What Factors Cause Cash Ratios to Increase in Western European and Nordic Countries?

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PURPOSES OF THE STUDY

Many papers have contribute to the understanding of cash holdings for firms in the U.S.. The possible reasons are also suggested according to different authors. However, cash holdings in Europe have not been investigated even though ample firm data exist in Europe. My study attributes to the analysis of cash ratios in Europe. From my research, I notice that cash ratios increases significantly for firms in western European and Nordic countries from 1980 to 2009. This paper analyzes potential reasons that lead to the increase of cash holdings.

DATA

The sample includes all Thomson One Banker firm-year observations from 1980 to 2009 with positive values for the book value of total assets and sales revenue for firms incorporated in western European and Nordic countries. Financial firms (SIC 6000-6999) and utilities (SIC 4900-4999) are excluded from the sample. Countries in the sample include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Spain, Sweden, Switzerland, and United Kingdom.

RESULTS

My study shows that changes of some firm specific characteristics have the most influence on cash ratios. These firm variables include net working capital, research and development costs, and cash flow volatility. Even though previous literature suggests that agency problems can induce management to hoard cash. But in my empirical research, this hypothesis cannot explain the increase in cash ratios, at least, not from firms in my sample.

KEY WORDS

Cash ratios, financial constraints, agency problems, cash flow volatility, dividends, euro

Contents

1   Introduction

After releasing the second quarter's financial statements, Apple Inc. announced its tremendous cash holdings of 76.4 billion US dollar, surpassing the cash reserves held by the United States government (73.7 billion US dollar). Other high-tech companies such as Microsoft and Google hold cash 58.8 billion and 39.1 billion USD, respectively. Moddy said the U.S. corporates altogether hold cash reserves of 1,240 billion USD at the end of 2010, 11% higher than the cash holdings at the end of 2009. So why do firm hoard so much in hand? Is that any better disposal rather than hold cash in hand? Would it cause too much attention from shareholders?

A firm may accumulate cash for several motives. Perhaps the most recognized one is to minimize transaction costs. Transaction costs decrease the motivation for firms to raise funds from external market even if firms could have valuable projects to invest. Another motive to hold cash is to enable firms to keep investing when cash flows are too low to fund positive NPV investments. Obtaining cash from external capital market is costly for firms due to information asymmetry. For example, in an economic downturn, investors may not have perfect knowledge to distinguish whether the firm's poor performance is due to general economic conditions or low growth opportunities for the firm. Consequently, to compensate the potential default risks, investors would request above-average return from the capital invested. Thus, external funds could be too expensive for firms if they do have valuable investment opportunities.

Chundson (1945) finds that cash/assets ratios tend to vary significantly by industrial sectors. Baskin (1987) argues that firms may use cash reserves for competitive purposes. For instance, cash reserves can signal a commitment to retaliation against market encroachment and to enable firms to seize new opportunities quickly. John (1993) suggests that firms wish to hold more cash when they are subject to greater financial distress costs. He finds that firms with high Tobin's Q ratios and low tangible assets are likely to hold more cash. More details on motives for firms to hold cash will be amplified later in Section 1.2.

1.1   Mathematical model

Opler, Pinkowitz, and Williamson (1997) develop a mathematical model that describes the general principle for firms to hold cash. In the model, a firm is short of cash if the general conditions are met. One thing to remind is that the model excludes many factors existing in real world. The model is just a simplistic model with very basic explanation power. But it can illustrate the most general

rationale for cash holdings. In a world of perfect capital market without information asymmetry or transaction cost, holding cash and cash equivalent is irrelevant since there is sufficient information on performance and conditions of firms to signal to outsiders. Thus, investors can make best decisions based on the transparent and sufficient information provided by firms. So they don't need to price this corresponding risk in the risk premium. On condition that firms need to raise cash from external capital market to fund its investments and daily operations, they can do so at zero cost because there is no liquidity premium in such a world with perfect information. Thus, if a firm borrows cash and invests in liquid assets, the wealth of shareholders will not be changed.

However, if it is costly for firms to raise funds from external capital market, the firms will weigh the marginal costs of holding one additional dollar against the marginal benefits of that one additional dollar. Holding extra cash reduces the possibility of being short of cash. The model provided by Opler, Pinkowitz, Stulz, and Williamson (1997) can be illustrated below:

A firm is defined short of cash if it has to reduce investments, dividends, or raise capital by selling securities or assets.

If a firm starts investments at time *t* in state of world *s(t)*, the investment is I(*s(t)*). In state *s(t)*, the beginning cash possessed by a firm is equal to the cash at the end of time *t-1,* L(*t-1*), plus the return on the beginning cash balance, r(*s(t)*)*L(*t-1*), and plus the cash flow from daily operations, C(*s(t)*). As the same time, the firm must pay tax, T(*s(t)*), pay for existing debts, bonds or derivatives, P(*s(t)*) and dividend d(*s(t)*).

A firm is short of cash if:

$$I(s(t)) > L(t-1)(1+r(s(t))) + C(s(t)) - T(s(t)) - P(s(t)) - d(s(t)) \qquad (1)$$
$$\text{And} \quad \partial I(s(t)) / \partial L(t-1) = (1+r(s(t))) \qquad (2)$$

Equation 1 indicates that the firm exhausts all of the internally liquid assets available before resorting to external capital market. And equation 2 indicates that if the firm has more liquid assets on hand it would invest in the PNV projects. Models of optimal cash holdings can differ in terms of costs of being short of cash and in terms of marginal cost of cash holdings.

The model offers several implications. The firm can avoid being short of cash in a particular state of the world by holding more cash reserves or by engaging in financial activities that reduce P(*s(t)*) in the same period. Hedging is an applicable and useful method that can reduce P(*s(t)*)or even make it

negative. Besides, the firm can issue equity. So it can reduce payments to bondholders. As a result, an optimal theory of cash holdings has to highlight the issue of why it is more efficient to hold an additional dollar of cash rather than leverage or hedging.

1.2 Motivations for cash holdings

Ample empirical studies have focused on motives for holding cash. The most studied motives are precautionary motive and transaction motive. Opler, Pinkowitz, Stulz, and Williamson (1997) summarize and extend previous studies and they propose three classical motives for cash holdings.

1.2.1 The transaction cost model

Accessing external capital market is always expensive in real world. A firm short of cash has to raise funds in the capital market, or liquidate existing assets, or reduce dividends, or renegotiate existing financial contracts. Unless the firm can liquidate the assets at low cost, firms generally prefer capital market. However, it's expensive to raise capital from external market. The fixed costs of accessing outside markets induce firms to raise funds infrequently and use cash reserves in case of need.

In a world with significant transaction costs, it's reasonable to expect very liquid assets such as cash to have a low return because these assets can be exchanged into other assets at a low cost. As a result, it's expensive for firms to hold cash due to the opportunity cost. Consequently, firms have an opportunity cost to hold cash. For example, the opportunity cost increases with interest rate if the firm holds its cash in the form of demand deposits. It's especially true to hold cash and cash equivalent when the liquidity premium of the term structure rises.

1.2.2 Information asymmetries and agency costs of debts

Information asymmetries make it more difficult for firms to raise capital from external market. Outsiders need to be sure that they are not wasting or risking their money by purchasing overpriced securities. Since outsiders know less than managers, they will tend to underprice the securities given managers' information. In fact, sometimes outsiders require

too much discount that the management thinks it's more reasonable and profitable not to sell the stocks. Thus, we can see that information asymmetry makes external financing more expensive. So firms with little debt capacity left would resort to cash reserves rather than the informationally sensitive securitites.

Agency costs of debt are another important issue if firms try to raise capital from external market. Agency costs emerge if the interest of shareholders differs from interest of debtholders and agency costs can deteriorate if the interest between debtholders varies. As a result, highly leveraged firms find it difficult and expensive to raise additional funds. Besides, firms may find it difficult or impossible to renegotiate existing debt agreements to prevent firms from default and bankruptcy. The controversy is that raising funds and make investments could only benefit debtholders rather than shareholders since debtholders own the priority when the firm's assets are liquidated in case of bankruptcy. So shareholders may veto the investment opportunities even though these investments have positive net present values.

In general, one would expect that large issuing of debts would be mostly costly for firms with high bankruptcy and distress costs. R&D expenditures are a proxy for distress for firms. Customers are reluctant to buy products or services from a financially distressed firm with highly specialized products that may require future services. If the firm is liquidated due to default on its debts, customers may not receive maintenance or warranty services anymore in the future. Thus, customers generally avoid high-tech firms that are too much leveraged. That's why we can see many high-tech firms have little or no debts in the books. Opler and Titman (1994) suggest that firms with high R&D expenses to sales are more vulnerable to financial distress.

1.2.3 Agency problem of managerial conflicts

Management and shareholders don't necessarily stand the same interest. Management can hold cash for its own benefits. They can hold cash simply because they are risk averse. More entrenched management would therefore be more likely to hold excess cash. Besides, managers can hoard cash to make investments that external market wouldn't be willing to finance. However, these investments can possibly reward managers with better bonuses or

simply boost the ego the management. So, to avoid the disciplines of the market, managers can hoard much cash for their own purposes. Since the managers can do so, outsiders will raise the costs of funding because the investors do not know whether management is raising cash to increase firm value or to purpose its own benefits. What's more, management may accumulate cash because it does not want pay out the cash to shareholders in the form of dividends in companies or countries where shareholders' rights are well protected.

2 Literature review

Cash holdings have been studied by many authors from different perspectives. If we refer to agency problems, the earliest literature could date back to Adam Smith who asserts that conflicts arise the moment ownership and management of companies separate. One of the most influential papers on agency problems is by Michael Jensen who shelter light on the problems for other interested researchers. More quantitative research on cash holdings comes later in the academic fields. Many papers provide mathematical models on cash flow volatility and hedging strategies. When referring data in western European and Nordic countries, I think one important issue in particular is the adoption of euro in January 1, 1999. Thus, the potential influence of euro on cash holdings is also provided in this section. Based on previous studies, I put this section into several sub-sections that can offer a smooth and reasonable manner to review the previous literature. These sub-sections will offer some insight on cash flow volatility, financial constraints, corporate governance, tax, dividends, and euro.

2.1 Cash flow volatility

Cash flows play an important role in the daily operations of corporations. Steady and sufficient cash flows can provide funds for further operations and repay current liabilities. Low cash flows may force companies to delay debt repayment or forgo capital expenditure. By enforcing sustainable cash flows, risk managers can add to the values of shareholders (Shimko 1997).

High cash flow volatility implies that a firm is more likely to have internal cash flow shortfalls. Minton and Schrand (1999) find that firms do not simply react to the shortfalls by changing the timing of discretionary investments to match cash flow realizations. Rather, firms tend to forgo investment opportunities. Theoretically, firms could smooth internal cash flow fluctuations by resorting to external financial markets. However, Myers and Majluf (1984) show that external market is more costly than internal capital. As a result, firms that require more external capital will reduce their investments, all else equal.

Cash flow volatility is not only derived from frequent cash flow shortfalls. It can be a result of high costs of access to external capital market. Volatility can affect capital costs due to capital market imperfections such as information asymmetry and contracting (e.g. debt covenants). For instance, analysts are less likely to follow firms with volatile cash flows, leading to greater information

asymmetry and higher costs of accessing equity capital for firms. So these two effects of cash flow volatility together imply that reductions in cash flow volatility through risk management activities can reduce a firm's expected under-investment costs (Froot et al., 1993; Myers, 1977).

Fazzari, Hubbard, and Petersen (1988) find a negative contemporaneous relation between annual investment levels and liquidity. Minton and Schrand (1999) suggest that cash flow volatility is associated with lower investment in average annual capital expenditure, R&D, and advertising expenses, even after industry-adjusting and controlling for the level of a firm's average cash flows and its growth opportunities. Besides, they find that firms experiencing cash shortfalls in a given year relative to their peers or relative to their own historical performance have significantly lower discretionary investment in that year than firms that are not experiencing shortfalls.

Shapiro and Titman (1986), Lessard (1990), Stulz (1990), and Froot et al. (1993) propose a link between cash flow volatility and investments to explain hedging activities that reduce cash volatility. Dolde (1995), GeHczy et al. (1997), Mian (1996), Nance et al. (1993), and Tufano (1996) find that firms that have the greatest expected benefits from reducing volatility are more active in risk management activities. Since investments are sensitive to cash flow volatility, would it be meaningful for firms to reduce or eliminate cash flow volatility? There is no definite answer for this question. Firms must weigh the benefits against the costs of elimination of cash flow volatility. Risk management costs vary based on different industries. For example, the risk management costs are relatively low for firms in the oil, gas, mining, and agriculture industries where liquid, well-developed derivatives markets exist for a risk that represents a significant source of a firm's cash flow volatility (Minton and Schrand 1999). Minton and Schrand also find that risk control costs tend to be higher for firms in which significant cash flow volatility is derived from factors that are relatively uncorrelated with interest rates, foreign exchange prices, or commodity prices.

The positive relation between a firm's current cost to raise funds and its historical cash flow volatility is a key issue for risk managers to focus on. Debt and equity holders use historical volatility to predict future cash flow volatility when they are pricing the financial contracts (Minton and Schrand 1999). This implication suggests that a firm's cost of accessing external capital market will depend on how the expected of cash flow volatility will be in an extended period in the future. As a result, cross-sectional differences of effects of risk management will rely on cross-sectional differences between cash flow volatility and costs to access capital market. Minton and Schrand further explain that risk management activities, which are not expected to have a persistent effect on

volatility in future periods, will not necessarily reduce a firm's current cost of accessing external capital market. To put further, debt and equity holders do not view the use of short-term financial derivatives to reduce volatility in the same way as the use of long-term risk reduction, such as moving a plant overseas to reduce foreign exchange price risk.

Idiosyncratic risk in the U.S. equity market has increased over the last few decades (Campbell, Lettau, Malkiel, and Xu (2001)). However, this trend in idiosyncratic risk has not gained attention until recently. One possible explanation is that firm-specific risks can be diversified away and therefore should not be a priced risk factor (ampbell, Lettau, Malkiel, and Xu (2001)). However, recent papers by Goyal and Santa-Clara (2003) and Ang, Hodrick, Xing, and Zhang (2006) indicate that idiosyncratic risk may be a priced risk factor. Nevertheless, Bali, Cakici, Yan, and Zhang (2005) find that there is not a significant premium for idiosyncratic risk if the sample size increases.

Many recent papers examine the determinants of the time trend in idiosyncratic risk. Beennett and Sias (2004) find that the growth of small firms, the growth of risky industries, and a decline of concentration in the same industry explains the time trend. Wei and Zhang (2006) find that fundamental factors, such as a decrease in net income and an increase in net income volatility, account for the growth in idiosyncratic volatility. They also note that new firms are more volatile than old firms. Malkiel and Xu (2003) suggest that an increase in institutional ownership, and an increase in stocks with higher predicted growth are all important factors for explaining the trend. Irvine and Pontiff (2005) as well as Gaspar and Massa (2006) find that an increase in competition is interconnected with the increase in idiosyncratic risk. Irvine and Pontiff extend that higher volatility of fundamental cash flows is connected with higher idiosyncratic volatility. Cao, Simin, and Zhao (2007) find that growth options explain the trend in idiosyncratic risk. Rajgopal and Venkatachalam (2005) show that decreasing earnings volatility and higher dispersion in analysts' forecasts of earnings are associated with the time trend in idiosyncratic volatility, though they cannot explain it entirely.

However, some authors question the existence of a time-trend in idiosyncratic risk. Brandt, Brav, and Graham (2005) find that, during recent years, idiosyncratic volatility has fallen substantially, refuting any time trend evidence by Ampbell, Lettau, Malkiel, and Xu (2001). They also find that the rise of idiosyncratic volatility in the later 1990s and the decrease of idiosyncratic volatility in the 2000s are most evident in firms with low stock prices and limited ownership of institutions. Consequently, they conclude that the time-serial behavior of idiosyncratic volatility is more likely

to reflect an episodic phenomenon than a time trend. Brandt, Brav, and Graham suggest that speculative trading behavior by individual investors in low-priced stocks accounts for both findings.

Some research identifies a large number of factors that can explain the level of idiosyncratic risk in the cross-sectionally listed U.S. firms. Harvey and Siddique (2004) find that a number of firm-specific factors can predict idiosyncratic volatility in the cross-section of firms. These factors include return on assets, firm size, trading volume, idiosyncratic skewness, operating leverage, and inventory growth. Pastor and Veronesi (2003) examine another model to investigate the hypothesis about idiosyncratic risk and uncertainty in valuation. They show that firms with greater uncertainty in valuation have higher idiosyncratic volatility and suggest that age is a good proxy for this uncertainty. What's more, they find that younger firms have higher idiosyncratic volatility than older firms. However, their model does not have time-serial implications; in their model, the volatility of new firms does not show time-serial effects. Furthermore, their model predicts that the idiosyncratic volatility of a given firm should decrease over time, as uncertainty about its profitability decreases over time. Brown and Kapadia (2007) conclude that increase in idiosyncratic risk after 1950s is the result of the new listing effect: firms that list later in the sample period have shown higher idiosyncratic volatility than firms that list earlier. Besides, they find that firms that list in any given decade do not display a time trend in idiosyncratic volatility.

2.2   Financial constraints

A firm is financially unconstrained if it has sufficient capital to make valuable investments both in current and future periods. Consequently, a financially unconstrained firm has no precautionary motive for cash holdings. On the other hand, a financially constrained firm cannot make additional future investments without reducing or suspending current investments since the firm has used up the internal and external financing resources.

Kim et al. (1998) argue that current investments and cash holdings are substitutes for future liquidity needs. They also predict that the current investment is positively associated with in cash flow volatility. However, Minton and Schrand (1999) find that higher cash flow volatility is related to lower average levels of investments. As a result, investment is negatively related to cash flow volatility.

Han and Qiu (2006) argue that a financially constrained firm increases its cash holdings when facing large cash flow volatility. But such behavior doesn't exist for financially unconstrained firms. Fazzari, Hubbard, and Petersen (1988) propose that investments will differ based on the available internal funds when firms face financing constraints. Zingales (1997) also finds that financial constraints could affect the link between cash flows and investments.

Keynes (1936) finds that cash holdings allow firms to undertake valuable projects when these projects are available. He also argues that the importance of cash holdings is influenced by the extent to which firms get access to external capital market. If the firm is financially constrained, how to manage liquidity would be vital for the daily operation of the firm. But future investments and cash holdings become irrelevant if the firm has unconstrained access to external capital market.

Almerda, Campellp, and Weisbach (2004) suggest that financial constraints should be related to firm's sensitivity to cash flows. Financially constrained firms should not display a systematic tendency to save cash while financially constrained firms should be sensitive to cash flows. Consequently, the cash flow sensitivity of cash provides a theoretically justifiable and empirically implementable measure of financial constraints.

2.3   Corporate governance

In the 1970s, the sense of shareholder protection was not yet strong on shareholders' minds. And proxy fights and hostile takeovers were rare. Thus, management had more power over the corporate issues than today. Then in 1980s, the rise of junk bond market enabled hostile takeovers even for the largest public firms. To defend themselves, many firms initiated anti-takeover defenses and other restrictions on shareholders. During the same period, many countries passed anti-takeover laws, providing firms more legal assistance against hostile takeovers. By 1990, the takeover market gradually cooled down. But the strength of shareholder rights has enhanced significantly since then. Some authors find that antitakeover provisions shelter management from the scrutiny and discipline of the market from corporate control. Thus, the agency problem between shareholders and managers has become a big issue of corporate governance.

Adam Smith explains that (due to the separation of ownership and control) "negligence and profusion, therefore, must always prevail, more or less, in the management of the affairs of such companies". Shareholder rights are the core issues in corporate governance. And the agency problems are the central topic for corporate governance. How to deploy internally generated funds, thus, becomes the key issue between shareholders and management (Jensen 1986). Corporate governance should develop a device to control management to highlight the problem. During the economic expansion, as cash holdings increase, management make strategic decisions about whether to distribute the cash to shareholders, use it for external acquisitions, or continue to hold it. It is not theoretically clear how self-interested managers will choose between spending free cash flow and hoarding it as cash reserves. Managers must trade off private benefits of current spending against the flexibility provided by accumulating excess cash reserves. Further, self-interested managers must consider the choices between spending excessively and holding too much visibly since either action could subject the management to the discipline of stakeholders.

One particular example of discipline of stakeholders is Kirk Kerkorian's attack on Chrysler. In 1995, Chrysler Corporation was experiencing unprecedented success. It has an operating profit per automobile of 2,100 dollar, almost triple the number for Ford and General Motors. With this tremendous performance comparing to other firms within the same industry, Chrysler got tremendous attention from shareholders. At that time, Chrysler has 7.5 billion dollar as cash. This shining amount of cash makes the corporate the goal of takeovers. Kirk Kerkorian made a bid for the firm with 20 billion dollar. Chrysler eventually compromised by disbursing 7.5 billion cash to its shareholders. In return, Kirk Kerkorian withdrew his attempt to take over Chrysler. This incidence implies that hoarding too much cash can arouse much attention from shareholders since shareholders tend to think it's a symbol of agency problem and they will demand managers to make proper investments of the funds or fire the management in question.

Stulz (1990) develops the free cash flow hypothesis, predicting that shareholders will choose to limit managers' access to free cash flow to alleviate the agency problems. The tricky part is how much internal capital should be allocated to managers to fund projects and acquisitions. Investment opportunities with positive NPV can enhance firm values while self-interested usage of internal capital by management can destroy values. Without a control threat, it is very difficult to convince managers to disgorge cash to shareholders.

Gompers, Ishii, and Metrick(2003) develop GIM index model that provides an index to trace agency problems and shareholder rights. The general principle of GIM index is straightforward. Agency problem is severe if the GIM index is high while the problem is moderate and less severe if the GIM index is low. They find that each one point increase in GIM is associated with a decrease in Tobin's Q from 2.2% points to 11.4% points based on different standards. Their finding suggests that financial market positively associate firm values with shareholder protection.

One dollar may not be worth one dollar if there is a chance that it would be wasted. Since good corporate governance is the shareholders' defense against the inefficient use of corporate assets by managers, an important question is that how corporate governance can impact the value and deploy use of cash reserves.

Many authors have conducted their studies concerning cash holdings based on different perspectives. Dittmar, Mahrt-Smoth, and Servaes (2003) compare average cash holdings across countries with different levels of shareholder protection and capital market development. They find that firms generally hold less cash in countries where shareholder rights are well protected and external capital markets are highly developed. This indicates that shareholders want to limit the management's control over cash and choose to do so when they have sufficient power.

Lins and Kalcheva (2004) study corporate governance controls at country level and investigate how country-level investor protection marginally affects cash holdings. They find that firms with weaker shareholder rights hold more cash and this relation is especially true in countries with weak shareholder protection. In addition, they find that cash holdings are severely negatively related to firm value if the management has too much control over the daily operation of the firm and if shareholder rights are not well protected.

Pinkowitz, stulz, and Williamson (2004) examine the effect of country-level protection of rights on cash holdings and show that cash is worth less to the minority shareholders of firms in countries with low investor protection. Dittmar, Mahrt-Smith, and Ervaes (2003) and Luns and Kalcheva (2004) find that firms generally hold less cash in countries with better shareholder protection.

Opler, Pinkowitz, Stulz, and Williamson (1999), and Kim, Mauer, and Sherman (1998) show that firms have an optimal level of cash holdings and firms will trade off the costs and benefits of holding cash to reach the appropriate level. Consistent with previous studies of agency problems,

they find that investors in countries with below median governance scores place a lower value (0.33 dollar) on a dollar that firms hold than investors in countries with above median governance scores(0.91 dollar).

All these studies suggest that firms with low level of shareholder protection tend to hoard cash rather than distribute the cash to shareholders. However, some other empirical studies show the opposite results that shelter new understanding on the topic.

Harforda, Mansib, and Maxwelle (2007) show that firms with weaker shareholder rights and low insider ownership have lower level of cash holdings than those with stronger shareholder rights and high insider ownership. The authors also provide potential reasons. For a given set of firms with high levels of cash, all else equal, the firms with weaker governance will spend cash more quickly than those with stronger governance. The authors find that this spending is on acquisitions and capital expenditures rather than on R&D.

Bliss and Rosen (2001) and Harford and Li (2007) show that for CEO compensation and wealth increase after investments such as acquisitions and large capital expenditures even if these investments destroy value. Given these incentives and the potential discipline arising from accumulating too much cash, weakly controlled managers choose to spend the cash quickly on acquisitions or capital expenditures. Mikkelson and Partch (2003) show that the persistent cash holdings do not lead to poor performance and do not represent conflicts between shareholders and managers. Similar research is ample. Harford (1999) suggests that it's reasonable for shareholders to be concerned about managers' stewardship of large internal cash reserves. He finds that cash-rich firms are more likely to make acquisitions and their acquisitions are more likely to be value-destroying.

Faleye (2004) suggests that proxy contests are increasing in excess cash reserves and that managers often lose their jobs following such contests. Thus, managers would prefer to convert the cash into real assets relatively quickly through investments or acquisitions. Even if these transactions destroy value, as long as management carries it out within boundary of being fired by shareholders, managers can successfully execute them. Despite the value-destroying activities, management can increase their personal compensation by stock options or bonuses. Given these incentives and the potential penalty from accumulating large cash reserves, weakly controlled managers choose to

spend the cash quickly on acquisitions and capital expenditures, rather than hoard it. Harford, Mansi, and Maxwell (2005) also find that poorly governed firms dissipate cash through acquisitions.

2.4   Dividends

Dividends are the agreement between shareholders and management. Firms are not obliged to pay dividends if they have not decided to pay. But dividend payment becomes a liability for the firm if the management has announced the plan to distribute dividends. Dividends can be proxies of the firm's performance. If the firm is not making any profit, there is low chance for it to pay dividends. If a firm suddenly cut its dividends, it's a symbol of the turning point of the profitability of the firm. Dividends are always one study area of corporate governance. Fama and French (2000) show that firms that have never paid dividends are more profitable than former payers who cut their dividends later on. Besides, they also have greater growth opportunities. On the other hand, dividend payers are more profitable than firms that have never paid. The typical firms that have never paid are that these firms generally invest at a higher rate, do more R&D, and have a higher Tobin's Q value.

Fama and French (2000) empirically investigate dividends for firms listed on NYSE, AMEX, and NASDAQ. They find that firms that pay dividends decreased from 66.5% to 20.8% for non-financial and non-utility firms during the sample period. They authors suggest that the decreased rate of dividend payment is due to the new listing effects. They argue that the new-listed firms that have never paid dividends are small sized, have low earnings, and invest a lot comparing to their earnings. Fama and French also assert that the benefits of dividends have declined over time. Managers who hold large amounts of stocks prefer capital gains to dividends. Better corporate governance methods (e.g. innovative stock options) decrease the advantages of dividends in controlling agency problems between shareholders and management.

Some authors study the behavior of dividend payment from the perspective of managerial entrenchment. Fama and French (2001) argue that, benefits by investigating U.S. industrial firms between 1980s and 1990s, managers dislike dividends since persistent dividend payments tremendously decrease their ability to go after their personal compensation. However, Carrie Pan (2007) finds that firms with entrenched managers are more likely to pay dividends. She also provides potential reason for this behavior. She asserts that firms choose a combination of anti-takeover provisions and payout policy to enhance value. Both anti-takeover provisions and large cash holdings can help deter hostile takeovers. But large cash holdings can cause great agency

problems, especially for firms with high free cash flows and weak investment opportunities. However, paying too much cash to shareholders increases the risks of hostile takeover. Thus, by adopting anti-takeover provisions, firms with low investment opportunities can induce managers to disgorge cash by paying out dividends rather than hoard cash.

2.5 Tax

Apple has nearly 50 billion cash in countries beyond its home borders. Like other U.S. companies, it prefers to keep its foreign earnings offshore rather than bring them home and pay tax. To attract cash reserves to flow back to the U.S., the Bush government has implemented new law to determine the rate of tax for cash retained in foreign countries. In October 2004, American Congress passed the American Job Creation Act, which allows an 85% tax deduction for repatriated earnings. This suggests a change of tax for foreign earnings from 35% to maximum 5.25%. As a result, U.S. multinational firms that held large amounts of cash abroad to avoid tax consequences could eventually let the cash reserved abroad flow back to the U.S., spurring investments and creating more job opportunities. Even though the obvious consequences have not been observed, it looks that high repatriation tax burdens keep firms to hold cash abroad.

Foley, Hartzell, Titman, and Twite (2007) find that the U.S. multinational firms that would induce large tax expenses by repatriating earnings have high cash holdings abroad. More specifically, they find that affiliates in countries with high tax costs of repatriating earnings hold more cash than affiliates of the same firm in countries with low tax costs to repatriate cash. The sensitivity of affiliate cash holdings to repatriation taxes is particularly important for technology-intensive firms.

2.6 Euro currency

January 1 1999 has witnessed one of the most important institutional changes in international financial markets: the adoption of euro. From the very beginning, the new currency has received significant amount of controversy. The euro-skeptics assert that the frustrating economic performance in Europe is due to the adoption of the currency. So a deep investigation of euro could cast the doubts away. However, a thorough analysis of euro is not quite realistic due to the short existing period of the currency. Besides, despite the criticism, many other countries joined European Monetary Union. January 1 2011, the latest member of EMU Estonia adopted euro. Till then, 17 countries joined Eurozone, with a population of 329 million using euro.

Euro plays an important role in the macro economy in Eurozone. Bris, Koskinen, and Nilsson (2008) argue that euro can have on impact either on firms' cost of capital or on expected cash flows. One chief component of the cost of capital is the risk-free rate. The real risk-free rate could possibly be changed due to the adoption of the common currency in 1999. The euro should have reduced real interest rates for countries that previously experiencing fluctuations in commodity prices. Alesina and Barro (2002) suggest that euro can be an effective commitment device to maintain monetary stability especially for countries that suffered from high inflation rates. Another way to reduce cost of capital is the reduction in risk premium such as currency risk premium. The adoption of euro eliminates this currency risk premium in Eurozone. Firms can eliminate entirely or partially their foreign currency risks by implementing currency hedging. However, if firms do not fully hedge, currency risk is priced in capital market (Adler and Dumas (1983); Dumas and Solnik (1995); De Santis and Gerard (1998)). The integration of financial markets could have lowered the cost of capital through risk-sharing activities (Bekaert and Harvey (1995); Stulz (1999)). Hardouvelis, Malliaropoulos, and Priestley (2006) find that, due to the news of euro, foreign equity holdings as a component of total equity holdings have surged for pension funds in euro countries while the portion of foreign equity has remained constant. Besides, the competition in financial market could also have an impact on the reduction of cost of capital. Rajan and Zingales (2003) argued that corporate bond issuance has tripled after the adoption of euro. As a result, corporate bonds provided an efficient source of funds rather than loans from banks.

The adoption of euro could have significantly increased expected firm cash flows. Rose (2000) and Glick and Rose (2002) suggest that euro has a dramatic impact on improving the bilateral trade flows within Eurozone. Empirical study by Rose and Wincoop (2001) shows that intra-European trade has increased by 50% since the adoption of euro. However, more recent research shows that the impact of euro on trade flows has decreases over time. For example, Bun and Klaassen (2007) suggest that the euro has increased the intra-European trade by only 3%. Baldwin (2006) estimates that the increase in trade is 9% within Eurozone.

3   Hypotheses

In this section, to investigate the potential factors that increase cash ratios, I will test several hypotheses provided by Bates, Kahle, and Stulz (2009). These firm characteristics are first studied by Opler, Pinkowitz, Stulz, and Williamson (1999). Bates, Kahle, and Stulz improved their model by adding a few more variables. All the variables to be tested in this section are market-to-book ratio, firm size, cash flow to assets, net working capital to assets, capital expenditures to assets, leverage, industry cash flow volatility, R&D to sales, and acquisitions to assets.

The variables used (Compustat annual data items in parentheses) and the hypotheses are as follows:

Market-to-book ratio

Firms with better investment opportunities value cash more since it is costly for these firms to be financially constrained (Han and Qu (2006) and Almerda, Campellp, and Weisbach (2004)) . Thus, these firms tend to hold more cash due to transaction costs. So the first hypothesis is that firms with high market-to-book ratio will hold relatively more cash.

I use the book value of assets (#6) minus the book value of equity (#60) plus the market value of equity (#199 *#25) as the numerator of the ratio and the book value of assets (#6) as the denominator.

Firm size

There are economies of scale to holding cash. As indicated by Harvey and Siddique (2004), large firms tend to hold relatively less cash comparing to smaller firms. So the second hypothesis assumes that firm size is negatively related to cash holdings.

I use firm size measured as the logarithm of book assets (#6). The book asset is adjusted for inflation for firm size. The inflation index is provided in the appendix.

Cash flow to assets

Firms with higher cash flows accumulate more cash (Minton and Schrand (1999)), all else equal. The third hypothesis is that cash flow to assets is positively associated with cash ratio.

Cash flow is measured as earnings after interest, dividends, and taxes but before depreciation divided by book assets ((#13 –#15 – #16 – #21) / #6).

Net working capital to assets

According to Bates, Kahle, and Stulz (2009), net working capital (NWC) should have a negative relation with cash holdings since NWC is made up by assets that could substitute for cash. In this hypothesis, NWC is net of cash.

I subtract cash (#1) from NWC (#179), so the NWC measure is net of cash.

Capital expenditures to assets

If capital expenditures create assets that can be used as collateral, capital expenditures could increase debt capacity and reduce the demand for cash. Further, as shown by Riddick and Whited (2009), a productivity shock can lead firms to temporarily invest more and save less cash, which would lead to a lower level of cash. At the same time, capital expenditures could proxy for financial distress costs and/or investment opportunities, in which case they would be positively related to cash (Shimko 1997). As a result, it's difficult to determine the relation between capital expenditures and cash ratios in this Hypotheses Section.

I measure capital expenditures as the ratio of capital expenditures (#128) to book assets (#6).

Leverage

If debt is sufficiently constraining, firms will use cash to reduce leverage, resulting in a negative relation between cash holdings and leverage. However, Acharya, Almeida, and Campello (2007) argue that firms with high leverage will hold more cash for precautionary purposes. At the same time, it will be more costly for these firms to access to external capital market. Thus, these firms tend to hoard cash for transaction motive. From this perspective, there is a positive relation between leverage and cash holdings. As a result, just like capital expenditure, it's not easy to hypothesize the relation between leverage and cash holdings so far in this section.

I measure leverage as the sum of long-term debt (#9) plus debt in current liabilities (#34) divided by book assets (#6).

Industry cash flow risk

Industries that experience high cash flow volatility tend to hold more cash reserves due to precautionary and transaction motive (Minton and Schrand (1999)). So I expect there is a positive relation between industry cash flow risk and cash ratios.

The detailed method to calculate industry cash flow risk is provided in the next section.

Dividend payout dummy

Firms that pay dividends are likely to be less risky and have greater access to capital markets. Besides, firms paying common dividends generally have a higher Tobin's Q. And normally, there is less information asymmetry in these firms. So it's less expensive for these firms to get external funding (Fama and French (2000)). Thus, I expect that dividends play a negative role in cash holdings.

I define dividend dummy variable equal to one in years in which a firm pays common dividends (#21). Otherwise, the dummy equals zero.

R&D to sales

Firms that invest much in R&D tend to have a high financial constraint cost. So these firms tend to hold more cash (Keynes (1936)). Thus, I expect R&D is positively related with cash holdings. On the other hand, R&D consumes much cash. In this sense, cash reserves should be negatively related to R&D (Bates, Kahle, and Stulz (2009)). thus, I have the third variable that is difficult to determine or hypothesize, at this stage, the relation with cash ratios.

R&D is measured as R&D (#46) divided by sales (#12), and is set equal to zero when R&D (#46) is missing. Results are similar if we use R&D to assets.

Acquisitions to assets

Acquisitions serve a similar function as capital expenditures (Bates, Kahle, and Stulz (2009)). So I expect acquisitions should be positively related to cash holdings.

Acquisition activity is defined as acquisitions (#129) divided by book assets (#6), where acquisition expenditures reflect only the cash outflows associated with acquisitions.

4   Data description

In this section, I first describe the data in the sample. Then I provide average cash ratio for the whole sample period to see whether there is a trend of cash holdings. Afterwards, I investigate the cash ratio based on different standards to determine the impact of certain firm-specific characteristics on cash holdings.

The data in the sample are collected from Thomson One Banker for the period 1980 to 2009. These data include surviving and non-surviving firms that exist on Thomson any time in the sample period. I require that firms have positive assets and positive sales to be included in the sample in a given year. I exclude financial firms (SIC codes 6000-6999) because they may carry cash due to capital requirements by regulatory authorities rather than the economic reasons that is the focus of my study. I also exclude utilities (SIC 4900-4999) because their cash holdings can be subject to regulatory supervision as well. Finally, I restrict the sample to firms that are incorporated in western European and Nordic countries. Countries in the sample are Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain, Denmark, Norway, Sweden, Switzerland, and UK. These countries have developed economy, in which sufficient firms are available for statistical analysis. Besides, they also have a relatively long history to trace their financial performance. Thus, I can obtain not only sufficient cross-sectional data, but also time-serial data to conduct my study.

4.1   The average cash ratio in western European and Nordic countries

In this section, I investigate the average cash ratio, leverage, and net leverage for the sample. Table I provides the relevant information. The third column of the Table I represents the number of observations in each year. I measure the cash ratio as cash and marketable securities divided by total assets. The second column provides the average cash ratio for the sample by year. This ratio increases from 7.7% in 1980 to the peak 20.0% in 2005. The average of these ratios is 13.7%. And the median number of the ratios is 12.7%. The increase of average cash ratio is 123% from 1980 to 2009.

To assess whether there was a statistically significant trend in the cash ratio, I estimate regressions of the cash ratio on a constant and time measured in years (not reported). The coefficient on the time trend for the average cash ratio corresponds to an annual increase of 0.37%, significant at 1%. The adjusted R^2 of the regression is 85%. This evidence is consistent with a positive time trend in cash holdings over the sample period. However, the usefulness of the results of the regression could be only applicable during the sample period. It would not make any sense if I try to extend the results to a different sample.

I now turn to the implications of the increase in the cash ratio by measuring leverage. The fourth column of Table I reports average leverage for the sample firms. I measure debt as long-term debt plus debt in current liabilities divided by book assets. Leverage increases dramatically from 1980 to 2009. The average leverage is 27.8% during the sample period. From one un-reported regression, I notice that the annual increase of leverage is 0.9%, significant at 1%. When I consider the average net leverage ratio, which subtracts cash from debt, I get a somehow different perspective regarding the time trend in leverage for the sample firms. The net leverage is 8.0% in 1980 and increases to 26.9% in 2009. Regressions on net leverage show that the coefficient is 0.55%. Thus, from the empirical result, we can see that the annual difference between leverage and net leverage is due to the increase in cash reserves. In Section 3.2, I will provide more information on cash ratio based on different methodologies to determine a more detailed explanation on cash holdings.
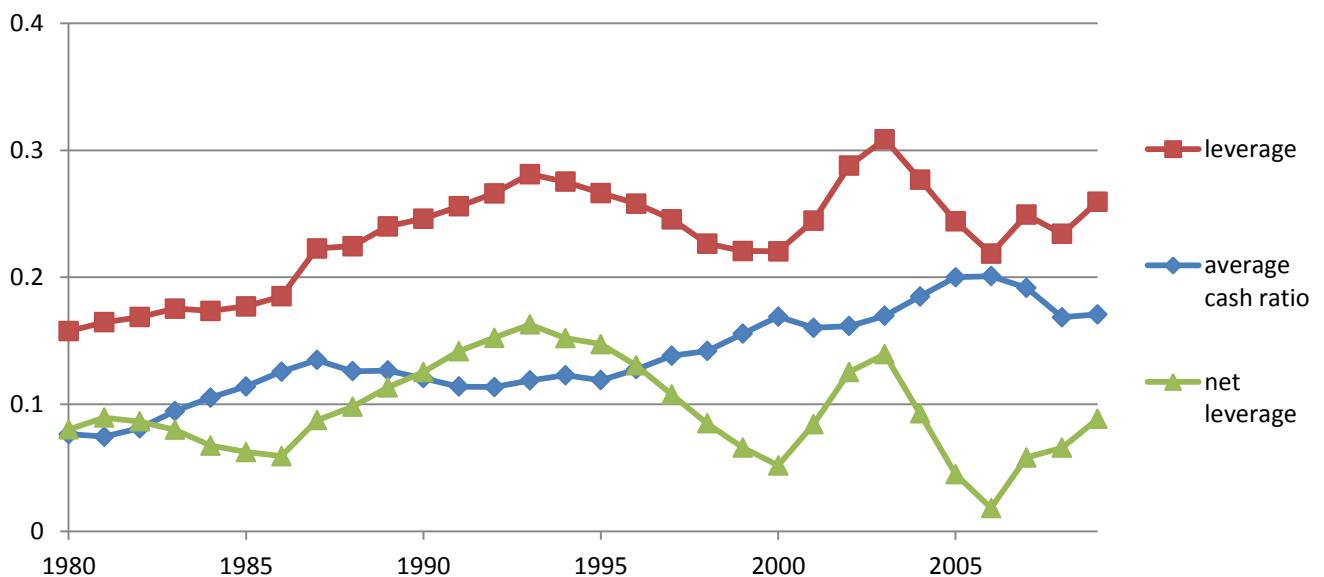
Figure I. Cash Ratio, Leverage, and Net Leverage in Western European and Nordic Countries. The sample includes all Thomson One Banker firm-year observations from 1989 to 2009 with positive values from the book value of total assets and positive sales revenue for firms incorporated in western European and Nordic countries. Financial firms (SIC code 6000-6999) and utilities (SIC code 4900-4999) are also excluded from the sample

Table I

Average Cash, Leverage, and Net Leverage Ratios from 1980 to 2009

The sample includes all Thomson One Banker firm-year observations from 1980 to 2009 with positive values for the book value of total assets and positive sales revenue for firms incorporated in western European and Nordic countries. Financial firms (SIC 6000-6999) and utilities (SIC 4900-4999) are excluded from the sample. Variables are defined in the Appendix.

Year	Average Cash Ratio	N	Leverage	N	Net Leverage	N
1980	0.0765881	389	0.1575787	390	0.0802402	389
1981	0.0744875	403	0.1646846	404	0.0894982	403
1982	0.0811218	415	0.1687164	416	0.0865082	415
1983	0.0946583	454	0.1753295	456	0.0799867	454
1984	0.1052377	515	0.1735591	516	0.067508	515
1985	0.114055	570	0.1771198	570	0.0624219	569
1986	0.1256534	658	0.1850516	658	0.0591853	657
1987	0.1348641	1122	0.2227181	1125	0.0875261	1122
1988	0.1260524	1384	0.2244787	1388	0.0980621	1384
1989	0.1265841	1562	0.2401801	1566	0.1133813	1562
1990	0.1205345	1645	0.2461465	1649	0.1254271	1645
1991	0.1139382	1689	0.2559356	1693	0.1418223	1689
1992	0.1135546	1719	0.2660529	1723	0.1523629	1719
1993	0.1187327	1799	0.281196	1806	0.1628919	1799
1994	0.122938	1829	0.2752724	1831	0.1521799	1828
1995	0.119039	1843	0.2663044	1847	0.1473626	1842
1996	0.1275482	2529	0.2579775	2533	0.1306477	2528
1997	0.1383274	2983	0.2457285	2991	0.1076874	2982
1998	0.1419193	3238	0.2264788	3243	0.0850395	3237
1999	0.1555977	3319	0.2207336	3319	0.0659118	3310
2000	0.1690532	3396	0.2205097	3397	0.0518114	3391
2001	0.1602802	3395	0.2446228	3393	0.0843914	3389
2002	0.1616558	3518	0.2878476	3514	0.1253902	3510
2003	0.1696875	3676	0.3087218	3669	0.1394513	3665
2004	0.1849076	3894	0.276947	3884	0.0928149	3882
2005	0.2000763	4092	0.2441527	4081	0.0449944	4076
2006	0.2008825	4157	0.2185214	4150	0.0183302	4141
2007	0.1916993	4087	0.2493337	4073	0.0580919	4069
2008	0.1685366	3836	0.2341924	3831	0.0657861	3827
2009	0.1708631	3537	0.2594542	3535	0.08851	3533

4.2 Increases in cash ratios by total assets

The evidence summarized in Section 4.1 illustrates a consistent increase in the average cash ratio. Previous literature review shows that firm size tends to have impact on cash holdings due to economies of scales and scope. Larger firms tend to have a lower ratio of cash reserves while smaller firms generally have higher ratio of cash. To investigate whether the increase in cash is related to firm size, I divide the sample firms into quarters each year according to the book value of their assets at the end of the prior year.

Table II shows the average cash ratio based on firm size from 1980 to 2009. The size of firms is calculated this way: first, the total assets are adjusted for inflation. Then all firms are pooled together. Firms are divided into four sub-samples (Q) based the order of total assets. Q1 has the smallest firm size while Q4 has the biggest size. Even though I obtained the firm size from the sample, the cash ratio is not available since the cash amount or the total assets are not registered in that year. Besides, in 1980s, data are too limited for my research purposes. So to make the analysis more meaningful, I require each sub-sample should have at least 10 observations. Thus, the time starts from 1999. We have a 10-year sample. Figure II illustrates the average cash ratio for firms from 1999 to 2009. The average cash ratio increases across each size firm size. But the increase is more pronounced for smaller firms. The cash ratio of small firms is well above 15% through the sample period while that for the largest firms is around 10%. I again make regressions on the cash ratio for each firm size and find a positive and significant slope coefficient for each, where largest firms have the smallest coefficient. Given this evidence, I conclude that the increase in cash ratios is not driven by the largest firms in the sample, and is more pronounced in small firms. The result is consistent with previous academic research.

Table II

Average Cash Ratio from 1980 to 2009 by Total Assets

The sample includes all Thomson One Banker firm-year observations from 1980 to 2009 with positive values for the book value of total assets and positive sales revenue for firms in western European and Nordic countries. Financial firms (SIC 6000-6999) and utilities (SIC4900-4999) are excluded from the sample. Firms are sorted based on their total assets. Q1 has the smallest amount of total assets while Q4 has the largest total assets. N stands for the number available in each category.

Year	Q1	N	Q2	N	Q3	N	Q4	N
1980	0.076699	388	0.033554	1		0		0
1981	0.074036	400	0.134645	3		0		0
1982	0.08054	412	0.160961	3		0		0
1983	0.094422	450	0.121248	4		0		0
1984	0.10518	509	0.110136	6		0		0
1985	0.113827	564	0.135452	6		0		0
1986	0.125437	648	0.122503	9	0.294153	1		0
1987	0.134911	1113	0.107451	8	0.301589	1		0
1988	0.126023	1371	0.113424	12	0.318414	1		0
1989	0.126656	1547	0.108029	14	0.274686	1		0
1990	0.120568	1625	0.112955	17	0.145581	3		0
1991	0.11408	1666	0.104337	15	0.116824	7	0.001758	1
1992	0.113737	1695	0.101246	15	0.111772	8	0.003056	1
1993	0.118746	1770	0.129349	18	0.110833	8	0.068177	3
1994	0.122854	1800	0.137515	18	0.097144	7	0.140235	4
1995	0.118966	1812	0.134677	20	0.083088	6	0.125934	5
1996	0.127774	2495	0.112016	22	0.11627	7	0.099258	5
1997	0.138628	2949	0.124574	19	0.098713	8	0.094491	7
1998	0.142342	3198	0.120015	24	0.104967	9	0.071327	7
1999	0.156394	3267	0.099452	27	0.11683	12	0.10785	13
2000	0.170594	3332	0.087679	27	0.122268	17	0.06192	20
2001	0.161627	4425	0.08714	33	0.139959	16	0.077536	21
2002	0.16268	3454	0.114583	35	0.121527	10	0.083261	19
2003	0.170427	3615	0.126201	33	0.1478	8	0.116604	20
2004	0.185781	3832	0.138364	35	0.156763	6	0.111076	21
2005	0.201516	4026	0.125894	33	0.111357	13	0.090371	20
2006	0.202711	4080	0.10727	38	0.104096	16	0.098477	23
2007	0.19338	4009	0.111544	40	0.117294	15	0.086695	23
2008	0.170308	3755	0.087194	40	0.093426	14	0.081613	27
2009	0.172432	3456	0.107021	43	0.108927	15	0.094828	23
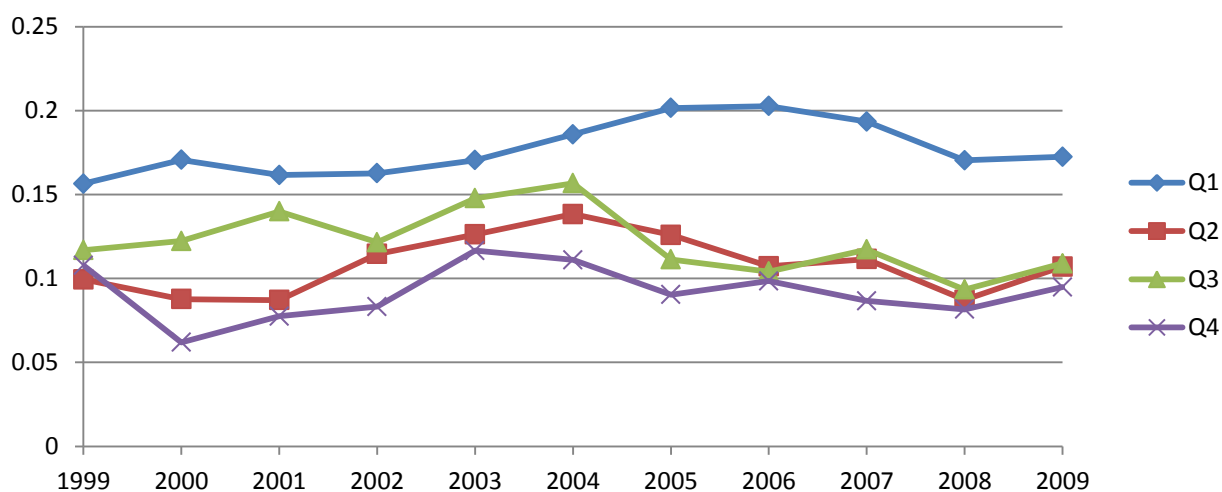
Figure II. Average cash ratios by firm size quarter from 1999 to 2009. The sample includes all Thomson One Banker firm-year observations from 1989 to 2009 with positive values from the book value of total assets and positive sales revenue for firms incorporated in western European and Nordic countries. Financial firms (SIC code 6000-6999) and utilities (SIC code 4900-4999) are also excluded from the sample. The cash ratio is measured as the ratio of cash and marketable securities to the book value of total assets. Firms are sorted into quarters based on the book value of sample firm assets in the prior fiscal year. The first quarter (Q1) comprises the smallest firms in the sample, while the fourth quarter(Q4) comprises the largest firms in the sample.

4.3   Increase in cash ratios by the payment of dividends

I next turn to the role of dividends. From previous section, the literature review shows that firms have become less likely to pay dividends since 1980s. Non-dividend payers with poor growth opportunities will accumulate more cash. In Table III, I reproduce the time series of the average cash ratio for dividend payers and non-dividend payers. The average cash ratio for dividend payers in a sample year is the average cash ratio of firms that a common dividend during that year. There is a dramatic increase in the cash ratio among the non-dividend payers, but not among the dividend payers. The increase for non-dividend payer is more than 300% for the sample period. I made a regression about the time effects for dividend payers and non-dividend payers. The coefficients of time effects are 0.2% and 0.7% for dividend paying firms and non-paying firms, respectively. Many papers consider non-dividend paying firms to be financially constrained, suggesting that the increase in cash holdings is more pronounced in financially constrained firms. Precautionary motive suggests that financially constrained firms are more likely to accumulate cash. One method to retain cash is by avoiding paying dividends.

Table III

Average Cash Ratio by the Payment of Dividend

The sample includes all Thomson One Banker firm-year observations from 1980 to 2009 with positive values for the book value of total assets and positive sales revenue for firms incorporated in western European and Nordic countries. Financial firms (SIC 6000-6999) and utilities (SIC4900-4999) are excluded from the sample. Firms are considered dividend payer if they pay common dividend by that year. Firms are considered non-dividend payer if they do not pay common dividend in that year.

Year	DividendPayer	N	Non-Dividend Payer	N
1980	0.043784	57	0.043784	57
1981	0.081577	337	0.03829	66
1982	0.090354	326	0.047306	89
1983	0.102281	372	0.06008	82
1984	0.113236	422	0.068943	93
1985	0.12147	481	0.073983	89
1986	0.133186	559	0.083119	99
1987	0.142573	959	0.089511	163
1988	0.130635	1197	0.096718	187
1989	0.130935	1356	0.097947	206
1990	0.125546	1375	0.095013	270
1991	0.121107	1349	0.085494	340
1992	0.124111	1272	0.083514	447
1993	0.131589	1292	0.085971	507
1994	0.131268	1406	0.095251	423
1995	0.126878	1424	0.092397	419
1996	0.133205	1853	0.112042	676
1997	0.138587	2204	0.137595	779
1998	0.133079	2334	0.164745	904
1999	0.14029	2237	0.187245	1082
2000	0.129117	1986	0.225304	1410
2001	0.12878	1844	0.197731	1551
2002	0.140291	1961	0.188564	1557
2003	0.15414	2120	0.190871	1556
2004	0.161448	2290	0.218401	1604
2005	0.163919	2338	0.248272	1754
2006	0.154881	2179	0.251559	1978
2007	0.149029	2140	0.2386	1947
2008	0.140994	1898	0.195511	1938
2009	0.157063	1775	0.184765	1762
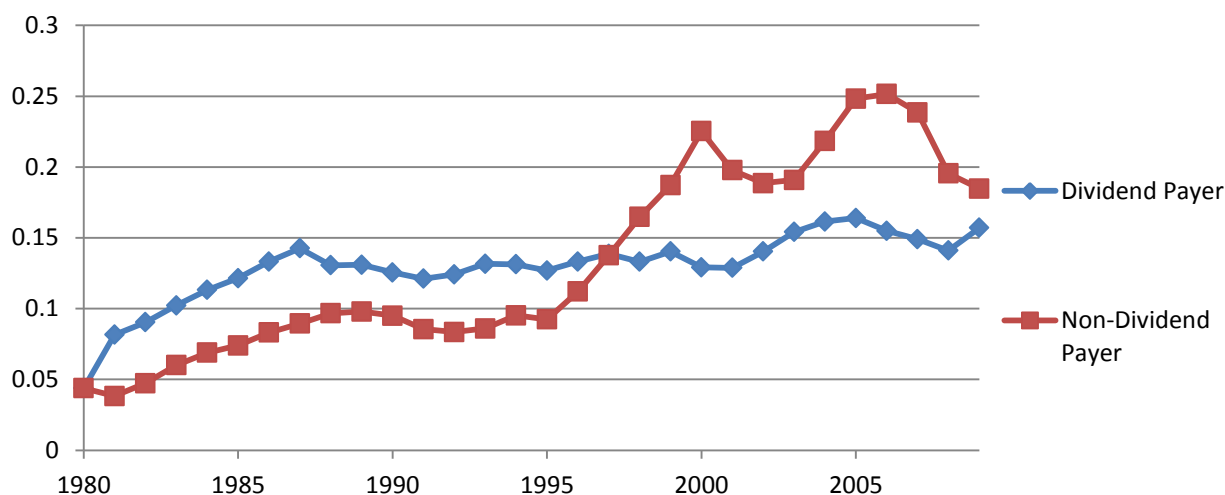
Figure III. Average cash ratios by the payment of dividend from 1980 to 2009. The sample includes all Thomson One Banker firm-year observations from 1980 to 2009 with positive values from the book value of total assets and positive sales revenue for firms incorporated in western European and Nordic countries. Financial firms (SIC code 6000-6999) and utilities (SIC code 4900-4999) are also excluded from the sample.

4.4 Increase in cash ratio by accounting performance

In Section 3.3, we briefly talked about financial constraints. In this section, we will provide more insight in this field. Firms with negative net income are more likely to be financially constrained than firms with positive net income. The existing literature shows that the cash flow sensitivity of corporate investments differs for financially constrained firms. I therefore divide the sample into firms with negative net income and non-negative-net-income firms. I report average cash ratios for these subsamples in the last two columns of Table IV. The firms with negative net income exhibit a significant increase in cash holdings. The average cash ratio of these firms in 2009 is six times the number in 1980. Firms with nonnegative net income also exhibit an increase in cash holdings. But the time trend is remarkably lower. From one un-reported regressions on time effects on cash holdings, I notice that the year effects on cash holdings are 0.2% for firms with non-negative net income while the number increases dramatically to 0.8% for firms with negative income respectively, both significant at 1%.

Table IV

Average Cash Ratios from 1980 to 2009 by Accounting Performance

The sample includes all Thomson One Banker firm-year observations from 1980 to 2009 with positive values for the book value of total assets and positive sales revenue for firms incorporated in western European and Nordic countries. Financial firms (SIC 6000-6999) and utilities (SIC4900-4999) are excluded from the sample. Firms with accounting losses at the fiscal end of the designated year are assigned to the negative net income subsample.

Year	Negative Net Income	N	Non- Negative Net Income	N
1980	0.039644	50	0.039644	50
1981	0.034565	59	0.081335	344
1982	0.037892	74	0.090503	341
1983	0.049183	61	0.101717	393
1984	0.065378	53	0.10981	462
1985	0.05929	42	0.118411	528
1986	0.085386	73	0.130678	585
1987	0.092084	103	0.139188	1019
1988	0.118538	97	0.126619	1287
1989	0.093349	114	0.129201	1448
1990	0.089144	211	0.125153	1434
1991	0.084747	341	0.121323	1348
1992	0.080079	447	0.125318	1272
1993	0.080298	455	0.131744	1344
1994	0.088112	305	0.129908	1524
1995	0.093913	296	0.123847	1547
1996	0.128888	466	0.127246	2063
1997	0.163822	545	0.132628	2438
1998	0.176297	674	0.132883	2564
1999	0.205777	844	0.138486	2475
2000	0.244668	1033	0.135998	2363
2001	0.20786	1326	0.129787	2069
2002	0.196366	1537	0.134725	1981
2003	0.199689	1480	0.149468	2196
2004	0.234441	1312	0.159738	2582
2005	0.276436	1333	0.163183	2759
2006	0.287998	1367	0.158199	2790
2007	0.272244	1354	0.151795	2733
2008	0.19802	1536	0.148847	2300
2009	0.18285	1579	0.161197	1958
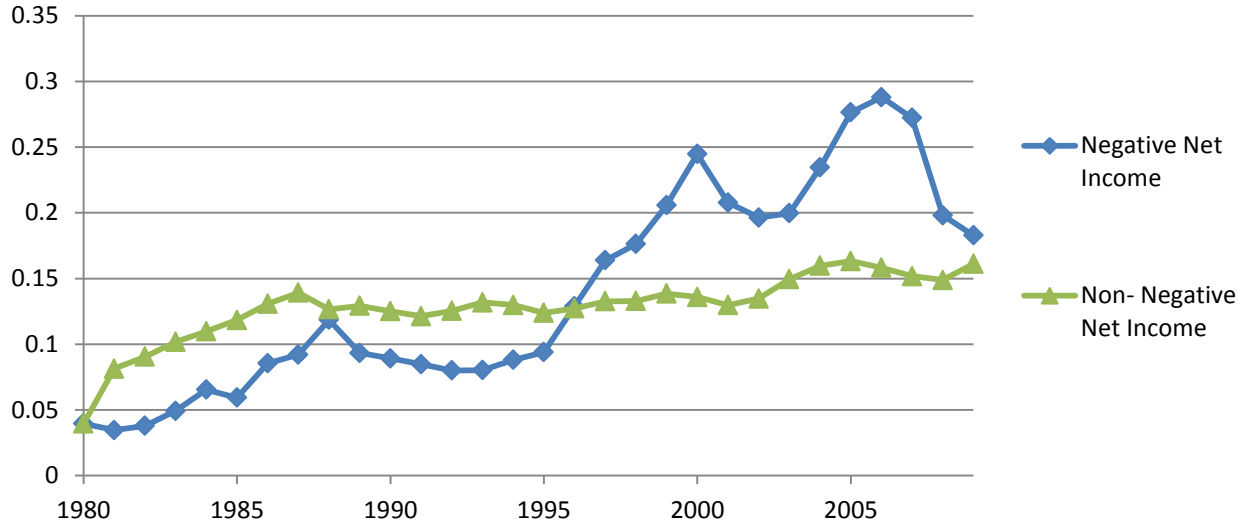
Figure IV. Average cash ratios by accounting performance from 1980 to 2009. The sample includes all Thomson One Banker firm-year observations from 1980 to 2009 with positive values from the book value of total assets and positive sales revenue for firms incorporated in western European and Nordic countries. Financial firms (SIC code 6000-6999) and utilities (SIC code 4900-4999) are also excluded from the sample. . Firms with accounting losses at the fiscal end of the designated year are assigned to the negative net income subsample.

4.5   Increase in cash holdings by idiosyncratic risks

The precautionary motive for cash holdings predicts that firms in industries that experience a large increase in idiosyncratic risk should have a greater increase in cash holdings than firms in industries that experience a small increase in idiosyncratic risk. To examine this, I divide the two-digit SIC code industries (for example, if the SIC code for the company is 3432, I will choose the first two digits 34 to represent the industry) in our sample into industries according to their cash flow volatility over the sample period. I measure cash flow risk as the standard deviation of industry cash flow to assets. Like I put firms into four quarters by total assets, I divide firms into four quarters based on their corresponding cash flow risks. Based on the method provided by Bates, Kalhe, and Stulz (2009), I computer the standard deviation of cash flow to assets for the previous 10 years for each year. At least three observations should be observed for calculation. Otherwise, the firm-year data is abandoned. I then average the firm cash flow standard deviations each year based on two-digit SIC code. Table V shows the average cash holdings according to their idiosyncratic risks. Q1 has the lowest idiosyncratic risk while Q4 has the highest. Regressions show that firms in Q4 have the largest coefficient 0.56%, which means the yearly increase of idiosyncratic risk is 0.56%. The time effect is 0.01% for firms in Q1. The clear evidence from the table is that the increase in cash ratios is concentrated in industries that experience a large increase in cash flow volatility.

Table V

Average Cash Holdings from 1980 to 2009 by Idiosyncratic Risk

The table summarizes the average cash-to-assets ratio for quarters of industries sorted by increase in idiosyncratic risk. We first divide the two-digit SIC code industries in our sample into industry quarters according to the increase in idiosyncratic cash flow volatility over the sample period. I measure cash flow risk as the standard deviation for the previous 10 years. I require at least three observations for the standard deviation to be calculated. I then take the average across the two-digit SIC code of the firm standard deviations. The sample includes all Thomson One Banker firm-year observations from 1989 to 2009 with positive values for the book value of total assets and sales revenue. Financial firms (SIC code from 6000-6999) and utilities (SIC 4900-4999) are excluded from the sample.

Year	Q1	Q2	Q3	Q4
1980	0.0805839	0.0605476	0.0850422	0.0768263
1981	0.0745677	0.0624338	0.0868931	0.075329
1982	0.0792874	0.0712483	0.0951071	0.078487
1983	0.0890782	0.0882158	0.1050754	0.0962467
1984	0.0934173	0.0970962	0.1231553	0.1078079
1985	0.1014132	0.1081447	0.1326089	0.1163049
1986	0.10995	0.11724	0.1426878	0.1321373
1987	0.1192347	0.1330005	0.1523119	0.1430105
1988	0.1145034	0.1234198	0.1418273	0.1301737
1989	0.116005	0.1181489	0.1366021	0.1400558
1990	0.1135218	0.1115921	0.1249301	0.1351565
1991	0.1030539	0.1060254	0.1193954	0.1283211
1992	0.0998029	0.10011	0.1252929	0.1290404
1993	0.1075583	0.0998034	0.1342984	0.1334042
1994	0.105637	0.1053491	0.1426664	0.1347345
1995	0.1083046	0.1046102	0.1280023	0.1322053
1996	0.1079792	0.106607	0.1269758	0.1511709
1997	0.1062792	0.1097881	0.1390701	0.1655216
1998	0.1003475	0.1063572	0.1380273	0.1739824
1999	0.0990145	0.1055673	0.1395328	0.1998353
2000	0.0912515	0.1013242	0.1523513	0.2226433
2001	0.0876269	0.0987291	0.1383874	0.2107964
2002	0.0847296	0.1032998	0.1374059	0.208087
2003	0.0891409	0.1073512	0.1396445	0.2166594
2004	0.098908	0.1143148	0.149411	0.2361465
2005	0.0992625	0.1182568	0.1694909	0.2527456
2006	0.099988	0.1257719	0.1790604	0.2454958
2007	0.1078583	0.1291524	0.1696291	0.2308564
2008	0.0921656	0.1098931	0.1461601	0.2053468
2009	0.0987748	0.1151314	0.1545426	0.2050039
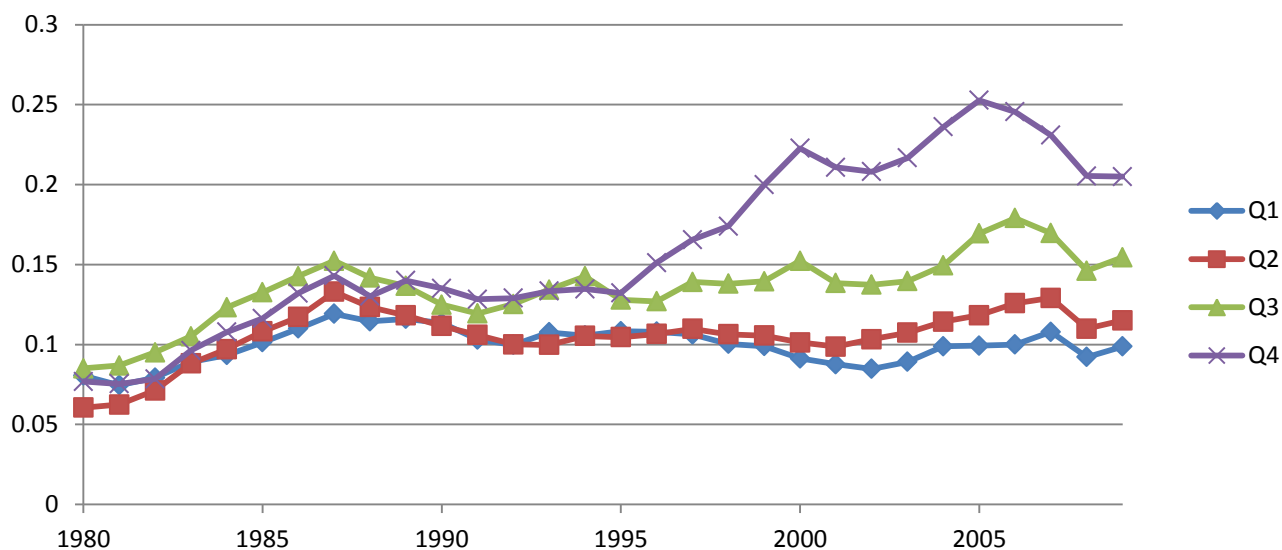
Figure V. Average cash ratios by idiosyncratic risks from 1980 to 2009. The sample includes all Thomson One Banker firm-year observations from 1980 to 2009 with positive values from the book value of total assets and sales revenue for firms incorporated in western European and Nordic countries. Financial firms (SIC code 6000-6999) and utilities (SIC code 4900-4999) are also excluded from the sample.

4.6 Increase in cash holdings by foreign income

Foley et al. (2007) note that multinational firms benefit from retaining cash abroad because earning repatriation would cause negative tax consequences. I use non-missing foreign pretax income to identify firms for which avoidance of taxes on foreign income might lead to higher cash holdings. There is no evidence that cash holdings increase more for firms with foreign income in the sample period. Table VI shows that the average cash ratio of firms without foreign taxable income increases from 7.8% in 1980 to 20.0% in 2009 and the cash ratio of firms with foreign taxable income is 7.8% in 1980 and increases to 16.5% in 2009. The yearly increase is 0.34% for firms with foreign income and 0.54% for firms without foreign income, both significant at 1%. As a result, it seems foreign earning repatriation doesn't play a significant role in cash holdings in western European and Nordic countries.

Table VI

The Average Cash Holdings from 1980 to 2009 by Foreign Income

The table summarizes the average cash ratio for firms that have and have not foreign income. The sample includes all Thomson One Banker firm-year observations from 1989 to 2009 with positive values for the book value of total assets and positive sales revenue for firms incorporated in western European and Nordic countries. Financial firms (SIC code from 6000-6999) and utilities (SIC 4900-4999) are excluded from the sample.

Year	Firm with Foreign Income	N	FirmWithout Foreign Income	N
1980	0.0779761	326	0.0694054	63
1981	0.0759175	332	0.0678008	71
1982	0.0833032	349	0.0695867	66
1983	0.0960552	409	0.0819618	45
1984	0.1050991	491	0.1080723	24
1985	0.1146094	549	0.0995613	21
1986	0.1248567	635	0.1476486	23
1987	0.13541	999	0.1304303	123
1988	0.1232199	1205	0.1451204	179
1989	0.1252436	1348	0.1350282	214
1990	0.1191947	1399	0.1281537	246
1991	0.1100635	1438	0.1361366	251
1992	0.1121888	1447	0.1208204	272
1993	0.1181069	1494	0.1217981	305
1994	0.1236613	1502	0.1196157	327
1995	0.1178903	1510	0.1242476	333
1996	0.1274209	2189	0.1283679	340
1997	0.1394961	2637	0.1294208	346
1998	0.1423259	2872	0.138729	366
1999	0.1579038	2951	0.137105	368
2000	0.1670816	3086	0.18868	310
2001	0.1580251	3074	0.1818762	321
2002	0.1556172	3124	0.2095353	394
2003	0.1658558	3242	0.1983111	434
2004	0.1785249	3450	0.2345034	444
2005	0.1941158	3616	0.2453564	476
2006	0.195226	3640	0.2407078	517
2007	0.1851033	3567	0.2369458	520
2008	0.160729	3288	0.2153823	548
2009	0.1653318	2985	0.2007743	552

Figure VI. Average cash ratios by foreign income from 1980 to 2009. The sample includes all Thomson One Banker firm-year observations from 1980 to 2009 with positive values from the book value of total assets and positive sales revenue for firms incorporated in western European and Nordic countries. Financial firms (SIC code 6000-6999) and utilities (SIC code 4900-4999) are also excluded from the sample.
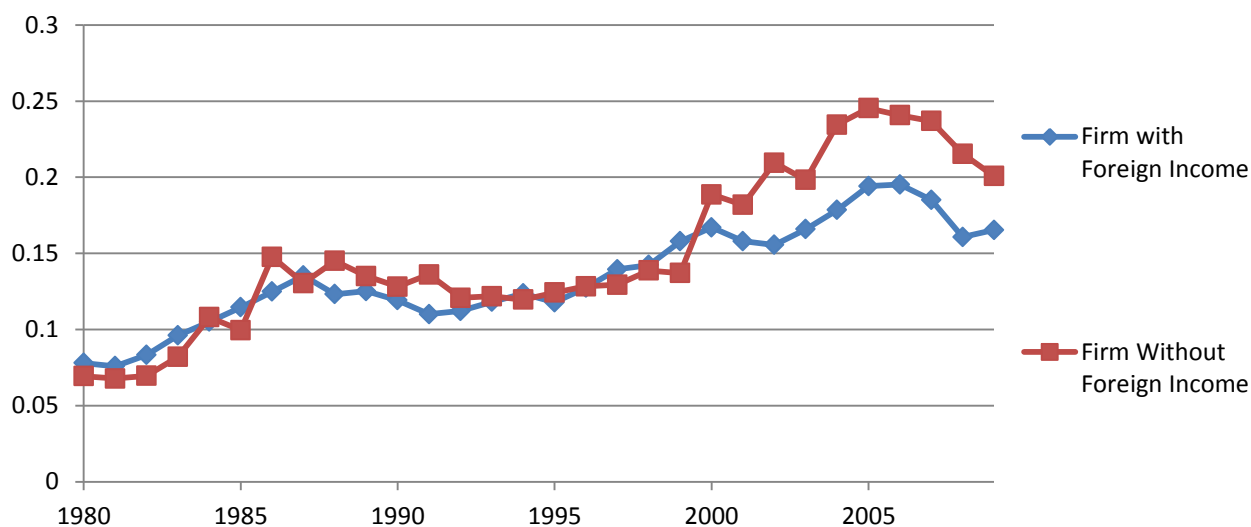
4.7   Increase in cash holdings by currencies

In January 1999, several European countries started using the common currency euro. They are Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, and Spain. Then later on, Cyprus, Estonia, Malta, Slovakia, and Slovenia also joined Euro Zone. However, it's quite difficult to put Greece into Euro zone because of the country's economic performance. So Greece is not included into the calculation. Besides, the other countries that later joined in Euro Zone are also not included since this study focuses on western European and Nordic countries. After these countries joined Euro Zone, interest rates were reduced and also foreign exchange rates were eliminated. Thus, firms in Euro Zone have less motivation than before to hedge against unexpected cash shocks for currency risks. Thus I test the effects of euro currency on cash holdings. The control group consists of Denmark, Norway, Sweden, Switzerland, and UK.

Table VII

The Average Cash Holdings from 1980 to 2009 by Currencies

The table summarizes the average cash ratio for firms that are in euro countries and outside euro countries within the sample. The sample includes all Thomson One Banker firm-year observations from 1989 to 2009 with positive values for the book value of total assets and positive sales revenue for firms incorporated in the countries adopting Euro currency. Financial firms (SIC code from 6000-6999) and utilities (SIC 4900-4999) are excluded from the sample. Firms are regarded as Euro Zone firms if they are Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain. Firms outside Euro Zone are from Denmark, Norway, Sweden, Switzerland, and UK.

Year	Firm in EuroZone	N	Firm outside EuroZone	N
1980	0.091421	102	0.091421	102
1981	0.066775	295	0.095554	108
1982	0.071654	304	0.107053	111
1983	0.08424	334	0.123657	120
1984	0.09196	364	0.137245	151
1985	0.100798	398	0.144732	172
1986	0.107482	461	0.168176	197
1987	0.122107	808	0.167691	314
1988	0.114273	982	0.154827	402
1989	0.115743	1090	0.151621	472
1990	0.110714	1160	0.144023	485
1991	0.103638	1195	0.138855	494
1992	0.102872	1218	0.139525	501
1993	0.105971	1272	0.149535	527
1994	0.112494	1278	0.147162	551
1995	0.108088	1281	0.144001	562
1996	0.112577	1756	0.161558	773
1997	0.124876	2097	0.170164	885
1998	0.133331	2295	0.16282	943
1999	0.14743	2311	0.174323	1008
2000	0.156062	2305	0.1965	1091
2001	0.144137	2209	0.190349	1186
2002	0.143295	2166	0.191071	1352
2003	0.149535	2151	0.198112	1525
2004	0.157637	2163	0.218984	1731
2005	0.165366	2156	0.238731	1939
2006	0.167935	2114	0.234975	2043
2007	0.165628	2051	0.217963	2036
2008	0.150184	1944	0.187394	1892
2009	0.15829	1802	0.183922	1735

Figure VII. **Average cash ratios by currencies from 1980 to 2009.** The sample includes all Thomson One Banker firm-year observations from 1980 to 2009 with positive values from the book value of total assets and positive sales revenue for firms incorporated in western European and Nordic countries. Financial firms (SIC code 6000-6999) and utilities (SIC code 4900-4999) are also excluded from the sample.
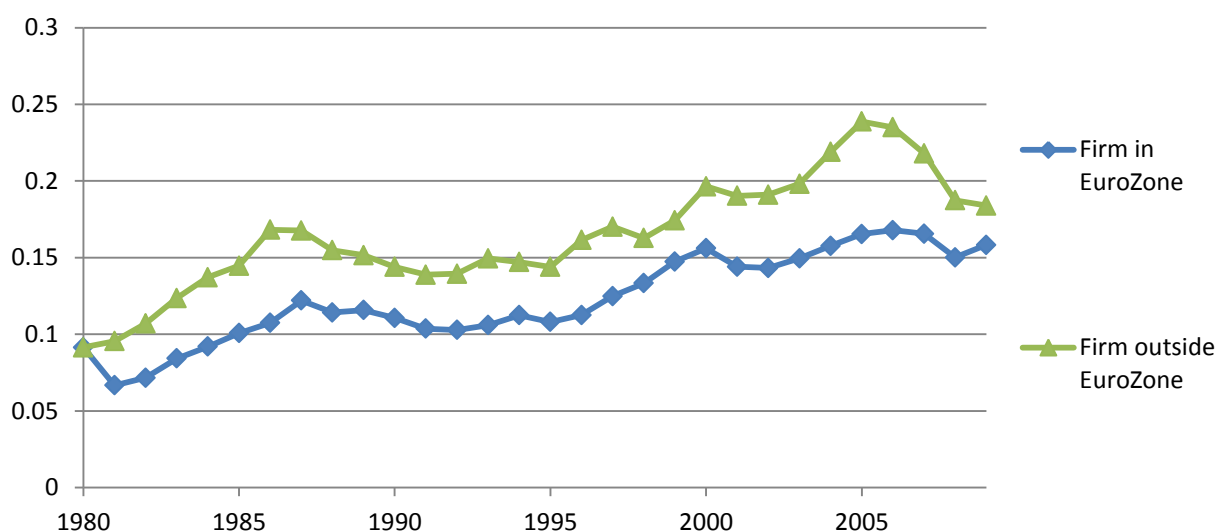
From Figure VII we can see that cash holdings outside Euro Zone are significantly higher than those of firms in Euro Zone. But it's hard to say whether the higher cash reserves lead to higher increase of cash holdings. From one regression that tests the time effects on cash holdings, the time effects on cash holdings are 0.30% and 0.37%, respectively, for firms in Euro Zone and outside Euro Zone in the sample, significant at 1%. From another regression, which includes time period from 1998 to 2007, I find significant differences. Time effects on firms within Euro Zone are 0.32% while 0.74% for firms outside Euro Zone, suggesting firms outside Euro Zone are facing more systemic risks than firms within Euro Zone. Even through many countries adopted Euro in 1999, the information was already well spread in the financial market. Thus I assume the financial markets well adopted the information already in 1998. Besides, data later than 2008 are not considered due to financial crisis, which can cause other factors to disturb my results.

4.8   Increase in cash holdings by agency problem

Jensen (1986) shows that agency theory predicts that cash holdings will increase for firms with high free cash flows. Pinkowitz, stulz, and Williamson (2004) examine the effect that country-level protection of rights has on cash holdings and show that cash is worth less to the minority shareholders of firms in countries with weak shareholder protection. To test the influence of agency problem on cash holdings, I have one separate section to study the impact of agency costs.

4.9   Summary

From a sample of firms in western European and Nordic countries from 1980 to 2009, I find a consistent increase in cash holdings over time. In particular, I find that cash holdings increase more in firms that are financially constrained as proxied by negative net income, than in other firms. Besides, smaller firms tend to hold larger cash reserves due to precautionary motivation. Similar, firms in industries experiencing greater volatility hold more cash on average. Further, firms in Denmark, Norway, Sweden, Switzerland, and UK, on average, demonstrate a higher increase in cash ratio. Detailed explanations will be investigated in later sections.

5   What causes the increase in cash ratios?

In this section, detailed methods are provided to test the increase in cash holdings. Section 5.1 investigates the relation of firm-specific characteristics and cash ratios and the time trend of increase in cash ratios not explained by the firm characteristics. Section 5.2 tests slope change of the demand for cash, which supplements the research of Section 5.1. In Section 5.3, Fama and MacBeth method is implemented to predict cash holdings. Within the same section, specific reasons are provided to demonstrate what causes the increase in cash ratios.

5.1   Did the demand function for cash holdings change?

In this section, I will examine whether the increase in cash holdings can be explained by firm characteristics and whether the relation between firm characteristics and the cash ratio changes over time. I start from regressions that relate the cash ratio to firm characteristics and investigate whether such regressions can explain the increase in cash ratios through changes in firm characteristics. This approach attempts to identify whether there is a regime shift in how firms determine their cash holdings.

In my thesis, I adopt several alternative definitions of cash ratios based on the method provided by Bates, Kahle, and Stulz (2009). These definitions include (1) cash to assets, (2) cash to net assets (where net assets equals book assets minus cash), (3) log of cash to net assets, and (4) cash to sales. Cash to assets is the most accepted and traditional measure. Cash-to-net assets ratio is provided by OPSW. However, this method can cause some problems. The cash-to-net assets ratio generates extreme outliers for firms with most of their assets in cash. I will provide corresponding solutions later. Foley et al. (2007) use the logarithm of the cash-to-net assets ratio. This approach will also be included in my analysis. However, Foley et al. (2007) notice that both cash-to-net assets ratio and logarithm of cash-to-net assets ratio generate extreme outliers. So will focus primarily on regressions using cash to assets as the dependent variable, but reproduce regressions using the log of cash to net assets for reference.

The explanatory variables adopted in my thesis are motivated by transaction and precautionary explanations presented in previous sections. These variables are from the method implemented by Opler, Pinkowitz, Stulz, and Williamson (1999). I also incorporate a firm's acquisition expenses to assets as an additional variable. According to Bates, Kahle, and Stulz (2008), acquisitions serve as

the similar function as capital expenditures. So it would be reasonable to add acquisition costs in the analysis to investigate its possible impact on cash holdings.

The sample includes all surviving and non-surviving firms available from Thomson One Banker in western and Nordic European countries from 1980 to 2009. However, the sample size significantly reduces when missing data are excluded from the observations. Besides, I made some statistical modification to the raw data to make the analysis more robust based on the method of Bates, Kalhe, and Stulz (2009). Outliers in firm-year explanatory variables are winsorized. First, Leverage is winsorized so that it is between zero and one. R&D to sales, acquisitions to assets, cash flow volatility, and capital expenditures to assets are winsorized at the 1% level, and the top tail of the market-to-book ratio is winsorized at the 1% level.

In Table VIII, six models are provided to test the relations between cash holdings and firm characteristics. The number in the parentheses is the *p*-value. In the Model 1 of Table VIII, ten firm-specific variables are tested to determine the possible relations with cash ratios. The signs of corresponding variables are generally consistent with my hypotheses except for three variables since the relations with cash ratios can be either negative or positive according to the hypotheses section. The coefficient of industrial cash flow volatility is positively related with cash ratios, significant at 1%. It's consistent with previous finding that firms in industries with high cash flow volatility tend to hold more cash to hedge their potential risks. Market to book ratio is also positively related with cash ratios. In the Hypotheses Section, it seems that this ratio could be either positive or negative. But for firms in my sample, it seems that capital market places a higher valuation if the firm holds relatively more cash. Firms with high market valuation tend to be firms with good investment opportunities and relatively high growth rate comparing to other firms within the same industries. So these firms are inclined to hold more cash for transaction motive.

Firm size is negatively related with cash holdings, significant at 1%. The possible explanation is economies of scale and of scope. Thus, big firms generally hold less cash. The regression result is consistent with my previous analysis in Data description Section. Cash flows in negatively related with cash holdings, with a *p* value of 0.000. Firms with high streams of cash flows are less concerned with urgent needs of cash. So it's less expensive for them to approach external market. Thus these firms are less motivated to hoard cash. Net working capital has the largest coefficient among the ten independent variables and it's significant of 1%. So NWC could influence cash holdings to a large extent. I will investigate NWC later in Section 5.3. NWC, when net of cash,

consists of receivables and inventories. They can relatively easily be converted into cash due to their high liquidity. So NWC is a substitute for cash, as evident from the regression.

Capital expenditure is also negatively related with cash ratios, significant at 5%. Bates, Kahle, and Stulz (2009) assert that capital expenditures provide collaterals that can be changed into liquid assets at a relatively low cost. Thus, these assets can play a similar role as cash, consistent with my regression result. Leverage has the second largest coefficient for these independent variables, significant at 1%. In previous section, the relation between cash holdings and leverage could be either positive or negative. First, if firms have cash, they will reduce their leverage since debts normally have a higher cost for the firm than the opportunity costs of cash. The other theory says that firms will accumulate more cash if they are too much leveraged due to precautionary motive. In my study for those firms in western European and Nordic countries, it seems firms prefer to reduce their leverage if they have excess cash. The significant coefficient on leverage could be that the denominator (total assets) is net of cash.

There are two distinct opinions of the relation of R&D and cash holdings. Firms with high R&D expenditures are considered financially constraint. So these firms tend to hold more cash for unexpected needs of cash. But the other theory says R&D consumes much cash so that firms will not hold much cash in hand. From the statistical result from the Table VIII, it seems, at least for firms in the sample, that firms with high R&D expenditures tend to hold more cash. Financial distress can be more expensive for these firms than firms that invest less in R&D. dividend payment is negatively related with cash ratios, consistent with previous studies. First, constant payment of dividends is a symbol of strong shareholder protection. Management in these firms cannot hoard cash easily at their will. Besides, firms paying dividends are more profitable than firms that don't pay dividends. So the financial position of these dividend paying firms are stronger. And thus, the financial constraint cost is less for these firms. It's somehow surprising that the coefficient on acquisitions is positive. It seems acquisition serve the similar function as capital expenditures. However, the coefficient on acquisition is positive, significant at 1%. The possible explanation could be agency costs. Managers in firms with strong shareholder protection generally face a dilemma that they intend to accumulate cash within the corporate rather than distribute it to shareholders in the form of dividends. However, shareholders constantly monitor the financial positive of the firm. They will discipline the managers if the managers hoard too much cash without proper action with the cash reserves, evident from the incidence of distribution of 7 billion dollars by Chrysler. Well informed with this knowledge, managers tend to use the cash for acquisitions even through these investments, on average, destroy

values. In return, managers get managerial compensation. Consequently, acquisitions are positively related to cash ratios.

Model 2 of Table VIII uses logarithm of cash to net assets as the dependent variable. The result is similar to Model 1 of Table VIII except for the intercept of the regression and significance of acquisitions. In Model 2, the intercept becomes negative while it's positive in Model 1. Acquisitions are still positive. But it's not significant anymore. The overall adjusted R^2 of Model 1 is 0.366. It decreases to 0.332 for Model 2. As suggested by Bates, Kalhe, and Stulz (2009), the Model 1 that adopts cash to assets is more appropriate than other models.

It is also possible that some factors other than those included in the regressions cause the increase in cash ratios. However, these potential variables are not included in Model 1 or 2 of Table VIII. I will try to provide more insight into this issue. But it's difficult or inefficient to exhaust all those possible independent variables. So I use dummies to test the potential differences. Model 3 of Table VIII reproduces Model 1 of Table VIII, using two decade dummies 1990s and 2000s. These dummies could add some insight to the increase in cash ratios. Model 3 uses cash to assets as dependent variable. Adding two dummies increases adjusted R^2 by less 1%. The independent variables have similar coefficients and significance as Model 1 of Table VIII. The 1990s dummy is positive, but not significant. The 2000s dummy is also positive, significant at 1%. Thus, it seems that there is an increasing trend of cash reserves not explained by firm characteristics studied in the model.

Model 4 of Table VIII reproduces Model 2 of Table VIII with two dummies. The dependent variable is logarithm of cash to net assets. Acquisition loses its significance in this model, same as in Model 2 of Table VIII. The other variables demonstrate similar results as in Model 2 of Table VIII. The 1990s dummy is negative but not significant. The 2000s dummy is positive and significant at 1%. Model 3 and 4 of Table VIII show that, holding the ten independent variables constant, there is an uprising trend of cash holdings in the 2000s. But the effect on 1990s is less obvious. I will try to give one explanation in later section.

Previous literature review shows that euro plays an important role in macro economy in Euro zone. Euro can impact firms' costs of capital and expected cash flows. Bris, Koskinen, and Nilsson (2008) show that, by using corporate-level data from seventeen European countries, the introduction of euro has increase Tobin's Q ratios by 17.1% in Euro zone that previously had weak currencies. Rather than testing the effects on Tobin's Q ratio, I'm primarily interested in euro's impact on the cash

ratios in Euro zone. So I have one control sub-sample that has firm data from western European and Nordic countries that have not adopted euro as the common currencies. These countries are Denmark, Norway, Sweden, Switzerland, and the UK. To put these countries in a sub-sample, I use a dummy variable post-euro dummy, which means the dummy is 1 if the year is after 1998. Even though euro was adopted in 1999, but on 2 May 1998 European Council decided which countries were allowed to enter the final phase of the EMU. Thus, choosing 1998 as the first year of euro seems reasonable since I use the end of each year (31th December) for calculation. Moreover, the financial market was assumed to well adopt the news already. So it sounds justifiable to use 1998 as the first year in post-euro dummy. If the country is one of Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain, then the euro country dummy is 1. So euro country ×post-euro dummy can distinguish countries adopting euro after 1998. This method is developed by Bris, Koskinen, and Nilsson (2008). Besides, to test the macro economic impact, I also put some other variables into the regression: changes of exchange rate[1], GDP growth, log of GDP per capita, change of short term interest rate, and term spread. These variables are also from the model of Bris, Koskinen, and Nilsson (2008). Detailed figures are provided in the Appendix.

Model 5 and 6 of Table VIII reproduce Model 1 and 2 of Table VIII separately by adding these macroeconomic variables and dummies. The adjusted R^2 has been improved by less than 1%. The firm-specific variables have similar coefficients and significance as in Model 1 and 2 of Table VIII. The coefficient of Euro country×post-euro dummy is negative for both Model 5 and Model 6 of Table VIII, which is consistent with my previous study in Data description section that firms in countries adopting euro increase their cash ratio to a less degree than firms in countries outside Euro zone. Even though the model developed by Bris, Koskinen, and Nilsson (2008) plays an important role in explaining the Tobin's Q ratio, the explanation power of the model is less significant to explain the increase in cash ratios.

In summary, Table VIII shows that the relationship between firm characteristics and cash ratios are consistent over the models and significant. The cash holdings, when holding other variables consistent, of 2000s are higher than in 1980s. But cash holdings in 1990s are not significant in either Model 3 or Model 4 of Table VIII. When euro impacts are tested, the coefficients of those macroeconomic variables are mostly significant. However, I didn't go further with the analysis since the explanation power of the model adds little to the simpler Model 1 and 2 of Table VIII. But the

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1 Exchange rate means how much one USD, for instance, can buy one euro. And it's calculated as one dollar divided by one euro. The change of exchange rate is calculated as exchange rate in time (t+1) minus exchange rate in time (t).

euro model confirms the previous study that the common currency reduces the incentives for cash holdings to certain degree in western European and Nordic countries because currency risk is eliminated and costs of capital has also decreased.

Table VIII

	1	2	3	4	5	6
Model	OLS	OLS	OLS	OLS	OLS	OLS
Dependent Variable	Cash/Assets	Log(Cash/ Net Assets)	Cash/Assets	Log(Cash/ Net Assets)	Cash/Assets	Log(Cash/ Net Assets)
Intercept	0.3194878	-0.960665	0.3065924	-1.08383	-0.4223277	-8.299387
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Industry Sigma	0.0108011	0.0767953	0.0106618	0.0751172	0.0106203	0.0737747
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market to book	0.0200739	0.1276609	0.0199669	0.1267308	0.0199481	0.1254646
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Real size	-0.0107128	-0.0458881	-0.0102408	-0.0408245	-0.0105002	-0.0434772
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash flow/ assets	-0.0558547	-0.3295142	-0.055617	-0.3263515	-0.0532694	-0.303409
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
NWC/ assets	-0.4029419	-3.978307	-0.3990292	-3.932591	-0.3989132	-3.924462
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capex	-0.0933029	-0.7892815	-0.0846052	-0.6904872	-0.0799067	-0.6340257
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-0.3802313	-3.313392	-0.3803342	-3.309617	-0.3838789	-3.343701
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R&D/ sales	0.0076013	0.0556279	0.0079056	0.0596524	0.0068301	0.0488784
	(0.009)	(0.026)	(0.006)	(0.017)	(0.019)	(0.051)
Dividenddummy	-0.0388761	-0.2482374	-0.0372856	-0.2293063	-0.0373725	-0.2310571
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Acquisitionactivity	0.0004178	0.0003394	0.0004356	0.0005407	0.0004815	0.0009471
	(0.000)	(0.600)	(0.000)	(0.403)	(0.000)	(0.149)
1990s dummy			0.0025769	-0.0044203		
			(0.539)	(0.903)		
2000s dummy			0.0123834	0.1179973		
			(0.002)	(0.001)		

GDP growth					-0.0767375	-0.8705524
					(0.175)	(0.074)
log (GDP growth/per capita)					0.0701374	0.6948978
					(0.000)	(0.000)
change of exchangerate					-0.0119408	-0.1206772
					(0.010)	(0.003)
Change of short term interest rate					-0.0046612	-0.0454861
					(0.000)	(0.000)
Termspread					-0.004475	-0.0402126
					(0.000)	(0.000)
Euro country×post-euro dummy					-0.0096743	-0.098732
					(0.008)	(0.002)
Adjusted R squred	0.3663	0.3315	0.3669	0.3328	0.3726	0.3395

5.2   The slope change in the demand for cash

Differences in the intercepts could result from changes in the relation between cash holdings and firm characteristics. To evaluate whether this is the case, I estimate models in Table IX to allow for changes in both the intercept and slope coefficients. The model is as follows:

Cash ratio=α + β_1Firm Size + β_2Firm size*dummy 1990s + β_4Firm size*dummy 2000s + β_5Leverage + β_6Leverage *dummy 1990s + β_7Leverage *dummy 2000s+ β_8Dividend Dummy + β_9Dividend Dummy *dummy 1990s + β_{10}Dividend Dummy *dummy 2000s+ β_{11}R&D + β_{12}R&D *dummy 1990s + β_{13}R&D *dummy 2000s+ β_{14}Acquisitions + β_{15}Acquisitions *dummy 1990s + β_{16}Acquisitions *dummy 2000s+ β_{17}Capital Expenditures + β_{18}Capital Expenditures *dummy 1990s + β_{19}Capital Expenditures *dummy 2000s+ β_{20}NWC+ β_{21}NWC *dummy 1990s + β_{22}NWC *dummy 2000s+ β_{23}Industry Sigma + β_{24}Industry Sigma *dummy 1990s + β_{25}Industry Sigma *dummy 2000s+ β_{26}Cash Flow/Assets + β_{27}Cash Flow/Assets *dummy 1990s + β_{28}Cash Flow/Assets *dummy 2000s+ β_{29}Marker to Book + β_{30}Marker to Book *dummy 1990s + β_{31}Marker to Book *dummy 2000s + ε

Model 1 of Table IX replicates Model 1 of Table VIII, but with dummy variables that interact with all independent variables. Adding the indicator variable increases the adjusted R^2 by less than 1%. The number in the parentheses is the *p*-value. So for the estimates, the coefficients of the variables is for data in the 1980s. By adding the coefficients interaction of 1990s and 2000s, the coefficients for 1990s and 2000s can be obtained. In general, the absolute value of a coefficient increases over time (i.e., the interactions are of the same sign as the coefficient for the whole sample period or the sign of the sum of the estimate and interaction is the same as the sign of the estimate for the sample). Since the firm data in from 1980s are quite limited, some coefficients of the independent variables are not significant anymore. Any some coefficients have different signs from Model 1 in Table VIII. Industry sigma, firm size, R&D, and dividend dummy no longer have significant coefficients in the Estimate. Besides, cash flow to assets, R&D, dividends, and acquisitions change the sign for this sub-sample. Cash flow to assets and acquisitions are significant at 5%.

In this estimate, cash flow to assets is positively related to cash ratio in 1980s. The possible explanation is that in the 1980s, the sense of shareholder protection was not strong enough to influence the behavior of management. Thus, managers could accumulate more cash from the high cash flows from daily operations of the firm. The situation gradually changed when shareholders rights became more important in the 90s. In the sub-sample, acquisitions are negatively related with cash holdings. In previous section, there are both possible relations between acquisitions and cash ratios. It could be that, in 1980s, managers would hoard cash rather than use it for acquisitions. Thus, acquisitions and cash holdings are negatively related. This explanation from agency problem is consistent with the one for cash flow to assets. Thus, I conclude that, in 1980s, shareholder protection was less implemented than afterwards for countries in western European and Nordic countries.

In interaction 1990s and 2000s in Model 1 of Table IX, the interactions are increasing both for 1990s and 2000s. Some coefficients change the sign during 1990s and 2000s. However, the coefficient for industry sigma is not significant for 1990s. But it's increasing for 2000s, significant at 5%. The result is consistent with previous literature review. The industry volatility could be due to new listing effects. Thus, their cash ratios increase over time. Cash flow to assets changes their sign in 1990s and 2000s, significant at 1%. This finding is interesting because it seems management became more concerned with their cash reserves. When they got more cash from cash flows, they tended to disburse the cash to shareholders. Thus, it's evident that shareholder protection became a daily issue on management's minds. Also, acquisitions and cash holdings became positive in 2000s, significant at 1%. I still seek to explain from shareholder protection perspective. To avoid too much attention from shareholders and the potential discipline, managers would choose to distribute the cash as dividends to shareholders or repurchase of shares from shareholders. However, a more beneficial method for managers is to implement acquisitions. Thus, their personal compensation could increase in the form of stock options and bonuses. Besides, even their ego could boost after the acquisitions even though these investments could destroy values.

Model 2 of Table IX re-produces Model 2 of Table VIII. This model provides a similar result as Model 1 of Table IX. However, firm size becomes positively related to cash holdings, significant at 1%. But it changes sign in 2000s. R&D to sales is negatively related to cash ratio, significant at

10%. It seems that, in 1980s, firms invested more on R&D when they had cash in hand. But the situation breaks in 2000s.

There are a few implications observed from Table IX. First, intercept has the same sign over the 1980s, 1990s, and 2000s. So it seems that there is an increasing time trend for cash reserves when holding the firm characteristics constant. In Table VIII, the dummy for 1990s is negative. But it does not exist anymore in Table IX. Besides, I believe shareholder protection was not very strong in 1980s as evidence from cash flow to assets and acquisitions have displayed different figures for 1980s and for 1990s and 2000s.

	1			2		
Model	Cash/Assets			log(cash/net assets)		
Dependent Variable	Estimate	Interaction 1990s	Interaction 2000s	Estimate	Interaction 1990s	Interaction 2000s
Intercept	0.1504421	0.1044568	0.1792709	-2.885355	1.397354	2.019283
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Industry sigma	0.0009928	-0.0018725	0.0109595	0.0556891	-0.0406563	0.0246319
	(0.845)	(0.738)	(0.034)	(0.204)	(0.401)	(0.582)
Market to book	0.0143278	0.0014089	0.0066033	0.2378316	-0.1293338	-0.1091554
	(0.030)	(0.836)	(0.322)	(0.000)	(0.028)	(0.058)
Firmsize	-0.0005364	-0.0055867	-0.010811	0.0809053	-0.0682453	-0.1424275
	(0.832)	(0.042)	(0.000)	(0.000)	(0.004)	(0.000)
Cash flow/assets	0.1684628	-0.267249	-0.2166378	2.963352	-3.63525	-3.243796
	(0.044)	(0.002)	(0.010)	(0.000)	(0.000)	(0.000)
NWC/assets	-0.3631584	-0.0156471	-0.0361271	-4.118556	-0.0527062	0.3609667
	(0.000)	(0.653)	(0.258)	(0.000)	(0.861)	(0.192)
Capex	-0.130662	0.0040877	0.0633049	-1.199863	0.1616395	0.6277001
	(0.027)	(0.949)	(0.298)	(0.019)	(0.769)	(0.233)
Leverage	-0.1069394	-0.1895203	-0.30688	-1.07734	-2.162352	-2.274372
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R&D/sales	-0.1571661	0.1622769	0.1281562	-2.06374	2.096603	1.92649
	(0.230)	(0.215)	(0.332)	(0.069)	(0.065)	(0.093)
Dividenddummy	0.0140439	-0.0125975	-0.0590886	0.1829459	-0.1227576	-0.475986
	(0.250)	(0.340)	(0.000)	(0.085)	(0.284)	(0.000)
Acquisitionactivities	-0.0007398	0.0004039	0.001504	-0.0078837	0.0055375	0.0099971
	(0.036)	(0.297)	(0.000)	(0.010)	(0.098)	(0.001)
Ajusted R square		0.3803			0.3435	

Table IX

5.3   Estimate Fama-MacBeth regressions

Section 5.2 shows that changes in firm characteristics are the major reason why cash holdings increase. In this section, I attribute the increase in cash holdings to changes in specific firm characteristics. The process consists of three steps. First, based on the method modified by Bates, Kalhe, and Stulz (2008), I implement Opler, Pinkowitz, Stulz, and Williamson (1997) model of 1980s using Fama-MacBeth regressions. The coefficients of the independent variables are calculated as the average annual cross-sectional regressions estimated from 1980 to 1989. Second, I compute how actual cash holdings in 1990s and 2000s differ from cash holdings in 1980s. Finally, I attribute the increases in predicted cash ratios to changes in firm characteristics.

After calculating ten cross-sectional regressions from 1980 to 1989, I obtained the averaged regression formula for prediction. The cross-sectional data is provided in the Appendix. The equation is:

Cash ratio= 0.218 - 0.003 Firm Size - 0.223 Leverage+ 0.007 Dividend Dummy + 0.012 R&D - 0.001Acquisitions -0.135 Capital Expenditures - 0.344 NWC - 0.0002 Industry sigma + 0.002 Cash flow/Assets + 0.0156 Market to book.

This equation provides the formula to predict cash ratios for 1990s and 2000s using the actual figures for the corresponding variables. Table X shows the results of actual and predicted cash ratios. For the whole sample, the prediction tends to over-estimate the cash ratios for 1990s and under-estimate for 2000s. The predicted average cash ratio over 1990 to 2009 is 14.6% while the actual number is 15.2%. The annual difference between actual and predicted is 0.67%. It seems the model, on average, underpredicts the cash ratios, as evident from previous section that there is an increasing time trend in cash ratios not explained the firm characteristics.

Then I divide the sample into firms paying dividends and firms not paying dividends. For firms paying dividends, the model tends to overpredict the cash ratios for 1990s and underpredict for the beginning of 2000s. On average, this model overpredicts cash ratios for firms paying dividends. On

the other hand, the model underpredicts cash ratios on average for firms not paying dividends, as evident that the averaged difference between actual and predicted cash ratios is positive.

The model predicts a 26% increase in the average cash ratio from 1990 to 2009 for the whole sample. How could such a big increase be interpreted? To provide some insight, I will investigate how firm characteristics change over time and how the changes influence the cash ratios. Think about a firm that has 11% capital expenditure to its total assets for 1980s. The coefficient on capital expenditure in the Fama-MacBeth regression is 13.5%.So I expect a cash ratio of 1.9% due to capital expenditure (11%*13.5%) for this firm in 1980s. average capital expenditure increases during the sample period. For example, average capital expenditure is 10.5% in 1999. So in 1999, a cash ratio of 0.14% could be explained by capital expenditure. Hold other variables constant, the average capital expenditure is 0.08 from 1990 to 2009. So during the sample period, I expect a 1.1% of cash ratio attributable to capital expenditure (8%*13.5%). In the next section, I will try to investigate what causes the increase in cash ratios.

Table X

Predicted Cash Ratios and Their Deviations from Actual Cash Holdings over Time

This table summarizes the predicted cash ratios of sample firms from 1990 to 2009. Predicted cash holdings for each year are derived from a Fama-MacBeth model predicting cash ratios, the coefficients of which are the average coefficients from annual cross-sectional regressions estimated over the period 1980 to 1989. Estimates from this regression are as follows: cash ratio= 0.218 - 0.003 Firm Size - 0.223 Leverage+ 0.007Dividend Dummy + 0.012 R&D -0.001 Acquisitions -0.135 Capital Expenditures - 0.344 NWC - 0.0002 Industry cash flow volatility + 0.002 Cash flow/Assets + 0.015 Market to book. The table summarizes differences between actual and predicted cash ratios, by year, for the whole sample, and for firms paying and not paying common dividends during a particular year. T-statistics summarize the statistical significance of differences between predicted and actual cash ratios for the whole sample and each of the observed subsamples independently. Variables are defined in the Appendix.

Year	WholeSample			FirmsPayingDividend			FirmsNotPayingDividend		
	Predicted	Actual	Actual-Predicted	Predicted	Actual	Actual-Predicted	Predicted	Actual	Actual-Predicted
1990	0.1258118	0.1205345	-0.0052773	0.1304714	0.1255459	-0.0049255	0.0926771	0.0950133	0.0023362
Std.Err.	(0.0029261)	(0.0031396)		(0.0030167)	(0.0034036)		(0.0087701)	(0.0079239)	
1991	0.120587	0.1139382	-0.0066488	0.1258761	0.1211071	-0.004769	0.0911667	0.0854944	-0.0056723
Std.Err.	(0.0027545)	(0.0030595)		(0.0029897)	(0.00345)		(0.0058968)	(0.0063854)	
1992	0.1241084	0.1135546	-0.0105538	0.1325685	0.1241113	-0.0084572	0.0938567	0.0835141	-0.0103426
Std.Err.	(0.0027419)	(0.002974)		(0.0029086)	(0.0035524)		(0.0061443)	(0.0050934)	
1993	0.1339331	0.1187327	-0.0152004	0.1409893	0.1315887	-0.0094006	0.1098515	0.0859713	-0.0238802
Std.Err.	(0.0025807)	(0.0029416)		(0.0028965)	(0.0035693)		(0.0050316)	(0.0048287)	
1994	0.1391803	0.122938	-0.0162423	0.1447156	0.1312677	-0.0134479	0.1144885	0.0952509	-0.0192376
Std.Err.	(0.002358)	(0.0029739)		(0.0025479)	(0.0033736)		(0.0054398)	(0.0061107)	
1995	0.135588	0.119039	-0.016549	0.140511	0.1268782	-0.0136328	0.1135499	0.0923966	-0.0211533
Std.Err.	(0.0022685)	(0.00294)		(0.002348)	(0.0033121)		(0.0062155)	(0.0061981)	

1996	0.1414923	0.1275482	-0.0139441	0.1438574	0.1332051	-0.0106523	0.1322336	0.1120419	-0.0201917
Std.Err.	(0.0022607)	(0.0028675)		(0.002312)	(0.0032304)		(0.006402)	(0.00602)	
1997	0.1434163	0.1383274	-0.0050889	0.1451277	0.1385865	-0.0065412	0.1363003	0.1375945	0.0012942
Std.Err.	(0.0020926)	(0.0028883)		(0.0021464)	(0.0031271)		(0.0060518)	(0.0066407)	
1998	0.1416238	0.1419193	0.0002955	0.1434432	0.1330787	-0.0103645	0.1347242	0.1647445	0.0300203
Std.Err.	(0.0022363)	(0.0028646)		(0.0022922)	(0.0030214)		(0.0062552)	(0.0066082)	
1999	0.1470928	0.1555977	0.0085049	0.1450736	0.1402902	-0.0047834	0.1539308	0.1872454	0.0333146
Std.Err.	(0.0024866)	(0.0032079)		(0.0025587)	(0.0034733)		(0.0066157)	(0.0066271)	
2000	0.1544327	0.1690532	0.0146205	0.1446439	0.1291171	-0.0155268	0.1723965	0.2253036	0.0529071
Std.Err.	(0.0021877)	(0.003516)		(0.0025298)	(0.0034626)		(0.0039505)	(0.0066415)	
2001	0.1439028	0.1602802	0.0163774	0.1380073	0.1287797	-0.0092276	0.152746	0.1977314	0.0449854
Std.Err.	(0.0018905)	(0.0033265)		(0.0023162)	(0.0035172)		(0.0031629)	(0.0058211)	
2002	0.1393698	0.1616558	0.022286	0.1374433	0.1402912	0.0028479	0.141606	0.1885639	0.0469579
Std.Err.	(0.0018059)	(0.0032526)		(0.0021672)	(0.0036764)		(0.0029825)	(0.0056348)	
2003	0.1498626	0.1696875	0.0198249	0.1469762	0.1541397	0.0071635	0.1534861	0.1908709	0.0373848
Std.Err.	(0.0017599)	(0.0032729)		(0.0020171)	(0.0038947)		(0.0030521)	(0.0055807)	
2004	0.1573094	0.1849076	0.0275982	0.1519435	0.1614475	0.009504	0.1642181	0.2184012	0.0541831
Std.Err.	(0.0016676)	(0.0033161)		(0.0019368)	(0.0036625)		(0.0028653)	(0.0060249)	
2005	0.1658608	0.2000763	0.0342155	0.1610023	0.1639194	0.0029171	0.1720946	0.2482718	0.0761772
Std.Err.	(0.0016118)	(0.0034755)		(0.0018577)	(0.0037153)		(0.0027873)	(0.0062382)	
2006	0.1716039	0.2008825	0.0292786	0.164191	0.154881	-0.00931	0.1804155	0.2515585	0.071143
Std.Err.	(0.0015251)	(0.0034058)		(0.0018408)	(0.0036287)		(0.0024861)	(0.0057261)	
2007	0.1678548	0.1916993	0.0238445	0.1625878	0.1490286	-0.0135592	0.1743206	0.2385998	0.0642792
Std.Err.	(0.0014984)	(0.0033216)		(0.0018105)	(0.0034992)		(0.0024732)	(0.0056283)	
2008	0.1537059	0.1685366	0.0148307	0.1530518	0.1409943	-0.0120575	0.1544525	0.1955105	0.041058
Std.Err.	(0.0017367)	(0.0031553)		(0.0021766)	(0.0035489)		(0.0027688)	(0.0051163)	
2009	0.1581187	0.1708631	0.0127444	0.1589846	0.1570629	-0.0019217	0.157131	0.1847651	0.0276341
Std.Err.	(0.001745)	(0.0031708)		(0.0020494)	(0.0037834)		(0.0029148)	(0.0050774)	

5.4   Variables that impact most on the increase in cash holdings

First, I use Fama-MacBeth method to predict cash ratios for 2000s. The model is:

Cash ratio= 0.218 - 0.003 Firm Size - 0.223 Leverage+ 0.007Dividend Dummy + 0.012 R&D - 0.001Acquisitions -0.135 Capital Expenditures - 0.344 NWC - 0.0002 Industry sigma + 0.002 Cash flow/Assets + 0.015 Market to book

The increase in the cash ratio (dependent variable) is calculated as the difference between the *average* cash ratio from 2000 to 2009 and the *average* cash ratio for 1980s. The independent variables are also calculated in the same manner by subtracting the *actual* data in 2000s from the *actual* data in 1980s.

Table XI attributes the increase in the predicted cash ratio to changes in the determinants of that ratio. The number in the parentheses is the *p*-value. We can see regression analysis based on the differences of dependent and independent variables. However, the sample of the analysis is reduced to 270 because of missing data. However, the table still can shelter some light on the analysis.

Model 1 of Table XI analyses the whole sample. But there is one issue with industry sigma, as measured as industry sigma. In my sample, these firms generally stay within the same industry. Even though it would be different if the sample size would be larger, my sample would result in a difference of 0. So there would be collinearity for this sample. However, I put the *absolute* value instead of the *difference* of industry sigma in the analysis of Model 1. Model 2 of Table XI deletes this collinearity item. The adjusted R^2 is hardly impacted. Still, due to the small sample size, many variables have insignificant coefficients. They are firm size, capital expenditure to assets, leverage, and R&D to sales. The variables with the biggest absolute value are cash flow to assets, NWC to assets, and R&D to sales. The coefficient is significant at 5% for cash flow to assets and 1% for NWC to assets. However, R&D to sales is not significant. The general conclusion is consistent with Bates, Kalhe, and Stulz (2008), who adopt the sample from the U.S. companies from 1980 to 2006. Then I try to put the firms into sub-samples of firms paying dividends and firms not paying

dividends. However, in the sample of non-paying firms, there are too much conllearity. So I only retain one sample of dividend paying firms. From Model 3 of Table XI, the adjusted R^2 is not affected. And it has the same conclusion as in Model 1 and Model 2 of Table XI.

Let's take a look at the change in the firm characteristics that influence the change of cash ratios most. The average NWC to total assets, net of cash, is 13.7% in 1980s. And it decreases to 10.1% in 2000s. The dramatic 26% change in NWC provides great explanation to the change of cash ratios. As more high-tech firms became listed in stock exchanges in the sample period, the average inventory decreases since these firms have mostly intangible assets. Besides, as the accounting techniques improves, such as SAP and Oracle, firms start to adapt advanced accounting techniques to reduce their receivables. Thus, the NWC has decreased over the sample period.

In risk management theories, greater volatility of cash flow increases the present value of deadweight costs of financial distress. Normally firms with high cash flow volatility would hedge more. However, if firms have unhedgeable risks, they would use cash to buffer the potential shocks, as documented in the literature review section. Thus, it's reasonable for firms experiencing high cash flow volatility to hold more cash reserves. In the 1980s, the average cash flow volatility to assets is 8%. But it dramatically increased to 16.6% in the 2000s, which is twice the number for 1980s.

In 1980s, R&D to sales is 3.8% but the number decreases to 9.0% in 2000s. The increase is over 50%. During the same period, capital expenditure decreases 28% from 10.1% to 7.9%. This contrast would indicate that R&D plays a more importance than capital expenditure over time (Bates, Kalhe, and Stluz (2009)). A possible explanation is that R&D expenditure is more costly since it puts firms at financial distress. Thus, it's more expensive to access external capital market. So firms prefer to hold cash reserves for precautionary purposes. However, capital expenditures result in assets that can be used as collaterals. So it can serve as a substitute for cash. The above analysis confirms the precautionary motive for the increase of cash holdings and implies that the changes in firm specific characteristics largely explain the secular trends of cash reserves.

Table V

Determinants of Changes in Predicted Cash between 1990 to 2009

This table summarizes the determinants of the change in predicted cash ratios between 1990 and 2009, where the change in the cash ratio is measured as the difference between the average cash ratio from 1990 to 2009 and the average cash ratio from 1980 through 1989. Estimates from this regression are as follows: cash ratio= 0.218 - 0.003 Firm Size - 0.223 Leverage+ 0.007 Dividend Dummy + 0.012 R&D -0.001 Acquisitions -0.135 Capital Expenditures - 0.344 NWC - 0.0002 ndustry sigma + 0.002 Cash flow/Assets + 0.015 Market to book

	Model 1	Model 2	Model 3
	Wholesample	Exclude Industry sigma	Dividend paying firms
Firmsize	-0.001123	-0.0015557	-0.0015501
	(0.718)	(0.618)	(0.621)
Dividends	-0.1056473	-0.1085065	
	(0.065)	(0.059)	
Acquisitions	-0.001488	-0.0014196	-0.0014206
	(0.006)	(0.009)	(0.010)
Capex	-0.0815465	-0.0796332	-0.0695869
	(0.217)	(0.23)	(0.297)
Industry sigma	0.0154635		
	(0.06)		
Cash flow/assets	0.2981101	0.2546257	0.2577097
	(0.012)	(0.03)	(0.029)
Market to book	0.021413	0.023854	0.0253601
	(0.009)	(0.004)	(0.002)
NWC/assets	-0.2550985	-0.240238	-0.2442252
	(0.000)	(0.000)	(0.000)
R&D/sales	-0.2481951	-0.245925	-0.2436823
	(0.159)	(0.165)	(0.171)
Leverage	-0.0053121	-0.0027457	-0.0017015
	(0.786)	(0.888)	(0.931)
Adjusted R squared	0.198	0.190	0.190

6   Agency problems and growth in cash ratios

The evidence collected so far indicates that empirical models of the demand for cash can explain the increase in cash reserves over time primarily through changes of firm specific characteristics. I incorporate several proxies in the models to demonstrate the precautionary and transaction motives for cash holdings. However, so far, I have not carried out analysis using direct proxies to test the effects of agency problems on cash holdings. In this section, I will perform several tests to evaluate whether agency problems can explain the increase in cash ratios systematically in the sample.

Gompers, Ishii, and Metrics (2003) develop a GIM index to measure managerial entrenchment. Specifically, GIM index is a cumulative index of 24 antitakeover governance provisions from the Investor Responsibility Research Centre (IRRC) volumes. Firms that have a high value of the GIM index are expected to have more entrenched management. GIM index is thoroughly investigated by many researchers. Bates, Kalhe, and Stulz (2009) find that the highest increase in cash ratio is not related to firms with the greatest GIM index. So there is no evidence to show that entrenched management hoards much cash, at least not from the sample provided by IRRC from 1990 to 2006.

Secondly, I examine the value of cash reserves over time. Several recent papers correlate agency costs of cash with the value of corporate cash reserves. Pinkowitz and Williamson (2004) modify the valuation model initiated by Fama and French (1998) by using cash ratios as an independent variable. This model is somehow ad hoc because it does not point out a functional form that is derived directly from a theoretical model. However, it does explain a significant amount of cross-sectional variation in firm values. The basic model of the regression is as follows:

$$V_{i,t} = \alpha + \beta_1 E_{i,t} + \beta_2 dE_{i,t} + \beta_3 dE_{i,t+2} + \beta_4 dA_{i,t} + \beta_5 dA_{i,t+2} + \beta_6 RD_{i,t} + \beta_7 dRD_{i,t} + \beta_8 dRD_{i,t+2}$$
$$+ \beta_9 I_{i,t} + \beta_{10} dI_{i,t} + \beta_{11} dI_{i,t+2} + \beta_{12} D_{i,t} + \beta_{13} dD_{i,t} + \beta_{14} dD_{i,t+2} + \beta_{15} dV_{i,t+2} + \varepsilon_{i,t} , \quad (1)$$

where $X_t = (E_t, A_t, RD_t, I_t, D_t,$ and $V_t)$ is the level of variable X in year t divided by the level of total assets in year t; dX_t is the change in the level of X from year t-2 to year t, X_t -X_{t-2} ; dX_{t+2} is the change in the level of X from year t to year $t+2$, X_{t+2} -X_t; V is the market value of the firm

calculated at fiscal year-end as the sum of the market value of equity and book value of short-term and long-term debt; E is earnings before extraordinary items plus interest, deferred tax credits, and investment tax credits; A is the total assets, RD is research and development expenditures; I is the interest expenses, and D is the common dividends. RD is set as zero if the data is missing.

To analyze the relation between market value and cash holdings in the model, I separate the change in assets into its cash and noncash portions based on Bates, Kalhe, and Stulz (2009). The model changes into the following:

$$V_{i,t} = \alpha + \beta_1 E_{i,t} + \beta_2 dE_{i,t} + \beta_3 dE_{i,t+2} + \beta_4 dNA_{i,t} + \beta_5 dNA_{i,t+2} + \beta_6 RD_{i,t} + \beta_7 dRD_{i,t} + \beta_8 dRD_{i,t+2} + \beta_9 I_{i,t} + \beta_{10} dI_{i,t} + \beta_{11} dI_{i,t+2} + \beta_{12} D_{i,t} + \beta_{13} dD_{i,t} + \beta_{14} dD_{i,t+2} + \beta_{15} dV_{i,t+2} + \beta_{16} L_{i,t} + \varepsilon_{i,t} , \quad (2)$$

where NA is net assets defined as total assets minus cash and L corresponds to cash holdings. The coefficient on cash holdings determines the value of cash holdings of one euro. If the agency problem causes the increase of cash reserves, the value of cash should decrease over time. This model has been implemented by Dittmar and Mahrt-Smith (2007), using U.S. firms. Now I would like to measure the value of cash with western European and Nordic firms.

Table XII reproduces estimates of the regression based on equation (2). Two models are provided in the table. Model 1 of Table XII includes all firms in the sample for which the data can be used in the regression. Two interaction terms with cash are added to allow the value of cash to change from 1980s to the 1990s and 2000s. Coefficients on these interaction variables are positive. But two of them are not significant. Fama and French (1998) point out that it could be inappropriate to incorporate all firms in their model because there is a systematic difference in the cost of equity across the sub-samples. It's possible that costs of equity are different for small firms. So Model 2 of Table XII, which replicates Model 1, uses a sub-sample of firms whose assets are over 100 million euro in 2004. Then cash and its interactions all have positive and significant coefficients. Besides, the explaining power has increase by more than 20%.

If cash holdings can be a proxy of agency problem, then the market will present this information in the firm's share price. However, the analysis shows that the market value of the firm is positively related to cash holdings. Thus, the agency problem is not proven from my study, at least not for the sample firms in western European and Nordic countries.

Table XII
OLS Regression Results for the Market Value of the Firm

The dependent variable for the regression is the market value of the firm in year t, M_t. For each independent variable X, X_t is the level in year t, divided by the level of total assets in year t; dX_t is the change in the level of X from year t-2 to year t, divided by total assets in year $t((X_t - X_{t-2})/A_t)$; dX_{t+2} is the change in the level of X from year t+2 to year t $t((X_{t+2} - X_t)/A_t)$. The first regression is for the full sample of firms that satisfy the data requirements, and for which I am able to calculate 2-year leads and lags. The second regression adds additional requirements that assets exceed 100 million euro. Variables are defined in the Appendix.

Model	1	2
Variable		
Intercept	0.8863323	0.8989866
	(0.003)	(0.000)
E_t	-0.8379181	2.913799
	(0.000)	(0.000)
dE_t	0.0277442	-0.010685
	(0.000)	(0.194)
dE_{t+2}	-0.2961308	1.104692
	(0.000)	(0.000)
dNA_t	-2.041559	0.4488626
	(0.000)	(0.000)
dNA_{t+2}	-4.289514	-0.7010721
	(0.000)	(0.000)
RD_t	0.0000203	0.0787984
	(0.971)	(0.000)
dRD_t	0.0000154	0.0000341
	(0.754)	(0.142)
dRD_{t+2}	-0.000022	-0.0013416
	(0.726)	(0.149)
I_t	0. 0000103	0. 0000452
	(0.000)	(0.000)
dI_t	0. 0001867	0. 0005378
	(0.006)	(0.000)
dI_{t+2}	-0. 000065	-0. 000411
	(0.023)	(0.009)
D_t	0.1625652	0.0876307
	(0.127)	(0.151)
dD_t	0.0000645	0.3027408
	(0.965)	(0.000)
dD_{t+2}	0.1628016	0.8346969
	(0.126)	(0.000)
dV_{t+2}	-0.3724957	-0.8853679
	(0.000)	(0.000)
L_t	2.245463	1.155829
	(0.239)	(0.000)
$L_t * D90s$	2.535239	0.4507338
	(0.220)	(0.003)
$L_t * D00s$	3.965503	0.7379604
	(0.043)	(0.000)
D90s	0.1239922	0.176666
	(0.711)	(0.000)
D00s	0.2634356	0.1877122
	(0.417)	(0.000)
Adjusted R spared	0.4223	0.6916

7 Conclusion

The average cash ratio increases significantly for western European and Nordic countries from 1980 to 2009. The average annual increase is 0.9%. From my study, I notice that firms with the most increase in cash ratios are smaller firms, firms not paying dividends, firms with accounting losses, and firms with most idiosyncratic risks. After documenting the increase in cash ratio, I investigate the reasons for that increase. I use the models developed by Opler, Pinkowitz, Stulz, and Williamson (1999) and Bates, Kalhe, and Stulz (2008) to analyze western European and Nordic countries.

The major causes for the increase in cash ratios are decrease in net working capital, increase in cash flow risks, and increase in research and development expenditures. While the contribution of changes in these firm specific characteristics to the overall increase in cash reserves varies across alternative empirical models of cash holdings, my conclusion is generally robust.

The increase in cash flow risks is connected to the widely studied increase in idiosyncratic risk. Brandt, Brav, Graham, and Kumar (2009) suggest that the recent decrease in idiosyncratic risk should lead firms to eventually decrease their cash reserves. Even though their study is based on US firms, cash reserves also decrease in my sample, with a peak in 2005, for firms in western European and Nordic countries.

Besides, research and development expenditures have demonstrated an important role comparing to capital expenditures in the increase of cash ratios. More and more high-tech companies became publicly traded despite the crash of bubbles of Internet firms in the beginning of 2000s. AT&T, Teleponica, and Nippon Telegraph are Top 50 on Forbes 500 in 2010. With fewer tangible assets, these firms invest more on R&D to pursue their competitive advantage. However, it's expensive to finance these projects from external capital market. As a result, greater R&D intense firms have to hold relatively more internally generated cash to buffer their potential cash shocks.

The evidence from my paper shows that the increase in cash ratios can largely be interpreted by the changes in firm characteristics in the sample. The change in the relation between firm characteristics and cash holdings attributes an insignificant role in the increase of cash reserves. The analysis is consistent with current papers that the precautionary motive for cash holdings is vital for firms that increase the cash reserves. Even if the market has developed many advanced derivatives to hedge potential risks for firms, there are still many risks that cannot be hedged fully. Besides, some firms find it too expensive to hedge the risks and simply reluctant to hedge. So cash reserves could substitute the hedging derivatives to defend the un-foreseeable risks.

There is considerable amount of cross-sectional variation in cash holdings that cannot be explained by my model. Thus, I would contribute this un-explained portion to agency problems. However, the tricky part for agency problem is that the issue shows somehow distinctively different role in different models. Agency problems seem not capable of explaining the aggregate increase in cash holdings, as evident from the model developed by Fama and French (1998). Consequently, I would like to see more advanced and convincing models that could provide better insight in this issue. And I hope more papers can contribute new understanding in the agency problems between shareholders and management.

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9   Appendix 1: Variable Definitions

Variable	Definition
Acquisitionactivity	The ratio of expenditures on acquisition relative to the book value of total assets
Capex	The ratio of capital expenditures to the book value of total assets
Cash flow	EBITDA-interest-taxes-common dividend
cashratio	The ratio of cash and marketable securities to the book value of total assets
Dividenddummy	A dummy variable equal to one if the firm paid dividend in that year, and zero if it did not
Industry sigma	The mean of the standard deviations of cash flow/assets over 10 years for firms in the same industry, as defined by the two-digit SIC code
Leverage	The ratio of total debt to the book value of total assets, where debt includes long-term debt plus debt in current liabilities
Market to book	Measured as (book value of total assets – book value of equity + market value of equity)/book value of total assets
Net Leverage	Calculated as the difference between total debt and cash and marketable securities, divided by the book value of total assets
NWC	Calculated as net working capital minus cash and marketable securities
Firmsize	The natural log of the book value of total assets in 2004 dollars
Tobin's Q	(Market value of common equity + Total assets – Book value of common equity) ÷ Total assets
R&D/sales	The ratio of research and development expense to sales
C	Cash and marketablesecurities
D	Common dividends
E	Earnings, calculated as earnings before extraordinary items + interest + income statement deferred tax credits + investment tax credits
I	Interestexpense
M	Market value of equity + short-term debt + long-term debt
NA	Net assets, calculated as book value of total assets – cash
RD	Research and development expense or zero when missing
GDP growth	Annual real growth rate in GDP
GDP/capita	Real GDP per capita, expressed in euros.
Short-term interest rate term spread	Six-month Treasury bill yield. (Source: Economist Intelligence Unit). Difference in yields between the ten-year government bond and the six-month Treasury bill.
Inflationrate	The inflation rate as measured by the annual change in CPI.

Time	AT	BE	DK	FI	FR	DE	IE	IT	LU	NL	NO	PT	ES	SE	SZ	UK
1980	1.78	4.48	-0.49	5.37	1.69	1.41	3.08	3.43	0.84	3.25	4.5	4.59	2.21	1.7	4.6	-2.09
1981	-0.14	-0.28	-0.89	1.29	0.92	0.53	3.33	0.84	-0.55	-0.78	1.55	1.62	-0.13	-0.2	1.6	-1.22
1982	1.95	0.59	3.71	3.04	2.43	-0.39	2.28	0.41	1.13	-1.24	0.13	2.14	1.25	1.2	-1.31	2.2
1983	2.95	0.31	2.65	3.02	1.19	1.57	-0.24	1.17	2.99	2.07	3.87	-0.17	1.77	1.8	0.64	3.69
1984	0.06	2.47	4.17	3.11	1.48	2.82	4.35	3.23	6.19	3.06	5.89	-1.88	1.78	4.3	3.01	2.69
1985	2.46	1.65	4.02	3.3	1.71	2.33	3.09	2.8	2.79	2.58	5.35	2.81	2.32	2.2	3.67	3.62
1986	2.32	1.82	4.95	2.64	2.45	2.29	-0.43	2.86	9.98	2.79	4.04	4.14	3.25	2.9	1.86	4.01
1987	1.35	2.31	0.29	3.49	2.49	1.4	4.66	3.19	3.95	1.93	1.78	6.38	5.55	3.5	1.59	4.56
1988	2.87	4.72	-0.14	5.22	4.6	3.71	5.22	4.19	8.46	3.44	-0.17	7.49	5.09	2.7	3.28	5.03
1989	3.74	3.47	0.57	5.06	4.16	3.9	5.81	3.39	9.8	4.42	1	6.44	4.83	2.8	4.33	2.28
1990	4.17	3.14	1.61	0.53	2.64	5.26	8.47	2.05	5.32	4.18	1.93	3.95	3.78	1	3.67	0.78
1991	3.34	1.83	1.3	-6.01	1.02	5.11	1.93	1.53	8.64	2.44	3.1	4.37	2.55	-1.1	-0.95	-1.39
1992	1.89	1.53	1.98	-3.49	1.37	2.23	3.34	0.77	1.82	1.71	3.52	1.09	0.93	-1.2	0.1	0.15
1993	0.37	-0.96	-0.09	-0.8	-0.91	-0.8	2.69	-0.89	4.2	1.26	2.79	-2.04	-1.03	-2.07	-0.19	2.22
1994	2.21	3.23	5.53	3.62	2.22	2.66	5.76	2.15	3.82	2.96	5.05	0.96	2.38	4.01	1.19	4.28
1995	2.54	2.38	3.07	3.96	2.12	1.89	9.63	2.83	1.43	3.12	4.19	4.28	2.76	3.94	0.35	3.05
1996	2.23	1.41	2.83	3.58	1.11	0.99	8.14	1.1	1.52	3.41	5.1	3.66	2.42	1.61	0.63	2.89
1997	2.13	3.74	3.2	6.2	2.24	1.8	11.46	1.87	5.94	4.28	5.39	4.38	3.87	2.71	2.08	3.31
1998	3.6	1.93	2.16	5.02	3.5	2.03	8.43	1.4	6.49	3.92	2.68	5.05	4.47	4.2	2.64	3.61
1999	3.34	3.54	2.56	3.9	3.3	2.01	10.9	1.46	8.42	4.68	2.03	4.08	4.75	4.66	1.31	3.47
2000	3.65	3.68	3.53	5.34	3.91	3.21	9.71	3.69	8.44	3.94	3.25	3.93	5.05	4.45	3.58	3.92
2001	0.52	0.79	0.7	2.29	1.85	1.24	5.7	1.82	2.52	1.93	1.99	1.97	3.65	1.26	1.15	2.46
2002	1.65	1.37	0.47	1.82	1.03	0	6.55	0.45	4.11	0.08	1.5	0.71	2.7	2.48	0.44	2.1
2003	0.8	0.79	0.38	2	1.09	-0.22	4.41	-0.02	1.55	0.34	1.01	-0.93	3.1	2.34	-0.2	2.81
2004	2.54	3.23	2.3	4.11	2.47	1.21	4.6	1.53	4.4	2.24	3.86	1.56	3.27	4.23	2.53	2.95

Year																
2005	2.46	1.71	2.45	2.92	1.9	0.75	6.02	0.66	5.43	2.05	2.74	0.76	3.61	3.16	2.64	2.17
2006	3.6	2.69	3.39	4.41	2.22	3.37	5.32	2.04	4.97	3.39	2.28	1.44	4.02	4.3	3.63	2.79
2007	3.73	2.92	1.58	5.33	2.37	2.66	5.63	1.48	6.64	3.92	2.73	2.39	3.57	3.31	3.64	2.68
2008	2.18	1	-1.12	0.92	0.22	0.99	-3.55	-1.32	1.44	1.88	0.75	0.02	0.86	-0.61	1.9	-0.07
2009	-3.89	-2.75	-5.21	-8.2	-2.63	-4.72	-7.58	-5.04	-3.66	-3.92	-1.43	-2.49	-3.72	-5.33	-1.91	-4.87

* All the below appendixes are from http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home

* The abbreviations of the first row represents the countries as follows: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom.

Time	AT	BE	DK	FI	FR	DE	IE	IT	LU	NL	NO	PT	ES	SE	SZ	UK
1980	19209	18885	18922	16763	18058	17572	11276	17395	24239	19437	21526	9990	12951	19492	25774	16176
1981	19133	18834	18761	16908	18122	17639	11509	17518	24039	19151	21784	10065	12854	19430	26008	15971
1982	19491	18950	19473	17325	18453	17588	11646	17580	24298	18827	21732	10216	12945	19651	25516	16342
1983	20099	19013	20005	17741	18574	17913	11535	17779	25017	19142	22501	10155	13112	19995	25621	16938
1984	20113	19480	20851	18196	18759	18484	11955	18348	26543	19653	23758	9930	13292	20835	26297	17365
1985	20597	19798	21681	18720	18985	18958	12283	18856	27240	20069	24952	10186	13551	21260	27146	17948
1986	21061	20155	22723	19151	19353	19386	12227	19394	29821	20517	25872	10608	13949	21825	27484	18626
1987	21331	20597	22758	19764	19728	19650	12793	20011	30799	20775	26207	11304	14686	22513	27725	19435
1988	21912	21495	22712	20736	20517	20275	13506	20841	33119	21350	26025	12182	15401	23017	28409	20372
1989	22630	22161	22834	21706	21246	20915	14377	21531	36008	22164	26173	13007	16113	23503	29412	20779
1990	23395	22792	23164	21725	21691	21823	15612	21954	37497	22936	26589	13573	16697	23555	30164	20882
1991	23935	23121	23438	20304	21803	22760	15823	22269	40191	23306	27279	14206	17092	23139	29515	20519
1992	24120	23379	23786	19488	21993	23091	16219	22433	40369	23526	28082	14367	17210	22727	29276	20497
1993	24012	23065	23682	19240	21700	22741	16567	22220	41473	23653	28691	14057	16996	22126	29030	20905
1994	24449	23739	24909	19845	22100	23275	17462	22693	42439	24210	29966	14159	17369	22852	29176	21744
1995	25031	24254	25555	20555	22489	23646	19063	23334	42531	24837	31070	14717	17823	23628	29096	22345
1996	25555	24552	26119	21221	22660	23812	20474	23583	42634	25574	32484	15214	18211	23971	29177	22935
1997	26069	25409	26837	22472	23087	24196	22605	24012	44595	26529	34049	15829	18866	24606	29750	23632
1998	26976	25840	27324	23540	23810	24694	24157	24342	46885	27402	34749	16565	19640	25627	30456	24417
1999	27823	26706	27929	24402	24479	25173	26500	24694	50136	28493	35215	17169	20466	26799	30705	25175
2000	28770	27624	28822	25651	25272	25949	28695	25594	53646	29406	36126	17749	21320	27948	31618	26071
2001	28809	27747	28923	26177	25557	26222	29864	26044	54373	29746	36665	17980	21850	28225	31648	26610
2002	29139	27993	28955	26587	25634	26177	31268	26079	55996	29577	37003	17976	22119	28832	31538	27072
2003	29242	28096	28990	27056	25732	26108	32115	25873	56183	29537	37165	17684	22429	29397	31212	27723
2004	29798	28882	29585	28092	26176	26430	33011	26011	57847	30099	38382	17856	22789	30519	31792	28404

2005	30324	29217	30219	28814	26474	26641	34218	25989	60069	30638	39169	17910	23228	31358	32426	28832
2006	31253	29807	31141	29963	26875	27571	35183	26368	62068	31631	39727	18108	23794	32522	33353	29466
2007	32289	30450	31501	31427	27347	28339	36275	26563	65140	32797	40422	18498	24202	33226	34292	30058
2008	32852	30509	30966	31570	27252	28669	34378	26013	64958	33288	40196	18477	24025	32762	34524	29837
2009	31475	29445	29193	28841	26391	27398	31593	24525	61422	31817	39122	18000	22961	30733	33481	28201

* All the below appendixes are from http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home

* The abbreviations of the first row represents the countries as follows: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom.

12 Appenidx 4: Long Term Interest Rates

Time	AT	BE	DK	FI	FR	DE	IE	IT	LU	NL	NO	PT	ES	SE	SZ	UK
1980	..	11.90	..	..	13.78	8.43	15.35	..	..	10.21	..	..	15.96	..	4.76	13.91
1981	..	13.44	..	..	16.29	10.13	17.27	..	..	11.55	..	..	15.81	..	5.57	14.88
1982	..	13.43	..	..	16.00	8.91	17.06	..	..	10.10	..	..	15.99	..	4.60	13.09
1983	..	11.94	..	..	14.37	8.08	13.90	..	..	8.61	..	..	16.91	..	4.17	11.27
1984	..	12.24	..	..	13.40	7.96	14.61	..	..	8.33	..	..	16.52	..	4.55	11.13
1985	..	10.97	..	..	11.87	7.04	12.78	..	..	7.33	12.91	..	13.37	..	4.70	10.97
1986	..	8.63	..	..	9.12	6.16	11.22	..	..	6.32	13.30	..	11.35	..	4.23	10.14
1987	..	8.18	11.28	..	9.48	6.25	11.26	..	..	6.40	13.31	..	12.81	11.68	4.03	9.57
1988	..	8.01	9.88	10.56	9.08	6.49	9.36	..	..	6.42	12.90	..	11.74	11.35	4.02	9.68
1989	..	8.59	9.71	12.09	8.80	7.03	9.17	..	..	7.22	10.83	..	13.60	11.18	5.20	10.19
1990	8.73	10.06	10.63	13.21	9.93	8.71	10.27	..	..	8.92	10.68	..	14.68	13.16	6.45	11.80
1991	8.55	9.31	9.26	11.71	9.04	8.46	9.37	..	..	8.74	10.00	..	12.36	10.69	6.24	10.11
1992	8.14	8.66	8.99	11.97	8.59	7.85	9.32	13.27	..	8.10	9.61	..	11.70	10.02	6.40	9.06
1993	6.71	7.22	7.30	8.83	6.78	6.52	7.58	11.19	..	6.36	6.88	..	10.21	8.54	4.55	7.48
1994	7.03	7.70	7.83	9.04	7.22	6.88	8.04	10.52	7.15	6.87	7.44	10.48	10.00	9.50	4.96	8.12
1995	7.13	7.38	8.27	8.79	7.54	6.86	8.23	12.21	7.23	6.90	7.42	11.47	11.27	10.24	4.52	8.20
1996	6.32	6.30	7.19	7.08	6.31	6.23	7.25	9.40	6.30	6.15	6.77	8.56	8.74	8.03	4.00	7.81
1997	5.68	5.59	6.26	5.96	5.58	5.66	6.26	6.86	5.60	5.58	5.89	6.36	6.40	6.61	3.36	7.05
1998	4.71	4.70	5.04	4.79	4.64	4.58	4.75	4.88	4.73	4.63	5.40	4.88	4.83	4.99	3.04	5.55
1999	4.68	4.71	4.92	4.72	4.61	4.50	4.77	4.73	4.67	4.63	5.50	4.78	4.73	4.98	3.04	5.09
2000	5.56	5.57	5.66	5.48	5.39	5.27	5.48	5.58	5.52	5.41	6.22	5.60	5.53	5.37	3.93	5.33
2001	5.08	5.06	5.09	5.04	4.94	4.80	5.02	5.19	4.86	4.96	6.24	5.16	5.12	5.11	3.38	4.93
2002	4.97	4.89	5.06	4.98	4.86	4.78	4.99	5.03	4.68	4.89	6.38	5.01	4.96	5.30	3.20	4.90
2003	4.15	4.15	4.31	4.14	4.13	4.07	4.13	4.30	3.32	4.12	5.05	4.18	4.13	4.64	2.66	4.53
2004	4.15	4.06	4.30	4.11	4.10	4.04	4.06	4.26	2.84	4.10	4.37	4.14	4.10	4.43	2.74	4.88
2005	3.39	3.37	3.40	3.35	3.41	3.35	3.32	3.56	2.41	3.37	3.75	3.44	3.39	3.38	2.10	4.41

2006	3.80	3.81	3.81	3.78	3.80	3.76	3.79	4.05	3.30	3.78	4.08	3.91	3.78	3.70	2.52	4.50
2007	4.30	4.33	4.29	4.29	4.30	4.22	4.33	4.49	0.00	4.29	4.77	4.42	4.31	4.17	2.93	5.01
2008	4.36	4.40	4.28	4.29	4.23	3.98	4.55	4.68	0.00	4.23	4.46	4.52	4.36	3.89	2.90	4.59
2009	3.94	3.82	3.59	3.74	3.65	3.22	5.23	4.31	0.00	3.69	4.00	4.21	3.97	3.25	2.20	3.65

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Time	AT	BE	DK	FI	FR	DE	IE	IT	LU	NL	NO	PT	ES	SE	SZ	UK
1980	..	14.03	..	..	12.21	9.54	..	16.79	..	..	12.23	..	16.52	..	5.77	16.62
1981	..	15.27	..	..	15.26	12.11	..	19.23	..	..	13.13	..	16.18	..	9.10	13.91
1982	..	13.97	..	..	14.62	8.88	..	19.91	..	..	15.37	..	16.28	13.25	5.06	12.29
1983	..	10.40	..	..	12.47	5.78	..	18.31	..	..	13.30	..	20.05	11.41	4.09	10.13
1984	..	11.42	..	..	11.70	5.99	13.23	17.27	..	..	13.02	..	14.90	11.93	4.35	9.94
1985	..	9.52	..	..	9.94	5.45	11.93	15.25	..	..	12.53	..	12.22	14.17	4.92	12.24
1986	..	8.08	..	..	7.71	4.64	12.52	13.39	..	5.68	14.39	..	11.66	9.83	4.22	10.94
1987	..	7.05	10.11	10.03	8.27	4.03	10.83	11.33	..	5.36	14.71	..	15.82	9.39	3.77	9.70
1988	..	6.73	8.48	9.97	7.94	4.33	8.05	10.82	..	4.82	13.51	..	11.65	10.08	3.08	10.33
1989	..	8.80	9.59	12.56	9.40	7.12	10.04	12.62	..	7.39	11.38	..	15.04	11.50	7.32	13.89
1990	8.96	9.63	10.90	14.00	10.32	8.49	11.31	12.23	..	8.68	11.54	..	15.15	13.67	8.92	14.77
1991	9.46	9.38	9.70	13.08	9.62	9.25	10.43	12.21	..	9.28	10.56	..	13.23	11.59	8.21	11.52
1992	9.46	9.37	11.02	13.25	10.34	9.52	14.32	14.01	..	9.35	11.83	16.71	13.34	12.86	7.85	9.62
1993	7.02	8.22	10.42	7.77	8.59	7.30	9.12	10.20	..	6.85	7.27	13.25	11.69	8.35	4.91	5.94
1994	5.12	5.70	6.13	5.35	5.85	5.36	5.93	8.51	..	5.18	5.85	11.11	8.01	7.40	4.19	5.50
1995	4.57	4.78	6.07	5.75	6.58	4.53	6.25	10.46	..	4.37	5.48	9.79	9.36	8.75	2.95	6.68
1996	3.37	3.22	3.87	3.63	3.94	3.31	5.42	8.82	..	3.00	4.89	7.37	7.50	5.79	2.02	6.03
1997	3.50	3.44	3.66	3.23	3.46	3.33	6.09	6.88	..	3.33	3.73	5.74	5.37	4.11	1.64	6.83
1998	3.60	3.56	4.14	3.57	3.56	3.54	5.43	4.99	..	3.46	5.79	4.31	4.24	4.19	1.55	7.34
1999	2.96	2.96	3.30	2.96	2.96	2.96	2.96	2.96	2.96	2.96	6.54	2.96	2.96	3.12	1.41	5.45
2000	4.39	4.39	4.90	4.39	4.39	4.39	4.39	4.39	4.39	4.39	6.75	4.39	4.39	3.95	3.17	6.11
2001	4.26	4.26	4.62	4.26	4.26	4.26	4.26	4.26	4.26	4.26	7.23	4.26	4.26	4.03	2.86	4.97
2002	3.32	3.32	3.48	3.32	3.32	3.32	3.32	3.32	3.32	3.32	6.91	3.32	3.32	4.07	1.13	3.99
2003	2.33	2.33	2.38	2.33	2.33	2.33	2.33	2.33	2.33	2.33	4.10	2.33	2.33	3.03	0.33	3.67
2004	2.11	2.11	2.14	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.01	2.11	2.11	2.11	0.48	4.57
2005	2.18	2.18	2.17	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.21	2.18	2.18	1.72	0.81	4.70

2006	3.08	3.08	3.13	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.10	3.08	3.08	2.33	1.56	4.80
2007	4.28	4.28	4.32	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.96	4.28	4.28	3.55	2.57	5.96
2008	4.63	4.63	4.87	4.63	4.63	4.63	4.63	4.63	4.63	4.63	6.22	4.63	4.63	3.91	2.48	5.49
2009	1.23	1.23	1.81	1.23	1.23	1.23	1.23	1.23	1.23	1.23	2.46	1.23	1.23	0.40	0.36	1.20

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Appendix 6: Exchange Rate of US Dollar to Local Currency

Time	AT	BE	DK	FI	FR	DE	IE	IT	LU	NL	NO	PT	ES	SE	SZ	UK	Euro
1980	0.94	0.72	5.64	0.63	0.64	0.93	0.62	0.44	0.72	0.90	4.94	0.25	0.43	4.23	1.68	0.43	..
1981	1.16	0.92	7.12	0.73	0.83	1.16	0.79	0.59	0.92	1.13	5.74	0.31	0.55	5.06	1.96	0.50	..
1982	1.24	1.13	8.33	0.81	1.00	1.24	0.89	0.70	1.13	1.21	6.45	0.40	0.66	6.28	2.03	0.57	..
1983	1.31	1.27	9.15	0.94	1.16	1.31	1.02	0.78	1.27	1.30	7.30	0.55	0.86	7.67	2.10	0.66	..
1984	1.45	1.43	10.36	1.01	1.33	1.46	1.17	0.91	1.43	1.46	8.16	0.73	0.97	8.27	2.35	0.75	..
1985	1.50	1.47	10.60	1.04	1.37	1.51	1.20	0.99	1.47	1.51	8.60	0.85	1.02	8.60	2.46	0.78	..
1986	1.11	1.11	8.09	0.85	1.06	1.11	0.94	0.77	1.11	1.11	7.39	0.75	0.84	7.12	1.80	0.68	..
1987	0.92	0.93	6.84	0.74	0.92	0.92	0.85	0.67	0.93	0.92	6.74	0.70	0.74	6.34	1.49	0.61	..
1988	0.90	0.91	6.73	0.70	0.91	0.90	0.83	0.67	0.91	0.90	6.52	0.72	0.70	6.13	1.46	0.56	..
1989	0.96	0.98	7.31	0.72	0.97	0.96	0.90	0.71	0.98	0.96	6.90	0.79	0.71	6.45	1.64	0.61	..
1990	0.83	0.83	6.19	0.64	0.83	0.83	0.77	0.62	0.83	0.83	6.26	0.71	0.61	5.92	1.39	0.56	..
1991	0.85	0.85	6.40	0.68	0.86	0.85	0.79	0.64	0.85	0.85	6.48	0.72	0.62	6.05	1.43	0.57	..
1992	0.80	0.80	6.04	0.75	0.81	0.80	0.75	0.64	0.80	0.80	6.21	0.67	0.62	5.82	1.41	0.57	..
1993	0.85	0.86	6.48	0.96	0.86	0.85	0.86	0.81	0.86	0.84	7.09	0.80	0.76	7.78	1.48	0.67	..
1994	0.83	0.83	6.36	0.88	0.85	0.83	0.85	0.83	0.83	0.83	7.06	0.83	0.81	7.72	1.37	0.65	..
1995	0.73	0.73	5.60	0.73	0.76	0.73	0.79	0.84	0.73	0.73	6.34	0.75	0.75	7.13	1.18	0.63	0.76
1996	0.77	0.77	5.80	0.77	0.78	0.77	0.79	0.80	0.77	0.77	6.45	0.77	0.76	6.71	1.24	0.64	0.79
1997	0.89	0.89	6.60	0.87	0.89	0.89	0.84	0.88	0.89	0.89	7.07	0.87	0.88	7.63	1.45	0.61	0.88
1998	0.90	0.90	6.70	0.90	0.90	0.90	0.89	0.90	0.90	0.90	7.55	0.90	0.90	7.95	1.45	0.60	0.89
1999	0.94	0.94	6.98	0.94	0.94	0.94	0.94	0.94	0.94	0.94	7.80	0.94	0.94	8.26	1.50	0.62	0.94
2000	1.09	1.09	8.08	1.09	1.09	1.09	1.09	1.09	1.09	1.09	8.80	1.09	1.09	9.16	1.69	0.66	1.09
2001	1.12	1.12	8.32	1.12	1.12	1.12	1.12	1.12	1.12	1.12	8.99	1.12	1.12	10.33	1.69	0.69	1.12
2002	1.06	1.06	7.89	1.06	1.06	1.06	1.06	1.06	1.06	1.06	7.98	1.06	1.06	9.74	1.56	0.67	1.06
2003	0.89	0.89	6.59	0.89	0.89	0.89	0.89	0.89	0.89	0.89	7.08	0.89	0.89	8.09	1.35	0.61	0.89
2004	0.81	0.81	5.99	0.81	0.81	0.81	0.81	0.81	0.81	0.81	6.74	0.81	0.81	7.35	1.24	0.55	0.81
2005	0.80	0.80	6.00	0.80	0.80	0.80	0.80	0.80	0.80	0.80	6.44	0.80	0.80	7.47	1.25	0.55	0.80

2006	0.80	0.80	5.95	0.80	0.80	0.80	0.80	0.80	0.80	0.80	6.41	0.80	0.80	7.38	1.25	0.54	0.80
2007	0.73	0.73	5.44	0.73	0.73	0.73	0.73	0.73	0.73	0.73	5.86	0.73	0.73	6.76	1.20	0.50	0.73
2008	0.68	0.68	5.10	0.68	0.68	0.68	0.68	0.68	0.68	0.68	5.64	0.68	0.68	6.59	1.08	0.54	0.68
2009	0.72	0.72	5.36	0.72	0.72	0.72	0.72	0.72	0.72	0.72	6.29	0.72	0.72	7.65	1.09	0.64	0.72
2010	0.76	0.76	5.62	0.76	0.76	0.76	0.76	0.76	0.76	0.76	6.04	0.76	0.76	7.21	1.04	0.65	0.76

* All the below appendixes are from http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home

* The abbreviations of the first row represents the countries as follows: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom.