCH	Increase (Decrease) in other assets and liabilities
AT	Total assets
AQC	Acquisition expense
CAPX	Capital expenditure
CEQ	Book value of equity
CHE	Cash and cash equivalents (marketable securities)
CHECH	Change in cash and cash equivalent
CSHO	Common shares outstanding
DLC	Long-term portion of current debt
DLCCH	Net change in short-term borrowings and current maturities of long-term debt
DLT	Long-term debt
DLTIS	Long-term debt issue
DLTR	Reduction in long-term debt
DLTT	Change in long-term debt
DPC	Depreciation and amortization
DVC	Common dividend issued

EBITDA	Earnings before interest, depreciation and amortization
ESUBC	Equity in net loss (earnings)
FIAO	Other financing activities
IBC	Income before extraordinary items
ICAPT	Total capital stock
INVCH	Decrease (Increase) in Inventory
INVT	Inventory
IVCH	Increase in investment
MIB	Minority interest
OIBDP	Earnings before interest and tax ratio
RECT	Receivables
PPENT	Property, Plant and Equipment
PRCC_F	Equity price at financial year end
PRSTKC	Purchase of common and preferred equity
RECCH	Decrease (Increase) in accounts receivables
SIV	Sale of investment
SSPIC	Gains (loss) from sale of property, plant and equipment, and investment
SSPIV	Sale of property, plant and equipment, and investment
SSTK	Sale of common and preferred equity
TXACH	Increase (Decrease) in accrued income taxes
TXDC	Deferred tax
TXTDITC	Deferred tax and investment credit
TXT	Tax expense
WCPAC	Change in operating working capital
XIDOC	Extra items and discontinued operations
XINT	Interest expense

CHAPTER B1. INTRODUCTION

To date, none of the grand theories of capital structure is of general practical use and the theory-practice gap in corporate finance is evident. Researchers then turn to surveying managers for insights. Frank and Goyal (2003) note that Graham and Harvey (2001) show in their survey that "some firms expressed views similar to the pecking order, but apparently not due to adverse selection". Here, we present another view on the pecking order theory where firms are found to obey the theory's financing behaviour not due to the presence of adverse selection problems but due to their practical need for financial flexibility. As expected, pecking order is more applicable for firms with high debt capacity because these firms can afford greater debt. On the other hand, the theory becomes less applicable for firms with lower debt capacity because they simply cannot afford to issue debt. Debt capacity measures firms' borrowing ability, and depends primarily on the nature of assets and the way business is conducted. Debt capacity may also be taken as a measure of credit constraint. The increase in applicability of pecking order with debt capacity is documented in various studies (Bharath et al., 2009, Frank and Goyal, 2003) when tangibility is used to measure intrinsic debt capacity. Simply said, two firms with the same level of adverse selection problem but different credit constraints will issue different amounts of debt and follow the pecking order theory to differing degrees. Bharath et al. (2009) find that the theory's applicability increases with the problem of adverse selection.

As financial flexibility (thereafter FF) is the most important determinant of capital structure (Campello et al., 2011), the FF motivation is used in this thesis to explain debt and equity use in practice. In the literature, there are numerous proxies used to measure FF; however, there is no single clear definition and measure for it. Using the general flexibility definition in the literature, FF is measured by the ease with which a firm obtains its required funding, and is given by the optimal balance of both the external and internal flexibility. Here, ***external flexibility*** refers to the ease of access, liquidity and cost of a firm's financial instruments in the external capital markets; and ***internal flexibility*** includes firm's *cash holdings* and *debt capacity* (which has been in the spotlight of capital structure research in recent years). While the external component is based on market variables that are not under the direct control of managers, the internal component is influenced by the volatility of cash and earnings, and managerial discretion and preference over a firm's internal liquidity position.

As a measure of credit constraint, debt capacity affects debt issue and the capital structure in the following ways. First, Frank and Goyal (2003) provide evidence for the failure of pecking order theory in explaining financing for small firms where information asymmetry is generally the largest. Here, it is suggested that the limit applicability of the theory is due to debt constraints because small firms generally have lower debt capacities. As such, instead of *choosing* equity over debt, small firms are *forced* to use equity instead of debt because they simply cannot use debt. Second, the sharp increase in cash holdings over time documented by Bates et al. (2009) may be explained by the fall in debt capacity over time. Due to the change in nature of business form, average debt capacity of US firms are found to fall over time. Thus, firms have to hold more cash and this trend is increasingly predominant as firms' debt capacity falls. This would mean the general trend of increased cash holdings over time is due to the larger amount of credit constraints faced by firms. Eliminating the periodic trend, firms with lower debt capacities are found to hold greater cash at any particular time point. Third, the difference in nature of firms' assets (measured by debt capacity) may be a plausible explanation for the observed persistence in capital structure. Recent studies (e.g. Leary, 2009, Lemmon and Roberts, 2010) used the high cost of switching to explain the observed debt persistence found in Lemmon et al. (Lemmon et al., 2008).[47] Lemmon and Roberts (2010) reported evidence of firms' heavy reliance on a single source of credit.[48] However, transaction cost may only explain part of the reliance as it forms only a small proportion of the total capital raised. Reliance on specific capital market may be largely due to a firm's core asset structure, where debt is largely collateralized using tangible assets. Whilst asset structure determines firm's primary debt capacity and debt usage, access to equity funds requires external market proxies.

Debt constrained firms not only stockpile cash, they sometimes seek ways to enhance equity liquidity for financing needs. It is noted that stockpiling cash reserves increases the adverse selection problem and leads to greater information asymmetry. However, instead of having a negative impact on their stock liquidity, these (high cash) firms are found to have greater equity liquidity. This suggests that cash holdings do not have sufficient impact on information asymmetry to affect equity liquidity. Similar to prior studies (Bharath et al., 2009, Frank and Goyal, 2003), the pecking order theory is found to have declining importance over time. In their paper, Bharath et al. (2009) suggest alternative ways of equity issue to circumvent information asymmetry problems (Fama and French, 2005), and increasing proportion of equity financing (Frank and Goyal, 2003) as possible explanations for the declining importance of the pecking order theory. In this work, firms' flexibility

[47] As the net cost of switching for most firms is high. Highly levered firms are observed to continue to issue more debt and remain highly levered for substantially long periods of time.

[48] Lemmon and Roberts (2009) investigate the response of financing and investment decisions from a change in supply of credit, and find that firms significantly modify their financing and investment decisions following a change in supply shock in their specific capital market. Furthermore, a contraction in credit supply in the debt market leads to a consequent reduction in debt use with no substitution to alternative sources of funding.

position in the equity market is used to explain how much equity firms issue and whether or not firms with greater equity flexibility will issue more equity for deficit funding. This is a direct test of external financing flexibility (equity market) on the pecking order theory.

This thesis investigates the interaction between FF and capital structure, i.e. how FF decisions affect firms' financing and investment decisions, through the pecking order model and conventional trade-off leverage model. By exploring the relationship between flexibility and firms' preference for debt or equity to finance deficit, the study examines how financing policy is affected by both (i) firm's internal cash and debt capacity, and (ii) firm's external flexibility which signals its capacity in the equity capital market. The two conventional theories of capital structure – the pecking order and the trade-off theories will be used as the base model to examine the impact of FF on capital structure.

First, the external equity flexibility (EEF) index is constructed using the four selected equity variables. Due to the nature of construction, the EEF index effectively measures inflexibility and has a positive correlation with debt capacity and a negative correlation with cash holdings – firms with better equity position have lower debt capacity and greater cash holdings. Similar to the increasing cash holdings and decreasing debt capacity trends over time, the EEF index decreases from 1970 to 2008, suggesting an increase in firms' accessibility to the equity market.

Second, the base pecking order model is adapted from Frank and Goyal (2003). The modified pecking order model is constructed with net equity issue as the dependent variable. Interaction variables between deficit and debt capacity, and deficit and EEF index are put into both models separately and the following results are obtained. A large proportion of the financing deficit is met by net equity issue, and the trend is increasing with time. Supporting Frank and Goyal (2003), net equity issue is found to track deficit better than net debt issue, suggesting that firms choose to issue equity rather than debt for financing needs. Results indicate that the amount of debt issued to finance deficit no longer depends solely on the amount of deficit a firm faces, but depends on the amount of deficit relative to the firm's borrowing capacity. It is found that only firms with sufficient debt capacity appear to follow a financing hierarchy, whereas firms with insufficient debt capacity do not follow the hierarchy because they simply cannot do so. Therefore, the pecking order theory is found to be contingent upon firms' ability to borrow.

Third, the basic and modified pecking order model is performed over subsamples of firms sorted according to each flexibility components – cash, debt capacity, EEF index and credit rating. Debt constrained firms are found to hold more cash, use less debt, and more equity financing for their deficit requirements. On the other hand, firms with better equity position issue more equity to finance their deficit. However, firms with better equity position may not issue less debt, i.e. equity is not a substitute for debt. This suggests that firms issue equity if they are able to; and they are not forced to issue equity as the last resort as suggested by the financing hierarchy.

Finally, the conventional leverage model and leverage change models are constructed with debt capacity and EEF index as additional determinants. The results confirm that there is no strict adherence to the financing hierarchy; rather the applicability of the pecking order is conditional on the amount of debt a firm is able to issue. Therefore, evidence against the pecking order model might be due to firms' incapacitated debt issue, rather than their preference for equity. Supporting Myers'

(2001) view, the pecking order model is shown to be a conditional theory based on a simple fact of whether or not firm has the capacity to issue debt when required. According to the trade-off theory, a strong mean reversion tendency of firms' leverage is observed. Supporting the practical findings in Graham and Harvey (2001), debt capacity and EEF index are the most important determinants of leverage in the two conventional models.

The rest of this part of the thesis is organised as follows. Chapter B2 provides a detailed literature review covering (i) conventional theories of capital structure, (ii) new financing theories with a focus on dynamic capital structure models, (iii) practicality issues of capital structure theories through non-conventional corporate finance studies, and finally (iv) a review of financial flexibility and its role and relevance in capital structure decisions. Chapters B3 and B4 describe the measurement and construction of flexibility variables, sample and variable specifications respectively. Chapter B5 presents the pecking order model hypotheses, specifications and results, while Chapter B6 reports the conventional leverage model. Chapter B7 then concludes the thesis by summarizing the key findings and making recommendations for future research direction.

CHAPTER B2. REVIEW OF CAPITAL STRUCTURE THEORIES

The capital structure puzzle remains because existing theories are able to co-exist and evidence on these theories is mixed. Current theories are only conditional ones that aid academics' and practitioners' understanding of firms; financing decisions (Myers, 2001) whilst none is an all-embracing theory of capital structure. While theory and field evidence could adequately provide rational analysis of corporate finance problems, the 'science' in corporate finance has yet to provide a satisfactory framework for unravelling all problems financial officers face (Jensen and Smith, 1984).

Academics are still in hopeful search for a model of capital structure that brings together key elements and theories for predicting firms' financing behaviour and explaining observed stylized facts in the imperfect capital market. Existing models of financing do not adequately describe leverage decisions and, aggravating the problem further, these models sometimes yield results that contradict observed stylized facts of firms' financing behaviour (Frank and Goyal, 2007). To understand the real motives behind firms' financing decisions, old and new theories of capital structure are reviewed in the light of recent dynamic modelling developments. The generalization and evidence obtained from previous models and theories are then compared with surveyed practical determinants of capital structure and empirically tested to seek its generality and usability.

In brief, theories of capital structure date back to the conventional trade-off theory derived from debt tax advantage and bankruptcy costs, subsequent pecking order theory based on information asymmetry, free cash flow principle and management entrenchment theory derived from the agency costs, to the more recent market timing and managerial inertia theories based on equity price variability and firms' market timing actions. Recent capital structure models are developed in a dynamic and/or structural manner pooling together a range of important factors affecting leverage decisions. Empirically, there have been numerous capital structure models that range from the conventional pooled regressions to more complex models that make use of instrumental variables and GMM; and to the use of natural experiments and simulations of structural models.

Practical determinants of capital structure have been highlighted since the survey by Graham and Harvey (2001), and there have been similar surveys done to identify the missing components in capital structure research. Whilst there is general support for the trade-off hypothesis by managers, considerations of practicality are found to play a much more important role in leverage decisions. Liquidity constraints and the need to preserve financial flexibility are the key considerations in making financing decisions because managers are forward looking and consider the expected liquidity position of firms in future periods. Evidence of the demand for flexibility is further documented in recent research (Bates et al., 2009, Byoun, May 2008, Gamba and Triantis, 2008, Lemmon and Roberts, 2010, Sufi, 2009), but most focus on a single component of flexibility, either cash, debt capacity (tangibility) or supply constraints.

Whilst financial flexibility is the most important determinant in capital structure, there are few papers analysing the relationship between leverage and flexibility, in contrast with those that focus on the conventional theories, trade-off and pecking order. In addition, the lack of consensus on the definition and measurement of financial flexibility is a major caveat to future research.

The rest of this Chapter will review the conventional and new theories of capital structure, followed by a discussion on the theory and practice gap in corporate finance and, finally, a look into the practical determinants of capital structure.

B2.1 Conventional theories of capital structure

B2.1.1 Trade-off theory

Although financing decisions of firms have no effect on the firm value and cost of capital in the perfect world envisaged by Modigliani and Miller (1958), these decisions do matter in our imperfect world. Breaking away from the zero-tax assumption, Modigliani and Miller (1963) build corporate income tax into their perfect world and examine the effect of taxation on capital structure. After which, the expected bankruptcy costs are incorporated into the firm's financing behaviour, thereby deriving the well-known trade-off theory in corporate finance literature. The trade-off theory postulates a unique optimal capital structure with value-maximising goal of firms using cost-benefit analysis for financing decisions. Marginal benefits and costs of leverage stem primarily from the tax deductibility of debt interest and debt-related bankruptcy costs.

The trade-off argument of Kraus and Litzenberger states that "the taxation of corporate profits and the existence of bankruptcy penalties are market imperfections that are central to the positive theories of capital structure" (1973, p.911). The adjustment towards an optimum (target adjustment behaviour) is made distinct from the conventional trade-off theory by Myers (1984) on important grounds[49]. Although the issues of taxes and bankruptcy costs are considered in detail by Miller (1977) and King (1974, 1977) respectively, the static trade-off theory is presented in Bradley et al. (1984) in the standard way. The term static trade-off theory was introduced to differentiate conventional trade-off models from the new and dynamic models where attempts are made to model more realistic tax structures and to take into account the issues of retained earnings and cash flow, and the mean reversion of leverage in a continuous-time framework. The dynamic models brought researchers back to the trade-off theory after years of turning away from the taxation-versus-bankruptcy cost-benefit analysis to the pecking order theory based on information asymmetry and agency costs in the 1990s (Frank and Goyal, 2007).

B2.1.2 Pecking order theory

To search for the crucial missing piece in explaining leverage behaviour, researchers devoted years of attention to the pecking order theory. Hence, corporate finance research output has been populated by empirical work on both trade-off theory and pecking order hypotheses. Whilst the two theories have been subjected to extensive research in corporate finance academia, there has been mixed evidence on the existence or co-existence of both theories.

Pecking order theory could be derived from either or both of the information asymmetry and agency costs arguments. The former is first used to describe the financing hierarchy where firms prefer internal funds over external financing and, if external funds are sought, debt over equity on the basis of adverse selection due to asymmetric information (Myers, 1984, Myers and Majluf, 1984). The latter is

[49] Frank and Goyal (2007) provide related discussions.

derived from the conflicts of interest and agency costs in the nexus of contracts among stockholders, bondholders and managers (Jensen and Meckling, 1976).

Due to imperfect information, managers are the only ones with knowledge of the true value of firms and future growth opportunities; and conveying this insider knowledge to external investors in a complete manner may not be feasible. Recognising this fact, external suppliers charge a premium for their funds and managers try to avoid such costs by utilising internal funds whenever possible. When external funds are sought, managers avoid issuing equity (except in cases where equity is overvalued) because such issuance entails signalling overvalued equity, whether or not equity is truly overvalued. Although debt is not explicitly considered in the pecking order analysis of Myers and Majluf (1984), Myers (1984) hypothesizes debt to fall between internal funds and equity (Frank and Goyal, 2007). Adverse selection may be used to prove the financing hierarchy hypothesis; however, the presence of adverse selection does not dictate the pecking order theory because the pecking order remains a unique case of the former (Halov and Heider, 2004).

According to agency theory, conflicts of interests between prospective stockholders and owner-managers result in underinvestment because managers avoid equity issuance, with the aim of circumventing additional monitoring and evading profit sharing. As such, managers prefer retained earnings to external financing. On the other hand, conflicts between stockholders and bondholders may result in inefficient investment and operating decisions as managers (acting on behalf of shareholders) engage in risk-shifting activities and increase leverage to fund higher dividend issues. Whilst agency theory is not used to support the conventional pecking order hypotheses, a simple nexus of contract postulated by the agency theory could be used to support the financing hierarchy (Myers, 2003). Agency theory is termed the third theory of capital structure – free cash flow theory in Myers (2001), where distinction is made between the pecking order theory (based on asymmetry information) and the free cash flow perspective (based on agency theory).

B2.2 New theories of capital structure

In recent years, research has thrown light on the older theories of capital structure with new ideas. Recent developments include the management entrenchment theory by Zweibel (1996), the effect of market timing actions on leverage by Baker and Wurgler (2002), the managerial inertia theory by Welch (2004), and finally dynamic trade-off tests where adjustment costs and various market realisms are incorporated into the model.

B2.2.1 Management entrenchment theory

Instead of modelling a shareholder-maximisation goal, Zweibel (1996) models managers' optimality and develops a capital structure model where managers optimally make leverage decisions to accomplish their empire-building desire. Cost-benefit analysis between managers' empire-building ambitions and adequate level of efficiency (to prevent unwarranted additional control) is performed when managers make financing decisions. High equity value allows managers to add equity to the firm, but simultaneously causes managers to be entrenched, thus resisting debt financing, even that necessary to restore the firm to the optimal leverage level. The management entrenchment theory is based on the agency theory where debt is used to constrain managers' behaviour. This new theory, however, casts some doubt on its own aptness since it implies an exploitation of existing equity holders rather than external new investors, thereby defying previous earnings management theory and studies (Baker and Wurgler, 2002).

B2.2.2 Market timing theory

The market timing theory by Baker and Wurgler (2002) postulates capital structure as "the cumulative outcome of firm's past attempts to time the equity market" (p.3). Firm's market timing activities have long-term impact on the debt-equity mix. Firms that seek funds when their market values are high eventually become lowly levered; while firms that raise funds when their market values are low become highly levered firms. Managers issue equity when they believe that current equity is overvalued, and this market timing behaviour is not reversed or undone by managers because it is costly to do so. Hence, deviation from the optimal capital structure is expected and the firm's debt-equity mix then becomes dependent on market timing activities which are the result of market value fluctuations.

Market timing theory is one of the few capital structure models that highlight the importance of the effect of the external capital market. Though not focusing on the capital market in terms of fund supply, market value of equity is taken into account and the latter incorporates investors' sentiment and equity valuation. In recent empirical papers on capital structure (Leary, 2009, Lemmon and Roberts, 2010), the availability of funds and capital market conditions are important in dictating capital structure. Some suggest the observed firm leverage to be a function of both the demand and supply of debt; hence, studying debt ratios using only the demand factors tends to overestimate leverage ratios because firms may be constrained in their access to the external capital market (Faulkender and Petersen, 2006).

B2.2.3 Managerial inertia theory

Welch (2004) finds that stock returns and stock return-adjusted historical capital structure are the best determinants in capital structure prediction. Welch's findings give support to Baker and Wurgler's (2002) market timing hypothesis of the long-term effect stock market fluctuations have on a firm's capital structure; but differ from previous research in focusing on firms' failure to readjust their leverage ratio subsequent to market value changes – managerial inertia. The strong correlation between lagged equity returns and leverage show that stock returns are the 'first order determinant' of leverage, and proxies used in past leverage models account for capital structure due to their correlation with stock price changes (Welch, 2004).

Welch (2004) further found that financing decisions are not made to reverse stock-induced debt-equity ratio changes, and firms were not found to rebalance their capital structures after major stock price movements, thereby concluding that stock return is the most important 'omitted dynamics' influencing capital structure. [50]

To sum up, Baker and Wurgler (2002) and Welch (2004) highlight the importance and impact of equity returns and variability on leverage decisions. However, as existing evidence remains mixed, this new focus requires more research to access the 'real' impact of stock prices and returns possibly in a dynamic framework with other endogenous variables affecting leverage. This leads us to the survey of dynamic capital structure models in the following section.

B2.2.4 Dynamic capital structure models

In a continuous-time framework, firms' financing behaviour is modelled in the dynamic framework using the expected financing requirement in the next period, coupled with other considerations for recapitalisation costs and differential tax

[50] Stock returns are *omitted* dynamics because they are generally not taken into account explicitly in conventional capital structure research.

treatment. Whilst the dynamic capital structure model has gained popularity only in the recent decade, it was first used in the 1980s in the firm valuation model of Brennan and Schwartz (1984) driven by debt tax incentive and agency costs. During the same period, Kane et al. (1984, 1985) model firms' financing decision-making using an option valuation framework where firm's financing policy is derived from the cost-benefit analysis using marginal cost of debt (i.e. bankruptcy costs) and marginal benefit of debt (which includes debt tax shield, extra rate of return and additional market premium over unlevered firms). Fischer et al. (1989) subsequently modelled firms' optimal leverage range as a function of firm-specific characteristics and recapitalisation costs.

Subsequent to the above key papers in the 1980s, various dynamic models have been developed and these can be conveniently categorised under the following (non-exhaustive) themes – (1) **asymmetric information and agency costs** (Boyle and Guthrie, 2003, Childs et al., 2005, Leland, 1998, Mauer and Ott, 2000, Mauer and Sarkar, 2005, Mello and Parsons, 1992); (2) **bankruptcy and corporate restructuring** (Goldstein et al., 2001, Leland, 1994, Leland and Toft, 1996, Strebulaev, 2007, Sundaresan and Wang, 2007); (3) **liquidity and financial constraint problem** (Boyle and Guthrie, 2003, Gomes, 2001, Hennessy and Whited, 2005); (4) **taxation** (Hennessy and Whited, 2005, Schuerhoff, 2004); (5) **adjustment and recapitalisation costs** (Flannery and Rangan, 2006, Leary and Roberts, 2005); (6) **real production and investment decisions** (MacKay and Phillips, 2005, Mauer and Triantis, 1994, Titman and Tsyplakov, 2007).

Over the years, researchers into capital structure developed the dynamic model by incorporating new elements and/or breaking away the restrictive assumptions in previous models. Since the late 1990s, development of the leverage models has exhibited a significant upward trend. However, prevailing models have varying focus and each has its own advantages over the others; however each presents an incomplete version of the capital structure model with at least one important feature absent.

Despite the emerging trend to incorporate diverse factors into the dynamic models of capital structure, Ju et al. (2005) return to the basics and develop a dynamic model that is solely based on the trade-off hypothesis of bankruptcy costs and debt tax shields, and the relatively straightforward model is able to exhibit outstanding predictive ability of firm's financing behaviour. This leads to a new school of thought that emerging capital structure research trying to incorporate too many factors that seemingly affect leverage decisions produces models that are too complex for practical application.

To seek the optimal balance between practicability and complexity, the next section reviews the capital structure models from another perspective and derives more important capital structure determinants from practitioners' opinions.

B2.3 Theory-practice gap of capital structure research

In spite of the extensive research into firms' capital structure, if one takes a step back and asks 'how useful are these theories to firms in practice?', the answer is unclear. While we ought to avoid denying the contribution of the capital structure theories to practitioners, it is not clear how these theories and the hard-fought debate in academia eventually turn into practical use in the imperfect world. This gap between theory and practice has long been recognised by researchers (Donaldson, 1961, Graham and Harvey, 2001, Pinegar and Wilbricht, 1989, Scott and Johnson, 1982, Trahan and Gitman, 1995); and these qualitative papers use interviews and survey results to bridge the theory-practice gap.

Evidently, most corporate finance research is quantitatively built on empirical tests or dynamic modelling using large samples of firms, with secondary data collected from reported financial statements and analysts' reports. During the recent decade, researchers have made use of the state-of-the-art techniques to simulate firms' financing decision making process alongside other corporate decisions. While these models excelled in statistical power and explained variability, they often have model specification weaknesses which could potentially be resolved using 'excellent qualitative details' from related clinical studies (Graham and Harvey, 2001).[51] These qualitative studies report some unique aspects of corporate behaviour from the practitioners' beliefs and views to complement statistical findings from previous quantitative models. It may be possible that, through this complement, more inference could be made from existing research findings; and more guidance could be extended to future capital structure research. Such 'non-conventional' research in corporate finance may be used as a tool to bridge the theory-practice gap. Trahan and Gitman (1995) suggested that the first step in closing the gap is to survey and communicate financial research needs of customers (financial practitioners) to researchers. Furthermore, gaining these views may help recognise previously unidentified yet important factors in financing decisions. The table below lists some examples of the clinical studies in corporate finance research.

[51] Clinical studies include case studies, interviews and surveys, etc.

Table B1 Examples of qualitative corporate finance research

Area of research	Examples of papers
Capital structure	Donaldson (1961), Scott and Johnson (1982), Pinegar and Wilbricht (1989), Trahan and Gitman (1995), Graham and Harvey (2001)[52], Banceland Mittoo (2004), Brounen et al. (2004), Campello, Graham and Harvey (2010), Campello, Giambona, Graham and Harvey (2011)
Capital budgeting	Gitman and Forrester (1977), Oblak and Helm (1980), Stanley and Block (1984), Sangster (1993), Pike (1996), Arnold and Hatzopoulos (2000), Ryan and Ryan (2002)
Cost of capital	Gitman and Mercurio (1982), Poterba and Summers (1995), Bruner, Eades, Harris and Higgins (1998)
Dividend policy	Baker, Farrelly and Edelman (1985), Bierman (1993)
Financial risk management	Bodnar, Hayt and Marston (1998), Block (1999)

The key findings from three of the capital structure surveys (Graham and Harvey, 2001, Pinegar and Wilbricht, 1989, Trahan and Gitman, 1995) highlight problems of current capital structure theories and models. According to the responses of practitioners, a capital structure model with realistic assumptions is needed. This model should be easy to understand and explained to top management and, at the same time, easy to apply with inputs that are readily available or can be easily estimated. It would be ideal if informal criteria such as financial flexibility and credit ratings could be considered for debt issuance models. Furthermore, financial planning principles may be included in guiding firms' refinancing decisions. Models of new financing that consider firms' marginal asset performance are of interest to practitioners in relation to their financing decisions. Finally, and most important of all, as investment and dividend policies are generally more binding and less flexible than capital structure decisions, the former should be considered when deriving the ultimate capital structure model.

[52] It may be also useful to note that Trahan and Gitman (1995) and Graham and Harvey (2001) covers not only capital structure issues but attempts to consider the important corporate finance issues that span over and beyond the above five categories.

Although it may be argued that such surveys represent beliefs and not necessarily actions, they should not be ignored since practitioners are the ultimate consumers of all finance research. Just as the frontiers of knowledge in corporate finance continue to expand at a fast rate, academic research results are of great worth in solving practical financing problems faced by firms if they are presented in an applicable and realistic manner (Jensen and Smith, 1984). Hence, the main aim of this thesis is to test and present the findings of the most important practical determinant of capital structure to fill a gap in capital structure research. The next section presents a detailed review the practical determinants of leverage, and reassesses the theoretical and research effort made on these determinants.

B2.4 Practical determinants of capital structure

As mentioned, practical determinants of capital structure have been in the light since the survey of 392 CFOs of the top US corporations by Graham and Harvey (2001). There have been surveys done in a similar respect in the European context (Bancel and Mittoo, 2004, Brounen et al., 2004) aiming to reinforce or to tease out cross-country differences in the practice of corporate finance. The top four debt policy factors from Graham and Harvey (2001) are (1) Financial flexibility (60%), (2) Credit rating (57%), (3) Earnings and cash flow volatility (47%), and (4) Insufficient internal funds (46%). All top four factors are related to firms' liquidity, cash flow and the ability to secure future funds. Similar importance of liquidity factors are found in the other two surveys. However, whilst the cost of debt (interest rate) ranked fifth in the pioneering survey, subsequent surveys highlighted the importance of tax deductibility of debt interest with higher ranks. Both factors are tied to the conventional trade-off theory in determining the optimal debt ratio.

Further support is given to the trade-off hypothesis when more than 80% of the US practitioners surveyed had target debt level (either a flexible, range, or fixed ratio) in mind when making capital structure decisions (Brounen et al., 2004, Graham and Harvey, 2001). The percentage falls to between 60% and 75% in the European context in the latter survey. Nonetheless, we may say that more than 60% of firms make leverage decisions with target debt level in mind. The evidence indicates that theoretical factors of capital structure remain largely important and should not be forsaken given the rise of practical constraints faced by practitioners. Instead, capital structure theories and research should be modified accordingly taking into account practicality to better predict firms' financing behaviour.

In reviewing the research on financial flexibility (hereafter denoted as FF), care has to be taken on whether the model tests solely on pecking order theory because some authors explicitly separate the impact of FF from the pecking order theory, while many combine them into a single proposition. The existence of financial slack due to the pecking order hypothesis of adverse selection problem should clearly be distinguished from managers' demand for FF because the latter demand was statistically more important for dividend-paying firms with little information asymmetry problem, thereby refuting the pecking order imperfect information theory (Graham and Harvey, 2001).

However, it is noted that there is no exact definition for 'financial flexibility', or it should be better said that there is no exact or fixed measure for it because different studies placed focus on various proxies for flexibility. As mentioned, some have classified FF as part of the pecking order theory test. The two most common proxies or variables used to measure FF are cash-on-hand and leverage in terms of spare/unused debt capacity. In general, cash holdings and cash flow are used to assess firms' ability to meet downside risk, while leverage and debt capacity are used in appraising firms' performance through their investment ability at the upside. Past studies examine cash and leverage separately and little is known about the interaction between the two most important components of FF. Although there are different proxies used to measure flexibility and many theories covering flexibility partially in their hypotheses or assumptions, there is no single definite definition and measure of it. Nonetheless, financial flexibility is clearly part of a firm's liquidity and financial risk and an important determinant of capital structure.

Defining FF is the most important initial task in this thesis; after which the measure(s) of FF will be discussed. FF relates to a firm's overall financial structure and whether there is sufficient flexibility to take advantage of or counter unforeseen opportunities or conditions. Gamba and Triantis (2008) define FF as the "ability of a firm to access and restructure its financing at a low cost; these firms are able to avoid financial distress in the face of negative shocks, and to fund investment readily when profitable opportunities arise." A similar definition is used by Byoun (May 2008) where it is the "firm's capacity to mobilize its financial resources in order to take preventive and exploitive actions in response to uncertain future contingencies in a timely manner to maximise the firm value." It is important to note that flexibility covers both *upside* and *downside* risks because valuable options are preserved by firms at each time period in order to cope with both positive and negative unforeseen events in the future.

Using the general flexibility definition discussed above, FF here encompasses a broader meaning that concerns firm's financial policies. FF measures the ease at which a firm obtains its required funding; and the cost of acquiring funding in present and future not only includes direct cost of debt or equity but includes opportunity cost, signalling cost, etc. FF is, thus, an optimal balance of the external and internal flexibilities of a firm, and at any single point in time giving a firm the flexibility to deal with both upside and downside risks. Here, ***external flexibility*** refers to the ease of access, liquidity and cost of the firm's financial instruments in the bond and equity market, thus giving inference to firm's external capital market capacity and credit supply constraints. Contrasted with internal liquidity, external constraints are governed by factors not wholly within the control of managers. On the other hand, ***internal flexibility*** includes firm's *liquid assets and cash holdings*, and *debt capacity* (which has been in the light of capital structure research in recent years)[53]; and this internal component is influenced by the volatility of cash and earnings, and managerial discretion and preference over a firm's liquidity position. In short, external flexibility measures the supply condition of firm's credit dictating a firm's external capital capacity, while internal flexibility represents the internal capacity deliberately preserved for future use.

This study aims to investigate the interaction between FF and capital structure, i.e. whether capital structure decisions are affected by FF position of firm, and whether leverage and FF decisions are made jointly. By exploring the relationship between flexibility and capital structure, the study examines how capital structure is affected by both (i) firm's internal asset structure, which is closely related to debt capacity, and (ii) firm's external liquidity which signals its capacity in the equity capital market. The two conventional theories of capital structure – the pecking order and the trade-off models will be used as the base model to examine the impact of FF on capital.

[53] Proxies or measures of debt capacity include lagged leverage level, total assets, financial distress measures, and financial constraints index, e.g. Whited and Wu (2006).

Recent studies (e.g. Leary, 2009, Lemmon and Roberts, 2010) used the high cost of switching to explain the observed persistence in capital structure found in Lemmon et al. (Lemmon et al., 2008) – because the net cost of switch for most firms is high, highly levered firms are observed to continue to issue more debt and remain highly levered for substantially long periods of time. Lemmon and Roberts (2010) find that firms significantly modify their financing and investment decisions following a change in supply shock in their specific capital market; and a contraction in credit supply in the debt market leads to a consequent reduction in debt use with no substitution to alternative sources of funding. [54] This suggests firms' heavy reliance on a single source of credit that partly explains the leverage persistence effect observed empirically. Questioning firms' strong dependence on a particular capital market, the high cost of switching due to transaction costs may only explain part of the reliance. As transaction costs form only a small proportion of the total capital sought in each market, these costs by themselves do not explain firms' reliance totally. Rather, firms' leverage persistence and reliance on specific capital market may be largely due to their core asset structure that determines fundamental debt capacity, where debt is collateralized using firms' tangible assets. Whilst asset structure determines firm's primary debt capacity, the firms' ability to substitute debt with equity remains reliant on their flexibility position in the equity market and, therefore, the lack of substitution observed may be due to firms' incapacity to do so and not their unwillingness to alternate between different sources of financing.

[54] Lemmon and Roberts (2007) investigate the response of financing and investment decisions from a change in supply of credit.

CHAPTER B3. MEASURING FINANCIAL FLEXIBILITY

B3.1 Internal flexibility: Cash and debt capacity

Internal flexibility comprises of two main components – (1) liquid assets and cash holdings, and (2) unused debt capacity. Inflexibility is caused by the existence of issuance costs, distress costs and financing constraints (mainly a result of asset tangibility) because these costs cause firms to face difficulty or higher costs in seeking external funds when internal funds are insufficient in bad times or for unexpected growth opportunities. Flexibility, however, cannot be attained by holding large internal funds because there are both agency costs and tax disincentive in holding cash.[55] Furthermore, there is an opportunity cost of cash since greater cash holdings reduce current positive investment (Almeida et al., 2004). In addition, evidence on preserved unused debt capacity is found in Sufi (2009), where firms have unused lines of credit twice the size of existing credit.

Here, debt capacity is measured as the maximum borrowing capacity of a firm, estimated by the value of its assets in liquidation. Since debt capacity and optimal debt levels are constrained by asset illiquidity, the redeployability of assets in times of distress here measures assets liquidation value (i.e. capacity to command additional debt) instead of the usual accounting measure of tangible assets. Debt capacity is proxied using a firm-level measure of expected asset liquidation value

[55] There is tax disincentive to holding cash because interest on cash is taxed at a (higher) corporate level rather than personal level, (Gamba and Triantis, 2006); and the tax costs involved in repatriating foreign income are considerably higher (Hatzell et al., 2006).

from Berger et al. (1996), and used in Almeida and Campello (2007) and Hahn and Lee (2009).[56]

Debt capacity, DC = Tangibility/Total assets

= [0.715*Receivables (RECT[2]) + 0.547*Inventory (INVT[3]) + 0.535*PPE (PPENT[8])] / (AT[6]) [57]

Cash plays a vital role in dictating total internal capacity and is found to have an important relationship with debt capacity in Part A. However, cash is an imperfect substitute of debt capacity (Bates et al., 2009, Sufi, 2009). Nevertheless, it gives flexibility to firms with differential access to external markets and different levels of risks. Whilst there have been numerous studies on the cash-holding policies of firms and the definition and value of cash are straightforward, there is no research studying how cash together with other liquidity aspects affects a firm's capital structure. In a recent paper by Bates et al. (2009), a dramatic two-fold increase in the average cash ratio for the period 1980 to 2006 is found in the US.[58] Precautionary motive to hold cash is the most important determinant of demand of cash because "firms face many risks that they cannot hedge or are reluctant to hedge with derivatives", (Bates et al., 2009). In part A, cash is dependent on level of debt capacity a firm owns; and this relationship is robust after taking into account other firm variables, and industry

[56] The previous two papers (Hahn and Lee, 2009, and Almeida and Campello, 2007) use the tangibility measure of existing assets as a proxy for tangibility of new investment. Rather than using the measure as a proxy, it is implicitly assumed here that it is, in fact, the tangibility of existing assets that matters because they provide collateral for total firm debt. In the initial measurement, cash variable is added into the basic measure of three variables with coefficient one because it represents a liquid asset that can be seized or recovered fully when a firm is liquidated.

[57] The initials beside each parenthesis represent the variable labels in the CRSP/Compustat Fundamentals Annual database and its relevant item number in the square brackets. Many past papers use the *Industrial* Annual instead of *Fundamentals* Annual database, and represent data items using numbers, e.g. long term debt = Item 9 + Item 34 and total assets = item 6. The variable item number is no longer updated and used by CRSP and Compustat after fiscal year 2006, when the sample data are extracted from the Fundamentals Annual database in the Xpressfeed format. As such, relevant variable labels are documented alongside with their old data item numbers. It should be noted that after the change in variable identification, there are some variables which are no longer available as they are combined with other items in the financial statements. Similarly, there are additional new variables which were conventionally reported as part of the variable in the old format, now reported separately as individual items.

[58] The four main reasons documented for such significant increase is the fall of inventories and capital expenditure, and increase in cash flow risk and research and development expenses.

effects. Furthermore, debt capacity replaces previous empirical determinants of cash to be the most important determinant of cash.

As shown in Figure B1, from 1970 onwards cash holdings exhibit a continuous increasing trend (also observed in Bates et al., 2009) until the recent one financial year (2008) due to the credit crisis. At the same time, debt capacity is found to exhibit a decreasing trend. However, average leverage remains rather stable, between 25-30% of total assets except for the slight dip after the 1997-1998 financial crisis and surge in the early 2000s. Evidence shows that cash is used as a substitute for debt capacity to maintain an optimal internal flexible position.

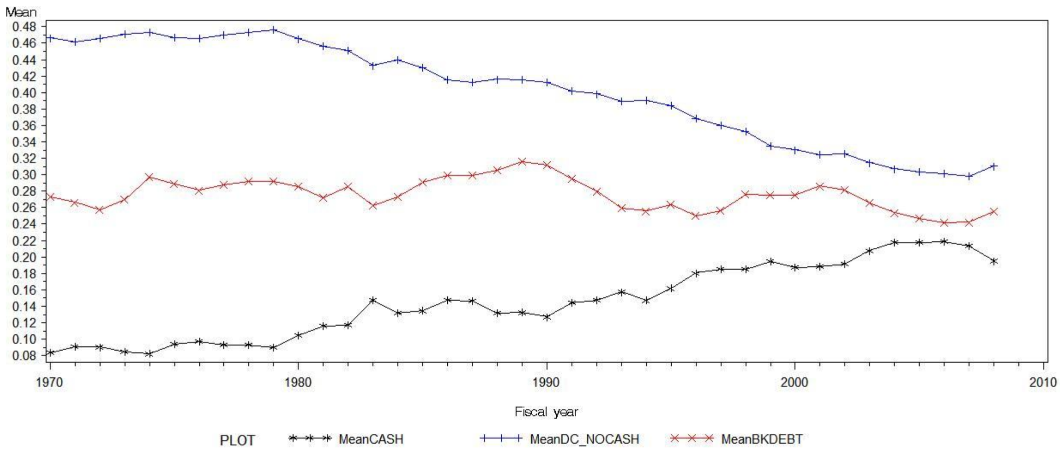


Figure B1 Average cash holdings, debt capacity, and debt to total assets, 1970-2008.

This figure shows the average cash holdings, debt and debt capacity variables plot over time from 1970 to 2008. All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Cash is the ratio of cash holdings and marketable securities to total assets. Debt is the sum of long term debt and debt in current liabilities to total assets. Debt capacity is the ratio of the ratio of (0.715*Receivables + 0.547*Inventory + 0.535*PPE) to total assets; and unused debt capacity is debt capacity less debt only computed when firms report a positive debt capacity. Cash, debt and debt capacity ratios are censored at [0,1] where ratio more than one is made equal to one.

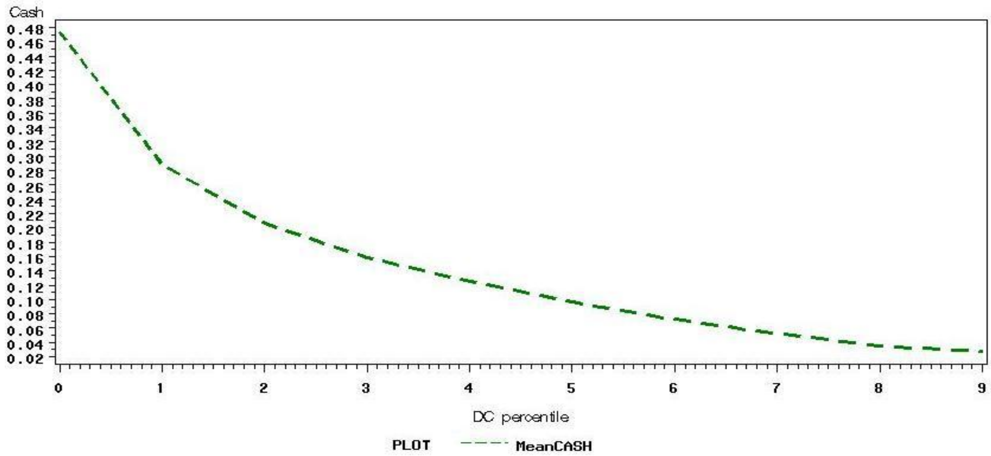


Figure B2 Average cash holdings in each deciles of debt capacity to total assets, 1950-2008.
This figure plots the average cash holdings of firms in each debt capacity percentile, where firms are ranked in ten groups according to their debt capacity level. Sample and variable specifications are reported in Figure B1.

Firms balance debt and cash holdings with the aim of achieving optimal internal flexibility. This internal component is directly influenced by its external counterpart that measures firms' external capital market capacity because firms with low debt capacities may not hold more cash if they can have easy access to external funds, subjected to the assumption that external funds are quickly and readily available when needed. As such, the internal substitution between cash and debt capacity may be influenced by the external flexibility – firms with high external flexibility will experience lower 'internal substitution effect', and vice versa.

B3.2 External flexibility measures: Debt and Equity market measures

Higher liquidity in equity and bond markets lowers the need for preserving flexibility internally (i.e. unused debt capacity). However, there are only a handful of papers examining the relation between equity liquidity and capital structure (e.g. Frieder and Martell, August 2006, Lesmond et al., March 2008, Lipson and Mortal, 2009). For bond liquidity, Kahl et al. (April 2008) provide evidence of the commercial paper market used by firms to enhance flexibility. In addition, credit rating is a major determinant of capital structure because firms are found to target credit rating and make use of debt to target a specific rating (or at least a minimum rating) Kisgen (2006).[59]

Previous studies of capital structure and FF (e.g. Byoun, May 2008, Denis and McKeon, March 2012) focuses mainly on firms' (internal) own demand for flexibility trading off value of flexibility with tax disincentive of cash, agency costs and opportunity cost of debt. This internal demand has to be matched with external conditions of the credit market to obtain the net value of flexibility. The external component of FF is measured in terms of (1) bond and commercial paper market access and liquidity, and (2) equity market cost and liquidity.

Examining the impact of FF with both internal and external conditions makes more sense since artificially preserving debt capacity internally without external availability of funds has no value. The role of excess debt capacity preserved becomes a questionable form of flexibility and has no true value unless these funds are readily sought and available when needed. Furthermore, shocks to specific capital markets have different impact on firms, especially when access from one market to the other (e.g. private to public debt market) is not straightforward, (Faulkender and Petersen, 2006). In other words, substituting from one capital source to the other is limited (Lemmon et al., 2008) and this implies that external capital market considerations are more important in capital structure research than the current attention given to them. Recent empirical evidence supporting the importance of source of capital and access to capital markets are found in Leary (2009), Faulkender and Pertersen (2006), and Kisgen (2006).

[59] Higher credit rating translates into direct benefits for firms in future, including (1) an expanded pool of eligible investors, (2) lower cost of debt due to signalling effect and having access to commercial paper market, (3) more favourable terms with other stakeholders and (4) the prevention of triggers and debt covenants.

B3.2.1 Debt market measures

Although it is reasonable to consider both debt and equity market factors as equally important in determining external flexibility, there are particular characteristics of the debt market which make its measurement more straightforward yet flawed. Ideally, the flexibility in getting funds from the bond market is measured by the access to market, the cost of issuing bonds and, lastly, the liquidity of debt instruments. In practice, access to market, measured using long-term credit rating, by itself is capable of measuring the probability of firm going into the bond market. First, a firm’s rating-targeting behaviour proves the firm’s effort in protecting its source of funds through maintaining its credit rating (Kisgen, 2006). Second, as a high proportion of debt issued is not traded (through an exchange), the cost and liquidity of debt measured using exchange traded bonds are not indicative of the entire population because the spread and volume of data of these privately exchanged issues are not available. Third, bonds are usually held by a small number of large institutional investors that intend to buy-and-hold rather than to buy-and-trade (Frieder and Martell, August 2006). Finally, Frieda and Martell (August 2006) suggest that because debt has a fixed income stream and is subjected to less adverse selection problems, the effect of higher liquidity on raising debt through better access is relatively smaller compared to the effect of equity liquidity on an equity issue. Taken together, the above points prove that it may suffice to measure bond market availability through a firm’s credit rating alone.

Furthermore, according to Faulkender and Petersen (2006) the high correlation between debt rating and issuance of public debt is proven in their study and evident in past research (Cantillo and Wright, 2000, Houston and James, 1996).

Thus, numeritized long term credit rating is used to measure firms' access to the public debt market. Whilst Byoun (May 2008) rank credit ratings into groups of seven, in this thesis a second numeritized variable is created by assigning a different rank for each rating level. [60] This is because maintaining rating level is important to firms and any rating change will mean a significant change in the cost and availability of funding, as such firms are found to target specific credit rating and avoid any rating change (Kisgen, 2006). In a similar manner, short-term commercial paper rating is numeritized using increasing rank for each rating level.[61]

Although credit rating is a straightforward and convenient measure of firms' ability to issue public debt, it is not without flaw. First, usage of credit rating eliminates the early observations prior to 1985, since ratings are only available from year 1985 onwards. Second, credit rating biases the sample towards larger and more reputable firms because younger and smaller firms generally do not have good credit standing. This potentially leads to a bias towards mature firms. Third, credit rating measures firms' ability to issue public debt and does not consider private debt or bank debt. This narrows the measurement of debt access towards public debt and eliminates consideration to the most convenient and commonly used bank debt market. The above shows that credit rating may not be suitable for all analysis. With this in mind, it may be useful to first consider bond and equity measure separately for the external flexibility index construction and further tests of capital structure.

[60] In Byoun (2008), S&P Long-term credit rating (item number 280) is numeritized as follow: Rating AAA: 7, Rating AA+ to AA-: 6, Rating A+ to A-: 5, Rating BBB+ to BBB-: 4, Rating BB+ to BB-: 3, Rating B+ to B-: 2, All other ratings: 1, Missing or no rating: 0. Values 4 to 7 represent investment grade firms, while values less than 4 represent non-investment or junk bonds. In this paper, long-term credit rating is ranked from 0 to 21 for each level of rating, where 0 represents missing rating (NM and NR), defaulted (D) or selectively default (SD) firms, 1 is for rating 'C', 2 for rating 'CC', 3 for rating 'CCC-', 4 for rating 'CCC', 5 for rating 'CCC+', and in a similar respect up to 21 for rating 'AAA'.

[61] Short-term credit rating is ranked from 0 to 10 for each level of rating, where 0 represents missing rating or defaulted (D) firms, 1 is for selective default (SD) firms, 2 for rating 'C', 3 for rating 'B-3', 4 for rating 'B-2', 5 for rating 'B-1', 6 for rating 'B', 7 for rating 'A-3', 8 for rating 'A-2', 9 for rating 'A-1, and 10 for rating 'A-1+'.

B3.2.2 Equity market measures

In general, equity liquidity depends on the intensity of asymmetric information about the value of the underlying asset. Other determinants of liquidity include inventory and order-processing costs (Bharath et al., 2009). At the firm level, the firm's financial health and performance is a major determinant of liquidity since it affects investors' confidence. As Liu (2006) suggests, firms themselves may be the cause of illiquidity of their equity; and liquidity risk may even be capable of capturing default premium – similar to the hypothesis on how solvency constraints result in liquidity risk (Chien and Lustig, 2010).

The relation between equity liquidity and leverage has been examined by relatively few researchers compared to the considerable research in capital structure. Liquidity is negatively related to leverage (Lipson and Mortal, 2009, and Frieda and Martell, 2006) due to lower issuance cost, since more liquid equity is subjected to lower bank charges and the time to complete a seasoned equity offering is shorter (Weston et al., 2005). Higher equity liquidity is related to lower information asymmetry. In the market microstructure literature, liquidity measures (e.g. bid-ask spread, trading volume, volatility) are used as proxies for the extent of adverse selection between informed and uninformed traders (Bharath et al., 2009). As such, lower information asymmetry results in higher equity liquidity and lower cost of equity, and thereby greater (less) use of equity (debt) by firms. Furthermore, firm's ability to raise external capital is affected by its equity liquidity (Weston et al., 2005). Supporting this, Bharath et al. (2009) provide evidence that highly levered firms have lower liquidity in the equity market; and Lipson and Mortal (2009) find that liquid firms have higher probability in issuing equity (compared to debt) when raising external capital. On the other hand, there might be a reverse relation due to the effect of leverage on equity liquidity. Lesmond et al. (March 2008) found that leverage explained more than 20% of the variation in liquidity costs, and concluded that increased debt use will eventually reduce equity liquidity.

Empirical evidence on the bi-lateral relationship between leverage and liquidity is important because it identifies a crucial missing piece in capital structure research. Liquidity is assumed to have an effect on leverage largely due to the presence of adverse selection costs owing to information asymmetry. Thus, liquidity is an important determinant of leverage. However, a recent study (Bharath et al., 2009) finds that a difference in degree of information asymmetry does not seemed to impact firms' leverage decisions as much as it did in earlier years (1970s and 1980s). As noted in Bharath et al. (2009), evidence of increasing equity issue is provided by Fama and French (2005) where firms find increasing ways to issue equity (e.g. through mergers, private placements, convertible debt, warrants, direct purchase plans, rights issues and employee options, grants, and benefit plans) while avoiding adverse selection costs. In another recent study (Leary and Roberts, 2010), measures of information asymmetry and agency costs (incentive conflicts) are separated, and incentive conflicts are the main driver of financing hierarchy behaviour. On a theoretical note, this means that the financing hierarchy suggested by the pecking order theory has become less applicable in recent years; unless when additional determinants of leverage from other theories (e.g. trade-off) are included, then the pecking order together with other conditional theories are able to explain up to 80% of financing behaviour, (Leary and Roberts, 2010).

In practice, liquidity and cost of equity issue include not only adverse selection costs, but floatation costs, SEO discounting and underpricing. As mentioned, liquidity is a broad concept and the resultant measure of many factors.

Although it is true that information asymmetry does affect liquidity, the latter is a broader concept with measurement partly determined by information problems.

In the informational asymmetry literature, some of the direct measures of information asymmetry are quoted and effective proportional bid-ask spreads, the probability of informed trading (PIN) and the relation between daily volume and first-order return autocorrelation (Bharath et al., 2009). Although these proxies are derived from liquidity measures, they are adjusted to specifically identify the effect of costs of adverse selection, and differ from the conventional broader measures of liquidity. Bharath et al. (2009) combined four measures of information asymmetry and three proxies to form a measure of information asymmetry, and use this measure to test the conventional pecking order model.

In the liquidity literature, there are a number of alternative measures of liquidity, each potentially measuring certain aspect of liquidity. This has prompted some studies to combine these measures to derive a combined measure or consider various measures jointly (2001, Korajczyk and Sadka, 2008). To cover various aspects of the equity market, equity flexibility is measured using (1) Hasbrouck's modified Roll estimate for equity costs, (2) Amihud's price impact measure, (3) Liu's trading discontinuity measure, and (4) Turnover ratio.

First, Hasbrouck (2009) finds the modified Gibbs sampler of the Roll model the best indirect (versus the direct TAQ measure) measure of effective trading cost. The effective cost of equity is estimated from the Basic Market-Adjusted model as: Modified Roll estimate, $BMA_{it} = \sqrt{-cov(\Delta p_{i,t}, \Delta p_{i,t-1})}$.[62] Accordingly, the estimate uses days on which trading occurs only and is set to zero if auto-covariance is positive. The Hasbrouck measure of equity cost is estimated at the end of each

[62] We thank Joel Hasbrouck for generously providing the Gibbs estimates of effective cost data for the sample period up to 2006.

calendar year using daily price data over the previous 12 months. For firms with fiscal year end month other than December, the modified Roll estimate takes the previous year's value.

Second, Amihud's (2002) measure of illiquidity is found to be the best measure of price impact (Hasbrouck, 2009). The price impact measure, computed as the daily absolute-return-to-dollar-volume ratio averaged over the prior 12 months (over one year for annual measure) with non-zero volume, is used. Following Bharath et al. (2009) and Lipson and Mortal (2009), year is defined as firm's fiscal (accounting) year period so market liquidity data match the accounting data measurement period.

Third, Liu's (2006) trading discontinuity measure is the standardized turnover-adjusted number of zero daily trading volumes over the prior 12 months. The trading discontinuity estimate measures the probability of no trade, namely, the frequent absence of trading indicates illiquidity. This measure captures multi-dimensions of liquidity such as trading costs, trading quantity, and trading speed, with particular emphasis on the latter.

Finally, turnover ratio computed as average daily turnover over the prior 12 months, where daily turnover is the ratio of the number of shares traded on a day to the number of shares outstanding on that day. The construction of the final three measures of liquidity requires the availability of daily trading volumes in the prior 12 months.

Table B2 reports the summary statistics for the flexibility variables defined above over the sample period 1970-2008. Due to data availability, credit rating is not available prior 1985. Liquidity variables for NASDAQ firms have limited availability prior 1983, and Hasbrouck's measure is only available up to 2006.

Therefore, summary statistics are computed according to the years data are available for each variable. For equity measures, NASDAQ firms are reported separately from NYSE and AMEX firms because of the difference in trading system, and corresponding differences in liquidity characteristics.

According to Table B2, the pooled statistics and the cross-sectional statistics do not differ much for the entire sample – indicating that there is no significant year-to-year change in these characteristics. On average, firms hold about 16% and 39% of total assets as cash and debt capacity respectively. Deficit is average at about 7% of total assets. An average firm has a non-investment grade or no long-term and short-term credit rating. Comparing NASDAQ and NYSE/AMEX firms, NASDAQ firms generally have lower liquidity but higher turnover in the equity market. Furthermore, NASDAQ firms have lower credit rating compared other exchanges.

When firm characteristics are analysed over different periods, some obvious trends are observed. First, cash increases significantly over time from 9% to 23% of total asset. Debt capacity to total asset falls from 47% to 30%; and cash flows exhibit a decreasing trend. Similar trends are displayed in Figure B3e and B3f. Notably, the fall in cash flows does not negatively impact cash holdings of firms; on the other hand, firms hold greater cash even though profitability falls. Deficit to total asset increases from 3% to 8%. Both long-term and short-term credit rating increases over time for all firms regardless of the exchange (see Figure B3c and B3d). This indicates an increase in access to public debt market by firms. For equity measures, firms in all three exchanges report increasing equity liquidity and turnover, but the magnitude of increase is larger for NASDAQ firms.

Table B2 Summary statistics of flexibility and firm variables for period 1970 to 2008

This table reports time-series (pooled) and cross-sectional summary statistics for firms in period 1970 to 2008. All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Cash is the ratio of cash holdings and marketable securities to total assets. Debt capacity is the ratio of the ratio of (0.715*Receivables + 0.547*Inventory + 0.535*PPE) to total assets. Cash flow computed using earnings method (CFe) is the ratio of the sum of earnings less interest, tax and common dividend to total assets computed according to Bates et al. (2009). Net cash flow computed based on cash flow method (CFcf) is the ratio of net cash flow to total assets, computed according to Frank and Goyal (2009). Deficit is computed as the sum of total dividend, net investment, change in working capital and net cash flow. Deficit is winsorized at the top and bottom 1%. Cash flow (CFe and CFcf) are winsorized at the bottom 1%. Cash and debt capacity ratios are censored at [0,1] where ratio more than one is made equal to one. Long-term credit rating (Ltrating) is a numeritized long-term S&P credit rating of firms following Byoun (May 2008) as follow: Rating AAA: 7, Rating AA+ to AA-: 6, Rating A+ to A-: 5, Rating BBB+ to BBB-: 4, Rating BB+ to BB-: 3, Rating B+ to B-: 2, All other ratings: 1, Missing or no rating: 0. Alternative long-term credit rating (Ltrating1) is a numeritized long-term S&P credit rating of firms taking values 0 to 21 for each rating grade. Short-term credit rating (Strating) is a numeritized short-term S&P credit rating of firms following: Rating A-1: 9, Rating A-2: 8, Rating A-3: 7, Rating B: 6, Rating B-1: 5, Rating B-2: 4, Rating B-3: 3, Rating C: 2, All other ratings: 1, Missing or no rating: 0. Liquidity variables specifications are reported in Chapter B3.2.2. Cross-sectional statistics are mean of the variables taken yearly, and pooled statistics are computed using the entire sample as a whole. Rating variables start from 1985 onwards, liquidity variables for NASDAQ firms start from 1983 onwards, Hasbrouck measure (BMA) is not available for 2007 and 2008, and the rest of the variables are computed from 1970 to 2008. Number of firms, N, for cross-sectional statistics is the average number of firms recorded in each year over the sample period.

Summary statistics for sample period 1970-2008							
	Time series (pooled) statistics			Cross-sectional statistics			
Internal flexibility measures	Mean	Median	Std dev	N	Mean	Median	Std dev
CASH	0.157	0.073	0.198	3825	0.153	0.081	0.177
DC	0.392	0.430	0.141	3760	0.398	0.419	0.120
Cfe	0.006	0.061	0.226	3827	0.011	0.060	0.194
CFcf	0.047	0.091	0.211	3781	0.051	0.091	0.189
LTRATING	0.656	0.000	1.486	2589	0.667	0.000	1.487
LTRATING _ALT	1.455	0.000	4.075	3827	1.346	0.000	2.970
STRATING	0.346	0.000	1.705	3827	0.318	0.000	1.265
DEF	0.069	0.017	0.249	3781	0.064	0.018	0.229
External flexibility measures (NASDAQ)							
Hasbrouck measure: BMA (%)	1.896	1.275	1.953	2005	1.787	1.319	1.595
Amihud measure: RTOV12 (millions)	11.052	0.605	77.148	2339	10.924	1.090	59.770
Liu measure: LM12	23.523	0.996	45.373	2301	23.584	5.601	38.840
Turnover: TO12 (%)	0.623	0.364	0.881	2301	0.619	0.413	0.725
LTRATING	0.174	0.000	0.708	2636	0.180	0.000	0.709
LTRATING _ALT	0.443	0.000	2.054	2636	0.607	0.000	2.343
External flexibility measures (NYSE & AMEX)							
Hasbrouck measure: BMA (%)	0.814	0.467	1.022	1544	0.866	0.520	1.005
Amihud measure: RTOV12 (millions)	4.510	0.159	28.526	1576	4.937	0.341	23.309
Liu measure: LM12	8.968	0.000	23.820	1476	9.093	0.256	22.389
Turnover: TO12 (%)	0.290	0.171	0.402	1476	0.331	0.262	0.305
LTRATING	1.522	0.000	2.025	1511	1.525	0.000	2.017
LTRATING _ALT	2.436	0.000	5.186	1511	4.971	0.000	6.469

Table B3 Summary statistics of flexibility and firm variables over different periods

This table reports the summary statistics of flexibility and firm variables for firms in different periods, 1970s 2000s, where firms from 1970 to 1979 will be under period 1970s. Sample and variable specifications are reported in Table B2.

Internal flexibility measures/Period		1970s	1980s	1990s	2000s
CASH	Mean	0.087	0.137	0.171	0.225
	Median	0.055	0.068	0.075	0.127
DC	Mean	0.474	0.432	0.373	0.300
	Median	0.493	0.465	0.403	0.307
Cfe	Mean	0.066	0.002	-0.005	-0.028
	Median	0.069	0.053	0.063	0.058
CFcf	Mean	0.107	0.063	0.024	0.011
	Median	0.109	0.098	0.081	0.077
LTRATING	Mean	.	0.570	0.598	0.791
	Median	.	0.000	0.000	0.000
LTRATING _ALT	Mean	.	0.978	1.956	2.599
	Median	.	0.000	0.000	0.000
STRATING	Mean	.	0.297	0.489	0.510
	Median	.	0.000	0.000	0.000
DEF	Mean	0.027	0.057	0.101	0.075
	Median	0.026	0.017	0.017	0.009
External flexibility measures (NASDAQ)		**1970s**	**1980s**	**1990s**	**2000s**
Hasbrouck measure: BMA (%)	Mean	2.333	1.883	2.300	1.162
	Median	1.972	1.452	1.653	0.788
Amihud measure: RTOV12 (millions)	Mean	29.750	13.820	14.259	4.242
	Median	29.750	1.860	0.883	0.071
Liu measure: LM12	Mean	.	40.331	25.853	7.174
	Median	.	12.000	2.000	0.000
Turnover: TO12 (%)	Mean	.	0.273	0.609	0.914
	Median	.	0.188	0.395	0.596
LTRATING	Mean	.	0.123	0.144	0.253
	Median	.	0.000	0.000	0.000
LTRATING _ALT	Mean	.	0.235	0.484	0.849
	Median	.	0.000	0.000	0.000
External flexibility measures (NYSE & AMEX)		**1970s**	**1980s**	**1990s**	**2000s**
Hasbrouck measure: BMA (%)	Mean	1.015	0.823	0.919	0.669
	Median	0.651	0.494	0.474	0.380
Amihud measure: RTOV12 (millions)	Mean	8.368	2.988	4.841	3.435
	Median	0.840	0.157	0.044	0.006
Liu measure: LM12	Mean	12.166	8.362	10.481	5.362
	Median	0.996	0.000	0.000	0.000
Turnover: TO12 (%)	Mean	0.136	0.233	0.306	0.666
	Median	0.099	0.187	0.235	0.492
LTRATING	Mean	.	1.375	1.477	1.663
	Median	.	0.000	0.000	0.000
LTRATING _ALT	Mean	.	2.105	4.804	5.431
	Median	.	0.000	0.000	0.000

B3.3 External Equity Flexibility index construction

For the purpose of this thesis, an external equity flexibility (EEF) index is constructed to assess a firm's position in the equity capital market. This measure includes all equity measures chosen as proxy for firms' flexibility position in the equity market. As seen from the Spearman rank correlation matrices in Table B4, all the variables exhibit substantial correlation with each other.[63] Time-series plots of the variables show similar moving time trends (see Figure B3). The Hasbrouck measure of equity cost and turnover exhibits an increasing trend. As expected, the turnover measure shows greater volatility compared to the equity cost estimate. Liu's illiquidity measure and Amihud's measure of price impact exhibit similar trends over time. This means that there is a high potential that a single common component can be extracted from the characteristics of the equity variables. Thus, following Bharath et al. (2009), the Principal Component Analysis (PCA) method is performed on selected variables to derive a single joint component that explains the maximum variance of the variables, i.e. the variance of flexibility. It is a simple and non-parametric variable reduction tool that works well for a large sample when variables are highly correlated, subjected to the underlying assumptions.[64] From Table B2, liquidity price impact (RTOV12) and illiquidity (LM12) are heavily skewed to the right with large standard deviation. This is due to the nature of the measurements. As the PCA requires normality assumption for all variables, the above two variables are

[63] Spearman ranking is performed on the standardized variables over the whole sample and each year (means of the correlations computed for yearly correlation) are reported in Table B4 Panel A and B respectively. The variables are standardized to ensure the scale of measurement is consistent as the liquidity measures, ratings and accounting ratios have different scales of measurement. As the credit ratings are only available after 1985, Spearman ranking is performed separately for the two rating variables after fiscal year 1985, while the correlations for the other variables are reported on the entire sample from 1950 to 2008.

[64] Assumptions for PCA include the following: (1) An interval or ratio level measurement scale, (2) Random sampling, (3) Linear relationship between observed variables, (4) Normality assumption for each observed variable, and (5) Bivariate normal distribution for each pair of observed variables.

transformed by taking the square root of all observed values.[65] To ensure the normality assumption is not violated due to the differences in the scale of measurements[66], all variables are standardized with cross-sectional mean and standard deviation equals to zero and one respectively in each year to construct the corrected correlation matrix based on standardized variables (see Table B4).[67] Furthermore, the PCA is performed based on correlation matrix instead of covariance matrix of the standardized variables as this will reduce dissimilar variations amongst the variables when there are extreme variances, when variables have a common source of fluctuations (which may be evident in the four liquidity variables), or when different unit measurements are involved.

Depending on the number of variables used, the PCA reduces the variables to a set of uncorrelated principal components (new variables) that account for most of the variance in the observed variables (Jolliffe, 2002). Ideally, only one principal component should be retained and this will represent the flexibility index. The selected principal component(s) is constructed linearly using the optimal weights produced by the eigenequation, satisfying the least squares principle. The weights (i.e. eigenvectors) computed are optimal weights such that no other set of weights would produce a set of components that accounts for greater variance in the observed variables (Hatcher, 1994). It is important to note that the PCA makes no assumption on the underlying causal relationship between variables, unlike the factor analysis where latent factors are assumed to drive the variance of observed variables.

[65] Following Hasbrouck (2005), square root transformation is used instead of log because the ratio of price impact (RTOV12) has both extreme values and zero values (Bharath et al., 2009). In a similar respect, square root transformation is applied to illiquidity measure (LM12) since the estimate displays similar tendencies of extreme and zero values.

[66] It is noted that the four variables are expressed in different scales. Equity cost estimate (BMA) and turnover (TO12) are expressed in percentage, price impact (RTOV12) is in millions, and illiquidity (LM12) is in its actual value (not in an interval or ratio scale).

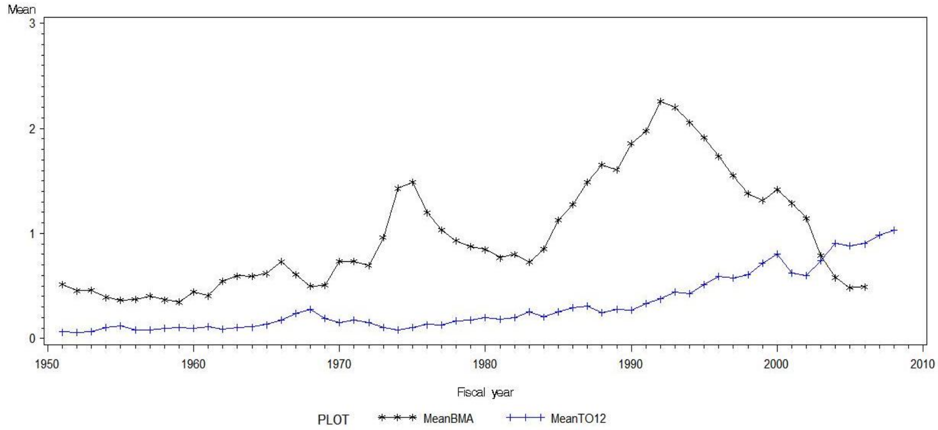
[67] By default, the *PROC PRINCOMP* procedure in SAS performs the PCA on corrected correlation matrix with standardized variables. Computing the principal components (by including options such as *NOINT* and *COV* in the main procedure) based on covariance matrix of non-standardized variables may lead to misleading results unless all observed variables have the same scale of measurement (SAS Support).

Following Bharath et al. (2009), the flexibility index (i.e. component) is estimated every year by performing the PCA on the standardized variables to derive individual optimal weights for each variable in each year. The weights are based on the variance of each variable. In this case, time-series effect is eliminated from the index, and the index only measures cross-sectional variation amongst the variables used. In each year, there is one unique index for each firm. For ease of reference, Table B5 summarises the expected signs of the variables if included in the final flexibility index. Notably, if the final index measures inflexibility instead of flexibility, the signs should be reversed.

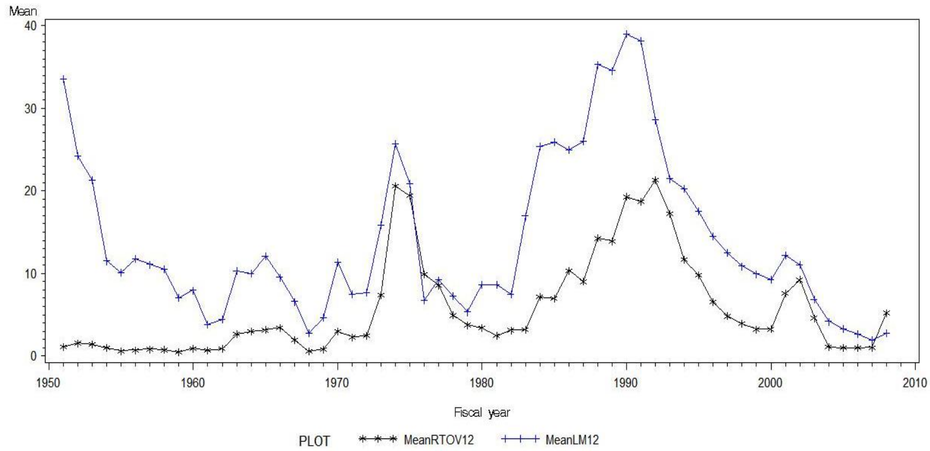
The PCA decomposes the correlation matrix of the variables, where the diagonal of the matrix consists of only ones, and minimises the sum of squared perpendicular distance to the component axis. By construction[68], the mean of the first component (flexibility index) over the whole sample and each year is zero. However, because the rest of the components are excluded, the index median and standard deviation are not zero and one respectively. Similar results are obtained and noted in Bharath et al. (2009).

[68] In the construction of the first component, optimal weights used can be either the basic eigenvectors or scaled eigenvectors computed using *PROC PRINCOMP* and *PROC FACTOR* functions in SAS respectively. As the underlying computations make the same assumptions of orthogonal rotation of variables and perform the same eigenequation on the correlation matrix with diagonal ones, eigenvalues produced are exactly identical with a unity mean. The true eigenvectors always satisfy the relationship Vi'*Vi=1, where Vi is the ith eigenvector. The scaled eigenvector values are computed as $Li=\sqrt{(Ei)}*Vi$, where Li is the vector of loadings (i.e. scaled eigenvector) for ith factor and Ei is the ith eigenvalue. The scaled eigenvectors takes into account the specific eigenvalues attached to the matrices of eigenvectors by employing the “average root” truncation test. It is noted that the median and standard deviation of the component computed using scaled eigenvectors will be exactly zero and one respectively as eigenvalues are taken into account in the computation. However, for the purpose of this paper only the first component is used, and using the scaled eigenvectors did not make any material difference to the final results and conclusions (test but not reported).

3a) Hasbrouck's modified Roll estimate (BMA) and Average daily turnover (TO12) 1950-2008



3b) Liu's trading discontinuity (LM12) and Amihud's price impact ratio (RTOV12) 1950-2008



3c) Long-term credit rating (numeritized), 1985-2008

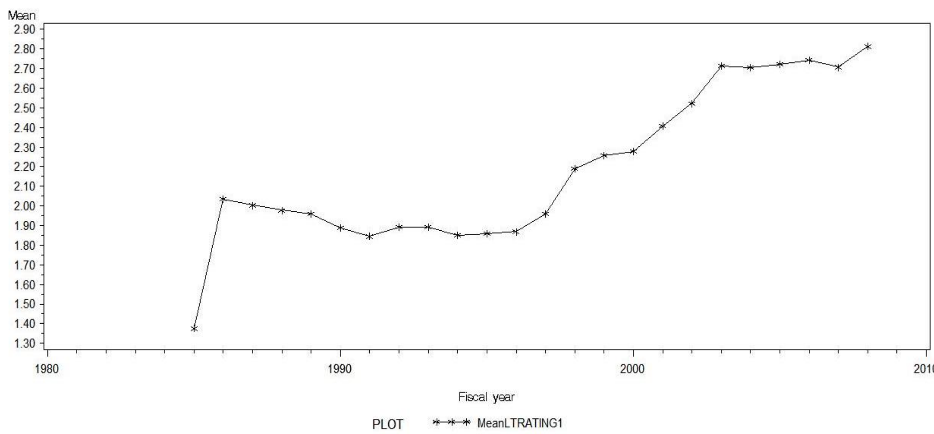
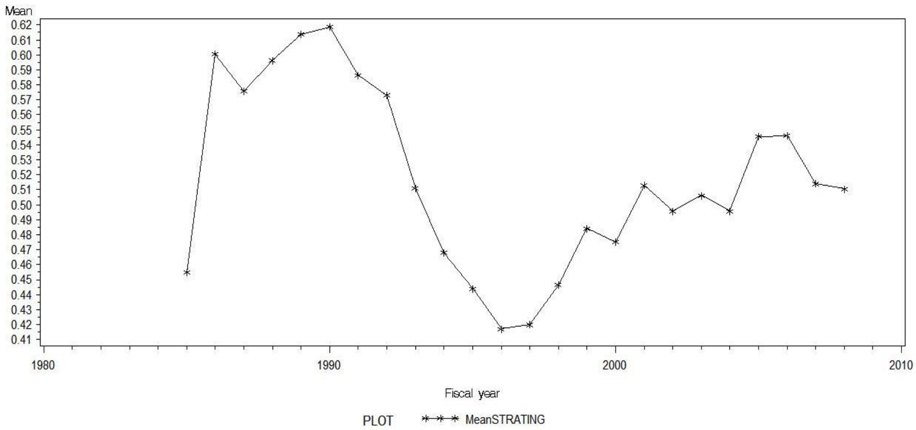
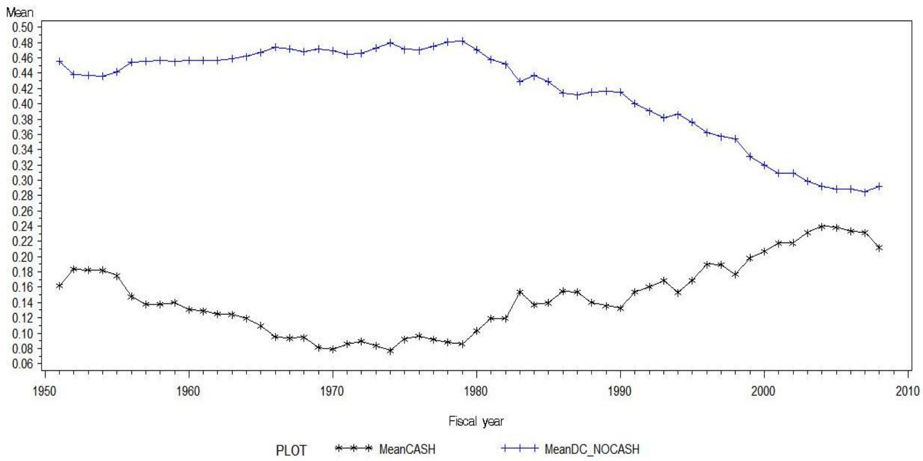


Figure B3 Plots of flexibility variables over sample period 1950 to 2008
Figures B3(a) to (h) show the plots of flexibility variables over the sample period 1950 to 2008 for which data is available for the respective variable. Sample and variable specifications are reported in Table B2. Liquidity variables specifications are reported in Chapter B3.2.2.

3d) Short-term credit rating (numeritized), 1985-2008



3e) Cash and debt capacity ratio, 1950-2008



3f) Net cash flow (CFcf) and cash flow (CFe), 1950-2008

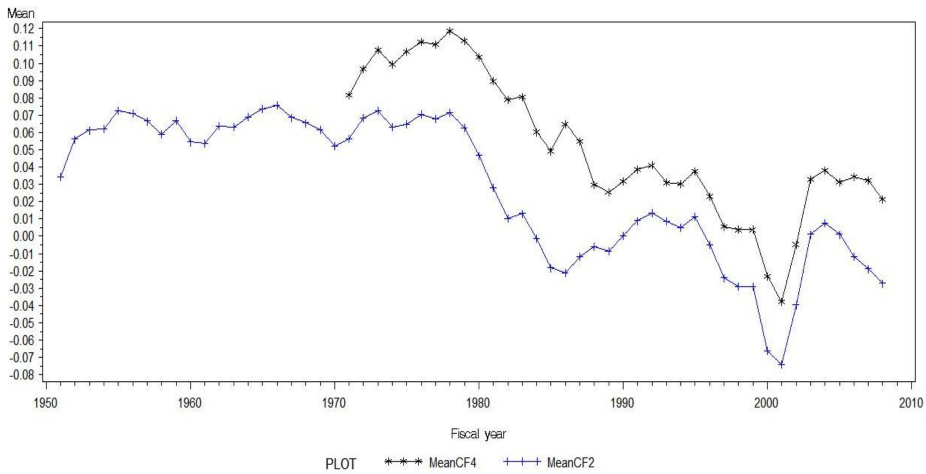


Figure B3 Plots of flexibility variables over sample period 1950 to 2008 (continued)

Table B4 Correlation matrices of standardized flexibility variables

This table reports the Pearson and Spearman rank correlation coefficients of standardized flexibility variables. Variables labels are represented with a Z as the variables are standardized prior to the derivation of the correlation coefficients. Sample and variable specifications are reported in Table B2. Liquidity variables specifications are reported in Chapter B3.2.2.

Pearson Correlation Coefficients									
Variable	ZBMA	ZRTOV12 _SQRT	ZLM12 _SQRT	ZTO12	ZCASH	ZDC	ZCF4	ZLT-RATING1	ZST-RATING
ZBMA	1								
ZRTOV12_SQRT	0.825	1							
ZLM12_SQRT	0.518	0.658	1						
ZTO12	-0.154	-0.246	-0.349	1					
ZCASH	0.000	-0.038	-0.047	0.164	1				
ZDC	0.032	0.070	0.121	-0.143	-0.687	1			
ZCF4	-0.237	-0.185	-0.068	0.001	-0.150	0.159	1		
ZLTRATING	-0.223	-0.182	-0.208	-0.003	-0.144	0.040	0.078	1	
ZSTRATING	-0.167	-0.124	-0.145	-0.044	-0.095	0.036	0.052	0.584	1

Spearman Correlation Coefficients									
Variable	ZBMA	ZRTOV12 _SQRT	ZLM12 _SQRT	ZTO12	ZCASH	ZDC	ZCF4	ZLT-RATING1	ZST-RATING
ZBMA	1								
ZRTOV12_SQRT	0.784	1							
ZLM12_SQRT	0.495	0.784	1						
ZTO12	-0.167	-0.450	-0.518	1					
ZCASH	0.056	-0.030	-0.063	0.169	1				
ZDC	0.034	0.114	0.133	-0.162	-0.610	1			
ZCF4	-0.322	-0.314	-0.143	0.043	-0.034	0.091	1		
ZLTRATING	-0.283	-0.304	-0.254	0.086	-0.094	0.022	0.043	1	
ZSTRATING	-0.152	-0.168	-0.116	0.036	-0.028	0.015	0.030	0.605	1

Table B5 Expected relationship of observed variables with financing flexibility

This table reports the expected sign of each flexibility variable in the final flexibility index. If the final index measures inflexibility, opposite signs is expected. Sample and variable specifications are reported in Table B2. Liquidity variables specifications are reported in Chapter B3.2.2.

Flexibility variables	**Expected relationship with financing**
Cash	+
DC	+
Net cash flows (CFcf)	+
Long-term credit rating (LTRATING)	+
Short-term commercial paper rating (STRATING)	+
Amihud's price impact ratio (RTOV12)	-
Liu's illiquidity ratio (LM12)	-
Hasbrouck's modified Roll estimate (BMA)	-
Average daily turnover (TO12)	+

Table B6 reports the eigenvalues and cumulative explained variance of the principal components for the sample period 1970 to 2006 for EEF index performed using the pooled and yearly PCA.[69] For the PCA performed yearly, only the first component has an eigenvalue significantly greater than one, while the eigenvalue of the second component is usually less than one or close to one (for the early years). The first component explains on average 60% of the variance in all four equity market variables, with a slight increase in variance explained over time.

For the entire sample and each year, each equity market variable contributes to the first component with the correct sign and substantial weight, see Table B6 Panel B. Due to the nature of the equity variables (where three out of four equity variables effectively measures illiquidity), the resultant component may be interpreted as an inflexibility index where a lower index value represents better equity position, and vice versa. The observed variables are generally evenly weighted (between 0.50 to 0.63) except for turnover ratio which has the lowest eigenvector magnitude (an average of -0.26) for all years.[70]

[69] The pooled PCA performs the analysis on the sample over the entire sample period, while the PCA performed yearly reports statistics in each year and the average of the yearly figures are reported in the table. As the Hasbrouck's Gibbs estimates of effective cost, BMA, has data availability only up to year 2006, the index construction is limited to the period up to 2006 only.

[70] It is noted that turnover is the only measure that is negatively correlated with other variables and the final component constructed. As such, the ratio is transformed into an illiquidity measure by taking one minus the original value to make sure the weights used are not affected by the correlation signs. The inverse turnover effectively measures the number of shares not traded on a day out of the total number of shares outstanding on that day. The PCA performed for the whole sample period and each year yield the same eigenvalues and eigenvectors (with only the sign for turnover ratio changed). As expected, the component computed changes in magnitude but produces the same results and conclusion. For ease of interpretation, it is ideal to have all measures entering the component with the same positive or negative relationship with the final component. However, the difference in sign of turnover ratio may act as a check to ensure the PCA is performed correctly with the final component effectively measuring illiquidity or inflexibility. Hence, the original turnover ratio is included in the final component, and not replaced by its own inverse.

Table B6 Eigenvalues and eigenvectors of principal components of PCA for EEF index

This table reports results of the Principal Component Analysis for the four equity liquidity variables. Variable definitions for the liquidity variables are detailed in Chapter B3.2.2. Panel A reports Eigenvalues of the principal components and the cumulative variance of each component. Panel B reports the eigenvector values for each liquidity variable for the computation of the first principal component which is identified as the EEF index. Both average and pooled values are reported. Pooled statistics use the whole sample from 1970 to 2006 when performing the PCA, while average statistics report the average values of the results of PCA performed yearly from 1970 to 2006.

Panel A

	Eigenvalues of principal components				Cumulative variance explained			
Period	Prin1	Prin2	Prin3	Prin4	Prin1	Prin2	Prin3	Prin4
Average (1970-2006)	2.448	0.946	0.482	0.125	61%	85%	96%	100%
Pooled (1970-2006)	2.457	0.952	0.434	0.157	61%	85%	96%	100%

Panel B

	Eigenvector values of first principal component (Prin1)			
Period	BMA	RTOV12 _SQRT	LM12 _SQRT	TO12
Average (1970-2006)	0.537	0.601	0.525	-0.260
Pooled (1970-2006)	0.560	0.594	0.533	-0.222

The magnitude of the weights is generally stable over time, except for turnover ratio which has weights greater than 0.20 only after the early 1970s. In an unlisted test, the PCA is performed on the entire sample after 1971, and the magnitude of eigenvector for turnover ratio only increases slightly from 0.205 to 0.227, while the weights for other variables remain about the same. The observed phenomenon in turnover ratio may be due to the developments in equity markets.[71] On the whole, the PCA results show that all variables contribute substantially to the final index and no one component is dispensable for the entire sample period and for each year. The first component of the PCA performed on the four equity variables is termed as EEF index and computed as follow.

$$EEF = 0.537*BMA + 0.601*RTOV12 + 0.525*LM12 - 0.260*TO12$$

Due to the nature of liquidity components in the index, the final EEF index effectively measures firms' illiquidity in the equity market – a low index represents

[71] After the founding of NASDAQ in 1971, trading volume and activities increased significantly as more firms able to access the equity market due to the less stringent listing requirement (compared to NYSE). Prior to the introduction of NASDAQ, equity trading may be generally limited to larger and more reputable firms. In addition, the electronic trading system and fully automated trading data (in NASDAQ and NYSE respectively), further supported greater volume of trading activities after the early 1970s.

high liquidity and a high index represents low liquidity in the equity market. Table B7 reports summary statistics of the EEF index across the sample period from 1970 to 2006. The EEF index has a median value of -0.6 – this shows that the proportion of firms with lower equity liquidity (value of EEF greater than the mean zero) is greater than the proportion of firms with higher equity liquidity. This is further proven in the minimum and maximum values reported. EEF has a maximum value of 17 and minimum value of -7 for the pooled data. Consistent with prior analysis, EEF index shows firms have increasing liquidity in the equity market over time. From year 1971 to 2006, the median value of EEF index increases in magnitude from -0.372 to -0.612.

As EEF index measures firms' flexibility in the equity market, Table B8 reports the correlation of EEF index with other flexibility variables across the years. EEF index has an increasing positive correlation with debt capacity – suggesting that firms with greater debt capacity has lower liquidity in the equity market, and this relationship increases with time. Conversely, EEF index has positive correlations with both long-term and short-term credit ratings. This shows that firms with better credit rating generally have higher equity liquidity. As noted in Chapter B3.2.1, credit ratings are biased towards larger, more reputable firms and, accordingly, more established firms have greater liquidity in the equity market and, therefore, lower EEF index. In a similar respect, EEF index has a negative correlation with cash but there is no increasing relationship between the two variables. From Table B8, the most important observation is the increasing positive relationship between debt capacity and EEF index because this indicates that firms are increasingly reliant on internal debt capacity if they are unable to issue equity.

Table B9 uses the three main flexibility variables to divide firms into subsamples of high and low flexibility according to the level of debt capacity, cash holdings and EEF index. High debt capacity firms hold very low cash (only 4% of total assets), have illiquid equity, higher net debt issue (and lower net equity issue) and leverage recorded on the books, and significantly lower financing deficit and growth opportunities. High debt capacity firms are slightly greater in firm size, better profitability, and older. The latter three, however, are slight differences. In a similar respect, the trend for high and low cash firms are the opposite for each firm characteristic in Table B9. The opposite trends prove the high negative relationship between debt capacity and cash as they are (to certain extent) substitutes for each other. For EEF index, the differences in firm characteristics for high and low EEF firms are not as obvious. The EEF index does not divide firm sample into distinct segments and the difference between firm characteristics are relatively small compared to debt capacity and cash measurements. This is due to the nature of EEF as an external market variable that does not measure any firm characteristics or use any firm ratios in its computation. Nevertheless, some differences are noted below. High EEF index (lower equity liquidity) firms have slightly larger debt capacity and leverage. This is important as it supports the EEF measure, since firms with lower equity liquidity use more leverage in their capital structure. High EEF index firms have slightly lower cash holdings, are slightly younger, have fewer growth opportunities and incur lower investment expenses. Finally, both net debt and equity issues are lower for illiquid firms. Whilst lower equity issue is expected for illiquid firms, debt issue is expected to be larger. Again, this might be due to measurement differences because debt issue is measured in *net* and not *gross* terms because leverage is higher (and according to expectation) for illiquid firms.

In the final univariate analysis for flexibility components, firms are sorted according to their industry groups and their mean and median values of debt capacity, cash and EEF index are reported in Table B10. Table B10 shows substantial industry variation in flexibility across different industries. Communications and software and biotechnology firms have the highest equity flexibility and lowest debt capacity. Software and biotechnology firms hold the most cash. This suggests that these firms rely primarily on equity funds and cash (for software and biotechnology firms) for funding requirements. On the other hand, services, retail, wholesale and mining firms have the lowest equity flexibility position. Retail, wholesale and mining firms however have the highest debt capacity and lowest cash holdings – suggesting a heavy reliance on debt funding compared to other industries. While significant industry variation is observed across industries, the difference in flexibility components generally provides results to support the measures of flexibility – debt capacity, cash and external equity flexibility because apparent opposite trends are observed between debt users and equity (and cash) users.

Table B7 Summary statistics of External Equity Flexibility (EEF) Index

This table reports summary statistics of the external equity flexibility (EEF) index across the entire sample, periods and years. EEF index is the first principal of the Principal Component Analysis (PCA) performed on the four equity liquidity variables. Variable definitions for the liquidity variables are detailed in Chapter B3.2.2. The equity liquidity variables are standardized prior performance of PCA. By construction, the EEF index has mean equals zero and variance equals one.

Statistics	N	Median	Min	Max
Time series (pooled) statistics	85064	-0.571	-6.745	17.275
Cross-sectional statistics	2299	-0.551	-3.505	11.547
Across periods				
1970s	15610	-0.483	-4.900	11.990
1980s	21236	-0.510	-6.745	15.994
1990s	34626	-0.602	-6.020	17.275
2000s	13592	-0.632	-5.416	15.859
Across years				
1970	1576	-0.374	-1.773	7.502
1975	1644	-0.515	-4.030	8.786
1980	1448	-0.531	-2.597	9.281
1981	1402	-0.527	-2.969	8.690
1982	1368	-0.482	-3.160	10.380
1983	1673	-0.525	-2.461	8.529
1984	1938	-0.491	-3.076	14.917
1985	2343	-0.515	-2.736	15.994
1986	2626	-0.545	-4.052	10.607
1987	2826	-0.504	-4.617	11.155
1988	2864	-0.468	-6.745	10.742
1989	2748	-0.514	-4.210	13.292
1990	2731	-0.495	-3.756	13.668
1991	2726	-0.566	-3.776	10.372
1992	3196	-0.571	-3.621	12.130
1993	3668	-0.566	-3.688	15.833
1994	4055	-0.526	-3.476	16.237
1995	4224	-0.556	-3.467	15.208
1996	4000	-0.614	-3.309	17.275
1997	3714	-0.649	-6.020	13.326
1998	3344	-0.704	-4.735	12.113
1999	2968	-0.739	-4.286	9.767
2000	2656	-0.673	-4.479	10.546
2001	2405	-0.685	-4.237	10.224
2002	2247	-0.656	-5.416	11.060
2003	2009	-0.623	-3.394	15.735
2004	1979	-0.599	-1.345	15.859
2005	1884	-0.586	-2.051	14.067
2006	412	-0.612	-1.637	9.971

Table B8 Correlations of flexibility variables performed yearly for period 1970 to 2008

This table reports the yearly Spearman rank correlation coefficients of EEF index with other flexibility variables – debt capacity, cash holdings, long-term and short-term credit rating. Sample and variable specifications are reported in Table B2. Liquidity variables specifications are reported in Chapter B3.2.2.

FYEAR	VARIABLE	DC	CASH	LTRATING	STRATING
1970	EEF	0.087	0.030	-	-
1971	EEF	0.067	-0.013	-	-
1972	EEF	0.083	-0.045	-	-
1973	EEF	0.086	-0.063	-	-
1974	EEF	0.082	-0.002	-	-
1975	EEF	0.085	-0.038	-	-
1976	EEF	0.111	-0.087	-	-
1977	EEF	0.098	-0.029	-	-
1978	EEF	0.166	-0.064	-	-
1979	EEF	0.139	-0.028	-	-
1980	EEF	0.147	0.012	-	-
1981	EEF	0.118	0.059	-	-
1982	EEF	0.124	0.008	-	-
1983	EEF	0.180	-0.067	-	-
1984	EEF	0.092	-0.022	-	-
1985	EEF	0.102	-0.025	-0.335	-0.283
1986	EEF	0.143	-0.075	-0.410	-0.315
1987	EEF	0.144	-0.068	-0.430	-0.310
1988	EEF	0.118	-0.033	-0.438	-0.326
1989	EEF	0.133	-0.040	-0.430	-0.325
1990	EEF	0.142	-0.072	-0.404	-0.317
1991	EEF	0.198	-0.126	-0.361	-0.285
1992	EEF	0.208	-0.117	-0.343	-0.250
1993	EEF	0.173	-0.093	-0.362	-0.245
1994	EEF	0.131	-0.064	-0.360	-0.237
1995	EEF	0.157	-0.098	-0.344	-0.219
1996	EEF	0.193	-0.140	-0.304	-0.192
1997	EEF	0.153	-0.081	-0.326	-0.196
1998	EEF	0.177	-0.057	-0.371	-0.225
1999	EEF	0.235	-0.099	-0.374	-0.240
2000	EEF	0.295	-0.189	-0.339	-0.235
2001	EEF	0.240	-0.141	-0.401	-0.244
2002	EEF	0.213	-0.093	-0.422	-0.234
2003	EEF	0.205	-0.079	-0.418	-0.249
2004	EEF	0.140	0.022	-0.539	-0.364
2005	EEF	0.121	0.042	-0.509	-0.331
2006	EEF	0.170	-0.053	-0.444	-0.235

Table B9 Firm characteristics according to high and low flexibility variables for period 1970 to 2008

This table reports the pooled mean values of firm characteristics computed across subsamples of firms sorted according to high and low flexibility – debt capacity, cash holdings, and EEF index. Firms are sorted into ten deciles according to each flexibility measurement. Low flexibility includes firms lying in the bottom three deciles of each flexibility measurement; and high flexibility includes firms lying in the top three deciles. As high (low) EEF index represents low (high) liquidity in the equity market, firms are named as illiquid (liquid) in the last two columns. Sample and variable specifications are reported in Table B2. Liquidity variables specifications are reported in Chapter B3.2.2.

	Low DC	High DC	Low Cash	High Cash	Low EEF (liquid)	High EEF (illiquid)
Variable	Mean	Mean	Mean	Mean	Mean	Mean
DC	0.258	0.528	0.488	0.294	0.391	0.423
CASH	0.342	0.042	0.019	0.391	0.163	0.148
EEF	-0.207	0.290	0.065	-0.159	-1.211	1.771
BMA	1.206	1.362	1.207	1.229	0.426	2.426
RTOV12	5.544	9.030	7.537	5.143	0.057	16.380
LM12	12.934	21.409	17.429	14.069	0.048	38.397
TO12	0.574	0.348	0.337	0.589	0.745	0.204
BKDEBT	0.121	0.243	0.254	0.106	0.183	0.195
LNAT	16.710	17.197	17.557	16.526	19.457	16.625
PROFIT	-0.078	0.043	0.037	-0.065	0.087	-0.002
Q	2.175	1.423	1.388	2.245	1.979	1.364
AGE	1.746	2.057	2.121	1.714	2.559	2.303
CF4	-0.061	0.062	0.061	-0.056	0.100	0.015
INVTMT	0.104	0.097	0.103	0.100	0.112	0.070
DEF	0.215	0.053	0.047	0.226	0.059	0.052
ΔLTDEBT	0.007	0.011	0.012	0.006	0.015	0.002
ΔEQUITY	0.214	0.107	0.104	0.211	0.149	0.045
DIVT	0.006	0.008	0.008	0.007	0.010	0.005

Table B10 Flexibility variables statistics across industry groups

This table reports the pooled mean and median values of flexibility variables (debt capacity, cash holdings, and EEF index) computed across subsamples of firms sorted according industry groups. Industry groups are sorted according to their SIC codes as follow: 1=Retail and wholesale, 2=Manufacturing, 3=Mining, 4=Transportation, 5=Communication, 6=Software and Biotech, 7=Services, 8=Healthcare, 9=Others. Sample and variable specifications are reported in Table B2. Liquidity variables specifications are reported in Chapter B3.2.2.

	DC				CASH				EEF			
Ind	Mean	Median	Min	Max	Mean	Median	Min	Max	Mean	Median	Min	Max
1	0.445	0.467	0.000	0.692	0.094	0.051	-0.007	1.000	0.138	-0.533	-4.735	15.859
2	0.423	0.456	0.000	0.701	0.134	0.064	-0.069	0.999	-0.035	-0.584	-6.745	15.833
3	0.435	0.471	0.000	0.665	0.113	0.056	-0.022	0.993	0.113	-0.602	-3.943	17.275
4	0.438	0.461	0.001	0.662	0.097	0.059	-0.006	0.995	-0.203	-0.724	-3.780	13.518
5	0.319	0.322	0.000	0.672	0.103	0.040	0.000	1.000	-0.412	-0.825	-3.394	9.515
6	0.280	0.263	0.000	0.703	0.336	0.290	0.000	0.999	-0.315	-0.725	-4.479	13.613
7	0.374	0.396	0.000	0.704	0.154	0.084	-0.003	0.995	0.241	-0.347	-4.617	16.237
8	0.357	0.374	0.009	0.660	0.137	0.072	0.000	0.978	0.055	-0.490	-6.020	13.668
9	0.401	0.437	0.000	0.688	0.133	0.070	-0.020	0.998	0.356	-0.295	-2.871	14.360
All	0.413	0.446	0.000	0.704	0.135	0.065	-0.069	1.000	0.010	-0.571	-6.745	17.275

CHAPTER B4. SAMPLE AND VARIABLE SPECIFICATIONS

Outliers for firm variables are winsorized in standard format following Bates, Kahle and Stulz (2009) and Bharath et al. (2009). Cash ratio is censored at [0,1] where ratio more than one is made equal to one, and ratio less than zero is made equal to zero. Debt capacity is censored at the top tier where ratio more than one is made equal to one.[72] Cash flow ratio (CFe) and Q ratio are winsorized at the bottom 1% level, and total dividend (DIVT, component in deficit ratio) is winsorized at the top 1% level. The rest of the accounting ratios (net cash flow to assets (CFcf), financing deficit (DEF), change in net working capital (WCCHANGE), net investment (NInvtmt), capital expenditure (Capex), true debt ratio (Tdebt), net debt issue (ΔLTDEBT), net equity issue (ΔEQUITY), and change in short-term debt (ΔStdebt)) are winsorized at both the top and bottom 1% level.

Computation of variables used in the thesis is as follows.

19. Cash holdings, CASH, (CHE[1]) equals cash and cash equivalents (marketable securities) reported in the balance sheet of the financial statement.
20. Debt capacity (DC) is measured as the maximum borrowing capacity of firm, estimated by the firm-level measure of expected asset liquidation value (less cash holdings) following Berger et al. (1996). Measurement of debt capacity implicitly assumes that it is in fact the tangibility of existing assets that matters because they provide collateral for total firm debt.

[72] No negative debt capacity is reported in the sample.

DC = Tangibility/Total assets

= [0.715*Receivables (RECT[2]) + 0.547*Inventory (INVT[3])

+ 0.535*PPE (PPENT[8]) / (AT[6])[73]

21. Unused debt capacity (UDC) is computed by netting leverage from debt capacity. UDC is only computed if DC is non-missing. If DC is zero, UDC is equal to negative of existing debt ratio. By construction, UDC has a minimum of negative one and is less than one, as such, no further winsorisation is required.

22. Cash flow to assets (earnings method) (CFe) is measured by the following

CFe = [Earnings(EBITDA[13]) - Interest (XINT[15]) - Tax (TXT[16])

- Common dividend (DVC[21])] / Total assets (AT[6])

23. Net cash flow (CFcf) to assets can be measured as follow using the cash flow method following Frank and Goyal (2003). There are variations to the measurement of cash flow in the literature and the most popular and commonly used two methods are chosen.

CFcf = [Income before extraordinary items (IBC[123]) + Depreciation and amortization (DPC[125]) + Extra items and discontinued operations (XIDOC[124]) + Deferred tax (TXDC[126]) + Equity in net loss(earnings) (ESUBC[106]) + Gains (loss) from sale of property, plant and equipment, and investment (SSPIC[213]) + Other

24. Net debt issues to total assets (ΔLTDEBT) is measured by long-term debt issue (DLTIS[111]) less reduction in long-term debt (DLTR[114]) divided by total assets. If the two components are not available, net debt issue ratio is computed as the change in long-term debt (DLTT[9]) (current value less its lagged value) divided by total assets.

[73] The initials beside each parenthesis represent the variable labels in CRSP/Compustat Fundamentals Annual database and its relevant item number in the square brackets. Many past papers use the *Industrial* Annual instead of *Fundamentals* Annual database, and represent data items using numbers, e.g. long term debt = Item 9 + Item 34 and total assets = item 6. The variable item number is no longer updated and used by CRSP and Compustat after fiscal year 2006, when the sample data are extracted from the Fundamentals Annual database in the Xpressfeed format. Relevant variable labels are documented alongside with their old data item numbers. It should be noted that after the change in variable identification, there are some variables which are no longer available as they are combined with other items in the financial statements. Similarly, there are additional new variables which were conventionally reported as part of the variable in the old format, now report separately as individual items.

25. Change in short-term debt ratio (ΔSTDEBT) is computed as the net change in short-term borrowings and current maturities of long-term debt (DLCCH[301]) to total assets.[74]

26. Net equity issues to total assets (ΔEQUITY) is measured by the sale of common and preferred equity (SSTK[108]) less the purchase of common and preferred equity (PRSTKC[115]) divided by total assets. If the two components are not available, net equity issue ratio follows Lemmon and Roberts (2010) and is computed as such,

ΔEQUITY (alternative) = Split-adjusted change in shares outstanding*Split-adjusted average stock price/Beginning period total assets
= (CSHO-LAGCSHO[25])*(LAGAJEX/AJEX[27])
(PRCC_F+LAGPRCC_F[199])(AJEX/LAGAJEX[27])/AT

27. Book value debt (BKDEBT) ratio is measured by the sum of long-term debt (DLTT[9]) and the long-term portion in current debt (DLC[34])[75] divided by total assets. Leverage ratio measurement is taken at book value using total debt to total asset ratio. Support for the use of book value is sought from the practical reasons of managers seeking to use book value debt target instead of market value target, (Myers, 1984, Shyam-Sundera and Myers, 1991). Confirming the practical motives, managers surveyed reveal their preference for book value target (Graham and Harvey, 2001). Empirically, Barclay et al. (2006) found book value debt theoretically superior in the tests and regressions of leverage, (MacKay and Phillips, 2005).

28. Market value debt ratio (MKTDEBT) is measured by the sum of long-term debt (DLTT[9]) and the long-term portion in current debt (DLC[34]) divided by

[74] If net change in short-term borrowings and current maturities of long-term debt (DLCCH[301]) is unavailable, it is estimated using the difference between this period's debt in current liabilities (DLC[34]) and that of last period.

[75] Following Frank and Goyal's (2003) recoding method, debt reported in current liabilities (DLC[34]) is recoded to zero if found to be missing because item may be unreported or combined with other variables on the financial statement. This is to prevent any observations from being eliminated unnecessarily.

market value assets, where market value assets (MVA) is computed as the sum of market value equity (PRCC_F[199]*CSHO[25]), book value assets (AT[6]), less book value equity (CEQ[60]) and deferred tax and investment credit (TXDITC[35])[76]. There are numerous papers supporting the use of market value leverage, e.g. Titman and Wessels (1988), Fama and French (2002) and Welch (2004). For robustness, market value leverage is used in addition to the base results from book value leverage.

29. True value debt ratio (TDEBT) is measured by the sum of long-term debt (DLTT[9]) and the long-term portion in current debt (DLC[34]) divided by total capital stock (ICAPT[37]), where total capital stock is defined as total financial capital of firm computed as the sum of total long term debt, preferred stock (carrying value), total common equity and minority interest, or (DLTT[9]+PSTK[130]+CEQ[60]+MIB[38]). Welch (2008) suggested using debt to capital ratio or liability to asset ratio where the converse is an equity ratio because the conventional measures of leverage (financial debt to asset ratio) are flawed as their converse comprises mainly non-financial liabilities.
30. Long-term credit rating, (LTRATING) is the numeritized long-term S&P credit rating of firms following Byoun (May 2008) as follow: Rating AAA: 7, Rating AA+ to AA-: 6, Rating A+ to A-: 5, Rating BBB+ to BBB-: 4, Rating BB+ to BB-: 3, Rating B+ to B-: 2, All other ratings: 1, Missing or no rating: 0. Maintaining rating level is important to firms and any rating change will mean a significant change in the cost and availability of funding, as such firms are found to target specific credit rating and avoid any rating change (Kisgen, 2006). An alternative numeritized long-term credit rating (LTRATING_ALT) variable

[76] End of fiscal year price (PRCC_F[199]) is estimated using end of calendar year price (PRCC_C[24])if the former is unavailable. Deferred tax and investment credit (TXDITC[35]) is estimated using deferred taxes (TXDB[74]) if the former is reported to be missing, and recoded to zero if the latter is unavailable.

takes the value of 0 up to 21 where each credit rating is assigned to a number, e.g. AAA: 21, AA+: 20, AA: 19, etc. For comparison of debt capacity model following Campello et al. (2011), a dummy variable (CREDIT) is used where CREDIT equals one when firm has a rating –BBB or above, and zero otherwise.

31. Short-term credit rating, (STRATING) is the numeritized long-term S&P credit rating of firms following: Rating A-1: 9, Rating A-2: 8, Rating A-3: 7, Rating B: 6, Rating B-1: 5, Rating B-2: 4, Rating B-3: 3, Rating C: 2, All other ratings: 1, Missing or no rating: 0.

32. Q ratio or market-to-book ratio (MTB) measures growth opportunities of firm and is computed as follows.

    Q = [Total assets (AT[6]) – Book value equity (CEQ[60]) + Market value equity (PRCC_F[199]*CSHO[25])] / Total assets (AT[6])

33. Capital expenditure ratio (CAPEX) is measured using capital expenditure (CAPX[128]) to total assets (AT[6]).

34. Financing deficit (DEF) is used in the test of pecking order theory (Frank and Goyal, 2003), and is computed as DEF = DIV + I + WCCHANGE – CFcf, where all items are scaled by total assets and defined as follow.

    DIV is the amount of cash dividends distributed, where DIV = DV[127].

    I is the net investment made during the period, computed in Section 4.2 as Net investment = [Capital expenditure (CAPX[128]) + Acquisitions (AQC[129]) - Sale of PPE (SPPIV[107]) + Increase in investment (IVCH[113]) - Sale of investment (SIV[109])] / Beginning period total assets (AT[6]).

    CFcf measures the cash flow after interest and taxes scaled by beginning period total assets instead of ending period total assets.

WCCHANGE is the change in net working capital computed as such, following Frank and Goyal (2003). For firms reporting standard cash flow format 1, WCCHANGE = WCPAC[236] + CHECH[274] + DLCCH[301]. For firms reporting standard cash flow format 2 and 3, WCCHANGE = - WCPAC[236] + CHECH[274] - DLCCH[301]. For firms reporting standard cash flow format 7, WCCHANGE = CHECH - DLCCH - RECCH -INVCH - APALCH - TXACH - AOLOCH - FIAO.[77] Above items used are defined as such,

WCPAC [236] : Change in operating working capital
CHECH [274] : Change in cash and cash equivalent
DLCCH [301] : Change in current debt
RECCH [302] : Decrease (Increase) in accounts receivables
INVCH [303] : Decrease (Increase) in Inventory
APALCH [304] : Increase (Decrease) in accounts payable and accrued liabilities
TXACH [305] : Increase (Decrease) in accrued income taxes
AOLOCH [307]: Increase (Decrease) in other assets and liabilities
FIAO [312] : Other financing activities

In general, firms adopted the ‘Statement of Cash Flows’ (Compustat format 7) after the 1988 accounting regulation changes. As such, firms with missing cash flow format on or after year 1988 is assumed to adopt format 7 for the purpose of computation above. Similarly, firms with missing cash flow format before year 1988 are assumed to adopt format 1 as it is the generally adopted version of ‘Cash Statement by Sources and Use of Funds’. Following Frank and Goyal (2003), firms with format code 4, 5 and 6 are disregarded because Compustat does not define format codes 4 and 6, and format code 5 is for Canadian reporting.

[77] The following firm variables are recoded to zero is reported to be missing – AOLOCH, FIAO and DLC. The following variables are recoded to equal its current value less lagged (one period) value if found to be missing – RECCH, INVCH, APALCH, TXACH, DLCCH and CHECH.

35. Tangibility (TANG) is the ratio of net property plant and equipment (PPENT[8]) to total assets (AT[6]).
36. Firm size (SIZE) measured by the natural logarithm of total assets (AT[6]) or total sales (SALE[6]) and denoted as LNAT and LNSALE respectively. To ensure accuracy of measurement over time, total assets and total sales are scaled by Consumer Price Index (CPI) and Gross Domestic Price (GDP) at year 2004. Scaled total assets and total sales however are found to yield results that are similar to the original values.
37. Profitability (PROFIT) is measured by the ratio of earnings before interest and tax to total assets (AT[6]).
38. Industry median leverage is the median book value debt (total long-term debt to total assets described in number 9) taken yearly based on 4 digit SIC code.

CHAPTER B5. THE PECKING ORDER MODEL

B5.1 Pecking order model specification

Following Frank and Goyal (2003) and Bharath at el. (2009), the *base pecking order model* of Shyam-Sunder and Myers (1999) is adapted.

$$\Delta DEBT_{it} = \alpha_D + \beta_D DEF_{it} + \varepsilon_{Dit} \qquad (a)$$

To measure effectively real investment or 'true value-adding' funds sourced from the debt market, deficit variable is disaggregated into its different components in the following *disaggregated base pecking order model*.

$$\Delta DEBT_{it} = \alpha_D + \beta_{D1} DIV_{it} + \beta_{D2} I_{it} + \beta_{D3} WCCHANGE_{it} – \beta_{D4} CFcf_{it} + \varepsilon_{Dit} \qquad (b)$$

Additionally, to examine the differential impact of debt capacity and firms' flexibility position on both debt and equity issues. Here, the dependent variable is changed to net equity issue in the following *modified pecking order model*.

$$\Delta EQUITY_{it} = \alpha_E + \beta_E DEF_{it} + \varepsilon_{Eit} \qquad (c)$$

where change in equity is the ratio of net equity issue (SSTK[108] +PRSTKC[115]) scaled by total assets. According to the accounting identities, the sum of debt and equity issue should match the amount of deficit exactly. Hence, the modified model is expected to exhibit trends that are exact opposite of the original model. However, depending on the different subsamples the models are testing, results may be different for the basic and modified models because different factors have varying impact on debt and equity issues. In addition, the modified model is used to examine the disaggregated components of deficit and to compare the main use (e.g. for investment or dividend payment) of debt and equity issues. Similar to the original model, deficit variable is disaggregated for the modified model (*disaggregated modified pecking order model*).

$$\Delta EQUITY_{it} = \alpha_E + \beta_{E1}\, DIV_{it} + \beta_{E2}\, I_{it} + \beta_{E3}\, WCCHANGE_{it} - \beta_{E4}\, CFcf_{it} + \varepsilon_{Eit} \qquad (d)$$

According to the strict pecking order theory, β_D in equation (*a*) is expected to be close to or equals to one, because any deficit will be first funded by debt, with equity being the last resort. However, this is subject to the assumption that debt is unlimited or always has a cost lower than equity. In the modified pecking order (Myers, 1984, Myers and Majluf, 1984), coefficient β_E is postulated to less than one but still remain positive. This is because there is a trade-off between adverse selection and cost of financial distress when firm becomes highly-levered, and firms will then issue equity in place of debt to maintain both liquid assets and debt capacity for future investment (Bharath et al., 2009).

In practice, β_D is not close to one because

(1) Debt is not unlimited, i.e. firms are 'debt constrained'. There is a limit to firm's borrowing capacity and at some point debt becomes either too expensive to obtain or not available totally. Firms in the first place do not have equal access to debt financing. However, this is generally not taken into account properly in many studies.

(2) Firms choose not to issue debt. Firms choose equity over debt because of many reasons, such as management entrenchment (Welch, 2004) or market timing (Baker and Wurgler, 2002) reasons. For instance, managers avoid debt to avoid debt holders' monitoring and thereby restricting their empire-building desires. In addition, equity is preferred to debt financing when managers think equity is overvalued.

Assuming the first reason dominates and that firm actually has little choice over its source of funds in practice, pecking order theory will be more applicable to firms with high borrowing capacity, and this applicability should monotonically decrease with the level of debt capacity (decreasing β_D). In a similar respect, firms with higher cash holdings and/or greater equity liquidity are expected to issue less debt, and β_D should fall as cash and liquidity increase. It is assumed that firms with low debt capacity have no choice but to resort to equity financing or seek funds internally through cash reserves. This suggests that firms do not choose to issue equity over debt, instead the majority have little choice over their source of funds. New capital structure theories of management entrenchment and market timing, which suggest managers' preference for equity issue, may be more applicable for a small proportion of firms, e.g. large, reputable or older firms, and it is expected that the pecking order model is less applicable to financially flexible firms.

Evidence of firms with low debt capacity holding substantially higher cash confirms the conjecture in that firms are somewhat forced to hold higher levels of cash in order to take advantage of *unplanned* investments because equity issue normally takes too much time and is market-dependent. However, this does not suggest that these firms do not issue equity. Rather, firms issue equity generally for planned investments or acquisitions. Therefore, depending on the level of cash held and the uncertainty of investments, the modified model (with equity issue instead of debt issue) may or may not hold for low debt capacity firms. It is predicted that firms with higher cash will have lower β_E in equation (*c*), and vice versa; and firms with greater certainty in investments will have a higher β_E in the modified model.

In the final stage of pecking order tests, the flexibility components – debt capacity and EEF index are put into the original equation to examine the magnitude of the effect of flexibility on debt issue for every unit of financing deficit firm needs finance. Following Bharath et al. (2009), flexibility components are multiplied to the deficit variable and put into the base pecking order model.

$$\Delta DEBT_{it} = \alpha_D + \beta_D\, DEF_{it} + \gamma_D\, DEF_{it}{*}DC_{it} + \varepsilon_{it} \qquad (e)$$

$$\Delta DEBT_{it} = \alpha_D + \beta_D\, DEF_{it} + \gamma_D\, DEF_{it}{*}EEF_{it} + \varepsilon_{it} \qquad (f)$$

where γ_D measures that for every dollar of financing deficit to cover in a fiscal year, the difference in debt (how much less debt) issued by firm whose debt capacity and EEF is a unit greater than the mean that year. In a similar respect, the two flexibility components are put into the modified pecking order model to examine how much more equity is used by firm when debt capacity and EEF decrease.

$$\Delta EQUITY_{it} = \alpha_E + \beta_E\, DEF_{it} + \gamma_E\, DEF_{it}{*}DC_{it} + \varepsilon_{it} \qquad (g)$$

$$\Delta EQUITY_{it} = \alpha_E + \beta_E\, DEF_{it} + \gamma_E\, DEF_{it}{*}EEF_{it} + \varepsilon_{it} \qquad (h)$$

In the regression with deficit and debt capacity interaction, γ_D is expected to be greater than γ_E; the opposite should be observed in the regression with deficit and EEF index interaction term, because debt capacity (EEF index) dictates the amount of debt (equity) issued by firms for financing deficit.

B5.2 Univariate analysis

In this section, univariate analysis for firms' financing variables is reported. Table B11 reports descriptive statistics of the financing variables over the whole sample. Three measures of debt are used – book value, market value and true value of debt. Market value of debt reports the lowest ratio as leverage is denominated by a firm's market value which is larger than the book value. True value of debt is largest because it is denominated by financing capital which is only part of total book value of assets. Average net equity issue is significantly larger than net debt issue; supporting the fact that the nominal value of an equity issue is naturally larger (and more frequent) than a debt issue which may be only renewal of long-term loan in some years.

Table B12 reports trends of financing variables over the sample period from the 1970s to the 2000s. Financing deficit increases about three fold from the 1970s to the recent two decades. A large proportion of financing deficit is financed by net equity issue, and the trend is increasing with time as average equity issue increased sharply from 0.9% to 10.4% from the 1970s to 1990s, and fall slightly to 9% in the recent decade. On the other hand, average net debt issue decreases from 1.5% to 0.6% from 1970s to 2000s, indicating that increase in deficit is financed by a proportionately larger increase in equity (to net off effect of falling net debt issue). The sharp rise in net equity issue is also reported in Frank and Goyal (2003), where the trend is not due to a sharp rise in IPOs but an actual increase use of equity financing. Financing behaviour does not obey the pecking order theory because net equity issue tracks deficit better than net debt issue, suggesting that firms choose to issue equity rather than debt for financing needs (Frank and Goyal, 2003). Average figures reported in Table B12 supports previous findings; and Figure B4a shows net equity issue tracking financing deficit very closely.[78]

To examine if firms use proportionately more equity or debt for investment purposes (the real firm value-adding component of financing deficit), average net investment is plotted in Figure B4b. Net investment exceeds total deficit before 1990, indicating that a substantial amount of investment is financed internally by cash reserves or cash flows. Nonetheless, net investment remains relatively stable over time ranging from 7% to 13% of total asset value. The increased deficit is likely to be due to the sharp decrease in net cash flows and increase in cash holdings over time reported in Table B1 Panel B. Figure B5 shows the average deficit and its components denominated by total assets. It is clear that the trend in deficit is driven primarily by net cash flows and change in working capital, with dividend payments and net investment relatively stable over time. However, when capital expenditure is denominated by the book value of property plant and equipment (PPE), there is an increasing trend of capital expenditure from 25% to 41%. This may be due to the general fall in value of net PPE (Frank and Goyal, 2003).

[78] The trend reported in Figure B4 is qualitatively similar to Figure 1 reported in Frank and Goyal (2003). Slight quantitative difference arises due to difference in scaling variable – ratios are scaled by net assets (total assets less current liabilities) in previous paper but scaled by total assets here; and reported ratios have lower values here. For robustness check, Appendix B-II reports the over time trend of financing and deficit variables denominated by net assets and the figure matches the previous paper almost identically.

Table B11 Summary statistics of financing and firm variables for period 1970 to 2008

This table reports time-series (pooled) and cross-sectional summary statistics of financing and related firm variables for period 1970 to 2008. All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Variables specifications and winsorisation method are reported in Chapter B4. Cross-sectional statistics are mean of the variables taken yearly, and pooled statistics are computed using the entire sample as a whole. Number of firms, N, for cross-sectional statistics is the average number of firms recorded in each year over the sample period.

Summary statistics for sample period 1970-2008								
Financing	Time series (pooled) statistics				Cross-sectional statistics			
measures	N	Mean	Median	Std dev	N	Mean	Median	Std dev
Book value debt	149236	0.243	0.213	0.212	3827	0.244	0.210	0.207
Market value debt	149236	0.197	0.148	0.191	3827	0.201	0.158	0.185
True value debt	149236	0.388	0.309	0.469	3827	0.388	0.304	0.442
Deficit	147475	0.069	0.017	0.249	3781	0.064	0.018	0.229
Net debt issue	149236	0.011	0.000	0.100	3827	0.011	-0.001	0.096
Short-term debt issue	149236	0.000	0.000	0.077	3827	0.000	0.000	0.074
Net equity issue	149236	0.069	0.001	0.245	3827	0.062	0.001	0.199
Net investment	149236	0.100	0.073	0.138	3827	0.099	0.072	0.128
Capital expenditure	149236	0.071	0.048	0.076	3827	0.071	0.049	0.072
Q ratio	145175	1.735	1.285	1.286	3722	1.687	1.290	1.148

Table B12 Summary statistics of financing and firm variables over different periods

This table reports the summary statistics of financing and related firm variables for firms in different periods, 1970s 2000s, where firms from 1970 to 1979 will be under period 1970s. All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Variable specifications and winsorisation method is reported in Chapter B4.

Summary statistics over different periods					
Internal flexibility measures/Period		1970s	1980s	1990s	2000s
Book value debt	Mean	0.267	0.263	0.234	0.208
	Median	0.254	0.233	0.194	0.151
Market value debt	Mean	0.258	0.213	0.175	0.155
	Median	0.238	0.172	0.117	0.089
True value debt	Mean	0.409	0.437	0.378	0.323
	Median	0.359	0.339	0.286	0.218
Deficit	Mean	0.027	0.057	0.101	0.075
	Median	0.026	0.017	0.017	0.009
Net debt issue	Mean	0.015	0.012	0.010	0.006
	Median	0.000	0.000	0.000	0.000
Short-term debt issue	Mean	-0.002	-0.002	0.002	0.002
	Median	0.000	0.000	0.000	0.000
Net equity issue	Mean	0.009	0.058	0.102	0.087
	Median	0.000	0.000	0.002	0.003
Net investment	Mean	0.098	0.126	0.098	0.074
	Median	0.074	0.089	0.071	0.054
Capital expenditure	Mean	0.077	0.086	0.069	0.053
	Median	0.057	0.059	0.046	0.032
Q ratio	Mean	1.175	1.634	1.989	1.973
	Median	0.953	1.233	1.475	1.504

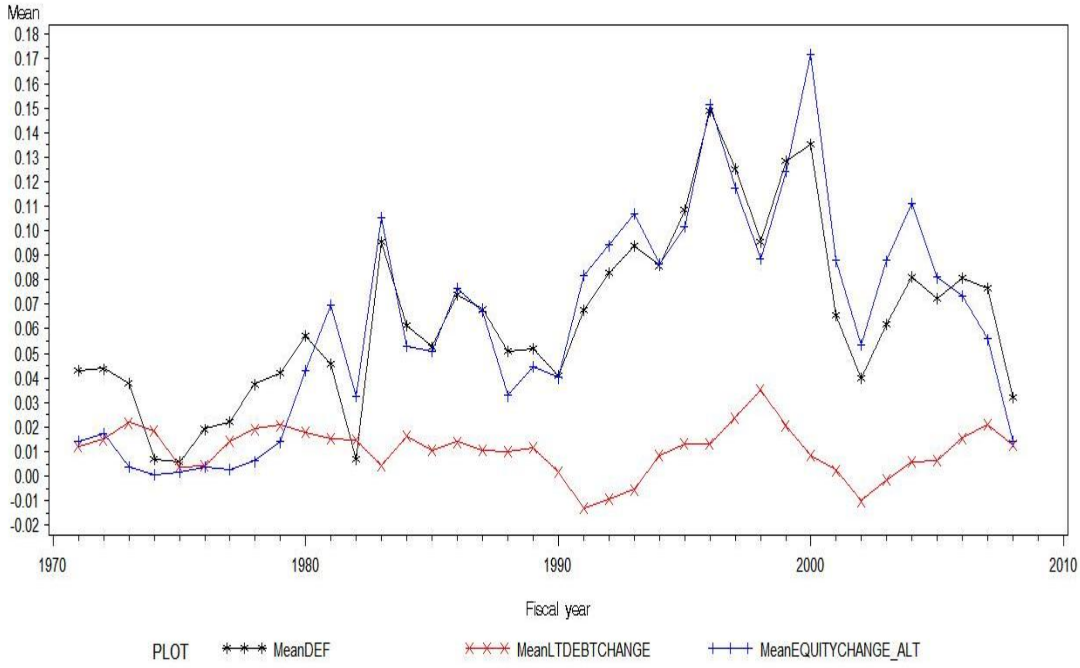


Figure B4a

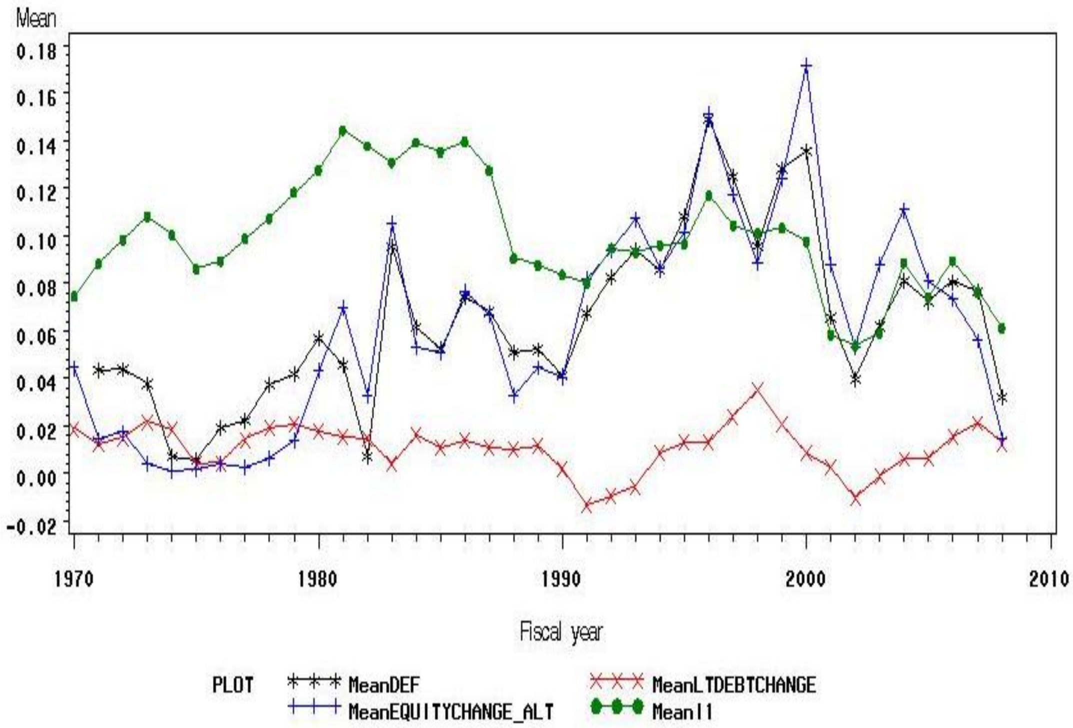


Figure B4b

Figure B4 Average net debt issue, net equity issue, deficit ratios and investment, 1970-2008
This figure plots the yearly averages of net debt and equity issues, and deficit ratios over the period 1970 to 2008. All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Variable specifications and winsorisation method is reported in Chapter B4.

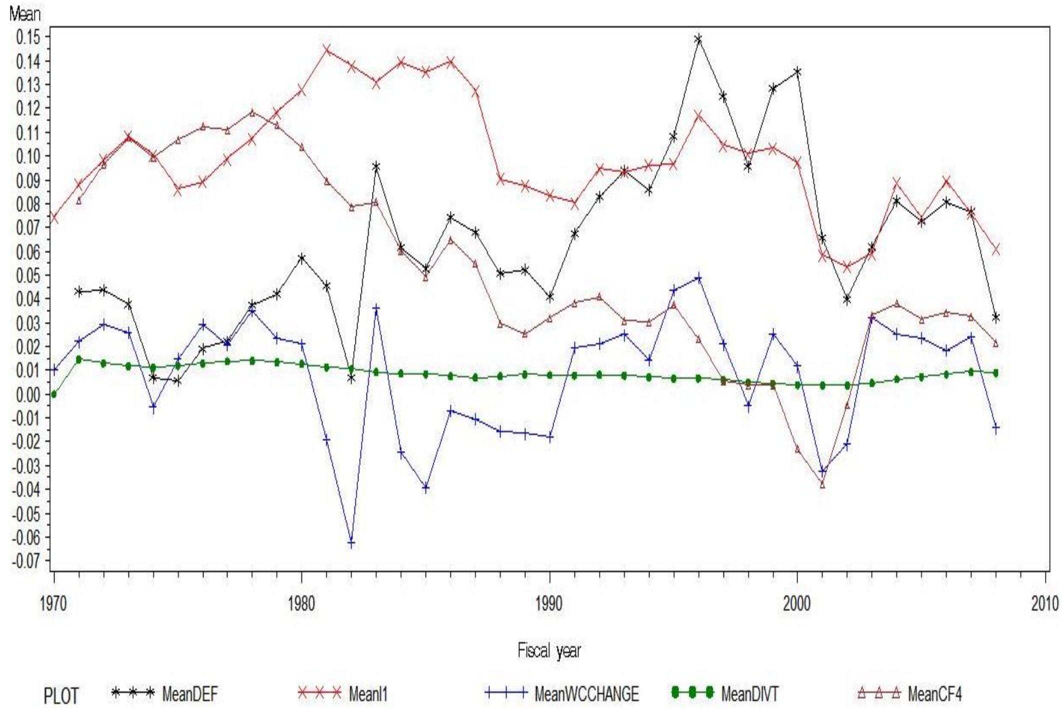


Figure B5 Average deficit and its components to total assets, 1970-2008.
This figure plots the yearly averages of financing deficit and its individual components – change in working capital, total dividend issued, net investment and net cash flow over the period 1970 to 2008. All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Variable specifications and winsorisation method is reported in Chapter B4.

B5.3 Pecking order model results

B5.3.1 Base and modified pecking order model results

The pecking order models (*a*) to (*f*) are estimated using OLS regressions and reported in Table B13. Panel A of Table B13 reports the results of basic and modified pecking order models (*a*) and (*c*). Results of the basic pecking order model in Panel A are generally consistent with Frank and Goyal (2003). The previous study reports pecking order model results based on sample from 1971 to 1998. Coefficient estimates for deficit and R-squared obtained for the models reported in Table B13 are consistently lower than the previous study. This is due to the lower values of firm ratios due to difference in scaling variable used.[79]

In accordance with expectations, deficit enters all regressions with positive and significant coefficient estimates; but different magnitude for both equations. With the exception of the 1970s, the basic pecking order model *(a)* with dependent variable net debt issuance reports lower R-squared compared to the modified model *(c)* with net equity issuance as the dependent measure. Similarly, with the exception of the 1970s, deficit has a lower estimate in all net debt issue regressions. Using the entire sample from 1971 to 2008, equity issuance is used proportionately much more than debt in financing deficit (coefficient estimate of 0.53 and 0.10 respectively), rejecting the pecking order's financing hierarchy. When the tests are performed across different periods, debt is the preferred form of financing for deficit only in the 1970s. From 1980s onwards, there is a decline in debt use in 1980s and 1990s (and slight increase in debt use in the most recent decade but still remaining low in

[79] Frank and Goyal (2003) scale all firm values using net assets (total assets less current liabilities). Here, all ratios are denominated by total assets. Due to the larger denomination, firm ratios reported here are consistently lower than in the previous study. For comparison, Appendix B-III reports regression results for sample 1971 to 1989 and 1990 to 1998 using different scaling variable, and results are both qualitatively and quantitatively similar to previous study even though the numbers of firms used are dissimilar.

proportion to equity use). On the other hand, there is a significant and consistent increase in equity use for deficit financing over time. Increase in equity use after the 1970s is expected since the development in equity markets means more firms have access to equity funds than previously. Equity funding only became more widely available and more popular in the 1970s and 1980s with the formation of the NASDAQ the early 1970s and also during the longest bull market, which started in the early 1980s. Thus, equity financing may have been used by more firms in the 1980s, making the trend more evident. Results support previous studies (Bharath et al., 2009, Frank and Goyal, 2003, Shyam-Sundera and Myers, 1991) where the pecking order model has declined importance and fails to explain the increased use in equity funds for financing purpose.

B5.3.2 Disaggregated base and modified pecking order model results

Next, the pecking order models are used with disaggregated financing deficit to provide important evidence of the use of debt and equity funds in financing each component. Panel B of Table B13 reports the results for equation *(b)* and *(d)*, with the following findings. First, cash flow enters both models with the correct negative sign since part of deficit is funded by internal cash flows. As expected, profitable firms issue less debt and equity due to greater cash inflows in each period. Second, dividend paying firms are found to issue greater debt (with the exception of 1990s). This supports the trade-off theory where dividend paying firms are generally larger firms with high cash flow but less opportunity or need for investments, therefore issuing debt (rather than equity) to take advantage of the tax deductibility of interest. This is supported by the modified pecking order model where dividend paying firms issue less equity in all periods except for the 1990s. Third, debt funds are mostly used for investment purpose followed by dividend payments; and the use of debt remains the same when regressions are performed across different decades. For the entire sample period and across different periods, low proportions of debt funds are used in funding working capital changes. Fourth, equity funds are mostly used for investments followed by funding working capital changes. However, as change in cash holdings is included in the change in working capital variable, it is highly likely that equity funds are kept as cash reserves at least in the same year of issue. Using the same conjecture, this also means that debt funds are used immediately in the same period and only a small proportion of debt funds is kept within the firm as cash reserves. Fifth, dividend payments do not significantly influence net equity issuance as dividend variable has negative coefficients in three out of four of the periods.[80] While firms issue debt to finance dividend payment, they do not issue equity for dividend purpose. Finally, the proportion of the use of funds remains the same for all periods for both debt and equity issues. The disaggregated models performed across time periods report similar decreasing trend for debt use in individual deficit components (i.e. similar to the decreasing debt use found in Panel A). Value-added components – investment and change in working capital are funded by debt in decreasing proportions over time, while these components are increasingly funded by equity. Debt-funded dividends on the other hand remain similar over different periods (with the exception of the 1990s where dividends are largely funded by equity and insignificant in debt issuance).

[80] Regression estimates for dividend payment indicate that increase in equity issue does not lead to increase in dividend payment. Rather, the opposite is found where equity issues and dividend payment have a negative relationship in 1970s, 19880s and 2000s. For the entire sample as a whole, dividend issue is found to have insignificant relationship with net equity issuance.

B5.3.3 Base and modified pecking order model with DC interaction results

Panel C of Table B13 reports regression results of the pecking order model with interaction effect between deficit and debt capacity. After adding the interaction term, deficit variable in the net debt issue regressions becomes unstable – deficit becomes insignificant over the entire sample, changes sign (from positive to negative) in the 1980s and 1990s, and returns a very small estimate for the most recent decade 2000s. Instability of deficit variable is also reported when net debt issue model is estimated using fixed effects regression and Fama-McBeth method (see Appendix B-IV). Results suggest that the amount of debt issued to finance deficit no longer depends solely on the amount of deficit firm faces, but depends on the amount of deficit relative to firm's borrowing capacity. Debt capacity measures firms' borrowing ability and is expected to have a positive impact on debt issuance. Accordingly, interaction between deficit and debt capacity is positive and significant for the pecking order regressions for the whole sample and across different periods. A decreasing trend for the estimates from the 1980s to the 2000s is found; and this is due to the fall in the use of debt to finance deficit over time. Taking the entire sample as a whole, the estimate for interaction term is 0.388 – to finance an average deficit of 6.9% (out of total assets), firms at the 75th percentile of debt capacity to total assets (0.505) will issue 59% more debt compared to firms at the 25th percentile of debt capacity (0.318).[81] The difference in debt issued between low and high debt capacity firms makes up about 45% of the average debt issued by all firms over the entire sample period. Comparing between firms at the 75th percentile of debt capacity

[81] Taking statistics from the entire sample (1970 to 2008), average deficit to total assets is 0.069, and debt capacity at the 25th and 75th percentile is 0.138 and 0.505 respectively. From Panel C of Table 13, the following equation is derived: Net debt issue to total assets = 0.388*Deficit*Debt Capacity. Accordingly, firms at the 25th and 75th percentile of debt capacity will issue 0.85% and 1.35% debt out of total assets respectively – this is equivalent to 59% more debt comparing firms at the 75th and 25th percentile of debt capacities, and 45% of the average net debt issued by firms over the entire sample.

and firms with no debt capacity, it will then be a decision of a full debt-funded deficit or a full equity-funded deficit (zero debt-funded deficit). Similar results are found when the latest decade (2000s) estimation results are considered in similar manner. A firm with the highest amount of debt capacity in 2000s issue about 60% more debt compared to firms with average level of debt capacity; and the difference makes up a significant 77% of the average net debt issued in 2000s.[82] Results from the base pecking order model show that the amount of debt firms issue to fund deficit is largely dependent on their ability to borrow, measured by debt capacity.

For the modified pecking order models, estimates for deficit increase significantly after an interaction term is included in the regression and is close to 1 for the entire sample. The increase in deficit coefficient, however, has to be adjusted for the negative coefficient of interaction term. The estimate for interaction between deficit and debt capacity is large, negative and significant for all net equity regressions. An increasing trend is exhibited over time for both deficit and interaction variable estimates. The coefficient for the interaction term in the modified pecking order model is of very large magnitude compared to the pecking order model. Converting the results in the second column into real terms, firms at the 25th percentile of debt capacity issues about 85% more equity compared to firms at the 75th percentile of debt capacity (because low debt capacity restricts borrowing and alternative equity financing has to be used). The difference in equity issued by low and high debt capacity firms makes up about 25% of the average equity issued.[83] The impact of debt capacity on equity issues is less than its impact on debt issues.

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[82] In a similar respect, the following equation is derived for period 2000s: 0.056*Deficit + 0.254*Deficit*Debt capacity. Firms at the 25th and 75th percentile of debt capacity will issue 0.76% and 1.22% of debt out of total assets and this is equivalent to 60% more debt issued by firms at the 75th percentile compared to firms at the 25th percentile of debt capacity, and 77% of the average net debt issued by firms in 2000s.

[83] Using results from column two of Panel C in Table 13, net equity issue is estimated as 9=0.957*Deficit - 1.323*Deficit*Debt capacity. Firms at the 25th and 75th percentile of debt capacity issues 3.7% and 2.0% of equity out of total assets – the difference in equity issue is 85% and this makes up about 25% of the average equity issued (6.9% out of total assets).

This is expected because debt capacity has a direct impact on borrowing and not equity issue, and firms are likely to make equity issuance decisions based on other factors, e.g. equity prices (overpriced equity induces equity issue) and liquidity.

To sum up the results in Panel C, only firms with sufficient debt capacity appear to follow pecking order financing hierarchy, whereas firms with insufficient debt capacity do not follow the hierarchy because they simply cannot do so. This, however, does not suggest that the pecking order model has failed in explaining firms' choice of financing, but the model hypothesis is contingent upon firms' ability to borrow. The modified pecking order model reports opposite results to support this. Although the effect on equity issue is smaller than debt capacity's direct impact on debt issue, results in the modified pecking order model support the inference made.

B5.3.4 Base and modified pecking order model with EEF interaction results

Panel D of Table B13 reports regression results of the pecking order model with interaction effect between deficit and external equity flexibility index. Coefficient estimates on deficit variable remain largely similar even after the additional variable is put into the model. The interaction term enters the base and modified models with a negative and significant coefficient. The negative and significant interaction term indicates that firms with lower equity liquidity (i.e. higher EEF index) issue significantly less equity and debt.

Although less equity issue is expected when EEF is higher, direct negative impact on debt issue is not hypothesized. Results suggest that whilst firms reduce equity financing when they become less flexible in the equity market, they might not increase debt financing at the same time, possibly because they may not be able to, and thus a reduction in debt issue.. Therefore, there is an important implication on both equity and debt issue when external flexibility changes. Firms are able to make more external equity and debt issues when they have greater external equity flexibility. Conversely, when firms are inflexible in the equity capital market, they do not substitute debt for equity and, supporting Lemmon and Roberts (2010), there is no or low substitutability between debt and equity.

Taking the sample as a whole (results in the first two columns of Panel D), to finance an average deficit of 6.9% (out of total assets), firms at 25th percentile of EEF (higher equity liquidity) will issue 20% more equity compared to firms at 75th percentile of EEF (lower equity liquidity). This is about 10% of the average amount of equity issued over the whole sample. While increase equity issuance is expected with increasing liquidity (decreasing EEF), an increase in debt issuance is not hypothesized. Results are consistent with Panel A. Here, a slight positive relationship is observed between net debt issue and equity liquidity. For the same level of deficit, firms at 25th percentile of EEF (higher equity liquidity) will issue 3% more debt compared to firms at 75th percentile of EEF (lower equity liquidity). Impact of EEF on net debt and equity issue is increasing over time.

On the whole, EEF has lower impact on debt and equity issue compared to debt capacity (in Panel C). This confirms the conjecture in the previous section that deficit is first financed by debt but is largely contingent upon firms' borrowing capacity, followed by firms' ability to issue equity when debt financing is not feasible. Furthermore, other factors contribute to firms' equity decisions and these are reflected in the lower impact of EEF observed in Panel D. Finally, for robustness tests, regressions reported in Table B13 are repeated using fixed effects regressions and Fama-McBeth estimation method (see Appendix B-IV and B-V respectively). Results obtained are largely similar and supportive of the findings above.[84]

[84] Supportive results are obtained with the exception of the relationship between dividends and equity issues in the fixed effects regression.

Table B13 Pecking order models on the entire sample (1971-2008) and by periods (1970s – 2000s)

This table reports OLS regression results of pecking order models (*a*) to (*f*) on the entire sample (1971 to 2008) and by periods (1970s to 2000s). All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variables are net long-term debt issue and net equity issue. Deficit ratio (DEF) is computed as the sum of cash dividends, net investment, change in working capital less cash flows to total assets. Variable specifications and winsorisation method is reported in Chapter B4. Panel A reports the basic pecking order model and modified pecking order model using net debt issue and net equity issue respectively. Panel B repeats the regressions with individual components of financing deficit. Panel C includes the interaction effect between deficit and external equity flexibility. OLS regressions are performed with heteroskedasticity adjusted standard errors clustered at firm-level. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in parentheses.

Model	OLS regression with heteroskedasticity robust standard errors adjusted for firm-level clustering									
Period	1970-2008		1970s		1980s		1990s		2000s	
Dependent	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY
	Panel A									
Intercept	0.004***	0.030***	0.008***	0.005***	0.006***	0.039***	0.003***	0.035***	-0.001	0.028***
.	(14.51)	(35.86)	(17.43)	(15.93)	(10.22)	(32.24)	(5.13)	(27.90)	(-1.37)	(17.56)
DEF	0.101***	0.534***	0.242***	0.060***	0.104***	0.333***	0.078***	0.670***	0.110***	0.780***
.	(43.43)	(61.97)	(42.10)	(14.95)	(25.62)	(35.57)	(25.37)	(66.85)	(20.91)	(35.36)
Adj R-Sq	0.061	0.298	0.191	0.035	0.067	0.239	0.038	0.379	0.072	0.344
Cluster	13326	13326	4342	4342	7138	7138	8512	8512	4559	4559
Obs	141519	141519	27715	27715	39300	39300	47196	47196	27308	27308
	Panel B									
Intercept	-0.011***	0.044***	-0.010***	0.003***	-0.022***	0.042***	-0.006***	0.048***	-0.010***	0.048***
.	(-22.79)	(35.49)	(-10.28)	(4.92)	(-21.84)	(25.60)	(-8.55)	(25.10)	(-13.99)	(19.14)
DIV	0.164***	0.026	0.322***	-0.091***	0.269***	-0.699***	-0.020	0.565***	0.362***	-0.008
.	(8.93)	(0.59)	(11.00)	(-4.60)	(6.98)	(-11.04)	(-0.60)	(7.06)	(8.57)	(-0.08)
I	0.238***	0.500***	0.455***	0.126***	0.300***	0.426***	0.181***	0.565***	0.219***	0.585***
.	(57.02)	(56.39)	(48.35)	(17.94)	(41.25)	(39.40)	(30.67)	(41.32)	(27.70)	(23.21)
WCCHANGE	0.059***	0.394***	0.167***	0.039***	0.070***	0.261***	0.025***	0.558***	0.064***	0.538***
.	(25.21)	(51.17)	(29.53)	(9.54)	(18.23)	(30.08)	(7.14)	(46.89)	(11.45)	(24.37)
CFcf	-0.077***	-0.641***	-0.273***	-0.086***	-0.074***	-0.436***	-0.061***	-0.702***	-0.088***	-0.807***
.	(-28.24)	(-60.90)	(-24.66)	(-10.16)	(-14.50)	(-34.80)	(-15.88)	(-53.23)	(-16.50)	(-34.42)
Adj R-Sq	0.105	0.331	0.273	0.069	0.133	0.300	0.070	0.380	0.108	0.359
Cluster	13326	13326	4342	4342	7138	7138	8512	8512	4559	4559
Obs	141519	141519	27715	27715	39300	39300	47196	47196	27308	27308

Table B13 Pecking order models on the entire sample (1971-2008) and by periods (1970s – 2000s) (continued)

Model	OLS regression with heteroskedasticity robust standard errors adjusted for firm-level clustering									
Period	1970-2008		1970s		1980s		1990s		2000s	
Dependent	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY
Panel C										
Intercept	0.002***	0.024***	0.007***	0.004***	0.002***	0.030***	0.002***	0.032***	-0.001	0.024***
.	(9.70)	(36.84)	(16.38)	(14.65)	(2.80)	(27.53)	(4.23)	(29.41)	(-1.02)	(15.88)
DEF	0.002	0.957***	0.142***	0.129***	-0.016**	0.634***	-0.002	0.955***	0.056***	1.141***
.	(0.65)	(65.64)	(5.61)	(5.28)	(-2.00)	(27.56)	(-0.31)	(58.59)	(7.08)	(31.02)
DEF_DC	0.388***	-1.323***	0.254***	-0.138***	0.447***	-0.686***	0.324***	-1.072***	0.254***	-1.621***
.	(31.24)	(-35.55)	(4.68)	(-2.76)	(18.56)	(-12.26)	(16.88)	(-21.05)	(7.58)	(-13.86)
Adj R-Sq	0.095	0.373	0.209	0.041	0.120	0.308	0.058	0.415	0.083	0.383
Cluster	13213	13213	4292	4292	7036	7036	8440	8440	4519	4519
Obs	139015	139015	27364	27364	38264	38264	46428	46428	26959	26959
Panel D										
Intercept	0.005***	0.019***	0.003***	0.000	0.009***	0.008***	0.007***	0.025***	-0.003***	0.035***
.	(14.31)	(21.48)	(4.39)	(0.07)	(10.66)	(10.31)	(12.89)	(20.96)	(-5.83)	(19.17)
DEF	0.140***	0.548***	0.316***	0.085***	0.172***	0.168***	0.129***	0.611***	0.110***	0.781***
.	(36.22)	(40.72)	(32.66)	(17.21)	(16.10)	(14.78)	(27.57)	(43.66)	(18.61)	(31.32)
DEF_EEF	-0.003	-0.068***	-0.014***	-0.018***	0.005	-0.029***	-0.007*	-0.080***	-0.005	-0.078***
.	(-1.48)	(-11.36)	(-2.60)	(-7.32)	(1.06)	(-4.92)	(-1.92)	(-11.75)	(-1.26)	(-5.05)
Adj R-Sq	0.093	0.273	0.265	0.091	0.118	0.137	0.082	0.318	0.075	0.341
Cluster	10313	10313	2278	2278	4406	4406	7565	7565	4407	4407
Obs	93726	93726	14034	14034	21241	21241	38746	38746	19705	19705

B5.4 Flexibility components in the pecking order models

B5.4.1 Base and modified pecking order models and flexibility

Next, we rank firms into different quintiles of flexibility variables and apply the basic pecking order model. Panel A of Table B14 shows that as debt capacity increases, the pecking order model's R-squared and coefficient estimates increase, with the exception of firms in the 1970s period. As firms with lower debt capacities keep greater cash, the model is expected to exhibit an opposite trend and decrease in R-squared and coefficient estimate when cash holdings increase. Results in Panel B mirror the findings in Panel A and show that firms with higher cash issue less debt to fund deficit, and such trend is consistent over the entire sample except for firms in the 1970s. Both panels report results that conform to the hypothesis that firms are debt constrained and their use of debt funds in deficit depends very much on the level of their actual debt capacity. Firms do not use debt financing because they do not have the opportunity to do so (due to low borrowing ability). Furthermore, firms with high cash (due to low debt capacity) are found to use less debt, and vice versa. Evidence suggests that firms' debt use is dependent on their ability to issue collateralized safe debt rather than their preference for debt over equity issues.

Moving on to firms' financing flexibility in the equity market, firms are assumed to issue more equity (and conversely less debt) when there is greater equity liquidity (lower EEF index). However, such an hypothesis is not supported in the regression results in Table B13 since debt issues decrease along with equity issues when equity liquidity is lower. In a similar respect, when firms are sorted according to different quintiles of EEF index (reported in Panel C of Table B14), debt issue does not increase with inflexibility in the equity market. Firms with lower equity liquidity do not issue more debt to compensate for lower equity issues, supporting previous findings in Lemmon and Roberts (2010). Although there is no specific trend between EEF and debt funded deficit, it is noted that firms at the two ends of EEF (higher or lower equity liquidity than average firms) tend to issue less debt to fund deficit; firms that use most debt funding in their deficits lie in the second quintile of EEF index (higher equity liquidity than average firms but not the highest liquidity group). Taking the average of the five quintiles, firms with more flexibility in the equity market (lower EEF index) issue slightly more debt – however, this trend is not evident across the firms groups and is only a generalised conclusion taken on the average if sample is halved. Further conclusions on debt and equity funded deficit can only be drawn after the modified pecking order model is performed over the same groups of firms sorted according to EEF index.

B5.4.2 Modified pecking order model and flexibility

To examine whether the analysis on debt financing holds for equity issue, the modified pecking order model (*c*) is performed across groups of firms sorted according to debt capacity, cash and EEF index (reported in Table B15). According to theoretical predictions, the modified pecking order model should report the same result as the base pecking order model but in a reverse manner. Table B15 Panel A shows a strong relationship between debt capacity level and equity funded deficit. With the exception of the last decile (firms with largest debt capacity), equity issue is monotonically decreasing with the level of debt capacity – firms with greater debt capacity issue less equity to fund their deficits. Results support the estimates reported in Panel A of Table B14. A slightly stronger relationship is found between debt capacity and equity funded deficit over different periods compared to that between debt capacity and debt funded deficit. This shows that not only does debt capacity affects borrowing ability of firms but also it has significant impact on firms' equity issue.

Table B15 Panel B reports a general trend of increasing equity issue with increased cash holdings. This is similar to the results in Table B14 where debt issue has a negative relationship with cash holdings. Results (reported in Table B17 and B18) from the modified model on different ranks of debt capacity and cash conforms to the hypothesis and are similar to that found in the original model where firms with high debt capacity and low cash use less equity financing, and vice versa. Together, both models show that firms which are more debt constrained hold more cash, use less debt, and at the same time use more equity financing for their deficit requirements.

Contrary to the mixed results obtained for EEF index, when the modified pecking order tests are done on different deciles of external flexibility index, a stronger negative trend is observed – where firms use less equity to fund a deficit when the EEF index increases and they are less flexible in the equity market. This is in sharp contrast with the mixed results obtained by the equity index in the basic model reported in Panel C. Here, it is found that firms with better equity position issue more equity to finance their deficit. The use of equity increases with equity flexibility, where firms in the lowest (highest) flexibility quintile always use the least (most) equity funds for their deficit needs. Not only does the model fit improve cross-sectionally as flexibility increases but also R-squared increases over time from 1970s to 2000s. A consistent negative relationship is found between equity issue and EEF. While the previous evidence suggests that equity market flexible firms only tend to issue less debt, there is strong evidence that they issue more equity. Firms with better equity position do issue more equity but at the same time may not issue less debt, i.e. equity is not a substitute for debt. This suggests that firms issue equity if they are able to; and they are not forced to issue equity as the last resort as suggested by the financing hierarchy.

B5.4.3 Robustness tests

For robustness tests, the following are performed. First, to ensure the consistency of results, firms are sorted into ten deciles according to levels of debt capacity, cash and EEF index (reported in Appendix B-VI and B-VII). The trends of the results observed are largely the same as firms sorted in five quintiles in Table B14 and B15, and this confirms the robustness of results even for smaller subsample of firms.

Second, to test the impact of credit rating on debt issue, firms are sorted according to long-term rating and subject to the same pecking order and modified pecking order tests. Results are reported in Appendix B-VIII. As hypothesized, long-term credit rating is not a good proxy for firms' debt (and equity) issuance ability – firms are not found to issue more debt or less equity as rating improves. The largest debt issuers are firms in group 2 and 3 with credit rating B- to BB+, while the largest equity issuers are firms with no credit rating. Results support the decision to exclude credit rating in the initial construction of external flexibility index, and prove that the use of credit rating variable requires further subsampling of firms to yield useful and conclusive results.

Third, to assess further whether any equity variable has a strong influence on the overall results, the base and modified pecking order model are performed on ranks of the equity market variables (equity cost estimate, BMA, liquidity price impact, RTOV12, illiquidity, LM12, and turnover, TO12) individually and reported in Appendix B-IX. Four sets of results are reported for the pecking order model. For equity cost estimate (BMA), hypothesis is not supported and the estimate decreases monotonically with increasing equity cost. Increasing equity costs is associated with less equity issue, and firms are expected to issue more debt to meet financing requirements. However, there is no substitution between equity and debt, and results support Lemmon and Roberts (2010). There is no consistent trend for liquidity price impact (RTOV12), but a general trend is evident – firms with greater liquidity (R=1 and R=2) issue more debt for deficit funding. Similar to the first measure, BMA, substitution between debt and equity is not found. In a similar respect, illiquidity estimate (LM12) shows no consistent trend, but firms with the least equity liquidity issue the most debt. Results for LM12 is consistent with turnover (TO12) where firms with lower liquidity issue more debt because they have less ability to issue equity for funding needs. On the whole, none of the equity liquidity variable is driving the results reported in Table B14 – while equity cost estimate and liquidity price impact measures support Lemmon and Roberts (2010) findings on the little substitution between different sources of capital, illiquidity estimate and turnover support the financial flexibility hypothesis where firms choose the financing source which provides them the best funding capacity.

Moving on to the modified pecking order model, an opposite but stronger trend is expected as equity market variables impact amount of equity issue directly. First, for equity cost and price impact measure, an inverted U-shaped trend is reported where firms in the middle deciles used the most equity, and firms in the top and bottom deciles used the least equity. As expected, firms in the top few deciles with higher equity costs and price impact, use less equity financing. On the other hand, for the bottom deciles of firms with lower equity costs and price impact, one plausible reason for their low equity usage may be due to firms' preference for debt rather than equity. Firms with lower equity costs and price impact may be larger and more established firms with access to both debt and equity financing. With greater flexibility (lower debt constraints), financing may be largely influenced by shareholders' preference for debt to decrease agency costs and managers' control over firms' cash holdings, firms' preference to seize tax deductibility of debt interest, or even firms following the pecking order theory financing hierarchy. Notwithstanding the mixed results obtained from the first two variables, illiquidity and turnover measures produce expected results, where firms with greater liquidity use more equity. Illiquidity and turnover are found to display very similar consistent trends for equity issuance. The basic and modified pecking order model regressions, individual equity variables, show that firms with increased liquidity use more equity to finance deficits but do not decrease their use of debt. Although there is weak evidence for substitution between debt and equity use, firms have the tendency to choose the financing source which provides them with the best funding capacity.

Table B14 Pecking order model (*a*) on different ranks of flexibility over different periods (1970s – 2000s)

This table reports OLS regression results of pecking order models (*a*) performed across subsamples of firms sorted according to debt capacity, cash holdings and EEF index for the period 1971 to 2008 and by periods (1970s to 2000s). In Panel A and B, group rank 1 (R_1) are firms with the lowest debt capacity and cash holdings, and group rank 5 (R_5) are firms with the highest debt capacity and cash holdings over the entire period and in difference periods (1970s to 2000s). In Panel C, group rank 1 (R_1) are firms with the highest equity liquidity, and group rank 5 (R_5) are firms with the lowest equity liquidity over the entire period and in difference periods (1970s to 2000s). All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variable is net long-term debt issue to total assets. Coefficient estimate is for independent variable deficit ratio (DEF), computed as the sum of cash dividends, net investment, change in working capital less cash flows to total assets. Variable specifications and winsorisation method is reported in Chapter B4. OLS regressions are performed with heteroskedasticity adjusted standard errors clustered at firm-level. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Panel A: Pecking order model (*a*) on deciles of debt capacity (R_1=Low debt capacity and R_5=High debt capacity)						
PERIOD	DECILE	R_1	R_2	R_3	R_4	R_5
1970-2008	Estimate	0.058***	0.116***	0.168***	0.199***	0.223***
	t-value	(23.80)	(24.34)	(26.16)	(27.31)	(31.74)
	AdjRSq	3%	7%	10%	13%	15%
1970s	Estimate	0.229***	0.260***	0.322***	0.301***	0.213***
	t-value	(23.55)	(22.65)	(26.62)	(26.44)	(20.72)
	AdjRSq	19%	21%	27%	25%	15%
1980s	Estimate	0.064***	0.147***	0.191***	0.254***	0.240***
	t-value	(14.09)	(16.20)	(15.54)	(17.65)	(17.57)
	AdjRSq	4%	10%	13%	18%	17%
1990s	Estimate	0.035***	0.076***	0.129***	0.152***	0.214***
	t-value	(10.11)	(10.95)	(13.53)	(13.70)	(18.88)
	AdjRSq	1%	3%	7%	8%	13%
2000s	Estimate	0.070***	0.112***	0.144***	0.151***	0.218***
	t-value	(12.21)	(10.42)	(9.98)	(9.23)	(12.46)
	AdjRSq	5%	7%	9%	8%	13%
Panel B: Pecking order model (*a*) on deciles of cash (R_1=Low cash holdings and R_5=High cash holdings)						
PERIOD	DECILE	R_1	R_2	R_3	R_4	R_5
1970-2008	Estimate	0.217***	0.212***	0.163***	0.100***	0.037***
	t-value	(33.72)	(31.64)	(26.78)	(20.05)	(17.58)
	AdjRSq	14%	14%	10%	6%	2%
1970s	Estimate	0.249***	0.290***	0.306***	0.277***	0.156***
	t-value	(22.19)	(25.24)	(26.33)	(25.03)	(16.90)
	AdjRSq	18%	23%	25%	24%	13%
1980s	Estimate	0.168***	0.182***	0.167***	0.119***	0.034***
	t-value	(17.35)	(17.21)	(15.71)	(12.93)	(9.21)
	AdjRSq	11%	13%	12%	8%	2%
1990s	Estimate	0.258***	0.225***	0.132***	0.068***	0.025***
	t-value	(22.87)	(18.64)	(14.24)	(9.17)	(8.22)
	AdjRSq	16%	13%	7%	3%	1%
2000s	Estimate	0.271***	0.228***	0.160***	0.082***	0.056***
	t-value	(14.94)	(14.26)	(10.24)	(7.02)	(10.75)
	AdjRSq	18%	15%	9%	4%	4%

Table B14 Pecking order model (*a*) on different ranks of flexibility over different periods (1970s – 2000s) (continued)

Panel C: Pecking order model (*a*) on deciles of EEF (R_1=High EEF and R_5=Low EEF)						
PERIOD	DECILE	R_1	R_2	R_3	R_4	R_5
1970-2008	Estimate	0.142***	0.172***	0.139***	0.125***	0.128***
	t-value	(23.71)	(21.47)	(22.43)	(20.19)	(19.48)
	AdjRSq	10%	12%	9%	8%	8%
1970s	Estimate	0.360***	0.322***	0.302***	0.324***	0.265***
	t-value	(20.32)	(18.87)	(17.32)	(19.76)	(16.28)
	AdjRSq	33%	31%	26%	28%	18%
1980s	Estimate	0.148***	0.182***	0.188***	0.175***	0.171***
	t-value	(10.81)	(8.87)	(11.08)	(9.77)	(10.80)
	AdjRSq	10%	12%	14%	11%	12%
1990s	Estimate	0.135***	0.157***	0.127***	0.126***	0.103***
	t-value	(16.70)	(14.75)	(15.53)	(13.85)	(11.17)
	AdjRSq	9%	11%	8%	8%	5%
2000s	Estimate	0.125***	0.169***	0.107***	0.081***	0.112***
	t-value	(10.31)	(10.41)	(9.23)	(8.74)	(9.38)
	AdjRSq	9%	12%	7%	5%	8%

Table B15 Modified Pecking order model (*c*) on different ranks of flexibility over different periods (1970s – 2000s)

This table reports OLS regression results of modified pecking order models (*c*) performed across subsamples of firms sorted according to debt capacity, cash holdings and EEF index for the period 1971 to 2008 and by periods (1970s to 2000s). In Panel A and B, group rank 1 (R_1) are firms with the lowest debt capacity and cash holdings, and group rank 5 (R_5) are firms with the highest debt capacity and cash holdings over the entire period and in difference periods (1970s to 2000s). In Panel C, group rank 1 (R_1) are firms with the highest equity liquidity, and group rank 5 (R_5) are firms with the lowest equity liquidity over the entire period and in difference periods (1970s to 2000s). All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variable is net equity issue to total assets. Coefficient estimate is for independent variable deficit ratio (DEF), computed as the sum of cash dividends, net investment, change in working capital less cash flows to total assets. Variable specifications and winsorisation method is reported in Chapter B4. OLS regressions are performed with heteroskedasticity adjusted standard errors clustered at firm-level. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Panel A: Modified Pecking order model (*c*) on deciles of debt capacity (R_1=Low debt capacity and R_5=High debt capacity)						
PERIOD	DECILE	R_1	R_2	R_3	R_4	R_5
1970-2008	Estimate	0.687***	0.584***	0.448***	0.359***	0.277***
	t-value	(74.98)	(46.44)	(30.91)	(26.43)	(22.41)
	AdjRSq	37%	31%	23%	20%	14%
1970s	Estimate	0.082***	0.064***	0.066***	0.070***	0.036***
	t-value	(8.75)	(7.93)	(7.32)	(8.37)	(4.20)
	AdjRSq	5%	4%	4%	5%	1%
1980s	Estimate	0.440***	0.415***	0.327***	0.296***	0.247***
	t-value	(31.77)	(22.76)	(16.01)	(14.11)	(12.05)
	AdjRSq	30%	32%	23%	20%	15%
1990s	Estimate	0.779***	0.680***	0.542***	0.440***	0.340***
	t-value	(59.99)	(34.03)	(23.81)	(18.82)	(16.11)
	AdjRSq	43%	34%	27%	22%	16%
2000s	Estimate	0.958***	0.766***	0.612***	0.440***	0.343***
	t-value	(36.40)	(23.67)	(14.19)	(11.83)	(9.74)
	AdjRSq	38%	33%	27%	21%	17%
Panel B: Modified Pecking order model (*c*) on deciles of cash (R_1=Low cash holdings and R_5=High cash holdings)						
PERIOD	DECILE	R_1	R_2	R_3	R_4	R_5
1970-2008	Estimate	0.202***	0.231***	0.346***	0.529***	0.713***
	t-value	(20.82)	(21.76)	(28.56)	(41.32)	(78.40)
	AdjRSq	10%	12%	17%	26%	40%
1970s	Estimate	0.054***	0.042***	0.069***	0.065***	0.065***
	t-value	(6.79)	(7.41)	(8.71)	(7.54)	(6.67)
	AdjRSq	3%	3%	5%	4%	3%
1980s	Estimate	0.185***	0.153***	0.228***	0.332***	0.444***
	t-value	(13.66)	(12.27)	(14.86)	(19.32)	(32.97)
	AdjRSq	12%	11%	16%	24%	31%
1990s	Estimate	0.240***	0.338***	0.458***	0.645***	0.819***
	t-value	(14.75)	(15.45)	(22.11)	(32.18)	(62.89)
	AdjRSq	10%	16%	22%	32%	46%
2000s	Estimate	0.266***	0.334***	0.482***	0.779***	0.988***
	t-value	(6.98)	(10.28)	(12.16)	(20.91)	(40.83)
	AdjRSq	11%	14%	16%	28%	45%

Table B15 Modified Pecking order model (*c*) on different ranks of flexibility over different periods (1970s – 2000s) (continued)

Panel C: Modified Pecking order model (*c*) on deciles of EEF (R_1=High EEF and R_5=Low EEF)						
PERIOD	DECILE	R_1	R_2	R_3	R_4	R_5
1970-2008	Estimate	0.660***	0.524***	0.598***	0.564***	0.354***
	t-value	(35.28)	(25.08)	(32.34)	(31.84)	(20.87)
	AdjRSq	28%	25%	29%	29%	18%
1970s	Estimate	0.134***	0.133***	0.067***	0.058***	0.035***
	t-value	(10.68)	(9.61)	(7.87)	(6.80)	(5.53)
	AdjRSq	11%	13%	7%	6%	3%
1980s	Estimate	0.256***	0.179***	0.147***	0.150***	0.086***
	t-value	(12.82)	(7.89)	(9.21)	(8.88)	(6.42)
	AdjRSq	19%	13%	11%	12%	7%
1990s	Estimate	0.776***	0.595***	0.699***	0.551***	0.394***
	t-value	(32.06)	(21.02)	(28.85)	(22.75)	(16.34)
	AdjRSq	33%	28%	37%	29%	22%
2000s	Estimate	0.864***	0.734***	0.794***	0.841***	0.582***
	t-value	(18.33)	(15.40)	(18.76)	(23.67)	(13.47)
	AdjRSq	31%	31%	33%	40%	27%

CHAPTER B6. THE CONVENTIONAL LEVERAGE MODEL

B6.1 Conventional leverage model specification

The pecking order regression models (Shyam-Sunder and Myers, 1999) are imperfect and subject to criticism in the literature (e.g. Chirinko and Singha, 2000). However, the models do allow us to compare the difference in proportion of debt and equity issues for firms with different levels of flexibility. To the extent that flexibility affects debt/equity financing, its impact on final leverage level will be evident. Conventional leverage regression is performed to examine the importance of flexibility in dictating debt level of firms. Determinants of leverage have been extensively researched and there are some ‘standard’ firm characteristics that have been theoretically and empirically tested as the main drivers of leverage. . The leverage model is adapted from Rajan and Zingales (1995) model used in Bharath et al. (2009).[85]

$$\begin{aligned} Leverage_{it} = \alpha &+ \beta_1 \, TANG_{it} + \beta_2 \, Q_{it} + \beta_3 \, SIZE_{it} \\ &+ \beta_4 \, PROFIT_{it} + \eta_i + \varepsilon_{it} \qquad (g) \end{aligned}$$

where leverage is measured by book value debt – the ratio of total long-term debt (DLTT[9] + DLC(34))[86] to total assets (AT[6]), tangibility is the ratio of net property plant and equipment (PPENT[8]) to total assets, Q (market to book assets) ratio is the ratio of market value assets (AT[6] + PRCC_F[199]*CSHO[25] - CEQ[60] - TXDB[74]) to book value assets, firm size is the natural logarithm of CPI adjusted

[85] Following the survey of Rajan and Zingales (1995), the four main independent variables – size, tangibility, profitability and market-to-book ratio are the standard firm characteristics used in leverage regression models.

[86] Following Frank and Goyal’s (2003) recoding method, debt reported in current liabilities (DLC[34]) is recoded to zero if found to be missing because item may be unreported or combined with other variables on the financial statement. Doing so will prevent any observations from being eliminated unnecessarily.

total assets value, profitability is the ratio of earnings before interest and tax (OIBDP[13]) [87] to total assets, and are η_i firm fixed effects. For robustness, the conventional leverage regressions are performed using OLS regressions with heteroskedasticity adjusted standard errors clustered at firm-level, fixed effects regression controlling for firm and year fixed effects, and Fama-McBeth regressions performed yearly. The three estimation methods are used on three measures of leverage – book value of debt, market value of debt and true value of debt, where the description on computation is detailed in Chapter B4. To test how financial flexibility affects leverage, flexibility components – debt capacity, cash and EEF index are included in the leverage regression.

$$\begin{aligned} Leverage_{it} = \alpha &+ \beta_1\, TANG_{it} + \beta_2\, Q_{it} + \beta_3\, SIZE_{it} + \beta_4\, PROFIT_{it} \\ &+ \beta_5\, DC_{it} + \beta_6\, EEF_{it} + \eta_i + \varepsilon_{it} \end{aligned} \tag{h}$$

Finally, following Frank and Goyal (2003) and Bharath et al. (2009), the following adapted test of capital structure theory is introduced. The previous papers performed the conventional leverage regression in first differences to combine the tests of pecking order theory and trade-off theory. As financing deficit measures change in funding requirement in each financial year, the variable is added into the model directly.

$$\begin{aligned} \Delta Leverage_{it} = \alpha &+ \beta_1\, \Delta TANG_{it} + \beta_2\, \Delta Q_{it} + \beta_3\, \Delta SIZE_{it} + \beta_4\, \Delta PROFIT_{it} \\ &+ \beta_5\, \Delta DC_{it} + \beta_6\, \Delta EEF_{it} + \beta_7\, DEF_{it} + \eta_i + \varepsilon_{it} \end{aligned} \tag{i}$$

B6.2 Conventional leverage model results

Table B16 reports the leverage model, equation (*g*), performed using OLS regressions, fixed effects regressions and Fama-McBeth estimation method for all three types of measures of leverage – book value debt, market value debt and true

[87] Earnings before interest and tax (OIBDP[13]) is estimated to be earnings before interest, tax and depreciation (EBITDA[13]) less depreciation and amortization (DP[14]) if the former is reported to be missing.

value debt. Results obtained are similar to the leverage regressions in Bharath et al. (2009). Coefficient estimates are consistent with previous literature and theory. Tangibility and firm size have direct positive relationship with leverage, while growth opportunities (measured by Q ratio) have negative relationship with leverage. All signs of estimates are consistent across different estimation techniques and measurements of leverage, with the exception of the positive coefficient for positive profitability in the OLS estimate. The positive estimate for profitability is supported by the trade off theory as profitable firms increase debt to take advantage of interest tax savings. However, the pecking order theory postulates profitable firms to have more cash holdings and make use of less debt, thereby lowering leverage. On the whole, Table B16 reports results that are robust across the three estimation methods and across the three different measures of leverage.

For robustness and to ensure that the leverage model is appropriately specified, a second variation to the conventional model includes industry median book value leverage computed yearly based on 4-digit SIC code is performed and results are reported in Appendix B-XI. This follows Denis and Mckeon (March 2012) and Frank and Goyal (2007), and partially considers the trade-off theory hypothesis while assuming that the debt target is industry determined. Inclusion of industry median leverage does not alter the initial estimates significantly but increases the model R-squared. This, however, does not alter the results and analysis of the conventional model; and the original model is used in subsequent tests.

To the extent that debt capacity increases net debt issue and adds to total firm leverage, a positive coefficient for debt capacity is expected. Table B17 reports the expected positive coefficient when debt capacity is included in the leverage model. By construction, debt capacity and tangibility (measured by net property plant and equipment) have a high positive correlation; therefore tangibility variable is excluded when debt capacity is put into the model. Appendix B-X confirms the high correlation (Pearson correlation coefficient of 0.41) between the two variables and excluding one of them reduces potential endogeniety problem. Results in Table B17 shows that all leverage determinants estimates remain quantitatively and qualitatively similar after the inclusion of debt capacity. Debt capacity is the most important independent variable with coefficient estimate up to 0.345 for OLS estimation on true value of debt ratio.[88] Estimates for debt capacity are slightly larger than estimates for tangibility, indicating the importance of debt capacity in dictating level of leverage. The results confirm that the debt capacity variable used here is a good proxy for borrowing ability and has a true impact in influencing total debt used.

Finally, external equity flexibility variable (EEF index) enters the leverage model with an expected positive relation because increased liquidity in the equity market (lower EEF index) reduces the need to issue debt and level of leverage. As such, level of debt is expected to increase with increased EEF index and decreasing equity liquidity. The strong positive relationship between leverage and EEF confirms the hypothesis. For ease of comparison, EEF index is transformed into a ratio variable (EEF10) by taking a division of ten. According to Table B6, EEF index ranges from -6.7 to 18, and division by 10 effectively reduces the range to between -0.67 and 1.8 while keeping the variable standardized with constant mean at zero. In Table B17, EEF index and debt capacity are equally important in their impact on level of leverage. Results are robust to different estimation techniques and leverage measurements. To the extent level of debt measures the amount of debt firms issue, the positive and significant relationship between EEF and leverage suggests firms

[88] In the leverage regression (*h*) with debt capacity (without EEF), coefficient estimate on debt capacity is reported to be up to 0.52 for OLS estimation on true value of debt (see Appendix B-XII). Again, this proves the importance of debt capacity in dictating the actual level of leverage firms keep on their books.

may not follow the strict financing hierarchy postulated by the pecking order theory. This is supported by findings in Chapter B5 where there is a positive relationship between net debt issue and equity liquidity. Together, the results confirm that there is no strict adherence to the financing hierarchy; rather the applicability of the pecking order is conditional on the amount of debt a firm is able to issue. Therefore, evidence against the pecking order model might be due to firms' incapacitated debt issue, rather than their preference for equity. Myers (2001) suggests that current theories of capital structure, including the pecking order model, are only conditional models to help explain firms' capital structure decisions. Supporting Myers' view, it is found that the pecking order model is a conditional theory based on a simple fact of whether or not firm has the capacity to issue debt when required. To the knowledge of the author, this is not tested and documented in the literature.

B6.3 Conventional leverage change model results

In the final leverage test, the conventional leverage model is run in first differences according to Frank and Goyal (2003) and Bharath et al. (2009) to combine the test of pecking order and conventional leverage determinants. Dependent variables are the change in book value debt, change in market value debt and change in true value debt. As the leverage change model requires firms to have at least two consecutive years of financial data, the sample is reduced to the 80,245 observations reported in Table B18. The usual leverage variables obtain estimates that are in line with theories and comparable to previous studies – negative on Q ratio, profitability and lagged leverage, and positive on debt capacity (in previous studies, tangibility is used) and firm size. The pecking order model is not entirely supported, since the estimate for financing deficit for book and market value of debt regression is not unity or close to one. Similar results are found in previous studies – although consideration of the pecking order model does preclude the trade-off theory and conventional determinants of leverage, financing deficit is a statistically significant determinant of leverage. However, when debt is scaled by total capital (where the reverse is equity) in model 4 to 6 of Table B18, estimates for financing deficit becomes statistically insignificant in the OLS and Fama-McBeth regressions, and negative in the fixed effects regression. This suggests firms' inclination towards using equity (instead of debt) to finance deficit – possibly owing to the greater accessibility to the equity market (as observed in Chapter B3).

Addition of debt capacity and EEF index do not alter the estimates of conventional leverage determinants. Large estimates for a lagged leverage variable are observed and this represents a strong mean reversion tendency of firms' leverage, supporting the trade-off theory (to the extent that mean reversion is towards the lagged value of leverage and firm has a debt target based on past levels of leverage). Debt capacity and EEF index obtain estimates that are larger than lagged leverage, suggesting the importance of both internal and external flexibility in determining leverage level. Estimates for flexibility components remain large and significant even after firm and year fixed effects are considered; and results remain robust to different estimation techniques and measurements of leverage.

To sum up, leverage regression results support the trade-off theory but less convincing evidence is found for the pecking order theory. To the extent debt capacity and EEF measure internal and external financial flexibility, results from the conventional leverage and change in leverage model support practical findings in Graham and Harvey (2001) where financial flexibility is the most important consideration when firms make capital structure decisions.

Table B16 Conventional Leverage model (*g*) over sample period 1970 to 2008

This table reports the conventional leverage model (*g*) on the entire sample (1971 to 2008). All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variables are three measures of leverage – book value debt, market value debt and true value debt ratios. Independent variables include tangibility (Tang) measured as the ratio of net property, plant and equipment to total assets, Q ratio measured as market to book value assets, firm size (Lnsale) measured as the natural logarithm of total sales, and profitability (Profit) measured as the ratio of earnings before interest and tax to total assets. Variable specifications and winsorisation method is reported in Chapter B4. Model 1, 4 and 7 report results of OLS regressions performed with heteroskedasticity adjusted standard errors clustered at firm-level. Model 2, 5 and 8 reports fixed effects regression controlled for firm and year fixed effects. Model 3, 6 and 9 reports results of Fama-McBeth regressions performed yearly. All regressions include a constant term. Goodness of fit statistic – R-squared is not reported for fixed effects regression. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

VARIABLE	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6	MODEL7	MODEL8	MODEL9
Model	OLS	FE	FM	OLS	FE	FM	OLS	FE	FM
Dependent	BKDEBT	BKDEBT	BKDEBT	MKTDEBT	MKTDEBT	MKTDEBT	TDEBT	TDEBT	TDEBT
Intercept	0.196***	-	0.199***	0.240***	-	0.248***	0.380***	-	0.374***
.	(44.02)	-	(12.66)	(59.22)		(10.02)	(43.48)		(11.03)
TANG	0.239***	0.270***	0.222***	0.195***	0.228***	0.183***	0.225***	0.283***	0.187***
.	(32.99)	(66.26)	(20.30)	(30.77)	(65.91)	(18.80)	(18.02)	(25.45)	(7.22)
Q	-0.021***	-0.010***	-0.018***	-0.058***	-0.040***	-0.065***	-0.041***	-0.023***	-0.032***
.	(-22.87)	(-23.15)	(-11.09)	(-76.50)	(-112.31)	(-7.84)	(-23.18)	(-20.30)	(-7.37)
LNSALE	0.003***	0.012***	0.005***	0.001***	0.007***	0.004***	0.003***	0.025***	0.009***
.	(4.63)	(29.14)	(3.12)	(2.70)	(18.99)	(4.13)	(2.78)	(21.59)	(2.74)
PROFIT	0.010***	-0.026***	-0.126**	0.012***	-0.017***	-0.125**	0.012**	-0.041***	-0.256**
.	(3.87)	(-21.12)	(-2.17)	(6.24)	(-16.09)	(-2.07)	(2.14)	(-12.44)	(-2.35)
R-sq	0.099	-	0.118	0.238	-	0.243	0.031	-	0.065
Obs	139248	139248	139248	139248	139248	139248	139248	139248	139248

Table B17 Leverage model (*h*) with debt capacity and EEF index over sample period 1970 to 2008

This table reports the leverage model (*h*) with EEF index on the entire sample (1971 to 2008). Sample and model specifications are reported in Table B16. Variable specifications and winsorisation method is reported in Chapter B4. All regressions include a constant term. Goodness of fit statistic – R-squared is not reported for fixed effects regression. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

VARIABLE	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6	MODEL7	MODEL8	MODEL9
Model	OLS	FE	FM	OLS	FE	FM	OLS	FE	FM
Dependent	BKDEBT	BKDEBT	BKDEBT	MKTDEBT	MKTDEBT	MKTDEBT	TDEBT	TDEBT	TDEBT
Intercept	0.146***		0.184***	0.168***		0.222***	0.139***		0.182***
.	(19.17)		(8.26)	(26.97)		(7.66)	(10.91)		(6.48)
DC	0.157***	0.156***	0.140***	0.172***	0.155***	0.126***	0.345***	0.304***	0.332***
.	(11.80)	(25.52)	(7.11)	(16.40)	(29.50)	(6.53)	(15.47)	(19.10)	(11.44)
EEF10	0.159***	0.154***	0.121***	0.177***	0.183***	0.157***	0.422***	0.333***	0.369***
.	(15.04)	(32.67)	(4.20)	(18.73)	(45.34)	(7.11)	(19.08)	(27.19)	(8.86)
Q	-0.020***	-0.007***	-0.025***	-0.052***	-0.036***	-0.072***	-0.024***	-0.014***	-0.027***
.	(-15.98)	(-13.82)	(-6.79)	(-53.96)	(-80.28)	(-6.35)	(-11.12)	(-10.41)	(-7.04)
LNSALE	0.013***	0.016***	0.011***	0.011***	0.011***	0.011***	0.028***	0.036***	0.025***
.	(14.83)	(27.29)	(3.58)	(14.80)	(22.86)	(5.86)	(16.84)	(24.40)	(6.24)
PROFIT	0.018***	-0.018***	-0.122**	0.014***	-0.013***	-0.138**	0.005	-0.032***	-0.263**
.	(6.33)	(-13.56)	(-2.11)	(6.40)	(-10.93)	(-2.17)	(0.89)	(-8.99)	(-2.53)
R-sq	0.077	-	0.093	0.226	-	0.232	0.062	-	0.092
Obs	92992	92992	92992	92992	92992	92992	92992	92992	92992

Table B18 Leverage change model (*i*) with debt capacity and EEF index over period 1970 to 2008

This table reports the leverage change model (*i*) with debt capacity and EEF index on the entire sample (1971 to 2008). Sample and model specifications are reported in Table B16. Variable specifications and winsorisation method is reported in Chapter B4. All regressions include a constant term. Goodness of fit statistic – R-squared is not reported for fixed effects regression. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

VARIABLE	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6	MODEL7	MODEL8	MODEL9
Model	OLS	FE	FM	OLS	FE	FM	OLS	FE	FM
Dependent	ΔBKDEBT	ΔBKDEBT	ΔBKDEBT	ΔMKTDEBT	ΔMKTDEBT	ΔMKTDEBT	ΔTDEBT	ΔTDEBT	ΔTDEBT
Intercept	0.026***		0.023***	0.020***		0.018***	0.122***		0.093***
.	(38.81)		(7.32)	(41.84)		(10.27)	(30.76)		(5.41)
ΔDC	0.205***	0.165***	0.257***	0.130***	0.109***	0.214***	0.299***	0.158***	0.429***
.	(15.82)	(25.41)	(6.49)	(13.26)	(19.11)	(3.96)	(7.70)	(7.57)	(4.96)
ΔEEF10	0.127***	0.115***	0.117***	0.161***	0.167***	0.156***	0.247***	0.214***	0.243***
.	(17.30)	(25.59)	(11.09)	(25.94)	(42.03)	(12.82)	(9.30)	(14.76)	(7.97)
ΔQ	-0.006***	-0.004***	-0.002	-0.027***	-0.022***	-0.039***	-0.015***	-0.008***	0.001
.	(-8.11)	(-10.41)	(-0.58)	(-42.94)	(-60.88)	(-6.98)	(-7.68)	(-5.92)	(0.06)
ΔLNSALE	0.013***	0.007***	-0.002	0.016***	0.009***	0.000	0.021***	0.013***	-0.003
.	(7.08)	(8.65)	(-0.31)	(11.29)	(12.61)	(0.06)	(4.53)	(4.78)	(-0.22)
ΔPROFIT	-0.024***	-0.019***	-0.083***	-0.015***	-0.014***	-0.078***	-0.040***	-0.029***	-0.152***
.	(-11.94)	(-18.19)	(-3.80)	(-11.34)	(-14.91)	(-3.14)	(-6.38)	(-8.40)	(-3.87)
DEF	0.070***	0.076***	0.154***	0.055***	0.062***	0.142***	-0.000	-0.027***	0.163*
.	(16.75)	(31.65)	(3.67)	(17.68)	(29.29)	(3.06)	(-0.03)	(-3.46)	(1.80)
LAGBKDEBT	-0.112***	-0.350***	-0.103***						
.	(-40.35)	(-118.11)	(-14.65)						
LAGMKTDEBT				-0.101***	-0.341***	-0.097***			
.				(-48.33)	(-118.29)	(-9.78)			
LAGTDEBT							-0.312***	-0.628***	-0.239***
.							(-29.52)	(-156.35)	(-6.51)
R-sq	0.092	0.324	0.193	0.156	0.357	0.251	0.129	-	0.190
Obs	78954	78954	78954	78954	78954	78954	78954	78954	78954

CHAPTER B7. CONCLUSION

Financial flexibility is the most important determinant of capital structure in practice. The impact of financial flexibility on firms' financing choice is tested using two main components of flexibility – debt capacity and external equity flexibility. The two components are used to predict different forms of financing – debt and equity issuance, using the pecking order models. The importance of debt capacity and external equity flexibility are assessed in the conventional leverage model with three measures of leverage. The following findings are obtained.

For internal flexibility, evidence shows substantial substitution effect between cash and debt capacity, and firms are found to have decreasing level of cash when debt capacity increases. For external flexibility, the newly constructed external equity flexibility variable (EEF index) shows that equity liquidity increases over time (while debt capacity decreases over time), suggesting increased reliance on equity funds as developments in the equity market promote greater accessibility. However, firms are increasingly reliant on internal debt capacity if they are denied access to equity funding. Lower equity liquidity firms have slightly larger debt capacity and more leverage in their capital structure. These firms have slightly lower cash holdings, are slightly younger, have fewer growth opportunities, and incur lower investment expenses. Substantial industry variation in flexibility characteristics is observed.

Financing deficit increases about three fold from the 1970s to the recent two decades. A large proportion of this deficit is financed by net equity issue and the trend is increasing with time. Supporting Frank and Goyal (2003), net equity issue is found to track deficit better than net debt issue, suggesting that firms choose to issue equity rather than debt for financing needs. In the 1970s and 1980s, a substantial amount of investment is financed internally by cash reserves or cash flows (as net investment exceeds total deficit). When financing deficit is disaggregated, the trend over time in deficit is driven primarily by net cash flows and change in working capital. Value-added components – investment and change in working capital are increasingly funded by equity. Debt funded dividends on the other hand remained similar over different periods. Results indicate that the amount of debt issued to finance the deficit no longer depends solely on the amount of deficit a firm faces but depends on the amount of deficit relative to the firm's borrowing capacity.

It is found that only firms with sufficient debt capacity appear to follow the pecking order financing hierarchy, whereas firms with insufficient debt capacity do not follow the hierarchy because they simply cannot do so. Therefore, the pecking order theory is contingent upon firms' ability to borrow. On the whole, EEF index has lower impact on debt and equity issue compared to debt capacity variable. This suggests that pecking order financing hierarchy remains useful in explaining firms' financing preference – deficit is first financed by debt but is largely contingent upon firms' borrowing capacity, followed by firms' ability to issue equity when debt financing is not feasible. Subsequently, firms' equity decisions are influenced by firms' flexibility in the equity market – reflected in EEF index.

Debt constrained firms hold more cash, use less debt and at the same time use more equity financing for their deficit requirements. Equity issue is monotonically decreasing with the level of debt capacity – firms with greater debt capacity issue less equity to fund their deficits. On the other hand, firms with better equity position issue more equity to finance their deficit, and the use of equity increases with equity flexibility. However, firms with better equity position may not issue less debt, i.e.

equity is not a substitute for debt. This suggests that firms issue equity if they are able to; and they are not forced to issue equity as the last resort as suggested by the financing hierarchy. Findings from the basic and modified pecking order model regressions, with individual equity variables, show that firms with increased liquidity use more equity to finance deficit but do not decrease their use of debt. Although there is weak evidence for substitution between debt and equity use, firms have the tendency to choose the financing source which provides them the best funding capacity.

Finally, the conventional leverage model results show that firms may not follow the strict financing hierarchy postulated by the pecking order theory, since a positive and significant relationship between EEF and leverage is found. The results confirm that there is no adherence to the financing hierarchy; rather the applicability of the pecking order is conditional on the amount of debt a firm is able to issue. Therefore, evidence against the pecking order model might be due to firms' incapacitated debt issue, rather than their preference for equity. Supporting Myers' (2001) view, evidence suggests that the pecking order model is a conditional theory based on a simple fact of whether or not firm has the capacity to issue debt when required. The conventional leverage change model reports a strong mean reversion tendency of firms' leverage, supporting the trade-off theory. Furthermore, debt capacity and EEF index are the most important determinants of leverage in the two conventional models, supporting the practical findings in Graham and Harvey (2001) where financial flexibility is the most important consideration when firms make capital structure decisions. Estimates for flexibility components remain large and significant even after firm and year fixed effects are considered; and results remain robust to different estimation techniques and measurements of leverage.

As financial flexibility has been proven to be a very important factor in financing decisions, further studies on financial flexibility on firms' investment decisions and firm value would add valuable insights into the impact of financial flexibility on firms' real value. Furthermore, the combination of the financial flexibility components (cash, debt capacity, equity and bond measures and credit rating) into a single index or measure will contribute greatly to the academic and practice as a single standardized measure of financial flexibility can be used to access firms' flexibility position directly.

APPENDIX B

Appendix B-I Eigenvalues and eigenvectors of principal components of PCA performed yearly for EEF index

This table reports results of the Principal Component Analysis for the four equity liquidity variables. Variable definitions for the liquidity variables are detailed in Chapter B3.2.2. Panel A reports Eigenvalues of the principal components and the cumulative variance of each component. Panel B reports the eigenvector values for each liquidity variable for the computation of the first principal component which is identified as the EEF index. Both average and pooled values are reported. Pooled statistics use the whole sample from 1951 to 2006 when performing the PCA, while average statistics report the average values of the results of PCA performed yearly from 1951 to 2006.

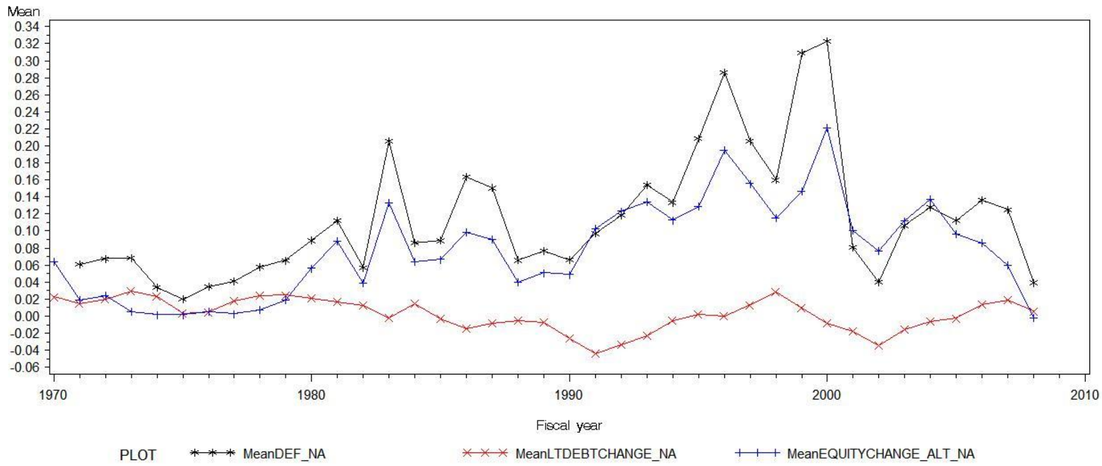
	EIGENVALUES OF PRINCIPAL COMPONENTS				EIGENVECTORS OF EEF INDEX (PRIN1)			
FYEAR	Prin1	Prin2	Prin3	Prin4	BMA	RTOV12 _SQRT	LM12 _SQRT	TO12
1951	2.253	1.183	0.389	0.176	0.590	0.630	0.477	0.167
1952	2.215	1.087	0.527	0.172	0.564	0.632	0.528	-0.054
1953	2.230	1.167	0.499	0.103	0.572	0.648	0.501	0.043
1954	2.205	1.071	0.574	0.149	0.554	0.640	0.527	-0.078
1955	2.105	1.148	0.567	0.180	0.542	0.652	0.530	0.025
1956	2.325	1.063	0.462	0.150	0.561	0.622	0.544	-0.044
1957	2.288	1.009	0.583	0.120	0.552	0.635	0.533	-0.089
1958	2.250	1.130	0.498	0.122	0.566	0.641	0.518	-0.006
1959	2.212	1.124	0.520	0.144	0.545	0.643	0.538	0.011
1960	2.216	1.037	0.609	0.139	0.562	0.643	0.520	0.013
1961	2.094	1.190	0.585	0.130	0.573	0.660	0.450	0.185
1962	2.070	1.134	0.682	0.114	0.571	0.672	0.471	0.003
1963	2.312	1.075	0.529	0.084	0.564	0.637	0.516	-0.103
1964	2.259	1.087	0.570	0.084	0.566	0.645	0.506	-0.085
1965	2.261	1.107	0.529	0.103	0.574	0.639	0.505	-0.083
1966	2.210	1.082	0.613	0.095	0.565	0.650	0.497	-0.107
1967	2.138	1.180	0.569	0.113	0.561	0.660	0.497	-0.056
1968	1.776	1.358	0.643	0.223	0.507	0.705	0.485	0.104
1969	1.796	1.336	0.660	0.208	0.396	0.705	0.582	-0.087
1970	2.030	1.002	0.830	0.137	0.519	0.675	0.523	-0.032
1971	2.092	1.015	0.782	0.111	0.546	0.670	0.500	-0.063
1972	2.150	1.057	0.676	0.117	0.529	0.653	0.507	-0.193
1973	2.355	0.971	0.577	0.098	0.521	0.617	0.511	-0.294
1974	2.478	0.940	0.509	0.073	0.537	0.605	0.513	-0.287
1975	2.585	0.903	0.444	0.068	0.524	0.593	0.520	-0.321
1976	2.479	0.946	0.494	0.081	0.534	0.604	0.515	-0.289
1977	2.460	0.965	0.491	0.084	0.537	0.609	0.519	-0.267
1978	2.364	1.059	0.498	0.079	0.536	0.628	0.526	-0.206
1979	2.285	1.061	0.556	0.098	0.528	0.637	0.524	-0.204
1980	2.410	1.011	0.486	0.093	0.498	0.617	0.539	-0.285
1981	2.344	1.020	0.540	0.096	0.482	0.624	0.538	-0.296
1982	2.335	0.961	0.591	0.113	0.489	0.618	0.526	-0.318
1983	2.192	1.050	0.612	0.147	0.449	0.636	0.550	-0.303
1984	2.303	0.973	0.584	0.140	0.510	0.618	0.511	-0.313
1985	2.476	0.908	0.484	0.132	0.549	0.589	0.509	-0.304
1986	2.547	0.866	0.457	0.129	0.538	0.580	0.512	-0.335
1987	2.553	0.868	0.437	0.142	0.534	0.577	0.519	-0.336
1988	2.568	0.872	0.421	0.139	0.545	0.571	0.518	-0.330
1989	2.553	0.878	0.433	0.136	0.550	0.570	0.514	-0.328

Appendix B-I Eigenvalues and eigenvectors of principal components of PCA performed yearly for EEF index (continued)

	EIGENVALUES OF PRINCIPAL COMPONENTS				EIGENVECTORS OF EEF INDEX (PRIN1)			
FYEAR	Prin1	Prin2	Prin3	Prin4	BMA	RTOV12 _SQRT	LM12 _SQRT	TO12
1990	2.545	0.899	0.424	0.132	0.556	0.569	0.515	-0.319
1991	2.604	0.869	0.396	0.131	0.553	0.567	0.522	-0.317
1992	2.588	0.890	0.394	0.127	0.552	0.571	0.523	-0.309
1993	2.578	0.923	0.382	0.117	0.559	0.577	0.528	-0.275
1994	2.559	0.911	0.394	0.136	0.555	0.575	0.527	-0.291
1995	2.544	0.912	0.386	0.157	0.558	0.573	0.533	-0.276
1996	2.576	0.929	0.371	0.124	0.555	0.580	0.534	-0.265
1997	2.608	0.915	0.359	0.119	0.556	0.581	0.536	-0.257
1998	2.565	0.928	0.371	0.135	0.559	0.584	0.538	-0.237
1999	2.593	0.942	0.372	0.094	0.554	0.595	0.541	-0.215
2000	2.523	0.928	0.418	0.130	0.540	0.595	0.535	-0.259
2001	2.637	0.859	0.384	0.119	0.556	0.574	0.524	-0.295
2002	2.602	0.872	0.413	0.113	0.559	0.579	0.520	-0.286
2003	2.551	0.919	0.372	0.157	0.563	0.580	0.537	-0.242
2004	2.342	1.002	0.488	0.168	0.562	0.617	0.542	-0.101
2005	2.303	0.985	0.505	0.206	0.549	0.613	0.547	-0.150
2006	2.287	0.986	0.500	0.227	0.524	0.608	0.549	-0.233
Average	2.448	0.946	0.482	0.125	0.537	0.601	0.525	-0.260

Appendix B-II Financing and deficit variables graph to match with Frank and Goyal (2003)

This figure plots the yearly averages of net debt and equity issues, and deficit ratios denominated by net assets (total assets less current liabilities)s over the period 1970 to 2008, to match with Frank and Goyal (2003) Figure B1. All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. Variable specifications and winsorisation method is reported in Chapter B4.



Appendix B-III Base pecking order model and disaggregated pecking order model for period 1971 to 1989

This table reports OLS regression results of the base pecking order model (*a*) for sample period 1971 to 1989 and 1990 to 1998 to match with Table B3 and B4 of Frank and Goyal (2003). All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variable is net long-term debt issue scaled by total assets. Deficit ratio (DEF) is computed as the sum of cash dividends, net investment, change in working capital less cash flows to total assets. Variable specifications and winsorisation method is reported in Chapter B4. OLS regressions are performed with heteroskedasticity adjusted standard errors clustered by firm and year. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Period	1971 - 1989		1990 - 1998	
	Frank and Goyal (2003)	Firm sample	Frank and Goyal (2003)	Firm sample
Dependent	ΔLTDEBT	ΔLTDEBT	ΔLTDEBT	ΔLTDEBT
Intercept	-0.002***	0.002***	0.007***	-0.023***
.		(3.08)		(-25.84)
DEF_NA	0.283***	0.173***	0.148***	0.153***
.		(124.02)		(76.15)
Adj R-Sq	0.265	0.187	0.12	0.120
Obs	89883	67015	57687	42396

Appendix B-IV Pecking order models on the entire sample (1971-2008) and by periods (1907s – 2000s) using fixed effects regression

This table reports fixed effects regression results of pecking order models (*a*) to (*f*) on the entire sample (1971 to 2008) and by periods (1970s to 2000s). All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variables are net long-term debt issue and net equity issue. Deficit ratio (DEF) is computed as the sum of cash dividends, net investment, change in working capital less cash flows to total assets. Variable specifications and winsorisation method is reported in Chapter B4. Panel A reports the basic pecking order model and modified pecking order model using net debt issue and net equity issue respectively. Panel B repeats the regressions with individual components of financing deficit. Panel C includes the interaction effect between deficit and external equity flexibility. Firm and year fixed effects are controlled in the following regression estimates. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	Fixed effects regression									
Period	1970-2008		1970s		1980s		1990s		2000s	
Dependent	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY
					Panel A					
DEF	0.128***	0.406***	0.259***	0.047***	0.146***	0.294***	0.091***	0.541***	0.147***	0.533***
.	(99.31)	(171.33)	(74.00)	(24.99)	(57.79)	(88.52)	(37.23)	(109.83)	(44.74)	(67.75)
Obs	141521	141521	27715	27715	39300	39300	47198	47198	27308	27308
					Panel B					
DIVT	0.138***	0.872***	0.356***	-0.188***	0.343***	0.351***	-0.440***	2.054***	0.512***	0.287**
.	(5.63)	(18.97)	(5.37)	(-4.90)	(4.30)	(3.24)	(-9.16)	(20.95)	(10.72)	(2.47)
I1	0.268***	0.458***	0.568***	0.083***	0.376***	0.344***	0.193***	0.538***	0.238***	0.530***
.	(119.97)	(109.56)	(87.01)	(22.14)	(72.05)	(48.53)	(49.92)	(68.18)	(49.83)	(45.58)
WCCHANGE	0.074***	0.364***	0.181***	0.038***	0.101***	0.283***	0.039***	0.504***	0.085***	0.480***
.	(55.91)	(146.90)	(53.78)	(19.71)	(41.69)	(85.93)	(14.94)	(95.33)	(24.75)	(57.62)
CF4	-0.120***	-0.359***	-0.332***	-0.046***	-0.143***	-0.221***	-0.101***	-0.396***	-0.119***	-0.418***
.	(-59.50)	(-94.99)	(-48.13)	(-11.54)	(-32.76)	(-37.21)	(-25.55)	(-49.22)	(-26.57)	(-38.24)
Obs	141519	141519	27715	27715	39300	39300	47196	47196	27308	27308
					Panel C					
DEF	0.011***	0.757***	0.153***	0.103***	-0.019***	0.541***	-0.001	0.807***	0.093***	0.884***
.	(4.18)	(159.32)	(9.41)	(11.62)	(-3.16)	(68.97)	(-0.14)	(90.40)	(16.38)	(66.92)
DEF_DC	0.410***	-1.066***	0.235***	-0.123***	0.519***	-0.639***	0.340***	-0.950***	0.234***	-1.463***
.	(55.25)	(-79.02)	(6.78)	(-6.47)	(33.19)	(-30.64)	(24.78)	(-34.74)	(12.11)	(-32.41)
Adj R-Sq	0.223	0.556	0.360	0.438	0.314	0.590	0.295	0.623	0.296	0.640
Obs	139015	139015	27364	27364	38264	38264	46428	46428	26959	26959
					Panel D					
DEF	0.180***	0.388***	0.339***	0.074***	0.257***	0.179***	0.156***	0.461***	0.154***	0.523***
.	(101.84)	(121.68)	(65.92)	(27.85)	(61.41)	(51.70)	(52.39)	(83.65)	(38.22)	(53.51)
DEF_EEF	-0.004***	-0.057***	-0.013***	-0.017***	0.006***	-0.025***	-0.008***	-0.072***	-0.013***	-0.064***
.	(-4.31)	(-34.53)	(-4.53)	(-11.41)	(2.80)	(-14.31)	(-5.22)	(-25.04)	(-6.41)	(-13.10)
Obs	93726	93726	14034	14034	21241	21241	38746	38746	19705	19705

Appendix B-V Pecking order models on the entire sample (1971-2008) and by periods (1907s – 2000s) using Fama-McBeth regressions

This table reports the Fama-McBeth regression results of pecking order models (*a*) to (*f*) on the entire sample (1971 to 2008) and by periods (1970s to 2000s). All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variables are net long-term debt issue and net equity issue. Deficit ratio (DEF) is computed as the sum of cash dividends, net investment, change in working capital less cash flows to total assets. Variable specifications and winsorisation method is reported in Chapter B4. Panel A reports the basic pecking order model and modified pecking order model using net debt issue and net equity issue respectively. Panel B repeats the regressions with individual components of financing deficit. Panel C includes the interaction effect between deficit and external equity flexibility. Fama-MacBeth regressions are performed using Newey and West (1987) standard errors controlling for autocorrelation. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Model	Fama-McBeth regression									
Period	1970-2008		1970s		1980s		1990s		2000s	
Dependent	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY
Panel A										
Intercept	0.004*	0.025***	0.007***	0.005**	0.006***	0.037***	0.002	0.034***	0.000	0.021
.	(1.82)	(4.88)	(6.01)	(2.92)	(3.66)	(7.12)	(0.27)	(28.70)	(0.05)	(1.72)
DEF	0.137***	0.453***	0.248***	0.062***	0.110***	0.328***	0.075***	0.652***	0.124***	0.762***
.	(6.72)	(4.99)	(24.46)	(4.13)	(9.82)	(6.11)	(10.54)	(22.89)	(12.29)	(11.20)
Adj R-Sq	0.095	0.266	0.196	0.039	0.073	0.240	0.036	0.410	0.083	0.361
Obs	141521	141521	27715	27715	39300	39300	47198	47198	27308	27308
Panel B										
Intercept	-0.012***	0.034***	-0.009***	0.003*	-0.021***	0.043***	-0.007	0.046***	-0.011***	0.042***
.	(-4.54)	(5.38)	(-6.53)	(2.10)	(-6.88)	(9.11)	(-1.19)	(11.46)	(-3.99)	(3.99)
DIVT	0.260***	-0.099	0.348***	-0.129***	0.292***	-0.672***	0.056	0.414*	0.364***	-0.002
.	(4.71)	(-0.56)	(9.56)	(-3.43)	(5.17)	(-3.37)	(0.55)	(2.04)	(6.93)	(-0.01)
I1	0.292***	0.416***	0.459***	0.115***	0.303***	0.409***	0.172***	0.565***	0.244***	0.558***
.	(8.64)	(7.10)	(47.62)	(4.88)	(28.19)	(18.72)	(11.69)	(25.85)	(10.82)	(11.27)
WCCHANGE	0.086***	0.348***	0.171***	0.043***	0.075***	0.260***	0.027***	0.540***	0.077***	0.538***
.	(5.09)	(4.93)	(19.70)	(3.78)	(7.28)	(5.43)	(4.67)	(16.94)	(7.34)	(7.95)
CF4	-0.129***	-0.501***	-0.286***	-0.066**	-0.083***	-0.446***	-0.059***	-0.679***	-0.099***	-0.799***
.	(-4.50)	(-5.58)	(-21.23)	(-2.42)	(-9.79)	(-25.13)	(-10.59)	(-21.96)	(-11.79)	(-12.10)
Adj R-Sq	0.151	0.300	0.275	0.072	0.144	0.311	0.067	0.415	0.128	0.386
Obs	141519	141519	27715	27715	39300	39300	47196	47196	27308	27308

Appendix B-V Pecking order models on the entire sample (1971-2008) and by periods (1907s – 2000s) using Fama-McBeth regressions (continued)

Model	Fama-McBeth regression									
Period	1970-2008		1970s		1980s		1990s		2000s	
Dependent	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY	ΔLTDEBT	ΔEQUITY
					Panel C					
Intercept	0.002	0.021***	0.006***	0.004**	0.001	0.027***	0.001	0.032***	0.000	0.019
.	(0.92)	(4.58)	(4.00)	(2.63)	(0.24)	(3.81)	(0.20)	(26.55)	(0.06)	(1.66)
DEF	0.040**	0.688***	0.134***	0.118***	-0.016	0.613***	-0.006	0.942***	0.060***	1.061***
.	(2.12)	(5.55)	(5.27)	(3.54)	(-0.82)	(4.77)	(-1.12)	(45.86)	(8.66)	(10.56)
DEF_DC	0.353***	-0.806***	0.292**	-0.112**	0.466***	-0.629***	0.324***	-1.065***	0.321***	-1.408***
.	(9.99)	(-4.69)	(3.04)	(-2.52)	(13.16)	(-3.71)	(14.59)	(-21.34)	(5.20)	(-6.55)
Adj R-Sq	0.125	0.305	0.217	0.047	0.133	0.312	0.056	0.452	0.100	0.393
Obs	139015	139015	27364	27364	38264	38264	46428	46428	26959	26959
					Panel D					
Intercept	0.004**	0.014***	0.003**	-0.000	0.009***	0.008***	0.005	0.023***	-0.002	0.028**
.	(2.11)	(3.24)	(3.14)	(-0.25)	(7.36)	(3.68)	(0.91)	(7.53)	(-0.56)	(2.98)
DEF	0.187***	0.378***	0.319***	0.083***	0.176***	0.151***	0.122***	0.558***	0.128***	0.823***
.	(7.12)	(3.89)	(21.21)	(5.13)	(16.44)	(8.96)	(19.07)	(9.36)	(10.06)	(10.18)
DEF_EEF	-0.008**	-0.049***	-0.014***	-0.019**	0.002	-0.028***	-0.008**	-0.082***	-0.013**	-0.070***
.	(-2.04)	(-5.15)	(-4.49)	(-3.29)	(0.22)	(-7.77)	(-2.85)	(-10.28)	(-2.86)	(-7.30)
Adj R-Sq	0.144	0.232	0.268	0.092	0.135	0.137	0.075	0.351	0.095	0.378
Obs	93726	93726	14034	14034	21241	21241	38746	38746	19705	19705

Appendix B-VI Pecking order model (*a*) on different ranks of flexibility components over different periods (1970s – 2000s)

This table reports OLS regression results of pecking order models (*a*) performed across subsamples of firms sorted according to debt capacity for the period 1971 to 2008 and by periods (1970s to 2000s). Group rank 1 (R_1) are firms with the lowest debt capacity and group rank 10 (R_10) are firms with the highest debt capacity over the entire period and in difference periods (1970s to 2000s). All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variable is net long-term debt issue to total assets. Coefficient estimate is for independent variable deficit ratio (DEF), computed as the sum of cash dividends, net investment, change in working capital less cash flows to total assets. Variable specifications and winsorisation method is reported in Chapter B4. OLS regressions are performed with heteroskedasticity adjusted standard errors clustered at firm-level. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Panel A: Pecking order model (*a*) on deciles of debt capacity (R_1=Low debt capacity and R_10=High debt capacity)

PERIOD	DECILE	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_10
	Estimate	0.046***	0.083***	0.111***	0.122***	0.160***	0.175***	0.194***	0.205***	0.252***	0.197***
1970-2008	t-value	(16.01)	(18.00)	(18.09)	(16.31)	(18.67)	(18.30)	(18.94)	(19.70)	(24.67)	(20.54)
	AdjRSq	3%	5%	7%	7%	10%	11%	12%	13%	17%	12%
	Estimate	0.214***	0.250***	0.236***	0.287***	0.311***	0.333***	0.319***	0.284***	0.256***	0.177***
1970s	t-value	(16.43)	(17.30)	(15.54)	(16.57)	(17.94)	(19.68)	(18.84)	(18.58)	(17.11)	(12.78)
	AdjRSq	18%	21%	18%	23%	25%	29%	27%	23%	19%	11%
	Estimate	0.049***	0.098***	0.138***	0.161***	0.168***	0.218***	0.263***	0.245***	0.289***	0.193***
1980s	t-value	(9.07)	(11.52)	(12.29)	(10.60)	(10.58)	(11.39)	(12.78)	(12.23)	(14.69)	(10.50)
	AdjRSq	3%	6%	10%	11%	12%	15%	19%	17%	22%	12%
	Estimate	0.026***	0.055***	0.066***	0.090***	0.133***	0.124***	0.135***	0.171***	0.224***	0.205***
1990s	t-value	(6.33)	(8.12)	(7.56)	(7.92)	(10.38)	(8.79)	(8.96)	(10.52)	(13.42)	(13.29)
	AdjRSq	1%	2%	3%	4%	7%	6%	7%	9%	13%	12%
	Estimate	0.060***	0.085***	0.133***	0.088***	0.148***	0.141***	0.145***	0.158***	0.233***	0.204***
2000s	t-value	(8.77)	(8.10)	(8.52)	(6.08)	(7.21)	(6.91)	(6.36)	(6.68)	(9.84)	(8.07)
	AdjRSq	4%	6%	9%	4%	9%	8%	8%	9%	15%	12%

Panel B: Pecking order model (*a*) on deciles of cash (R_1=Low cash holdings and R_10=High cash holdings)

PERIOD	DECILE	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_10
	Estimate	0.202***	0.234***	0.213***	0.212***	0.180***	0.147***	0.120***	0.083***	0.062***	0.027***
1970-2008	t-value	(23.63)	(24.13)	(22.12)	(22.64)	(20.83)	(17.27)	(15.81)	(12.60)	(13.58)	(11.46)
	AdjRSq	13%	16%	14%	14%	11%	9%	7%	4%	4%	2%
	Estimate	0.246***	0.252***	0.287***	0.292***	0.297***	0.314***	0.279***	0.276***	0.221***	0.114***
1970s	t-value	(15.76)	(15.69)	(17.91)	(17.89)	(18.14)	(19.11)	(17.63)	(17.82)	(15.32)	(9.49)
	AdjRSq	17%	19%	22%	24%	24%	26%	24%	24%	19%	9%
	Estimate	0.157***	0.183***	0.167***	0.197***	0.179***	0.154***	0.148***	0.093***	0.070***	0.020***
1980s	t-value	(12.28)	(12.29)	(11.29)	(13.08)	(12.52)	(9.76)	(10.82)	(7.50)	(8.22)	(5.11)
	AdjRSq	10%	13%	11%	15%	13%	10%	10%	5%	4%	1%

Appendix B-VI Pecking order model (*a*) on different ranks of flexibility components over different periods (1970s – 2000s) (continued)

Panel B: Pecking order model (*a*) on deciles of cash (R_1=Low cash holdings and R_10=High cash holdings) (continued)											
1990s	Estimate	0.245***	0.271***	0.238***	0.213***	0.142***	0.123***	0.084***	0.055***	0.037***	0.020***
	t-value	(15.74)	(16.66)	(14.03)	(12.57)	(10.40)	(9.82)	(7.29)	(5.71)	(5.66)	(5.52)
	AdjRSq	15%	18%	14%	12%	7%	6%	4%	2%	2%	1%
2000s	Estimate	0.244***	0.304***	0.252***	0.206***	0.219***	0.114***	0.084***	0.080***	0.077***	0.048***
	t-value	(10.74)	(10.42)	(10.40)	(9.81)	(9.84)	(5.64)	(4.96)	(4.96)	(6.97)	(8.08)
	AdjRSq	16%	20%	18%	13%	14%	6%	4%	4%	6%	4%
Panel C: Pecking order model (*a*) on deciles of EEF (R_1=High EEF and R_10=Low EEF)											
PERIOD	DECILE	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_10
1970-2008	Estimate	0.132***	0.159***	0.173***	0.172***	0.157***	0.124***	0.117***	0.134***	0.119***	0.136***
	t-value	(17.96)	(15.36)	(14.95)	(15.43)	(16.67)	(15.15)	(13.82)	(14.77)	(13.50)	(14.07)
	AdjRSq	9%	11%	13%	12%	11%	8%	7%	8%	7%	8%
1970s	Estimate	0.380***	0.328***	0.290***	0.355***	0.308***	0.296***	0.327***	0.322***	0.275***	0.254***
	t-value	(15.26)	(14.16)	(11.87)	(15.41)	(11.95)	(12.63)	(13.42)	(14.52)	(11.16)	(11.82)
	AdjRSq	34%	30%	29%	33%	27%	24%	27%	28%	19%	17%
1980s	Estimate	0.147***	0.147***	0.172***	0.193***	0.217***	0.161***	0.184***	0.166***	0.137***	0.203***
	t-value	(9.16)	(6.09)	(6.54)	(5.98)	(8.57)	(7.13)	(6.80)	(6.99)	(6.74)	(8.69)
	AdjRSq	10%	9%	12%	12%	17%	11%	12%	10%	9%	15%
1990s	Estimate	0.112***	0.176***	0.154***	0.159***	0.139***	0.117***	0.110***	0.145***	0.098***	0.108***
	t-value	(11.31)	(12.86)	(10.00)	(10.86)	(11.26)	(10.78)	(9.14)	(10.56)	(7.71)	(8.06)
	AdjRSq	7%	13%	10%	11%	9%	7%	6%	9%	5%	6%
2000s	Estimate	0.132***	0.110***	0.189***	0.153***	0.127***	0.090***	0.084***	0.078***	0.125***	0.099***
	t-value	(8.57)	(5.66)	(7.23)	(7.56)	(6.90)	(6.13)	(6.53)	(5.83)	(8.03)	(5.44)
	AdjRSq	10%	6%	15%	11%	9%	6%	6%	5%	10%	6%

Appendix B-VII Modified Pecking order model (*c*) on different ranks of flexibility components over different periods (1970s – 2000s)

This table reports OLS regression results of modified pecking order models (*c*) performed across subsamples of firms sorted according to debt capacity for the period 1971 to 2008 and by periods (1970s to 2000s). Group rank 1 (R_1) are firms with the lowest debt capacity and group rank 10 (R_10) are firms with the highest debt capacity over the entire period and in difference periods (1970s to 2000s). All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variable is net long-term debt issue to total assets. Coefficient estimate is for independent variable deficit ratio (DEF), computed as the sum of cash dividends, net investment, change in working capital less cash flows to total assets. Variable specifications and winsorisation method is reported in Chapter B4. OLS regressions are performed with heteroskedasticity adjusted standard errors clustered at firm-level. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Panel A: Modified Pecking order model (*c*) on deciles of debt capacity (R_1=Low debt capacity and R_10=High debt capacity)											
PERIOD	DECILE	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_10
1970-2008	Estimate	0.695***	0.648***	0.606***	0.553***	0.455***	0.441***	0.394***	0.323***	0.265***	0.288***
	t-value	(58.80)	(44.35)	(35.78)	(29.40)	(23.74)	(20.06)	(19.53)	(18.03)	(15.66)	(16.10)
	AdjRSq	37%	34%	31%	30%	23%	23%	21%	18%	13%	15%
1970s	Estimate	0.082***	0.082***	0.057***	0.072***	0.071***	0.061***	0.088***	0.052***	0.024*	0.047***
	t-value	(6.18)	(6.49)	(4.67)	(7.08)	(5.07)	(5.28)	(6.73)	(5.04)	(1.96)	(3.85)
	AdjRSq	4%	5%	3%	6%	4%	4%	7%	3%	1%	2%
1980s	Estimate	0.437***	0.423***	0.424***	0.402***	0.336***	0.316***	0.297***	0.295***	0.213***	0.279***
	t-value	(24.50)	(20.19)	(17.63)	(14.30)	(11.99)	(10.61)	(9.83)	(10.12)	(8.53)	(8.73)
	AdjRSq	28%	31%	33%	29%	24%	22%	19%	22%	13%	17%
1990s	Estimate	0.783***	0.746***	0.724***	0.618***	0.526***	0.560***	0.468***	0.408***	0.330***	0.349***
	t-value	(45.99)	(35.96)	(27.02)	(20.66)	(17.80)	(16.06)	(14.23)	(12.43)	(11.45)	(11.40)
	AdjRSq	42%	41%	37%	30%	25%	28%	24%	21%	16%	17%
2000s	Estimate	0.994***	0.875***	0.771***	0.758***	0.663***	0.560***	0.537***	0.340***	0.365***	0.323***
	t-value	(29.35)	(20.45)	(16.85)	(16.64)	(11.63)	(8.62)	(9.50)	(7.81)	(6.95)	(6.86)
	AdjRSq	40%	34%	29%	39%	29%	26%	26%	17%	18%	15%
Panel B: Modified Pecking order model (*c*) on deciles of cash (R_1=Low cash holdings and R_10=High cash holdings)											
PERIOD	DECILE	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_10
1970-2008	Estimate	0.214***	0.187***	0.202***	0.258***	0.298***	0.391***	0.487***	0.562***	0.658***	0.718***
	t-value	(15.08)	(14.65)	(13.78)	(16.92)	(18.19)	(22.22)	(25.43)	(32.59)	(43.65)	(62.05)
	AdjRSq	11%	9%	11%	12%	13%	20%	25%	27%	35%	40%
1970s	Estimate	0.046***	0.063***	0.046***	0.039***	0.067***	0.071***	0.058***	0.073***	0.051***	0.073***
	t-value	(4.33)	(5.36)	(5.28)	(5.21)	(6.85)	(5.74)	(4.75)	(5.92)	(4.53)	(5.07)
	AdjRSq	2%	5%	3%	2%	5%	4%	4%	5%	2%	3%

Appendix B-VII Modified Pecking order model (*c*) on different ranks of flexibility components over different periods (1970s – 2000s) (continued)

Panel B: Modified Pecking order model (*c*) on deciles of cash (R_1=Low cash holdings and R_10=High cash holdings) (continued)											
PERIOD	DECILE	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_10
1980s	Estimate	0.193***	0.174***	0.138***	0.168***	0.184***	0.278***	0.301***	0.359***	0.454***	0.420***
	t-value	(9.98)	(9.50)	(7.93)	(9.40)	(9.71)	(11.45)	(12.25)	(15.02)	(20.74)	(25.44)
	AdjRSq	12%	11%	9%	12%	13%	21%	22%	27%	36%	28%
1990s	Estimate	0.252***	0.226***	0.281***	0.388***	0.439***	0.476***	0.615***	0.666***	0.768***	0.835***
	t-value	(11.65)	(9.24)	(9.39)	(12.38)	(14.54)	(16.69)	(21.11)	(24.06)	(33.39)	(49.64)
	AdjRSq	11%	9%	14%	17%	19%	25%	32%	32%	39%	45%
2000s	Estimate	0.308***	0.213***	0.315***	0.353***	0.372***	0.567***	0.730***	0.811***	0.824***	1.045***
	t-value	(5.14)	(5.43)	(6.62)	(7.95)	(6.86)	(9.99)	(11.98)	(17.26)	(19.88)	(35.04)
	AdjRSq	14%	8%	15%	13%	11%	20%	27%	29%	35%	46%
Panel C: Modified Pecking order model (*c*) on deciles of EEF (R_1=High EEF and R_10=Low EEF)											
PERIOD	DECILE	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_10
1970-2008	Estimate	0.720***	0.538***	0.502***	0.544***	0.605***	0.592***	0.614***	0.505***	0.435***	0.273***
	t-value	(29.28)	(18.90)	(16.96)	(18.54)	(22.51)	(23.23)	(24.68)	(20.29)	(16.83)	(12.72)
	AdjRSq	28%	26%	24%	26%	29%	29%	32%	26%	22%	15%
1970s	Estimate	0.135***	0.125***	0.154***	0.110***	0.075***	0.059***	0.053***	0.061***	0.028***	0.042***
	t-value	(8.06)	(7.09)	(7.18)	(6.38)	(5.09)	(7.34)	(4.26)	(5.32)	(3.64)	(4.33)
	AdjRSq	11%	11%	15%	11%	7%	6%	5%	7%	2%	3%
1980s	Estimate	0.286***	0.203***	0.148***	0.217***	0.137***	0.157***	0.158***	0.143***	0.114***	0.059***
	t-value	(10.75)	(6.94)	(5.33)	(6.01)	(6.34)	(6.72)	(5.73)	(6.98)	(5.55)	(3.45)
	AdjRSq	21%	16%	12%	16%	9%	13%	13%	11%	10%	3%
1990s	Estimate	0.851***	0.612***	0.605***	0.584***	0.709***	0.690***	0.612***	0.474***	0.438***	0.349***
	t-value	(26.12)	(18.34)	(14.55)	(15.16)	(20.66)	(20.27)	(17.85)	(14.29)	(12.97)	(10.19)
	AdjRSq	34%	30%	30%	27%	39%	35%	32%	25%	24%	19%
2000s	Estimate	0.879***	0.804***	0.698***	0.766***	0.842***	0.755***	0.846***	0.834***	0.782***	0.378***
	t-value	(14.96)	(9.87)	(10.62)	(11.15)	(13.14)	(13.37)	(18.04)	(15.33)	(12.05)	(7.50)
	AdjRSq	29%	35%	28%	35%	33%	33%	41%	39%	35%	19%

Appendix B-VIII Base and Modified Pecking order model on different ranks of long-term credit rating over different periods (1970s – 2000s)

This table reports OLS regression results of pecking order model (*a*) and modified pecking order model (*c*) performed across subsamples of firms sorted according to long-term rating for the period 1985 to 2008 and by periods (1980s to 2000s). Group rank 0 (R_0) are firms with the lowest long-term credit rating and group rank 7 (R_7) are firms with the highest long-term credit rating over the entire period and in difference periods (1980s to 2000s). All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variable is net long-term debt issue to total assets. Coefficient estimate is for independent variable deficit ratio (DEF), computed as the sum of cash dividends, net investment, change in working capital less cash flows to total assets. Variable specifications and winsorisation method is reported in Chapter B4. OLS regressions are performed with heteroskedasticity adjusted standard errors clustered at firm-level. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in the parentheses.

Pecking order model (*a*) on deciles of long-term rating (R_1=Low rating and R_7=High rating)									
PERIOD	DECILE	R_0	R_1	R_2	R_3	R_4	R_5	R_6	R_7
	Estimate	0.090***	0.152***	0.380***	0.330***	0.265***	0.194***	0.109***	0.125***
1970-2008	t-value	(48.51)	(3.90)	(19.27)	(15.89)	(11.20)	(7.91)	(4.14)	(2.93)
	AdjRSq	5%	8%	29%	22%	16%	11%	8%	13%
	Estimate	0.099***	0.165	0.294***	0.169***	0.198***	0.175***	0.093***	0.262**
1980s	t-value	(29.77)	(1.63)	(8.18)	(4.90)	(2.79)	(2.97)	(3.03)	(2.09)
	AdjRSq	6%	6%	24%	10%	10%	9%	9%	16%
	Estimate	0.064***	0.241***	0.428***	0.413***	0.270***	0.169***	0.170***	0.115***
1990s	t-value	(23.37)	(4.15)	(15.64)	(15.00)	(9.43)	(6.57)	(3.86)	(3.54)
	AdjRSq	3%	18%	31%	31%	18%	9%	11%	12%
	Estimate	0.090***	0.048	0.418***	0.378***	0.294***	0.272***	0.071	0.103
2000s	t-value	(20.01)	(1.24)	(14.28)	(10.84)	(7.89)	(8.40)	(0.74)	(1.53)
	AdjRSq	6%	1%	33%	25%	17%	19%	1%	14%
Modified Pecking order model (*c*) on deciles of long-term rating (R_1=Low rating and R_7=High rating)									
PERIOD	DECILE	R_0	R_1	R_2	R_3	R_4	R_5	R_6	R_7
	Estimate	0.553***	0.116***	0.160***	0.120***	0.119***	0.138***	0.079***	0.221***
1970-2008	t-value	(97.61)	(3.06)	(9.80)	(8.27)	(6.88)	(6.72)	(3.28)	(2.79)
	AdjRSq	31%	4%	6%	3%	3%	6%	3%	7%
	Estimate	0.345***	0.021	0.037***	0.038***	0.090***	0.034	0.043*	0.382***
1980s	t-value	(45.78)	(0.82)	(3.21)	(2.87)	(3.43)	(1.02)	(1.85)	(4.00)
	AdjRSq	25%	-0%	2%	1%	6%	1%	2%	10%
	Estimate	0.692***	0.132***	0.207***	0.171***	0.091***	0.119***	0.119***	0.271
1990s	t-value	(79.34)	(2.84)	(7.52)	(7.62)	(3.30)	(5.47)	(3.07)	(1.55)
	AdjRSq	39%	7%	7%	6%	2%	5%	3%	7%
	Estimate	0.825***	0.189*	0.256***	0.116***	0.164***	0.297***	0.203*	0.159**
2000s	t-value	(47.93)	(1.96)	(6.18)	(3.64)	(6.42)	(7.26)	(1.80)	(2.26)
	AdjRSq	37%	5%	8%	2%	3%	15%	5%	5%

Appendix B-IX Base and Modified Pecking order model on different ranks of equity liquidity variables over different periods (1970s – 2000s)

This table reports OLS regression results of pecking order model (*a*) and modified pecking order model (*c*) performed across subsamples of firms sorted according the four equity liquidity variable for the period 1971 to 2008 and by periods (1970s to 2000s). For BMA, RTOV12 and LM12, group rank 1 (R_1) are firms with the highest liquidity and group rank 10 (R_10) are firms with the lowest liquidity debt capacity over the entire period and in difference periods (1970s to 2000s). For TO12, group rank 1 (R_1) are firms with the lowest liquidity and group rank 10 (R_10) are firms with the highest liquidity debt capacity over the entire period and in difference periods (1970s to 2000s). All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variable is net long-term debt issue to total assets for Pecking Order model and net equity issue to total assets for Modified Pecking Order model. Coefficient estimate is for independent variable deficit ratio (DEF), computed as the sum of cash dividends, net investment, change in working capital less cash flows to total assets. Variable specifications and winsorisation method is reported in Chapter B4. OLS regressions are performed with heteroskedasticity adjusted standard errors clustered at firm-level. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in parentheses.

		Pecking Order Model (*a*)					Modified Pecking Order Model (*c*)				
Decile	Stat	R_1	R_2	R_3	R_4	R_5	R_1	R_2	R_3	R_4	R_5
BMA	Estimate	0.215***	0.139***	0.108***	0.098***	0.100***	0.374***	0.550***	0.550***	0.581***	0.475***
	t-value	(24.24)	(21.87)	(21.70)	(20.41)	(18.95)	(8.41)	(11.15)	(10.60)	(18.70)	(19.74)
	AdjRSq	15%	9%	7%	6%	6%	1%	2%	3%	5%	9%
RTOV12	Estimate	0.208***	0.156***	0.119***	0.121***	0.126***	0.393***	0.542***	0.617***	0.516***	0.349***
	t-value	(26.17)	(27.04)	(23.76)	(24.22)	(22.67)	(6.52)	(11.60)	(19.49)	(20.85)	(17.76)
	AdjRSq	15%	11%	8%	8%	7%	1%	3%	5%	7%	8%
LM12	Estimate	0.126***	0.139***	0.148***	0.127***	0.153***	0.610***	0.491***	0.490***	0.476***	0.301***
	t-value	(25.85)	(22.68)	(23.04)	(21.57)	(23.51)	(14.43)	(12.89)	(16.46)	(18.78)	(13.31)
	AdjRSq	9%	9%	10%	8%	10%	3%	3%	3%	6%	5%
TO12	Estimate	0.161***	0.160***	0.137***	0.125***	0.120***	0.232***	0.371***	0.502***	0.528***	0.628***
	t-value	(22.23)	(23.20)	(21.66)	(22.83)	(25.99)	(11.17)	(14.04)	(15.90)	(16.15)	(15.92)
	AdjRSq	10%	11%	9%	8%	8%	1%	3%	4%	4%	4%

Appendix B-X Conventional leverage regressions (with industry median leverage) over sample period 1970 to 2008

This table reports conventional leverage model with additional independent variable (industry median leverage) on the entire sample (1971 to 2008). All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variables are three measures of leverage – book value debt, market value debt and true value debt ratios. Independent variables include tangibility (Tang) measured as the ratio of net property, plant and equipment to total assets, Q ratio measured as market to book value assets, firm size (LNSALE) measured as the natural logarithm of total sales, profitability (Profit) measured as the ratio of earnings before interest and tax to total assets, and industry median leverage (SIC_Median_Bkdebt) computed yearly based on 4-digit SIC code. Variable specifications and winsorisation method is reported in Chapter B4. Model 1, 4 and 7 report results of OLS regressions performed with heteroskedasticity adjusted standard errors clustered at firm-level. Model 2, 5 and 8 reports fixed effects regression controlled for firm and year fixed effects. Model 3, 6 and 9 reports results of Fama-McBeth regressions performed yearly. All regressions include a constant term. Goodness of fit statistic – R-squared is not reported for fixed effects regression. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in parentheses.

VARIABLE	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6	MODEL7	MODEL8	MODEL9
Model	OLS	FE	FM	OLS	FE	FM	OLS	FE	FM
Dependent	BKDEBT	BKDEBT	BKDEBT	MKTDEBT	MKTDEBT	MKTDEBT	TDEBT	TDEBT	TDEBT
Intercept	0.068***		0.080***	0.126***		0.140***	0.168***		0.182***
.	(14.86)		(12.24)	(32.39)		(10.06)	(18.93)		(11.83)
TANG	0.146***	0.248***	0.143***	0.112***	0.210***	0.113***	0.076***	0.249***	0.063***
.	(21.23)	(62.75)	(18.10)	(18.99)	(62.53)	(15.02)	(6.17)	(22.84)	(3.01)
Q	-0.010***	-0.008***	-0.010***	-0.047***	-0.037***	-0.057***	-0.022***	-0.020***	-0.019***
.	(-10.92)	(-19.57)	(-5.33)	(-67.28)	(-110.96)	(-6.94)	(-12.96)	(-18.17)	(-3.97)
LNSALE	0.003***	0.016***	0.003***	0.001**	0.010***	0.003***	0.003**	0.030***	0.006**
.	(4.61)	(38.13)	(2.99)	(2.33)	(28.50)	(3.37)	(2.52)	(27.02)	(2.37)
PROFIT	-0.006**	-0.025***	-0.124**	-0.003*	-0.016***	-0.122**	-0.011**	-0.039***	-0.251**
.	(-2.58)	(-21.97)	(-2.35)	(-1.66)	(-16.98)	(-2.20)	(-2.35)	(-12.50)	(-2.50)
SIC_MEDIAN	0.603***	0.432***	0.595***	0.528***	0.396***	0.526***	0.993***	0.727***	0.952***
BKDEBT	(50.61)	(72.55)	(49.02)	(52.24)	(78.42)	(23.35)	(44.06)	(44.20)	(27.35)
R-sq	0.206		0.216	0.335		0.334	0.091		0.127
Obs	145020	145020	145020	145020	145020	145020	145020	145020	145020

Appendix B-XI Correlation coefficients of leverage model variables

This table reports correlation coefficients of independent variables used in leverage models (g) and (h) over the sample period 1970 to 2008. All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variables are three measures of leverage – book value debt, market value debt and true value debt ratios. Independent variables include debt capacity (DC) measured as the ratio of debt capacity to total assets, external equity flexibility (EEF) index, tangibility (Tang) measured as the ratio of net property, plant and equipment to total assets, Q ratio measured as market to book value assets, firm size (LNSALE) measured as the natural logarithm of total sales, profitability (Profit) measured as the ratio of earnings before interest and tax to total assets, and industry median leverage (SIC_Median_Bkdebt) computed yearly based on 4-digit SIC code. Variable specifications and winsorisation method is reported in Chapter B4.

Panel A: Pearson Correlation Coefficients

	BKDEBT	MKTDEBT	TDEBT	DC_NOCASH	EEF	TANG	Q	LNSALE	PROFIT	SIC_MEDIAN_ BKDEBT
BKDEBT	1									
MKTDEBT	0.823	1								
TDEBT	0.692	0.581	1							
DC	0.208	0.292	0.182	1						
EEF	0.096	0.172	0.117	0.111	1					
TANG	0.277	0.294	0.127	0.407	-0.036	1				
Q	-0.183	-0.432	-0.136	-0.335	-0.191	-0.170	1			
LNSALE	0.077	0.150	0.050	0.166	-0.470	0.109	-0.199	1		
PROFIT	0.082	0.145	0.058	0.285	-0.060	0.139	-0.203	0.265	1	
SIC_MEDIAN_BKDEBT	0.411	0.453	0.281	0.281	0.060	0.337	-0.271	0.119	0.208	1

Panel B: Spearman Correlation Coefficients

	BKDEBT	MKTDEBT	TDEBT	DC_NOCASH	EEF	TANG	Q	LNSALE	PROFIT	SIC_MEDIAN_ BKDEBT
BKDEBT	1									
MKTDEBT	0.877	1								
TDEBT	0.915	0.819	1							
DC	0.274	0.347	0.288	1						
EEF	0.065	0.139	0.066	0.136	1					
TANG	0.311	0.330	0.253	0.377	-0.065	1				
Q	-0.219	-0.527	-0.226	-0.336	-0.294	-0.176	1			
LNSALE	0.127	0.200	0.153	0.075	-0.570	0.166	-0.080	1		
PROFIT	-0.057	-0.039	-0.049	0.211	-0.217	0.122	0.067	0.310	1	
SIC_MEDIAN_BKDEBT	0.430	0.453	0.403	0.275	0.056	0.347	-0.291	0.135	0.118	1

Appendix B-XII Leverage model (*h*) with debt capacity variable over sample period 1970 to 2008

This table reports leverage model (*h*) with debt capacity variable on the entire sample (1971 to 2008). All public firms (i.e. share code 10 or 11 in CRSP/Compustat) are included with the exception of financial (SIC=69000-6999), utilities (SIC 4900-4999), and government (SIC=9000-9999) firms. Firms with missing or negative total assets and total sales are excluded. The dependent variables are three measures of leverage – book value debt, market value debt and true value debt ratios. Independent variables include debt capacity (DC) measured as the ratio of debt capacity to total assets, tangibility (Tang) measured as the ratio of net property, plant and equipment to total assets, Q ratio measured as market to book value assets, firm size (LNSALE) measured as the natural logarithm of total sales, and profitability (Profit) measured as the ratio of earnings before interest and tax to total assets. Variable specifications and winsorisation method is reported in Chapter B4. Model 1, 4 and 7 report results of OLS regressions performed with heteroskedasticity adjusted standard errors clustered at firm-level. Model 2, 5 and 8 reports fixed effects regression controlled for firm and year fixed effects. Model 3, 6 and 9 reports results of Fama-McBeth regressions performed yearly. All regressions include a constant term. Goodness of fit statistic – R-squared is not reported for fixed effects regression. The table reports coefficient estimates where *** represents significance at 1% level, and ** and * represents significance at 5% and 10% respectively. T-values are reported in parentheses.

VARIABLE	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6	MODEL7	MODEL8	MODEL9
Model	OLS	FE	FM	OLS	FE	FM	OLS	FE	FM
Dependent	BKDEBT	BKDEBT	BKDEBT	MKTDEBT	MKTDEBT	MKTDEBT	TDEBT	TDEBT	TDEBT
Intercept	0.163***		0.170***	0.196***		0.220***	0.217***		0.211***
.	(26.74)		(10.41)	(38.96)		(9.69)	(20.77)		(9.87)
DC	0.240***	0.223***	0.218***	0.231***	0.189***	0.185***	0.519***	0.440***	0.514***
.	(21.40)	(44.12)	(6.09)	(26.56)	(43.99)	(6.98)	(26.08)	(32.24)	(7.98)
Q	-0.019***	-0.010***	-0.016***	-0.055***	-0.040***	-0.063***	-0.030***	-0.023***	-0.024***
.	(-19.95)	(-24.72)	(-7.22)	(-71.44)	(-112.58)	(-8.52)	(-16.77)	(-20.17)	(-4.99)
LNSALE	0.004***	0.012***	0.006***	0.002***	0.007***	0.005***	0.003***	0.026***	0.006*
.	(5.90)	(28.47)	(3.44)	(3.92)	(18.81)	(4.46)	(2.70)	(22.08)	(1.72)
PROFIT	0.005*	-0.030***	-0.132**	0.005***	-0.021***	-0.131**	-0.013**	-0.047***	-0.264**
.	(1.79)	(-24.65)	(-2.19)	(2.58)	(-19.79)	(-2.11)	(-2.34)	(-14.34)	(-2.45)
R-sq	0.058	-	0.082	0.213	-	0.214	0.039	-	0.074
Obs	137036	137036	137036	137036	137036	137036	137036	137036	137036

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