6-2017

Essays in corporate cash holdings

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Submitted to Lee Kong Chian School of Business in partial fulfilment of the requirements of the Degree of Doctor of Philosophy in Business (Finance)

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Abstract

This dissertation addresses three topics in corporate cash holdings. The first paper provides a new determinant of cash holdings by examining the impact of earnings transparency on corporate cash holdings. Motivated by Barth et al. (2013), who show that firms with less earnings transparency tend to have higher cost of equity, this paper shows that the cross-section differences in earnings transparency cause variations in firm cash holdings because firms with less earnings transparency have more incentives to hold cash in order to avoid costly external financing. Using data of US firms from 1980 to 2013, it is found that earnings transparency is significantly negatively associated with cash reserves. This impact remains significant when corporate governance measures, accounting-based earnings quality, geography diversity and other information asymmetry measures are accounted for. And this impact is more pronounced in firms with more growth opportunities, more R&D expenses and more financial constraints. It is further found that firm with lower earnings transparency have a higher value of cash holdings, suggesting that cash held by firms with lower earnings transparency are expected to be used to invest, which is also a verification that firms with less earnings transparency hold more cash for precautionary motivation.

The second paper studies on the channel of the relation between corporate cash holdings and stock return. Corporate cash holding is found to be able to predict stock return. Some scholars attribute this to the association of cash with systematic risk with respect to growth options. Others find that the relation is a mispricing effect. I try to test whether the relation between cash and return is

driven by systematic risk that captured by cash. The empirical results do not support the risk explanation of cash-return relation. First, the risk loading on CASH factor cannot predict returns, which is not consistent with rational frictionless asset pricing models. Second, CASH factor cannot reflect future GDP growth. Third, CASH and its factor loading exhibit no association with implied cost of capital derived from analysts' earnings forecasts. Additionally, I find institutional investors tend to buy in more stocks of firms with more cash, and the cash-return relation is less pronounced in firms with more institutional investors, providing evidence supporting the mispricing explanation. Overall, this study casts doubt on the argument that cash can serve as a proxy of systematic risk in the explanation of cross sectional variation in stock returns while finds evidence of the mispricing story.

The third paper studies the monitoring role of sovereign wealth funds on corporate cash holding policy and uses Temasek Holdings as the case. We find that Temasek's presence has a negative effect on cash for companies with poor governance quality while its cash effect becomes positive for well-governed firms. Temasek's discerning effect on cash policies highlights the effective monitoring role of sovereign funds.

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Acknowledgements

Firstly, I am indebted to my supervisor Prof. Rong WANG, who taught me a lot about academic research. From her, I learned lots of methodology on how to conduct research and also learned that as an academic researcher, I should pursuit the truth continuously and study carefully and deeply. I appreciate all her contributions of time and patience to make me grow a lot through my Ph.D. experience.

I am also grateful to the rest of my dissertation committee: Prof. Fangjian FU, Prof. Qing TONG and Prof. Jiwei WANG for their generous suggestions on my dissertation. They were always willing to help and give their best suggestions.

My sincere thanks also go to Prof. Xiaping CAO, Dr. Sili ZHOU and Nelson YAP. Through the corporation with them, I learn a lot.

I also appreciate my classmates Angela HE and Mengyao KANG. The Ph.D experience is more colourful with you.

Last but not least, I would like to thank my husband WANG Yan and my parents who are always supporting me. Thank you.

Chapter 1: Earnings Transparency and Corporate Cash Holdings

1.1 Introduction

Corporate cash holdings exhibit a persistent increase in the past decades. The average cash-to-assets ratio of industrial firms rises from 10.5% in 1980 to 23.2% in 2006 (Bates, Kahle, and Stulz (2009)). This number keeps at high level of around 22%[1] till now. For the absolute amount, the reported aggregate cash holdings and short-term investments of universe COMPUSTAT firms excluding financial firms and utility firms are over $2.12 trillion at the end of 2014, experiencing a leap compared to $1.7 trillion of fiscal year 2006 shown by Duchin (2010). However, the question why firms hold cash draws attention only within recent years. Although the literature has provided several determinants of cash holdings, there are still space to explore what else factors could affect corporate cash holdings. This paper tries to provide a new determinant of cash holdings by investigating how earnings transparency affects cash holdings.

Earnings transparency, firstly expressed by Barth, Konchitchki, and Landsman (2013) (hereafter, BKL (2013)), measures the extent to which firm's accounting earnings is incorporated into the economic value. It is constructed based on the explanatory power (R-Square) of regressing stock return on earnings. Higher earnings transparency indicates more changes of firm value can be explained by earnings, or from the perspective of investors, it indicates investors can get more useful information to predict stock value based on earnings. Therefore, variations in earnings transparency lead to variations in information asymmetry. BKL (2013) find that everything equalling, firms with lower earnings transparency have more

[1] The number is based on all public US firms listed on NYSE, Amex, Nasdaq excluding utility firms (with SIC code from 4900 to 4999) and financial firms (with SIC code from 6000 to 6999). The corresponding number of 1980 and 2006 is 10.8% and 23.8%, which are comparable to Bates et al. (2009).

costs of capital because uninformed market participants require higher returns to compensate on information asymmetry and vice versa.

Opler et al. (1999) analyse comprehensively the implications of trade-off theory and financing hierarchy theory on corporate cash holdings and introduce us to how information asymmetry affects corporate cash holdings. As they document, the direct effect of information asymmetry on cash holdings comes from the high costs of capital caused by adverse selection; to avoid expensive external funds caused by high information asymmetry, firms keep more internal savings (Myers and Majluf (1984)).

Given the settings of how information asymmetry affects corporate cash holdings, I hypothesize that firms will hold more cash reserves to avoid high equity costs associated with lower earnings transparency. This is intuitive since if firms realize that the expected costs of capital are high, they would hold more cash for future investments because of precautionary motive. To gain a basic idea about this relation, figure 1 breaks the final sample into firms with higher earnings transparency and those with lower earnings transparency and compares the average cash over total assets between these two kinds of firms from 1980 to 2013. This figure indicates an obvious gap in cash holding policies between these two kinds of firms. Specifically, we can recognize that firms with lower earnings transparency tend to persistently hold more cash than firms with higher earnings transparency.

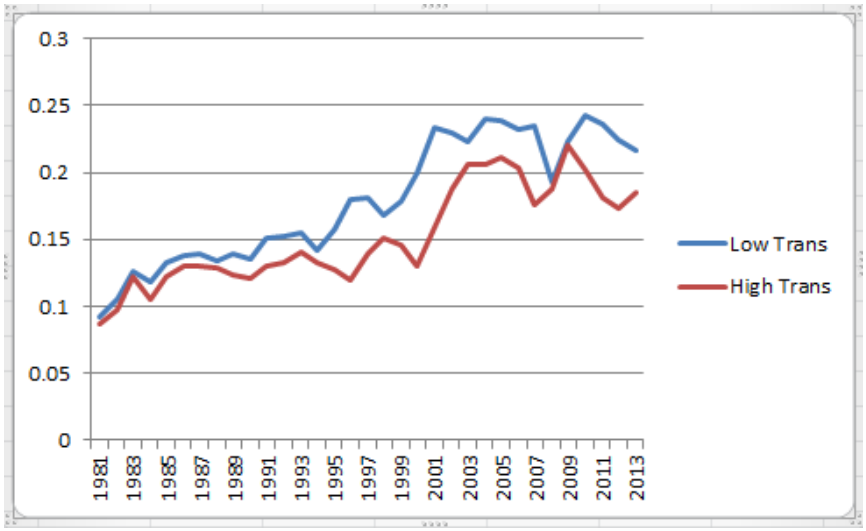


Figure 1. Average annual cash holdings for firms with high transparency and firms with low transparency

This figure plots the average annual cash over total assets of firms with high transparency and firms with low transparency. The sample is constituted of observations excluding financial and utility firm-years from 1980 to 2013 and is divided into 'High Trans' and 'Low Trans' groups based on 1-year lagged earnings transparency annually. A firm is assigned as high transparent firm if its lagged earnings transparency is higher than the median value, and otherwise it is assigned as a low transparent firm.

Based on firms in United States from 1980 to 2013, I find that earnings transparency is cross sectionally negatively related to firms' cash holdings. For example, the univariate statistics suggest that moving from the first earnings transparency quintile to the fifth quintile decreases the cash-to-net asset ratio (cash-to-asset ratio) by 16.6% (4.6%) and the average cash-to-net asset ratio (cash-to-asset ratio) in the sample is 36.3% (18.2%). In the multivariate tests, after controlling the general financial characteristics, firm fixed effects and time fixed effects, earnings transparency is still significantly negatively associated with corporate cash holdings. Because earnings transparency is correlated with firm financial characteristics, the marginal impacts of earnings transparency on cash holdings decline a lot compared to the univariate tests. However, the impacts are not trivial. Everything equalling, moving from the first quintile of earnings transparency to the fifth quintile increases the average cash over net assets ratio by 4.13% ($e^{\{0.643-0.246)*0.103}$ *100%=4.13%), about 1.5% increase in the ratio given the

average value of cash over net assets 0.363. The results are consistent with the conjecture that firms would hold more cash to avoid higher external capital cost.

To examine the impacts of earnings transparency on firms' cash holdings policies, it is important to address the endogeneity problems. This study is exposed to two kinds of endogeneity problems. The first is the omitted variable problem. It is possible that the relation is caused by omitted variables that simultaneously related to both cash holdings and earnings transparency. This paper identifies three omitted variables: earnings quality, corporate governance and information asymmetry measures. The first omitted variable is earnings quality. García Teruel, Martínez Solano, and Sánchez Ballesta (2009) (hereafter, GMS (2009)), Sun, Yung, and Rahman (2012) (hereafter, SYR (2012)) have shown that accounting based measures of earnings quality (i.e., accrual quality, absolute abnormal accruals) are negatively related to cash holdings using Spain data and US data respectively. Since both earnings transparency and accounting-based earnings quality could measure firm-specific information contained in earnings, it is natural to ask whether earnings transparency could provide extra explanation of corporate cash holdings beyond accounting based earning quality. So I control these accounting-based measures and find that the negative effects of earnings transparency on cash holdings still hold. The second omitted variable is corporate governance. It is possible that the relation between earnings transparency and corporate cash holdings is because that both of them are affected by agency problems. So I control corporate governance measures (i.e., G-index, institutional ownership and inside ownership) in the multi-regression to exclude this possibility. The results still hold after corporate governance is controlled. The third omitted variable is multinational diversification. Fritz Foley et al. (2007) find firms hold

more foreign cash to avoid incurring taxes when repatriating foreign earnings, suggesting that multinational firms tend to hold more cash than domestic firms. Earnings transparency is likely to be different in multinational firms and domestic firms as the transparency of foreign earnings is intuitively lower. I exclude this possibility by dividing firms into domestic firms and multinational firms and doing the tests within subsamples separately. The idea is that if the correlation between cash holdings and earnings transparency is caused by the geography distributions of cash and earnings, we cannot find significant relation within subsamples with only domestic firms and the difference of coefficients between these two subsamples should be huge. However, the empirical results show that the coefficients of Trans are significant when either subsample is used and the magnitudes are similar. Last but not least, firm-level and year-level fixed effects are included in the models to capture fixed differences in cash holdings across firms and years. And it is shown that fixed effects have no influence on the results. The second endogeneity problem is the reverse causality problem. Since earnings transparency and corporate cash holdings are jointly determined, the negative relation between earnings transparency and cash holdings may be caused by the feedback effect of cash holdings on earnings transparency. To address this problem, following Harford, Mansi, and Maxwell (2008), I use one-year lagged earnings transparency as the independent variable; also I add one-year lagged cash holdings as the control variable to test the impact of earnings transparency on the change of cash holdings. The results suggest that the ex-ante earnings transparency has a negative effect on current cash holdings and a negative effect on the change of cash holdings.

To identify the channels how earnings transparency affects cash holdings, I investigate the heterogeneous effects of earnings transparency on cash holdings across subsamples. If firms hold more cash to avoid costly external financing associated with earnings transparency, keeping earnings transparency constant, firms suffered more when there was difficulty accessing in external capital market are expected to hold more cash. To verify this, I provide evidence based on three kinds of firms whose performances are more sensitive to costs of capital: (1) firms with more investment opportunities; (2) firms with more R&D investments; (3) financial constrained firms (firms whose investments are much dependent on financing). Accordingly, the full sample is divided based on market-to-book ratio, R&D expenses and financial constraint. The empirical results show that the effects of earnings transparency on cash holdings are more pronounced in firms with more investment opportunities (higher market to book ratio), more R&D expenses and more financial constraints. This subsample tests support the main hypothesis that earnings transparency affects corporate cash holdings through its effect on costs of capital.

This paper also studies the influence of earnings transparency on the value of cash holdings. The paper mainly argues that firms with lower earnings transparency tend to hold more cash for precautionary motive and vice versa. Faulkender and Wang (2006) find that the marginal value of cash is higher for firms that have more difficulty to access the external capital market because cash can help them avoid incurring high costs. Hence, everything equalling, a firm's value is expected to increase more by holding more cash if it has lower earnings transparency and vice versa. Consistent with this rationale, I find a negative relation between earnings transparency and the value of cash holdings.

This study makes several contributions to the literature. First, it contributes to the literature on the determinants of corporate cash holdings. In existing literature, precautionary motivation and agency cost theory are the most generally used mechanisms to explain why firms hold cash. Based on these mechanisms, researchers have found lots of specific determinants of corporate cash holdings, such as financial characteristics (Opler et al. (1999)), firm diversification (Duchin (2010)), refinancing risk (Harford, Klasa, and Maxwell (2014)), corporate governance (Harford, Mansi, and Maxwell (2008)), shareholder protection (Dittmar, Mahrt-Smith, and Servaes (2003)). This paper tries to provide an additional determinant by examining how earnings transparency affects cash holdings.

It also contributes to the literature on how financial report quality affects corporate financial decisions. The measures of earnings attributes include the earnings quality and earnings informativeness. Earning quality is measured as accrual quality or absolute abnormal accrual. Earnings informativeness is measured as how much information contained in earnings are incorporated into stock prices. Earnings quality is shown to have effect on corporate investment and financing policies (G. C. Biddle and Hilary (2006), G. Biddle, Hilary, and Verdi (2009), Gomariz and Ballesta (2014), GMS (2009), SYR (2012)). How earnings informativeness affects corporate financial policy is still an open question. The main reason might be that, as BKL (2013) show in their paper, the measure of earnings informativeness which is called earnings relevance in previous literatures (the adjusted R^2 from firm-by-firm time-series return-earnings regressions using ten-year rolling window) has some drawbacks that it only reflects dated information but cannot capture the intertemporal variation of earnings-return

relation. Since they promote a better measure called earnings transparency to measure the information of earnings incorporated into stock price, this paper uses earnings transparency to study the impacts of earnings transparency on corporate cash holdings. This study shed lights on how earnings informativeness affects corporate financial policy.

Before continuing, it is important to show that this paper is different from similar papers by GMS (2009), and SYR (2012). In their papers, they find accrual quality negatively affects cash holdings using Spain and U.S data respectively. This paper provides extra information on how earnings attribute affecting corporate cash holdings besides their papers. I start by arguing that earnings transparency is much different from accounting-based earnings quality both economically and statistically. Economically, accounting-based earnings quality measures the reliability of accounting information, while earnings transparency captures how much earnings information contributes to stock valuation. High earnings quality does not necessarily indicate high earnings informativeness, especially when additional information beyond earnings contributes more to stock value (Sinha and Watts (2001)). Statistically, the correlation between accrual quality and earnings relevance is very small in magnitude: 0.0528 (both Pearson and Spearman) (Francis et al. (2004)). Second, earnings transparency is a measure based on the relation of market returns and earnings, which cannot be fully manipulated by managers, indicating that earnings transparency is less endogenous than accrual quality in addressing cash holding issues. More importantly, this study is quite different from theirs in that I provide more consistent evidence to show how earnings transparency affects cash holdings through the channel of precautionary motivation. Specifically, when examining

how accrual quality affects the value of cash holdings, SYR (2012), using the methodology of (Dittmar and Mahrt-Smith (2007)), find that the value of excess cash increases with accrual quality, and they conclude that firms hold less cash when cash values more while they hold more cash when cash values less, which is count-intuitive. However, following Faulkender and Wang (2006), this paper actually finds that the marginal value of cash for firms with lower earnings transparency is higher. I also do this test using accrual quality, finding that, with the methodology of Faulkender and Wang (2006), good accrual quality decreases the marginal value of cash holdings, which is consistent with the effects of earnings transparency. Therefore, I argue that although SYR (2012) find good accrual quality can increase value of excess cash, they cannot conclude good accrual quality can increase the marginal value of total cash. This paper provides more consistent evidence on how earnings attributes affect the level of cash holdings and the value of cash holdings with a precautionary story.

1.2 Hypothesis

1.2.1 Precautionary Motivation

The precautionary motive of cash holdings is promoted by Keynes (1936), who shows that financial fictions are important reasons for firms to hold cash. Because of the existence of financial frictions, firms may experience adverse shocks in forms of high costs of capital when accessing external financing markets. To avoid losses from lack of financing caused by high costs of capital, they tend to hold more cash. Stemming from this, recent studies find that firms with more growth opportunities, higher cash flow uncertainty and higher refinancing risk tend to hold more cash holdings (Opler et al. (1999), Harford, Klasa, and Maxwell (2014)). Information asymmetry is a specific form of financial friction. Firms with

more information asymmetry will stock more cash because external capital costs are much higher for them (Gao, Harford, and Li (2013)).

1.2.2 Hypothesis Development

Earnings transparency measures the extent to which the information reflected by earnings contributes to stock price. Higher earnings transparency, i.e. higher R^2 of earnings-return regression, indicates the economic value relates more to earnings and therefore investors could get more information from earnings to predict stock return. So the information asymmetry associated with earnings is high when earnings transparency is low. Based on the well-established positive relation between information asymmetry and costs of capital, BKL (2013) document a negative relation between earnings transparency and the expected costs of capital. The precautionary motive suggests that firms trade off on external capital and internal capital and tend to save more cash during periods when external costs of capital are high. Therefore, the main hypothesis is obtained as below.

Hypothesis 1: Earnings transparency negatively affects corporate cash holdings cross sectional, or, firms with lower earnings transparency tend to reserve larger cash holdings and vice versa.

The precautionary motive also suggests that firms with better investment opportunities hold more cash because adverse shocks and financial distress are more costly for them (Bates, Kahle, and Stulz (2009)). Suppose hypothesis 1, i.e., firms with lower earnings transparency hold more cash for precautionary motive is right, holding earnings transparency constant, if firms lose more when there's a shortfall of cash flow, they will hold even more cash than firms whose value is less sensitive to cash flow shortfall. This will lead to heterogeneous effects of earnings transparency on cash holdings. I provide three scenarios when firms

would suffer from more losses if there's an adverse cash flow shock: (1) Firms with more investment opportunities (firms with higher market to book ratio), because more growth options would be foregone if there's a lack of funds; (2) Firms with more R&D expenses, because these firms have larger financial distress costs (Opler et al. (1999)) due to the nature of R&D investments; (3) Financial constrained firms, because investments in these firms depend more on financing availability. Hence, I have the first sub hypothesis of hypothesis 1.

Hypothesis 1a: The negative relation between earnings transparency and cash holdings is more pronounced in firms with more growth opportunities, more RD expenses and more financial constraints.

According to Faulkender and Wang (2006), the value shareholders place on cash is determined by the distributions of cash holdings, i.e., paying out as dividend, or servicing debt or other liabilities, or raising cash. Among these three kinds of distributions, they find that cash holdings increase firm value only when firms with high costs of external capital need to raise capital. As shown in hypothesis 1, firms with lower earnings transparency hold more cash for precautionary motive to avoid incurring higher external capital costs. Hence, I have the second sub hypothesis of hypothesis 1.

Hypothesis 1b: The value of cash holding is negatively related to earnings transparency.

1.3 Methodology, Variables and Data

1.3.1 Methodology

In the empirical sections, I investigate whether earnings transparency negatively affects corporate cash holdings. Since earnings transparency is calculated based on the relation between earnings and return with a period from three month after

previously fiscal year end to three months after the current year fiscal year end, both investors and firms cannot get the contemporary earnings transparency data. Instead, they make decisions based on previous data. Therefore, I use the 1-year lagged earnings transparency as independent variable. Using lagged earnings transparency also could control the reverse causality problem. The specific model is as below:

$$\text{Cash}_{i,t} = \beta_0 + \beta_1 * \text{Trans}_{i,t-1} + \gamma' * \text{Xs}_{i,t} + \eta_i + \tau_t + \varepsilon_{i,t} \quad (1)$$

,where Cash is firm cash holdings, Trans represents earnings transparency, and Xs are control variables following Opler et al. (1999).The following parts of this section are the detailed descriptions of the variables. The regressions are estimated using both OLS regression with firm and time fixed effects and Fama-Macbeth regression with Newey West test.

1.3.2 Variables Description

Cash Holdings

Two measures of cash holding are used in this paper: the natural log of cash over net assets and cash over total assets. Since firms' ability to generate future profits is a function of assets in place, the first measure is calculated as the ratio of cash and short-term investments (#1[2]) to net assets (Opler et al. (1999)). Net asset equals to total assets (#6) minus cash and short-term investments (#1). However, this measure generates extreme outliers for firms with most of their assets as cash. To address the skewness problem, following previous papers, I use the natural logarithm of cash over net assets in multivariate regressions. The second measure is cash and short-term investments (#1) over total book assets (#6). This measure

[2] #No. means the Compustat data item number.

is also extensively used. I use both the two measures in most regressions and get similar and robust results.

Earnings Transparency (hereafter, Trans)

Trans is measured by the explanatory power (adjusted R^2) of regressing returns on earnings and change in earnings in BKL (2013). Trans is constructed by two components. The first is called Transi in their paper. Transi is measured by the adjusted R^2 of annual earnings-return regressions estimated across industry, capturing industry commons in earnings transparency since firms within the same industry have similarity in accounting practices. The second component is called Transin. It is calculated as the adjusted R^2 from the annual returns-earnings regressions estimated across portfolios sorted by residuals from regressions calculating transi. Transin captures the differences of earnings-return relation that cannot be captured by industry variations. 'Trans' is calculated strictly following BKL (2013).

Firstly, I estimate the model below annually to get the first component "Transi":

$$\mathrm{RET}_{i,j,t} = \alpha_0^I + \alpha_1^I \frac{E_{i,j,t}}{P_{i,j,t-1}} + \alpha_1^I \frac{\Delta E_{i,j,t}}{P_{i,j,t-1}} + \mathfrak{C}_{i,j,t} \qquad (2)$$

, where $\mathrm{RET}_{i,j,t}$ is the sign of annual compounded return for firm i in industry j during a period extending from 9 months prior to the fiscal year-end t and 3 months after the fiscal year-end t, corresponding roughly with the period between earnings announcements, $\frac{E_{i,j,t}}{P_{i,j,t-1}}$ denotes income before extraordinary items and discontinued operations (#18) deflated by price at the beginning of fiscal year (#199), $\Delta E_{i,j,t}$ denotes change of $E_{i,j}$ from year t-1 to year t. The model is estimated annually across industry classified following Barth, Beaver, and

Landsman (1998). Transi is the adjusted R^2 of the estimated regression and has an identical value for firms in the same industry.

Secondly, I estimate a similar model below and get the second component "Transin":

$$\mathrm{RET}_{\mathrm{i,p,t}} = \alpha_0^{IN} + \alpha_1^{IN} \frac{E_{i,p,t}}{P_{i,p,t-1}} + \alpha_1^{IN} \frac{\Delta E_{i,p,t}}{P_{i,p,t-1}} + \mathfrak{C}_{i,p,t}. \quad (3)$$

The variables are similar to those in 'Trans' model except that these variables are calculated at portfolio level instead of industry level. Portfolios are classified based on residuals from the first step. Specifically, from the first step, I yield the estimated parameters on industry level, and then I input the firm- and year-specific data to get the firm-level estimated value of return. The firm-level residual is the part of return that cannot be explained by the estimated model, and it is calculated as realized return minus estimated value of return. Based on the value of residuals, the sample is divided into 4 groups. In each year, the model is estimated across the 4 portfolios and the adjusted R^2 from this regression is the second component, which is called Transin. The annual Transin has identical value for firms in the same portfolio.

Finally, I get firm- and year-specific Trans which is equals to the sum of Transi and Transin.

Financial Control Variables

Following the existing literature on the determinants of corporate cash holdings, financial characteristics are controlled in the model. The variables are illustrated as follows. Market-to-Book ratio (hereafter, MB) is proxy for investment opportunity. Firms with more investment opportunities tend to hold more cash for precautionary use. Size affects corporate cash holding negatively. There are several reasons. First, larger firms generally are more profitable so firms do not

need to keep much cash than similar smaller firms. Second, larger firms have more assets that can be used as collateral so that they can more easily get external financing. Third, larger firms have less information asymmetry so that the external financing is cheaper. Forth, the transaction cost of converting financial assets to cash holdings is lower for large firms because of economies of scale. Cash flow from operation (hereafter, CFO) is a source of cash stockpiles; also cash flow can capture firms' investment opportunity. Therefore, CFO is expected to be positively related to corporate cash holding. Capital expenditures (hereafter, CAPX) represents long-term expenses in current year, which is an outflow of liquid assets. It's expected that CAPX is negatively associated with cash holdings. Net working capital (hereafter, NWCAP) is current assets less current liabilities, which can be interpreted as the long-term capital used on current assets. NWCAP has a substitution effect on firm cash holdings because it can be easily converted to cash, indicating a negative relation with cash. Leverage is the ratio of long-term and short-term debt to total assets. Pecking order theory suggest that firms raise capital firstly from internal capital, then from equity market and finally from bond or debt market. High leverage signals that the firm is lack of internal funds. So it is expected that leverage is negatively related to cash holdings. Industry cash flow volatility (hereafter, Indsigma) captures not only cash flow uncertainty within the industry but also investment opportunities. So it is expected a positive relation between industry cash flow volatility and corporate cash holdings. Firms with more R&D expenditures (hereafter, R&D/sales) tend to have more investment opportunities, higher future cash flow risk, and higher probabilities to get distressed. Therefore, such firms tend to hold more cash in precaution. Acquisition (hereafter, Aqc) is also an expense of the current year, having a negative effect on

corporate cash holdings. Divdummy is a dummy variable to measure whether firms pay cash dividend. Dividend in cash is an outflow of cash. Addionally, paying dividends signals that firms do not intend to stockpile cash. So firms that have higher cash dividend are expected to hold less cash holdings. All in all, it is expected that firm with smaller size, higher market to book ratio, higher R&D expenses, more net working capital, less capital expenditure and acquisitions, higher cash flow volatility, higher cash flow, lower leverage and less cash dividend tends to hold more cash. The calculations of these variables are illustrated in the appendix.

1.3.3 Data Source and Sample Construction

I get firm specific financial data from COMPUSTAT industrial annual file and return data from CRSP annual file. Following both cash holding literature and Barth et al. (2013), the data requirements are the followings: (1) firms in the sample are incorporated in the United States; (2) observations have positive equity book value, positive assets and positive sales in a given year; (3) to mitigates the effects of outliers, it is treated as missing observations if any earnings variable of $\frac{E_{i,t}}{P_{i,t-1}}$ and $\frac{\Delta E_{i,t}}{P_{i,t-1}}$ is not between -1.5 and +1.5; (4) delete observations if share price in fiscal year end is less than $1; (5) R&D is set as 0 when is missing; (6) some obvious data errors are excluded, such as negative cash holdings, a higher value of cash holdings than total assets. (7) compounded annual return is trimmed at 1% level, and all the variables are winsorized at 1% level; (8) exclude financial firms (SIC codes 6000-6999) since they have to follow specific capital restrictions regulations and utility firms (SIC codes 4900-4999) since they are subject to regulatory supervision in a number of states; (9) there must be at least 10 observations each industry year when calculating Transi.

The final sample is based on US firms for 34 sample years from 1980 to 2013. Because the construction of Trans requires lagged data of earnings and cash flow volatility are calculated with minimum 5 years data, some data prior to 1980 are used.

1.3.4 The Determinants of Earnings Transparency

BKL (2013) describe some sources that may cause the variations of earnings transparency. The sources include accounting system, manager discretion, accounting standards and clarity of firm disclosures. The sources are reasonable but not easy to measure in number. Here, I analyse some possible determinants and provide empirical results in Appendix B. The first is accounting based earnings quality. The precision of earnings affects the information quality of earnings, and hence the earnings transparency which captures the information of earnings related to stock return. The results show that better earnings quality, higher earnings transparency. Similarly, corporate governance also affect the information quality of earnings and hence earnings transparency. Better corporate governance leads to higher earnings transparency. The third one is the dummy of multinational firms. Foreign earning is less informative to investors, so that firms with more foreign earnings have lower earnings transparency. Hence MNC have lower earnings transparency. MNC is measured as 1 if firms whose foreign earnings are more than 25% of the total revenues in the past three years, otherwise, it equals to 0. The last is information asymmetry. Information asymmetry induces more agency problems, making earnings transparency become lower. I find consistent results empirically that accrual quality, institutional ownership, MNC, annual bid-ask spread and analyst numbers affect earnings transparency.

1.4 Empirical Results

1.4.1 Summary Statistics

Trans has two components called Transi and Transin. Transi is the adjusted R^2 from annually regressing compounded return on earnings and change in earnings across industry. It is industry-neutral and captures explanation variations of earnings on returns that can be captured by their industry membership. Transin is calculated as the adjusted R^2 from regressing compounded return on earnings and change in earnings across portfolios sorted by firm-specific residuals that cannot explained by industry commons.

Panel a, table 1 presents the industry classification details. This classification[3] is following Barth, Beaver, and Landsman (1998). Panel B, table 1 provides the mean and median statistics of Trans, Transi and Transin across industries. Trans equals to the sum of Transi and Transin. Transi has industry variations. It is higher in industries of 'Food', 'Textiles, printing, publishing' and 'Chemicals', while lower in industries such as 'Pharmaceuticals', 'Computers' and 'Services', which is consistent with BKL (2013). Transin, which is industry-neutral, has few variations across industry. This statistical distribution is consistent with how it is constructed.

Table 2 reports summary statistics of the key variables. The statistics include the mean, median, standard deviation, value of 25th and 75th percentiles. The ratio of cash to net assets (total assets less cash) is largely positively skewed with a mean value of 36.3% and a median value of 8.6%. The skewness of cash over total assets is less severe than that of cash over net assets, with a mean value of 15.7% and a median value of 7.9%. I use both cash over total assets and the nature log of

[3] I also use two-digit SIC code, Fama French 17 industry classification and Fama French 48 industry classification to identify industries. It's shown that the main results are robust to different the industry classifications.

cash over net assets as the independent variable to provide more comprehensive and robust results. Trans in this sample has a mean value and a median value of 0.459 and 0.451 respectively, comparable to 0.42 and 0.41 in BKL (2013), suggesting a symmetric deviation of Trans. As for other financial variables, the average MB is 1.803, with CFO of 4.2%, NWCAP of 13.4%, CAPX of 6.5%, leverage of 21.3%, Indsigma of 0.083, RD/sales of 14.9% and AQC of 2.1%. All the statistics are comparable with similar previous studies.

Table 3 reports Pearson pairwise correlations between variables. Earnings transparency exhibits significant negative correlations with both cash over total assets and cash over net assets. The coefficients are 0.072 with p-values 0.0001 and 0.056 with p-values 0.0001 respectively. For other control variables, the correlations between Trans and Realsize, NWCAP, CFO, leverage, divdummy are positive and significant, while the correlations between Trans and MB, CAPX, RD/sales, Aqc and Indsigma are negative and significant. Overall, this evidence show earnings transparency is significantly associated with cash holdings and the other financial characteristics, indicating that these financial variables should be controlled in the multivariate regressions.

Table 1 Industry classification and summary statistics of trans across industry

This table provides the industry classification details and the summary statistics of earnings transparency across industry. Panel A presents the industry classification details. This classification follows Barth et al. (1998) dividing firms into 15 industries according to primary SIC codes. Panel B presents the summary statistics of earnings transparency within each industry except financial and utility industries. Specifically, it shows the mean, median, standard deviation, minimum, maximum, numbers of observations of earnings transparency. The sample used in panel B includes observations available both in COMPUSTAT and CRSP from 1980 to 2013. The data requirements are illustrated in the sample section. All variables are winsorized at 1% and 99% level.

Panel A. Industry Classification

Industry	Primary SIC code
1. Mining and construction	1000—1999, except 1300—1399
2. Food	2000—2111
3. Textiles, printing and publishing	2200-2799
4. Chemicals	2800—2824, and 2840—2899
5. Pharmaceuticals	2830—2836
6. Extractive industries	2900—2999, and 1300—1399
7. Durable manufacturers	3000—3999, except 3570—3579, and 3670—3679
8. Computers	7370—7379, 3570—3579, and 3670—3679
9. Transportation	4000—4899
10. Utilities	4900—4999
11. Retail	5000—5999
12. Financial institutions	6000—6411
13. Insurance and real estate	6500—6999
14. Services	7000—8999, except 7370—7379
15. Other	>9000

Panel B Statistics of Trans within each industry

	Trans		Transi		Transin	
Industry	Mean	Median	Mean	Median	Mean	Median
1.Mining, construction	0.464	0.448	0.108	0.077	0.357	0.338
2.Food	0.495	0.501	0.142	0.135	0.354	0.335
3.Textiles, printing, publishing	0.496	0.474	0.141	0.142	0.355	0.338
4.Chemicals	0.498	0.497	0.143	0.137	0.356	0.338
5.Pharmaceuticals	0.427	0.422	0.073	0.048	0.354	0.335
6.Extractive industries	0.448	0.434	0.094	0.076	0.355	0.338
7.Durable manufacturers	0.450	0.431	0.096	0.088	0.355	0.338
8.Computers	0.439	0.431	0.084	0.080	0.355	0.335
9.Transportation	0.455	0.434	0.101	0.095	0.354	0.335
11.Retail	0.449	0.426	0.095	0.104	0.354	0.335
14.services	0.427	0.405	0.073	0.061	0.354	0.335
15.Other	0.417	0.441	0.072	0.089	0.343	0.331

Table 2 Description of variables

This table provides summary statistics of main variables. The sample includes observations available both in COMPUSTAT and CRSP from 1980 to 2013. The data requirements are illustrated in the sample section. All variables are winsorized at 1% and 99% level. Cash/AT = cash holdings and marketable securities (#1)/total assets (#6). Cash/NAT = cash holdings and marketable securities (#1)/ [total assets (#6) - cash holdings and marketable securities (#1)]. TRANS is earnings transparency constructed following Barth et al. (2013). $Trans_{t-1}$ is 1-year lagged earnings transparency. RealSize is the natural log of total assets (#6) in 1994 dollars. MB = [total assets (#6)-book value of equity (#60) + share outstanding (#25)* prcc_f (#199)]/total assets (#6). RD/sales=XRD (#46)/sales (#12). CF= [OIBDP (#13)-Xint (#339)-Txt (#16)-Dvc (#21)]/total assets (#6). NWCAP= [wcap (#179) - cash holdings and marketable securities (#1))/total assets (#6). CAPX=capital expenditure (#128)/total assets (#6). Leverage = total liabilities (#181)/total assets (#6). Indsigma is the mean of the past 20 years cash flow volatility averaged in two-digit SIC code. Aqc=acquisitions (#129)/ total assets (#6). Divdummy is a binary variable. Divdummy equals to 1 if dvc (#21) is higher than 0, otherwise it equals to 0.

Variable	Mean	Std.	P25	Median	P75	max	min	N
Cash/At	0.157	0.189	0.024	0.079	0.218	0.955	0.000	77689
Cash/Nat	0.363	1.072	0.025	0.086	0.278	21.185	0.000	77689
Trans	0.459	0.178	0.319	0.451	0.598	0.935	0.079	77689
$Trans_{t-1}$	0.456	0.177	0.310	0.439	0.594	0.935	0.079	77689
MB	1.803	1.408	1.046	1.361	1.986	20.279	0.504	77689
RealSize	5.022	2.089	3.483	4.877	6.460	11.617	-0.253	77689
CF	0.042	0.144	0.027	0.070	0.108	0.322	-1.076	77689
NWCAP	0.134	0.182	0.003	0.121	0.259	0.608	-0.400	77689
CAPX	0.065	0.064	0.023	0.045	0.083	0.482	0.000	77689
Leverage	0.213	0.179	0.050	0.193	0.331	0.770	0.000	77689
Indsigma	0.083	0.044	0.049	0.076	0.107	0.260	0.017	77689
RD/sales	0.149	0.930	0.000	0.000	0.046	21.334	0.000	77689
Aqc	0.021	0.057	0.000	0.000	0.008	0.436	-0.017	77689
Divdummy	0.388	0.487	0.000	0.000	1.000	1.000	0.000	77689

Table 3 Pearson correlations between earnings transparency and cash holdings

This table reports the Pearson correlations between earnings transparency and financial variables. The sample includes observations available both in COMPUSTAT and CRSP from 1980 to 2013. The data requirements are illustrated in the sample section. All variables are winsorized at 1% and 99% level. Cash/AT = cash holdings and marketable securities (#1)/total assets (#6). Cash/NAT= cash holdings and marketable securities (#1)/ [total assets (#6) - cash holdings and marketable securities (#1)]. TRANS is earnings transparency constructed following Barth et al. (2013). $Trans_{t-1}$ is 1-year lagged earnings transparency. RealSize is the natural log of total assets (#6) in 1994 dollars. MB = [total assets (#6)-book value of equity (#60) + share outstanding (#25)* prcc_f (#199)]/total assets (#6). RD/sales=XRD (#46)/sales (#12). CF= [OIBDP (#13)-Xint (#339)-Txt (#16)-Dvc (#21)]/total assets (#6). NWCAP= [wcap (#179) - cash holdings and marketable securities (#1))/total assets (#6). CAPX=capital expenditure (#128)/total assets (#6). Leverage = total liabilities (#181)/total assets (#6). Indsigma is the mean of the past 20 years cash flow volatility averaged in two-digit SIC code. Aqc=acquisitions (#129)/ total assets (#6). Divdummy is a binary variable. Divdummy equals to 1 if dvc (#21) is higher than 0, otherwise it equals to 0. P-values are shown in brackets.

	1	2	3	4	5	6	7	8	9	10	11	12	13
$Trans_{t-1}$	1												
Cash/At	-0.072	1											
	<.0001												
Cash/Nat	-0.056	0.735	1										
	<.0001	<.0001											
MB	-0.115	0.379	0.267	1									
	<.0001	<.0001	<.0001										
RealSize	0.055	-0.167	-0.106	-0.084	1								
	<.0001	<.0001	<.0001	<.0001									
CF	0.027	-0.353	-0.370	-0.242	0.263	1							
	<.0001	<.0001	<.0001	<.0001	<.0001								
NWCAP	0.033	-0.288	-0.228	-0.178	-0.238	0.191	1						
	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001							
CAPX	-0.014	-0.194	-0.146	0.020	0.005	0.150	-0.196	1					
	0.0002	<.0001	<.0001	<.0001	0.2062	<.0001	<.0001						
Leverage	0.025	-0.430	-0.228	-0.238	0.151	0.008	-0.114	0.121	1				
	<.0001	<.0001	<.0001	<.0001	<.0001	0.0293	<.0001	<.0001					
Indsigma	-0.065	0.360	0.289	0.256	0.060	-0.191	-0.192	-0.166	-0.177	1			
	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001				
RD/sales	-0.025	0.382	0.524	0.241	-0.078	-0.464	-0.155	-0.065	-0.088	0.240	1		
	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001			
Aqc	-0.018	-0.111	-0.074	-0.016	0.142	0.065	-0.063	-0.099	0.143	0.062	-0.040	1	
	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001		
Divdummy	0.135	-0.218	-0.151	-0.119	0.311	0.180	0.090	0.047	-0.002	-0.265	-0.114	-0.010	1
	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	0.6568	<.0001	<.0001	0.0069	

1.4.2 Univariate Test

The results of univariate analysis of cash holdings associated with earnings transparency are reported in table 4. The table reports the mean value of cash ratios and other financial variables for firms grouped in quintiles based on Trans and also the differences of variables between the highest quintile and the lowest quintile. The difference-in-mean and t-statistics are calculated annually and averaged across year. It's found convincing evidence of the relatively higher cash levels in firms with lower earnings transparency than in firms with higher earnings transparency. For example, firms in the highest quintile of Trans averagely have 18.2% of total assets as cash relative to 13.5% in firms with lowest quintile of Trans. The differences are even larger for cash over net assets, with 44.6% of mean value for lowest quintile firms relative to 28% of mean value for highest quintile firms. The univariate results suggests earnings transparency and corporate cash holdings are negatively correlated, which is consistent with hypothesis 1.

Additionally, the results show a consistent relation between earnings transparency and financial characteristics (except cash flow) with the Pearson pairwise correlations in the previous section. Firm with less earnings transparency have significantly more growth options, smaller size, less net working capital, lower leverage, higher industry cash flow risk, less capital expenditure, higher RD expense, higher acquisition expense, less dividend pay-out ratio.

1.4.3 Main Results

The results of the previous subsections suggest a negative correlation between earnings transparency and corporate cash holding. In this section, I test this through multivariate regressions. The dependent variable is corporate cash holdings, measured as the nature log of cash and short-term investments divided

by net assets and cash and short-term investments over total assets. The independent variable is earnings transparency denoted as Trans. The fundamental control variables are described previously. Table 5 presents the main results of regressions predicting corporate liquidity levels in the 1980-2013 periods. In order to show the robustness of the relation between earnings transparency and corporate cash holdings, both OLS regressions and Fama Macbeth regressions are used.

Table 4 Univariate tests

This table presents the results of the univariate tests. The sample includes observations available both in COMPUSTAT and CRSP from 1980 to 2013. The data requirements are illustrated in the sample section. All variables are winsorized at 1% and 99% level. In each year, firms are classified into 5 groups according to the value of 1-year lagged earnings transparency. The 'Low' group contains observations with Lag (Trans) in the lowest quintile, while 'High' group are observations with Lag (Trans) in the highest quintile. Cash/AT = cash holdings and marketable securities (#1)/total assets (#6). Cash/NAT = cash holdings and marketable securities (#1)/ [total assets (#6) - cash holdings and marketable securities (#1)]. TRANS is earnings transparency constructed following Barth et al. (2013). $Trans_{t-1}$ is 1-year lagged earnings transparency. RealSize is the natural log of total assets (#6) in 1994 dollars. MB = [total assets (#6)-book value of equity (#60) + share outstanding (#25)* prcc_f (#199)]/total assets (#6). RD/Sales=XRD (#46)/sales (#12). CF= [OIBDP (#13)-Xint (#339)-Txt (#16)-Dvc (#21)]/total assets (#6). NWCAP= [wcap (#179) - cash holdings and marketable securities (#1))/total assets (#6). CAPX=capital expenditure (#128)/total assets (#6). Leverage = total liabilities (#181)/total assets (#6). Indsigma is the mean of the past 20 years cash flow volatility averaged in two-digit SIC code. Aqc=acquisitions (#129)/ total assets (#6). Divdummy is a binary variable. Divdummy equals to 1 if dvc (#21) is higher than 0, otherwise it equals to 0. The t-test and the Wilcoxon rank-sum test of the differences in cash holdings and other financial characteristics between high earnings transparency firms and low transparency firms are given in superscript ***, **, and * denoting statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	low	2	3	4	high	diff.
$Trans_{t-1}$	0.246	0.350	0.476	0.565	0.643	-0.397***
Cash/At	0.182	0.164	0.158	0.145	0.135	0.046***
Cash/Nat	0.446	0.394	0.379	0.316	0.280	0.166***
MB	2.219	1.728	1.717	1.687	1.658	0.562***
RealSize	4.831	4.724	5.024	5.201	5.328	-0.497***
CF	0.052	0.024	0.034	0.049	0.052	0.000
NWCAP	0.130	0.135	0.121	0.139	0.145	-0.015***
CAPX	0.070	0.063	0.064	0.065	0.063	0.007***
Leverage	0.198	0.216	0.220	0.217	0.216	-0.018***
Indsigma	0.085	0.084	0.084	0.081	0.079	0.006***
RD/sales	0.180	0.160	0.176	0.127	0.105	0.076***
Aqc	0.025	0.018	0.021	0.022	0.021	0.004***
Divdummy	0.325	0.301	0.387	0.437	0.488	-0.163***

Table 5 Regressions of corporate cash holdings on earnings transparency

This table presents estimates of regressions explaining corporate cash holdings. The sample includes observations available both in COMPUSTAT and CRSP from 1980 to 2013. The data requirements and the control variables are described in 'sample' and 'variable description' sections. All variables are winsorized at 1% and 99% level. For columns (1), (2), (3), (5), (6) the dependent variable is measured as cash and short-term investment divided by book assets. For columns (4) and (7), the dependent variable is the log of cash over net assets. The independent variable is 1-year lagged earnings transparency. Columns (1), (2), (4), (5) and (7) show estimates from OLS regressions including year and firm fixed effects. Standard errors are clustered at the firm level. Column (3) and (6) are estimates from Fama-Macbeth regressions with Newey-West test. Robust standard errors are under coefficients. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	7
VARIABLES	Cash/At	Cash/At	Cash/At	log(Cash/Nat)	Cash/At	Cash/At	log(Cash/Nat)
$(Cash/At)_{t-1}$					0.513***	0.748***	
					(0.007)	(0.019)	
$[log(Cash/Nat)]_{t-1}$							0.458***
							(0.006)
Trans	0.003***						
	(0.002)						
$Trans_{t-1}$		-0.011***	-0.024***	-0.102***	-0.011***	-0.014***	-0.090***
		(0.003)	(0.006)	(0.027)	(0.002)	(0.003)	(0.023)
MB	0.009***	0.009***	0.018***	0.076***	0.006***	0.004***	0.056***
	(0.001)	(0.001)	(0.004)	(0.007)	(0.001)	(0.001)	(0.005)
RealSize	-0.005***	-0.004**	-0.010***	-0.067***	-0.000	-0.002***	-0.028**
	(0.002)	(0.002)	(0.001)	(0.019)	(0.001)	(0.000)	(0.012)
CF	0.013	0.009	-0.067	0.253***	0.057***	0.063***	0.487***
	(0.009)	(0.010)	(0.042)	(0.070)	(0.007)	(0.015)	(0.054)
NWCAP	-0.314***	-0.323***	-0.305***	-2.740***	-0.244***	-0.120***	-2.112***
	(0.009)	(0.010)	(0.019)	(0.084)	(0.007)	(0.008)	(0.061)
CAPX	-0.305***	-0.330***	-0.542***	-2.533***	-0.388***	-0.349***	-3.284***
	(0.013)	(0.014)	(0.059)	(0.134)	(0.011)	(0.009)	(0.109)
Leverage	-0.261***	-0.252***	-0.349***	-2.869***	-0.135***	-0.081***	-1.723***
	(0.008)	(0.008)	(0.018)	(0.080)	(0.006)	(0.009)	(0.057)
Indsigma	-0.023***	0.000	0.433***	0.964***	-0.009	0.097***	0.486**
	(0.035)	(0.036)	(0.076)	(0.363)	(0.022)	(0.017)	(0.223)
RD/sales	0.013***	0.013***	0.104**	0.078***	0.007***	0.032**	0.047***
	(0.002)	(0.002)	(0.039)	(0.012)	(0.001)	(0.014)	(0.008)
Aqc	-0.185***	-0.185***	-0.243***	-1.278***	-0.336***	-0.413***	-2.678***
	(0.008)	(0.008)	(0.050)	(0.087)	(0.009)	(0.034)	(0.085)
Divdummy	0.005*	0.007***	-0.028***	0.044	0.001	-0.007***	-0.002
	(0.003)	(0.003)	(0.007)	(0.028)	(0.002)	(0.001)	(0.018)
Constant	0.299***	0.294***	0.303***	-0.953***	0.151***	0.101***	-0.393***
	(0.007)	(0.008)	(0.008)	(0.073)	(0.008)	(0.007)	(0.084)
Year	Y	Y		Y	Y		Y
Firm	Y	Y		Y	Y		Y
N	89281	77,689	77,689	77,689	75,678	75,678	75,678
adj. R-sq	0.806	0.809	0.481	0.753	0.866	0.799	0.810
Number of groups			34			33	

Columns from (1) to (4) are results of the relation between earnings transparency and corporate cash holdings. Column (1) presents the estimates of regressing cash over total assets on contemporaneous Trans. The estimates show that there's no significant relation between cash and contemporaneous earnings transparency, suggesting cash and earnings transparency are less likely to have feedback causality problems. The lagged earnings transparency is used not only to address reverse causality concerns, but also for the following reason: earnings transparency is measured as the R^2 of regressing realized returns on earnings so that both the insiders and outsiders will not know its value until the subsequent period. This is also consistent with BKL (2013), who show that earnings transparency is negatively related to expected cost of capital and subsequent realized returns. Column (2) and column (3) show the results of regressing cash over total assets on lagged earnings transparency with OLS regression and Fama Macbeth regression respectively. To control the unobservable constant variables, all OLS regressions include firm level and year level fixed effects. Column (4) uses the natural log of cash over net assets as the dependent variable.

The coefficients on Trans is negative and significant at 99% confidence level under all model specifications, suggesting that transparent firms are more likely to hold less cash compared to less transparent firms and vice versa. This is consistent with the hypothesis that high earnings transparency reduces information asymmetry among market participants, resulting in lower costs of equity and hence firms will hold fewer saving for precaution. In terms of economic significance, Column (2) indicates the average earnings transparency can explain 3.2% of the cross-sectional variations of cash over total assets. Column (4) suggests that, all other things being equal, moving from the first quintile of

earnings transparency to the fifth quintile increases cash over net assets ratio by 1.5%, a 4.1% increase given that the average value of cash over net assets is 0.363. The results are even stronger when using Fama Macbeth regressions as shown in column (3).

Another way to address the adverse causality problem is to study the impact of earnings transparency on the change of cash holdings (Harford, Mansi, and Maxwell (2008)). This analysis is conducted by controlling lagged cash holdings in the regression. The results are presented in columns from (5) to (7). Column (5) and column (7) show results using OLS regressions. Column (6) shows results using Fama Macbeth regression. The coefficient of Trans keeps negative and significant at 99% confidence level, suggesting that when earnings transparency is higher, firms tend to decrease their holdings of cash with a higher speed and vice versa. The results are robust with different regression specifications and different measures of cash.

While the key variable is earnings transparency, the regressions include control variables based on previous related studies. Specifically, the controls include market-to-book ratio, firm size, cash flow of operating, NWCAP, CAPX, leverage, Indsigma, RD/Sales, Aqc and Divdummy. Almost all the coefficients of control variables have their expected signs. Firms with higher leverage, more net working capital, more dividends, and more capital expenditures tend to hold less cash holdings, while firms with higher growth opportunity (higher market-to-book or higher R&D expenses), higher operating risk (Indsigma) and higher operation cash flows tend to have more cash reserves.

1.4.4 Other Control Variables

1.4.4.1 Accounting-based Earnings Quality

Besides earnings transparency, there are other measures called accounting-based measures to evaluate earnings-related information, such as accrual quality and absolute abnormal accruals. Both earnings transparency and these accounting-based earnings quality are measures of the information contained in earnings. SYR (2012) and GMS (2009) find a negative relation between accounting-based earnings quality and corporate cash holdings based on firms listed on United States exchanges and Spanish exchange respectively. Although Francis et al. (2004) show that market-based earnings quality and accounting-based earnings quality have little statistical correlation, I control accounting based variables to provide evidence that earnings transparency can provide extra information in affecting firms' cash holding policy.

Accounting-based earnings quality are measured based on accounting information only, capturing the accuracy of financial reporting disclosing information about expected cash flows which can inform stakeholders. Accrual quality and absolute abnormal accruals are the most frequently used accounting-based earnings quality. Accrual quality is calculated as the standard deviation of residuals from a regression of accruals on operating cash flows of last year, present year and forward year Dechow and Dichev (2002). This measure captures the estimation errors of earnings under accrual accounting basis. Absolute abnormal accruals are accruals that cannot be explained by the fundamentals, i.e. revenues and gross PPE. These two measures are adverse earnings quality measures which means higher of these measures indicates poorer of earnings quality.

I control these two variables in model 4 to show the robustness of the impact of earnings transparency on cash holdings. The model is designed as follows:

$$\mathrm{Cash}_{i,t} = \beta_0 + \beta_1 * \mathrm{Trans}_{i,t-1} + \beta_2 * \mathrm{ACC}_{i,t} + \gamma' * \mathrm{Xs}_{i,t} + \eta_i + \tau_t + \varepsilon_{i,t} \quad (4)$$

, where ACCs represent accounting-based earnings quality measures, i.e., accrual quality and absolute abnormal accruals; Trans is earnings transparency and Xs are control variables.

Table 6 Summary statistics for accounting-based earnings quality

This table reports summary statistics of accounting based earnings quality variables and corporate governance variables. The constructions of accounting based earnings quality variables are provided in the appendix B. The definitions of other financial variables are the same as in previous tables. All variables are winsorized by 1% and 99%. AQ and Abs_Abn_Acc represent accrual quality, discretionary accruals and absolutely abnormal accrual respectively. Panel A presents the summary statistics of key variables of accounting-based earnings quality sample. Panel B reports the Pearson correlations between Trans and earnings quality measures.

Panel A. Summary Statistics of accounting-based earnings quality sample

Variable	Mean	Std.	P25	Median	P75	max	min	N
Cash/At	0.145	0.176	0.024	0.074	0.198	0.955	0.000	54658
Cash/Nat	0.312	0.957	0.024	0.080	0.247	21.185	0.000	54658
Trans	0.468	0.178	0.323	0.466	0.604	0.935	0.079	54658
$Trans_{t-1}$	0.461	0.178	0.314	0.455	0.599	0.935	0.079	54658
AQ	0.047	0.036	0.022	0.037	0.061	0.324	0.001	54658
Abs_abn_acc	0.056	0.059	0.017	0.038	0.073	0.568	0.000	54658

Panel B. Summary Statistics of Institutional ownership sample

	1	2	3
$Trans_{t-1}$	1		
AQ	-0.108	1	
	<.0001		
Abs_abn_acc	-0.069	0.434	1
	<.0001	<.0001	

Panel A, table 6 reports the summary statistics of accounting-based earnings quality measures and the dependent and independent variables. AQ represents accrual quality and Abs_Abn_Acc represents absolute abnormal accruals. The mean (median) of AQ have a value of 0.047 (0.037), similar to 0.0442 (0.0313) in Francis et al. (2005). The mean (median) of Abs_Abn_Acc has value of 0.056 (0.038), comparable to 0.088 (0.036) in Sun et al. (2012). Furthermore, the cash

ratios and Trans have values comparable to those in the sample of the main regression. Panel B shows that the correlation coefficients between Trans and the accounting based measures are very small, all less than 0.108, suggesting that earnings transparency and accounting based earnings quality contain little overlapped information statistically.

Table 7 Regression estimates with accounting based earnings quality measures

This table presents estimates results from regressions explaining firm level cash holdings when accounting based earnings quality are accounted for. The sample includes observations available both in COMPUSTAT and CRSP from 1980 to 2013. The data requirements and the control variables are described in 'sample' and 'variable description' sections. All variables are winsorized by 1% and 99%. In Columns (1), (2) and (3), the dependent variable is measured as log of cash and short-term investments over net asset ratios. In Columns (5), (6) and (7), the dependent variable is the cash and short-term investment divided by book assets. The independent variable is 1-year lagged earnings transparency. All columns present estimates from OLS regressions including year and firm fixed effects with standard errors clustered at the firm level. The standard errors are under the coefficients. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

VARIABLES	(1) Cash/At	(2) Cash/At	(3) Cash/At	(4) log(Cash/Nat)	(5) log(Cash/Nat)	(6) log(Cash/Nat)
$Trans_{t-1}$	-0.009***	-0.008***	-0.009***	-0.114***	-0.110***	-0.113***
	(0.003)	(0.003)	(0.003)	(0.031)	(0.031)	(0.031)
AQ		0.114***			0.977***	
		(0.036)			(0.319)	
Abs_abn_acc			0.018*			0.154
			(0.011)			(0.106)
MB	0.009***	0.009***	0.009***	0.075***	0.073***	0.074***
	(0.001)	(0.001)	(0.001)	(0.009)	(0.009)	(0.009)
RealSize	-0.003	-0.003	-0.003	-0.071***	-0.068***	-0.071***
	(0.002)	(0.002)	(0.002)	(0.024)	(0.024)	(0.024)
CF	0.011	0.012	0.012	0.324***	0.334***	0.326***
	(0.012)	(0.012)	(0.012)	(0.090)	(0.090)	(0.090)
NWCAP	-0.337***	-0.335***	-0.336***	-2.994***	-2.981***	-2.992***
	(0.012)	(0.012)	(0.012)	(0.103)	(0.103)	(0.103)
CAPX	-0.340***	-0.340***	-0.341***	-2.932***	-2.929***	-2.937***
	(0.017)	(0.017)	(0.017)	(0.160)	(0.161)	(0.160)
Leverage	-0.234***	-0.235***	-0.234***	-2.822***	-2.831***	-2.822***
	(0.010)	(0.010)	(0.010)	(0.097)	(0.097)	(0.097)
Indsigma	0.032	0.029	0.032	0.924**	0.896**	0.923**
	(0.039)	(0.039)	(0.039)	(0.421)	(0.420)	(0.421)
RD/sales	0.010***	0.010***	0.010***	0.057***	0.059***	0.058***
	(0.002)	(0.002)	(0.002)	(0.015)	(0.015)	(0.015)
Aqc	-0.188***	-0.190***	-0.191***	-1.509***	-1.522***	-1.531***
	(0.009)	(0.009)	(0.009)	(0.102)	(0.102)	(0.102)
Divdummy	0.010***	0.011***	0.010***	0.065**	0.070**	0.066**
	(0.003)	(0.003)	(0.003)	(0.032)	(0.032)	(0.032)
Constant	0.278***	0.272***	0.277***	-0.895***	-0.949***	-0.906***
	(0.010)	(0.010)	(0.010)	(0.096)	(0.097)	(0.095)
Year	Y	Y	Y	Y	Y	Y
Firm	Y	Y	Y	Y	Y	Y
N	54,658	54,658	54,658	54,658	54,658	54,658
adj. R-sq	0.810	0.810	0.810	0.751	0.751	0.751

Table 7 presents the regression results after controlling accounting based earnings quality measures. Column (1), (2) and (3) use cash over total assets as dependent variable, while Column (4), (5) and (6) use natural log of cash over net assets as dependent variable. Column (1) and column (4) are estimates before controlling accounting based earnings quality. Column (2) and (5) are results after controlling accrual quality. Column (3) and (6) are results after controlling absolute abnormal accruals. Under all regression specifications, the results show a significant negative relation between Trans and subsequent cash holdings, suggesting that earnings transparency captures different information related to earnings with accounting-based earnings quality measures in affecting corporate cash holdings. What's more, the magnitudes of coefficients of Trans after controlling accounting-based earnings quality measures are almost the same with those in the main regressions (table 5), indicating a low correlation between accounting based earnings quality variables and earnings transparency.

1.4.4.2 Corporate Governance

There are some papers studying how corporate governance affects earnings-return relation. For example, Fan and Wong (2002) find that a large separation of the voting and cash flow rights reduces the credibility of the accounting information, indicating that agency problems negatively affect earnings informativeness. Harford, Mansi, and Maxwell (2008) show that corporate governance has a positive impact on cash holdings because managers in firms with poor governance tend to dissipate excess cash on bad investments. To mitigate the possibility that the impact of earnings transparency on cash holdings is because corporate governance affects earnings quality and cash holdings simultaneously, I include

corporate governance measures in the regression. Specifically, I control governance measures in model 5.

$$\mathrm{Cash}_{i,t} = \beta_0 + \beta_1 * \mathrm{Trans}_{i,t-1} + \beta_2 * \mathrm{GOV}_{i,t} + \gamma' * \mathrm{Xs}_{i,t} + \eta_i + \tau_t + \varepsilon_{i,t} \quad (4)$$

, where GOV denotes corporate governance measures: g-index and institutional ownership and insider ownership; Trans is earnings transparency and Xs are control variables.

Table 8 Summary statistics of corporate governance sample

This table provides summary statistics of corporate governance variables. Panel A presents the summary statistics of the key variables of the sample when corporate governance is measured by Gindex following Gompers et al. (2003). The G-index sample is available from 1990 to 2007. Panel B presents the summary statistics of the key variables of the sample when corporate governance is measured by institutional ownership. The Institutional ownership sample is from 1980 to 2013. Panel C presents the summary statistics of the key variables of the sample when corporate governance is measured by inside ownership. Inside ownership is the equity held by top 5 officers divided by total common share outstanding. Inside ownership sample is from 1992 to 2013. The definitions of other financial variables are the same as in previous tables. All variables are winsorized at 1% and 99% level.

Panel A Summary Statistics of G-index sample

Variable	Mean	Std.	P25	Median	P75	N
Cash/AT	0.144	0.174	0.023	0.072	0.199	9294
Cash/NAT	0.282	0.713	0.023	0.078	0.249	9294
Trans	0.475	0.184	0.324	0.489	0.616	9294
Trans_{t-1}	0.475	0.185	0.324	0.496	0.612	9294
G-index	9.101	2.706	7.000	9.000	11.000	9294
RealSize	7.095	1.436	6.052	6.952	8.033	9294

Panel B Summary Statistics of Institutional ownership sample

Variable	Mean	Std.	P25	Median	P75	N
Cash/AT	0.157	0.189	0.024	0.079	0.218	77689
Cash/NAT	0.363	1.072	0.025	0.086	0.278	77689
Trans	0.459	0.178	0.319	0.451	0.598	77689
Trans_{t-1}	0.456	0.177	0.310	0.439	0.594	77689
Institutional Ownership	0.394	0.298	0.125	0.354	0.629	77689
RealSize	5.022	2.089	3.483	4.877	6.460	77689

Panel C Summary Statistics of Inside ownership sample

Variable	Mean	Std.	P25	Median	P75	N
Cash/AT	0.147	0.167	0.024	0.081	0.211	22236
Cash/NAT	0.256	0.460	0.025	0.088	0.268	22236
Trans	0.456	0.181	0.308	0.458	0.596	22236
Trans_{t-1}	0.456	0.181	0.304	0.457	0.597	22236
Inside Ownership	0.042	0.080	0.003	0.010	0.036	22236
RealSize	7.075	1.549	5.961	6.927	8.057	22236

Table 8 reports the summary statistics of corporate governance variables. The first is G-index. G-index is a proxy of shareholder protection. Lower G-index indicates higher shareholder protection. Panel A is for G-index sample. G-index has a mean value of 9.101 and a median value of 9.000, comparable to 9.23 and 9.000 in Harford, Mansi, and Maxwell (2008). Since data for G-index are only available between 1990 and 2007 and only available for comparable larger COMPUSTAT firms, the sample have totally 12453 observations. The second measure of corporate governance is institutional ownership. Institutional investors tend to monitor managers more effectively. Panel B, table 8 documents the summary statistics of key variables of the institutional ownership sample. The institutional ownership has a mean value and median value of 0.394 and 0.354 respectively which are comparable with previous studies. The third measure is insider ownership. Managers holding more stocks are more likely to align their interests with firm owners. Insider ownership has a mean and median value of 0.042 and 0.010 respectively.

Table 9 shows that the impacts of earnings transparency on corporate cash holdings are still significant accounting for different corporate governance measures. The dependent variable is log of cash over net assets. In Columns (1) and (2), the governance measure is G-index. In Column (3), (4) and (5), the governance measure is inside ownership. In Column (6), (7) and (8), the governance measure is institutional ownership. The independent variable is 1-year lagged earnings transparency. Following Harford, Mansi, and Maxwell (2008), in Column (2), (5) and (8), I control year and industry fixed effects with standard errors clustered at the firm level. All other columns present estimates from OLS regressions including year and firm fixed effects with standard errors clustered at

the firm level. This table shows that the relation between earnings transparency and corporate cash holdings is negative and statistically significant after account for the impact of governance measures under different regression specifications. The results are similar when use cash over total assets as dependent variable.

Table 9 Regression estimates accounting for corporate governance measures

The table presents estimates results from regressions explaining firm level cash holdings when corporate governance are accounted for. The sample includes observations available both in COMPUSTAT and CRSP. The data requirements and the control variables are described in 'sample' and 'variable description' section. All variables are winsorized by 1% and 99%. The dependent variable is log of cash over net assets. In Columns (1) and (2), the governance measure is G-index. In Column (3), (4) and (5), the governance measure is inside ownership. In Column (6), (7) and (8), the governance measure is institutional ownership. The independent variable is 1-year lagged earnings transparency. In Column (2), (5) and (8),I control year and industry fixed effects with standard errors clustered at the firm level All other columns present estimates from OLS regressions including year and firm fixed effects with standard errors clustered at the firm level. The standard errors are under the coefficients. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	$\log(\frac{Cash}{NAT})$	$\log(\frac{Cash}{NAT})$	$\log(\frac{Cash}{NAT})$	$\log(\frac{Cash}{NAT})$	$\log(\frac{Cash}{NAT})$	$\log(\frac{Cash}{NAT})$	$\log(\frac{Cash}{NAT})$	$\log(\frac{Cash}{NAT})$
$Trans_{t-1}$	-0.099*	-0.302***	-0.095**	-0.105**	-0.244***	-0.111***	-0.112***	-0.221***
	(0.056)	(0.073)	(0.041)	(0.042)	(0.055)	(0.027)	(0.027)	(0.033)
$Gindex_{t-1}$		-0.025***						
		(0.009)						
Institutional $Ownership_{t-1}$		0.437		0.672***				
				(0.287)	(0.241)			
Inside $Ownership_{t-1}$							0.082	0.402***
							(0.061)	(0.057)
MB	0.112***	0.235***	0.119***	0.116***	0.190***	0.078***	0.077***	0.134***
	(0.018)	(0.018)	(0.011)	(0.011)	(0.012)	(0.007)	(0.007)	(0.007)
RealSize	-0.226***	-0.145***	-0.192***	-0.189***	-0.118***	-0.070***	-0.077***	-0.105***
	(0.051)	(0.020)	(0.032)	(0.035)	(0.015)	(0.019)	(0.020)	(0.009)
CF	0.371	-1.616***	0.314*	0.265	-0.448*	0.266***	0.270***	-0.495***
	(0.288)	(0.326)	(0.184)	(0.198)	(0.231)	(0.070)	(0.071)	(0.065)
NWCAP	-3.009***	-2.287***	-2.876***	-2.772***	-2.173***	-2.732***	-2.735***	-2.801***
	(0.220)	(0.187)	(0.167)	(0.175)	(0.148)	(0.084)	(0.084)	(0.071)
CAPX	-4.573***	-4.936***	-3.383***	-3.305***	-4.674***	-2.554***	-2.564***	-3.662***
	(0.435)	(0.529)	(0.275)	(0.292)	(0.362)	(0.136)	(0.136)	(0.163)
Leverage	-2.084***	-3.320***	-1.893***	-1.814***	-2.941***	-2.854***	-2.846***	-3.751***
	(0.187)	(0.163)	(0.137)	(0.146)	(0.131)	(0.081)	(0.081)	(0.068)
Indsigma	-0.897	2.057***	-0.039	0.007	3.155***	0.889**	0.901**	3.477***
	(0.665)	(0.770)	(0.519)	(0.575)	(0.579)	(0.356)	(0.357)	(0.365)
RD/sales	0.041	1.559***	0.452***	0.410***	1.810***	0.079***	0.079***	0.159***
	(0.114)	(0.189)	(0.112)	(0.137)	(0.193)	(0.012)	(0.012)	(0.010)
Aqc	-1.784***	-2.577***	-1.719***	-1.744***	-2.839***	-1.284***	-1.285***	-1.915***
	(0.191)	(0.214)	(0.118)	(0.119)	(0.155)	(0.087)	(0.087)	(0.104)
Divdum	-0.055	-0.284***	0.003	-0.012	-0.249***	0.045	0.044	-0.184***

my								
	(0.063)	(0.054)	(0.045)	(0.046)	(0.043)	(0.028)	(0.028)	(0.027)
Constant	-0.353	-0.533***	-0.716***	-0.143	-0.702***	-0.768***	-0.752***	-0.639***
	(0.317)	(0.181)	(0.194)	(0.291)	(0.152)	(0.098)	(0.099)	(0.086)
Year	Y	Y	Y	Y	Y	Y	Y	Y
Firm	Y	Y	Y	Y	Y	Y	Y	Y
N	12,453	12,453	23,058	20,789	20,789	77,223	77,223	77,223
adj. R-sq	0.807	0.493	0.781	0.789	0.506	0.754	0.754	0.453

1.4.4.3 Multinational Diversification

The U.S. tax code binds firms to pay extra taxes when they repatriate foreign earnings from lower tax ratio countries, therefore U.S. firms would rather to hold earnings abroad in form of foreign cash holdings if there are repatriation taxes, suggesting a positive relation between cash holdings and repatriation taxes (Fritz Foley et al. (2007)). Foreign earnings and domestic earnings are valued differently. Bodnar and Weintrop (1997) and Christophe (2002) find that the value relevance of foreign earnings in form of ERCs (earnings return coefficient) is higher than the value relevance of domestic earnings. Therefore, it may be that the relation of earnings transparency and cash holdings could be caused by repatriation tax costs. Although to my knowledge, there's no literature on the direct relation between earnings transparency and its geography distribution, to make the results more convincing, I run the main regressions using sample with only domestic firms to exclude the influence of foreign sales. And compare the results to results with multinational firms (hereafter, MNCs). Firms are identified as domestic firms or MNCs following the approach of Pinkowitz, Stulz, and Williamson (2016). “Domestic firms” are firms with no foreign sales firms in the current and previous 3 years. MNCs are firms with more than 25% of its sales coming from outside its home country in any of the prior 3 years. The results are shown in table 10. Column (1) and column (2) are estimates for domestic firms. Column (1) and

column (2) are estimates for multinational firms. The dependent variable is cash over total assets in column (1) and (3). The dependent variable is log of cash over net assets in column (2) and (4). All estimates are made with OLS regression. The results show that the coefficient of earnings transparency is negative and significant no matter which subsample is used. What's more, there is little difference in the magnitude of the effect between these two subsamples. These evidences indicate that the effect of earnings transparency on cash holdings is not dominated by whether firms are domestic or multinational.

Table 10 Regressions of corporate cash holdings on earnings transparency within domestic and multinational subsamples

This table presents estimates from regressions explaining firm level cash holdings within domestic firms and MNCs. "Domestic firms" are firms with no foreign sales firms in the current and previous 3 years. MNCs are firms with more than 25% of its sales coming from outside its home country in any of the prior 3 years. The sample includes observations available both in COMPUSTAT and CRSP from 1980 to 2013. The data requirements and the control variables are described in sample and variable description section. All variables are winsorized at 1% and 99% level. Columns (1) and (2) are for domestic firms; column (3), (4) are for MNCs. For columns (1) and (3), the dependent variable is measured as cash divided by total assets. For columns (2) and (4), the dependent variable is the log of cash over net assets. The independent variable is 1-year lagged earnings transparency. All regressions are OLS regressions including year and firm fixed effects. Standard errors are clustered at the firm level. Robust standard errors are under coefficients. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

	Domestic Firms		MNCs	
	(1)	(2)	(3)	(4)
Variables	Cash/AT	$\log(\frac{Cash}{NAT})$	Cash/AT	$\log(\frac{Cash}{NAT})$
$Trans_{t-1}$	-0.014***	-0.107**	-0.014**	-0.165***
	(0.005)	(0.051)	(0.006)	(0.052)
MB	0.004***	0.044***	0.010***	0.075***
	(0.002)	(0.014)	(0.002)	(0.012)
RealSize	0.012***	0.043	-0.005	-0.105***
	(0.004)	(0.040)	(0.005)	(0.038)
CF	0.045***	0.562***	0.030	0.278*
	(0.016)	(0.133)	(0.022)	(0.156)
NWCAP	-0.346***	-2.933***	-0.321***	-2.440***
	(0.016)	(0.147)	(0.021)	(0.178)
CAPX	-0.259***	-2.008***	-0.473***	-3.035***
	(0.019)	(0.195)	(0.040)	(0.341)
Leverage	-0.273***	-3.180***	-0.200***	-2.256***
	(0.014)	(0.147)	(0.018)	(0.160)
Indsigma	0.017***	0.087***	0.050***	0.274***
	(0.004)	(0.025)	(0.017)	(0.087)
RD/sales	-0.175***	-0.988***	-0.230***	-1.514***
	(0.016)	(0.194)	(0.018)	(0.159)
Aqc	-0.114	0.344	-0.021	0.022

	(0.071)	(0.732)	(0.066)	(0.701)
Divdummy	0.004	0.053	0.010	0.006
	(0.004)	(0.053)	(0.007)	(0.064)
Constant	0.370***	-0.668	0.310***	-0.244
	(0.096)	(1.072)	(0.038)	(0.289)
Year	Y	Y	Y	Y
Firm	Y	Y	Y	Y
N	25,621	25,621	15,265	15,265
adj. R-sq	0.832	0.778	0.828	0.800

1.4.4.4 Other Information Asymmetry Measures

Since earnings transparency affects cash holdings through the costs of equity due to information asymmetry related to earnings, it is natural to ask how the information asymmetry related to earnings differs from other information asymmetry measures in affecting cash holdings.

Chung, Kim, Kim and Zhang (2015) use different information asymmetry measures to test the effect of information asymmetry on corporate cash holdings. The measures include PIN, price impact, adverse selection components of the spread, dispersion of analysts' earnings forecasts and the number of analysts. They find that these information asymmetry measures has a negative effect on cash holdings, that is, firms with higher information asymmetry tend to hold less cash. The idea is that when information asymmetry is high, the shareholders may not want managers to hold large amount of cash because it is costly for them to monitor managerial actions. Different from the measures of information asymmetry above, earnings transparency is a proxy for the information asymmetry related to earnings. And different from their paper, it is found in this paper that earnings transparency has a negative effect on cash. Since both earnings transparency and the measures above are proxy of information asymmetry, I include bid-ask spread and numbers of analysts to see whether the effect of earnings transparency on cash holdings still hold. Table 11 shows the results that

when bid-ask spread and numbers of analysts are controlled, the coefficient of earnings transparency is still negative and significant.

Table 11 Regression estimates controlling information asymmetry

This table reports the results of regression cash on earnings transparency when information asymmetry measures, including bid-ask spread and number of analysts are controlled. The dependent variable is the natural log of cash over net assets. The independent variable is 1-year lagged earnings transparency. B-A spread is annualized bid ask spread. #Analyst is the number of analysts following a firm. Other controls are the same as defined in previous tables. All regressions are OLS regressions including year and firm fixed effects. Standard errors are clustered at the firm level. Robust standard errors are under coefficients. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

	(1)	(2)	(3)
VARIABLES	log(Cash/Nat)	log(Cash/Nat)	log(Cash/Nat)
$Trans_{t-1}$	-0.083**	-0.071**	-0.083***
	(0.033)	(0.032)	(0.025)
B-A spread	-0.050***	-0.060***	
	(0.017)	(0.012)	
#Analyst	-0.002		-0.008***
	(0.002)		(0.002)
MB	0.067***	0.059***	0.067***
	(0.007)	(0.006)	(0.005)
RealSize	-0.167***	-0.150***	-0.044**
	(0.028)	(0.024)	(0.018)
CF	0.210***	0.179**	0.236***
	(0.077)	(0.072)	(0.060)
NWCAP	-2.178***	-2.100***	-2.216***
	(0.116)	(0.109)	(0.077)
CAPX	-2.315***	-2.309***	-1.981***
	(0.221)	(0.200)	(0.127)
Leverage	-1.600***	-1.942***	-2.529***
	(0.104)	(0.099)	(0.074)
Indsigma	0.554	0.903**	0.923***
	(0.451)	(0.438)	(0.324)
RD/sales	0.023***	0.019***	0.032***
	(0.007)	(0.007)	(0.007)
Aqc	-1.206***	-1.058***	-0.955***
	(0.096)	(0.095)	(0.083)
Divdummy	-0.012	0.052	0.032
	(0.038)	(0.037)	(0.026)
Constant	-0.630***	-0.799***	-1.469***
	(0.206)	(0.177)	(0.123)
Year	Y	Y	Y
Firm	Y	Y	Y
N	32,523	38,209	73,466
adj. R-sq	0.800	0.786	0.725

1.5 Heterogeneity Effect of Earnings Transparency on Cash Holdings

The tests above show that the effect of earnings transparency on cash holdings is significantly negative, providing support of hypothesis 1. To identify the 'precautionary motive' channel, hypothesis 1a further states the heterogeneity in the impact of earnings transparency on cash holdings, that is, the effects are more pronounced in firms that are more sensitive to costs of capital. As discussed in the hypothesis part, these firms are usually with higher market to book ratio, more R&D expenses and more financial constraints.

To conduct the heterogeneity tests, in each year, the sample is divided into two subsamples based on market-to-book ratio, R&D over sale ratio and financial constraints measures respectively. A firm is assigned as a high growth (low growth firm) firm if its market-to-book ratio is higher (lower) than the market-to-book ratio of the firm at the 70th (30th) percentile of the annual market-to-book ratio distribution. Similarly, a firm is assigned as a high R&D expenditure (low R&D expenditure) firm if R&D over sale ratio is higher (lower) than the R&D over sale ratio of the firm at the 70th (30th) percentile of the annual R&D over sale ratio distribution. I use six financial constraints measures: dividend payout ratio, firm size (sales adjusted to 1994 dollars), bond rating, commercial paper rating, SA index (Hadlock and Pierce (2010)), WW index (Whited and Wu (2006)). Specifically, the firms are grouped as financial constrained firms if dividend (previous year sales) is less than the 30th percentile value, and are grouped as financial unconstrained firms if dividend (previous year sales) is higher than the 70th percentile value. The firms are grouped as financial constrained firms if SA index (WW index) is less than the 30th percentile value, and are grouped as financial unconstrained firms if SA index (WW index) is

higher than the 70th percentile value. And the firms are grouped as financial constrained firms if firms with positive debt do not have a bond rating (commercial paper rating), and are grouped as financial constrained firms if firms with positive debt have a bond rating (commercial paper rating).

Table 12 Heterogeneity in firms with different growth options and R&D expenses

This table reports the estimates from cross-section regressions explaining firm level cash holdings using growth and RD expenditure subsamples. The sample includes observations available both in COMPUSTAT and CRSP from 1980 to 2013. The data requirements and the control variables are described in 'sample' and 'variable description' section. All variables are winsorized by 1% and 99%. The growth subsamples are grouped based on market-to-book ratio. A firm is assigned as a high growth (low growth firm) firm if MB is higher (lower) than the MB of the firm at the 70th (30th) percentile of the annual MB distribution. Similarly, a firm is assigned as a high R&D expenditure (low R&D expenditure) firm if RD/Sales is higher (lower) than the RD/Sales of the firm at the 70th (30th) percentile of the annual RD/Sales distribution. Column (1) and column (2) are results of growth subsamples. Column (3) and column (4) are results of RD expenditure subsamples. The dependent variable in all regressions is the natural log of cash over net assets. The independent variable is 1-year lagged earnings transparency. All columns present estimates from OLS regressions including year and firm fixed effects with standard errors clustered at the firm level. The standard errors are under the coefficients. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)
	Market to book ratio		RD/Sales	
	Low Growth	High Growth	Low R&D	High R&D
Variables	$\log(\frac{Cash}{NAT})$	$\log(\frac{Cash}{NAT})$	$\log(\frac{Cash}{NAT})$	$\log(\frac{Cash}{NAT})$
$Trans_{t-1}$	-0.045	-0.179***	-0.076**	-0.124***
	(0.058)	(0.048)	(0.038)	(0.047)
MB	0.434***	0.046***	0.106***	0.059***
	(0.098)	(0.007)	(0.016)	(0.007)
RealSize	-0.067*	0.011	-0.132***	0.017
	(0.039)	(0.031)	(0.028)	(0.030)
CF	-0.044	0.241**	0.183	0.309***
	(0.199)	(0.103)	(0.138)	(0.089)
NWCAP	-2.700***	-2.748***	-2.598***	-2.893***
	(0.157)	(0.148)	(0.128)	(0.130)
CAPX	-2.130***	-3.746***	-2.085***	-3.327***
	(0.258)	(0.243)	(0.172)	(0.247)
Leverage	-3.291***	-2.413***	-2.637***	-2.768***
	(0.153)	(0.141)	(0.113)	(0.143)
Indsigma	0.248	0.304	1.250***	-1.086
	(0.725)	(0.688)	(0.472)	(0.767)
RD/sales	0.189**	0.068***		0.068***
	(0.095)	(0.012)		(0.010)
Aqc	-0.828***	-2.619***	-0.873***	-2.122***
	(0.183)	(0.179)	(0.124)	(0.147)
Divdummy	0.049	0.056	0.047	0.055
	(0.043)	(0.060)	(0.037)	(0.057)
Constant	-1.337***	-0.709***	-1.169***	-0.447***
	(0.170)	(0.115)	(0.110)	(0.113)
Year	Y	Y	Y	Y
Firm	Y	Y	Y	Y
N	23,719	23,719	39,976	23,719
adj. R-sq	0.768	0.809	0.700	0.794

Table 13 Regression estimates across groups of financially constrained and unconstrained firms

This table presents regression estimates across groups of financially constrained and unconstrained firms. I use letter (C) for constrained firms and (U) for unconstrained firms. The whole sample includes observations available both in COMPUSTAT and CRSP from 1980 to 2013. The dependent variable is natural log of cash over net assets. The independent variable is 1-year lagged earnings transparency. All variables are calculated the same as in previous tables. All regressions are specified as OLS regressions with year and firm fixed effects with standard errors are clustered at firm level. The standard errors are under the coefficients. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

	Payout Ratio		sale		Bond Rating		Commercial Paper Rating		SA Constrain		WW Constrain	
	UC	C	UC	C	UC	C	UC	C	UC	C	UC	C
$Trans_{t-1}$	-0.053	-0.173***	-0.071	-0.099*	-0.083	-0.085**	0.017	-0.099***	-0.086**	-0.158***	-0.080*	-0.113*
	(0.051)	(0.048)	(0.045)	(0.058)	(0.051)	(0.040)	(0.082)	(0.034)	(0.043)	(0.061)	(0.043)	(0.063)
MB	0.109***	0.066***	0.101***	0.053***	0.133***	0.090***	0.067*	0.107***	0.115***	0.038***	0.108***	0.035***
	(0.018)	(0.009)	(0.020)	(0.009)	(0.023)	(0.009)	(0.035)	(0.009)	(0.018)	(0.009)	(0.020)	(0.009)
RealSize	-0.158***	-0.003	-0.255***	0.131***	-0.349***	-0.014	-0.221***	-0.077***	-0.226***	0.092**	-0.304***	0.031
	(0.041)	(0.025)	(0.035)	(0.034)	(0.041)	(0.029)	(0.079)	(0.025)	(0.035)	(0.041)	(0.034)	(0.033)
CF	-0.514**	0.148	-0.259	0.103	-0.400	0.205**	-1.071	0.186**	0.143	0.218**	-0.412	0.148
	(0.238)	(0.092)	(0.270)	(0.097)	(0.291)	(0.097)	(0.657)	(0.093)	(0.214)	(0.094)	(0.284)	(0.096)
NWCAP	-3.517***	-2.355***	-3.037***	-2.392***	-2.584***	-2.646***	-2.658***	-2.551***	-3.205***	-2.619***	-3.276***	-2.306***
	(0.187)	(0.113)	(0.183)	(0.140)	(0.227)	(0.120)	(0.417)	(0.110)	(0.164)	(0.140)	(0.174)	(0.142)
CAPX	-3.771***	-2.019***	-3.570***	-2.091***	-2.913***	-2.324***	-5.150***	-2.291***	-3.674***	-1.948***	-3.408***	-1.952***
	(0.287)	(0.196)	(0.322)	(0.224)	(0.329)	(0.198)	(0.819)	(0.173)	(0.259)	(0.239)	(0.288)	(0.238)
Leverage	-2.645***	-3.066***	-2.260***	-3.636***	-1.486***	-2.882***	-2.648***	-2.408***	-2.185***	-3.793***	-2.468***	-3.396***
	(0.154)	(0.115)	(0.154)	(0.156)	(0.173)	(0.114)	(0.333)	(0.096)	(0.140)	(0.164)	(0.147)	(0.155)
Indsigma	0.377	0.965*	0.192	1.135	0.043	1.165**	0.470	0.855**	0.384	1.614*	0.098	0.978
	(0.599)	(0.581)	(0.549)	(0.808)	(0.587)	(0.513)	(0.866)	(0.427)	(0.498)	(0.882)	(0.518)	(0.724)
RD/sales	0.557	0.082***	0.159	0.073***	-0.003	0.078***	0.657	0.072***	0.206***	0.067***	-0.045	0.076***
	(0.500)	(0.016)	(0.362)	(0.015)	(0.048)	(0.017)	(0.858)	(0.015)	(0.051)	(0.012)	(0.062)	(0.013)
Aqc	-1.721***	-1.219***	-1.383***	-1.456***	-0.946***	-1.125***	-1.516***	-1.063***	-1.384***	-1.469***	-1.264***	-1.751***
	(0.195)	(0.147)	(0.159)	(0.209)	(0.148)	(0.121)	(0.296)	(0.100)	(0.135)	(0.251)	(0.140)	(0.246)
Divdummy	-0.082	0.054	-0.034	0.172***	-0.080	0.132***	-0.061	0.050	0.034	0.108*	-0.071	0.158**
	(0.053)	(0.053)	(0.046)	(0.058)	(0.056)	(0.042)	(0.150)	(0.035)	(0.046)	(0.060)	(0.049)	(0.072)
Constant	-0.316*	-1.091***	-0.135	-1.129***	0.268	-1.194***	-0.060	-1.111***	0.117	-1.380***	1.126***	-1.245***
	(0.190)	(0.107)	(0.201)	(0.139)	(0.272)	(0.118)	(0.597)	(0.112)	(0.295)	(0.223)	(0.309)	(0.194)
Year	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
N	22,338	33,941	23,719	23,719	16,450	36,632	5,435	47,647	26,563	19,830	24,740	21,961
adj. R-sq	0.783	0.792	0.740	0.813	0.709	0.774	0.701	0.750	0.690	0.832	0.703	0.812

The results of subsample analysis are reported in table 11 and table 12. To save space, I only tabulate the results with the log of cash over net assets as the dependent variable. The results are quite similar when use cash over total assets as dependent variable. In table 11, Columns (1) and (2) present the results based on subsamples sorted by market-to-book ratio; columns (3) and (4) present the results for subsamples based on R&D expenses. It is found that the impacts of earnings transparency are stronger in high growth firms and in firms with more R&D expenditure. In column (3), because low R&D group are all constituted by firms without any R&D expenditure, the coefficient of R&D is shown as missing. The economic magnitude is also larger for firms with more growth opportunity and more R&D expenditures. Table 12 reports the results of how financial constraint affects earnings transparency-cash holding relation. It is shown that the effects of earnings transparency are much stronger for financial constrained firms based on almost all the six proxies. These results support the hypothesis 1a[4].

1.6 The Value of Cash Holdings and Earnings Transparency

I finally test how earnings transparency affects the value of cash. Faulkender and Wang (2006) find that the marginal value of cash depends on the potential distribution of cash. The possible distributions of cash include: 1) paying dividends, 2) servicing debt or other liabilities and 3) raising cash. They empirically show that cash increases firm value only when it is raised for immediate use. And they find that cash values more when firms have less cash, less leverage, more investment opportunities and more financial constraints. Based on their paper, if the main hypothesis in this paper is accurate, cash held by firms with lower earnings transparency have a higher value. The reason is that

[4] When I use 50% threshold and 40%, 60% threshold to get the subsamples, similar results are obtained.

firms with lower earnings transparency hold more cash in order to avoid high costs of equity, which is the 'raising cash' type distribution in Faulkender and Wang (2006). Following the methodology of their paper, I test the relation between value of cash holdings and earnings transparency using the model below:

$$\begin{aligned} r_{i,t} - R^{B}_{i,t} = {} & r_0 + r_1 * Trans_{i,t-1} + r_2 * Trans_{i,t-1} * \frac{\Delta C_{i,t}}{M_{i,t-1}} + r_3 * \frac{\Delta C_{i,t}}{M_{i,t-1}} + r_4 \\ & * \frac{\Delta E_{i,t}}{M_{i,t-1}} + r_5 * \frac{\Delta NA_{i,t}}{M_{i,t-1}} + r_6 * \frac{\Delta RD_{i,t}}{M_{i,t-1}} + r_7 * \frac{\Delta I_{i,t}}{M_{i,t-1}} + r_8 * \frac{\Delta D_{i,t}}{M_{i,t-1}} \\ & + r_9 * \frac{C_{i,t-1}}{M_{i,t-1}} + r_{10} * \frac{L_{i,t}}{M_{i,t-1}} + r_{11} * \frac{C_{i,t-1}}{M_{i,t-1}} * \frac{\Delta C_{i,t}}{M_{i,t-1}} + r_{11} * \frac{L_{i,t}}{M_{i,t-1}} \\ & * \frac{\Delta C_{i,t}}{M_{i,t-1}} + \varepsilon_{i,t} \qquad (4) \end{aligned}$$

,where C denotes for cash, E for earnings, NA for net assets, RD for research and development, I for interest, D for dividends, L for leverage, M for market value, ΔX for the changes in the variable X. The dependent variable is the excess stock return (the stock return adjusted by the return of Fama French 25 portfolios based on BM ratio and size). The variable of interest is r_2. All these variables are constructed following Faulkender and Wang (2006).

Table 14 Earnings transparency and the marginal value of cash holdings

This table presents the results of regressions of the excess stock return on changes in firm characteristics. All variables except L_t, excess stock return and earnings transparency are deflated by the lagged market value of equity (M_{t-1}). C_t is cash plus marketable securities, E_t is earnings before extraordinary items plus interest, deferred tax credits, and investment tax credits, and NA_t is total assets minus cash holdings. I_t is interest expense. Total dividends (D_t) are measured as common dividends paid, L_t is market leverage. ΔX_t is compact notation for the 1-year change, $X_t - X_{t-1}$. The subscript t means the value of the variable is at the end of fiscal year t. All columns present estimates from OLS regressions including year and firm fixed effects with standard errors clustered at the firm level. The standard errors are under the coefficients. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

	(1)	(2)
Variables	$r_{i,t} - R^B_{i,t}$	$r_{i,t} - R^B_{i,t}$
$Trans_{t-1}$	-0.148***	-0.132***
	(0.013)	(0.013)
$Trans_{t-1}*\Delta C_t$		-0.742***
		(0.147)
ΔC_t	0.822***	1.634***
	(0.031)	(0.094)
ΔE_t	0.511***	0.509***
	(0.018)	(0.018)
ΔNA_t	0.205***	0.203***
	(0.009)	(0.009)
ΔRD_t	0.696***	0.706***
	(0.199)	(0.197)
ΔI_t	-1.199***	-1.182***
	(0.132)	(0.132)
ΔD_t	0.900***	0.913***
	(0.217)	(0.216)
C_{t-1}	0.538***	0.519***
	(0.025)	(0.025)
L_t	-0.854***	-0.842***
	(0.019)	(0.019)
$C_{t-1}*\Delta C_t$		-0.562***
		(0.092)
$L_t*\Delta C_t$		-0.997***
		(0.101)
Constant	0.133***	0.118***
	(0.014)	(0.014)
Year	Y	Y
Firm	Y	Y
N	56,249	56,249
adj. R-sq	0.317	0.325

Table 13 presents the estimations. The coefficient of earnings transparency is negative and significant, suggesting that firms with higher earnings transparency tend to have lower abnormal subsequent return and vice versa, consistent with BKL (2013). The coefficient of the interaction term of earnings transparency and cash holdings is negative, suggesting that the marginal value of cash is higher in

firms with lower earnings transparency and vice versa. This result indirectly verifies the main results that firms with lower earnings transparency hold more cash for precautionary motive.

1.7 Conclusion

In this paper, I provide a new determinant of cash holdings by investigating how earnings transparency affects corporate cash holdings. Earnings transparency is a new measure of earnings informativeness and is first proposed by BKL (2013). It is calculated as the adjusted R^2 of regressing stock return on earnings and change in earnings. Higher R^2 means higher explanation, indicating that larger part of stock return could be explained by the information contained in earnings. BKL (2013) further find that firms with higher earnings transparency are expected to be able to raise external financing with a lower cost because earnings transparency could reduce information asymmetries between management and investors. Since one important reason that firms hold cash is to protect firms from capital shortfall, firms that can raise capital at lower cost are expected less likely to be in trouble of capital dilemma and hence hold less cash, suggesting a negative relation between earnings transparency and cash holdings. This paper empirically verifies this argument. To address the endogeneity problem, I identify four omitted variables: accounting-based earnings quality, corporate governance, multinational diversification and information asymmetry measures such as bid-ask spread and number of analysts. I controlled these variables in the regression, finding that the main results are not significantly influenced. Additionally, the effect of earnings transparency on cash holdings is caused by precautionary motives of firms holding cash. This can be supported by the following evidence. First, this effect is stronger among firms with more growth opportunities, more R&D expenses and

more financial constraints. Second, the marginal value of cash holdings is higher in firms with lower earnings transparency.

Since the information environment is changing across time, it is interesting to know how the effect of earnings transparency on cash holdings changes. The SOX Act mandated strict reforms to improve financial disclosures from corporations and prevent accounting fraud. So SOX could improve earnings transparency and enhance the information environment of firms. I did the test and the results are shown in Appendix C. It shows that the effect is more pronounced before 2002. The coefficient of Trans is negative and significant before 2002, and it is not significant at all after 2002. The reason maybe that since the earnings transparency is improved, it would not be an important factor for the investors to take into account to price firms' stock. Or it is because that the earnings information is less important than before because there are more and more sources to get firm specific information.

The limitation of this study is that the endogeneity problem is not well addressed. Because earnings transparency is quite abstract and there is few literature on this area, the determinants of earnings transparency is not well defined and it is not easy to find some exogenous variable or shock to address the endogeneity problem.

Chapter 2: Is Cash-Return relation risk induced?

2.1 Introduction

In the paper of Palazzo [2012, Cash holdings, risk, and expected returns, Journal of Financial Economics, 104(1), 162-185], a relation between cash holdings and expected return is built based on the precautionary motivation for firms to hold cash. The idea of his paper is that firms save assets as cash to avoid the costly external funding when cash flow is highly positively correlated with aggregate shocks, indicating firms tend to hold cash to hedge on risk (higher correlation between cash flow and aggregate shocks) and hence firms with more cash have higher subsequent returns to compensate on this risk. Empirically he shows the spread return of portfolios sorted by cash cannot be fully explained by Fama French three factors, suggesting that the risk captured by cash holdings is different from market systematic risk, small size risk and low value risk. His paper indicates cash can serve as a risk proxy (Simutin, 2010). However, although the paper does provide evidence that cash holdings can explain cross sectional variations in stock returns, whether this relation is risk induced is not sophisticatedly evidenced.

Besides the rational asset pricing theory, behaviour finance is another important strand to explain the variation in stock returns. Researchers have found some anomalies with respect to accounting information, such as accrual anomaly (e.g., Sloan, 1996) and net operating assets (e.g., Hirshlefer et al., 2004), cannot be explained by rational theories. Instead, these anomalies are found to be attributed to mispricing caused by investors' limits of attention on the information contained in these financial numbers. Cash is also a kind of financial information. From perspective of corporate finance, the amount of cash held by firms is subject to

two important reasons: financial constraints (e.g., Almeida, 2004) and agency problems (e.g., Jensen, 1986). The financial constraint story indicates positive impacts of large cash holdings, while the agency problem story indicates negative impacts. If the market participants cannot interpret the information indicated by cash precisely, they would misprice the stock, resulting in anomalies in subsequent periods when the mispricing is corrected.

There are recently two papers trying to explain cash-return relation through mispricing channel. The ideas in these two papers are quite similar: investors overreact on the agency problems captured by high cash holdings and underestimate the stock value, so buying stocks with high cash holdings will get high subsequent stock returns. The first paper is by Li and Luo (2016), finding that cash-return relation is heavily influenced by investor sentiment since the relation is more pronounced after high sentiment periods and that cash-return relation is stronger when limits-to-arbitrage measured by transaction costs, institutional ownership and idiosyncratic volatility is higher. The second paper is the working paper by Lam et al. (2016) who find that cash-return relation is a surrogate for knowing mispricing and support a mispricing channel how cash holdings and stock returns are correlated. First, they find that the return predictability in cash holdings is subsumed by accruals and profitability effects and also by net operating assets effect. Second, they find that the positive relation strengthens when limits to arbitrage is more severe, indicating that cash-return relation is stronger within firms with severe mispricing phenomenon.

The above two papers, especially the latter one, contradict with Palazzo's paper since if cash can serve as a proxy for systematic risk, the predictability of cash on stock return should not be subsumed by any other variables. Therefore, whether

returns on high cash holdings are compensation of systematic risk is actually in debate. However there are very few papers to dissect the cash-return relation in the existing literature. Whether cash-return relation is risk induced is still an open empirical question. This paper tries to fill this gap by exploring the ability of cash to serve as a risk proxy using a systematic way that researchers have developed.

The controversy about whether it is the risk or the equity characteristics that explains expected returns for a specific anomaly has been studied since 1990s. For example, Daniel and Titman (1997) argue that it is the size and book-to-market characteristics rather than the loadings on SMB and HML that affect expected returns. Davis et al. (2000) find that risk factors explain expected returns better than characteristics when the sample periods is large and their test covers period from 1926 to 1997, compared to that of Daniel and Titman's (1997) which covers from 1963 to 1997. Core et al. (2008) test whether the accruals quality is a priced risk factor. Mohanram et al. (2009) test whether PIN factor is priced. Hirshleifer et al. (2012) test whether the accrual anomaly is because of risk or mispricing. The methodologies used to test whether a factor is a risk factor are quite mature and systematic.

Following these papers, I use several common used methods to test whether CASH can serve as a risk proxy in explaining the cross sectional variations of stock returns. First, I construct the cash factor, LMS (large amount minus small amount), by taking a long position on firms with large amount of cash holdings and taking a short position on firms with small amount of cash holdings. The mean monthly time-series premium for the LMS of 0.27% and is statistically different from zero with a significance level of 95%.

Then I use a two-stage cross sectional regression method (2SCSR). In the first stage, it estimates factor betas and in the second stage, estimates the factor risk premiums. Under the rational factor pricing explanation of cash holding anomaly, expected returns are determined by a stock's cash factor loadings. If cash affects stock returns because of systematic risk it captures, the risk premium on cash factor loadings should be positive and significant. However, it is found that the coefficient on LMS loadings is positive but is not significant.

In addition to the 2SCSR tests, I also use several other approaches that are used in the literature. One such test is to examine whether LMS can predict future GDP growth. This methodology have been used by Chen (1991), Liew and Vassalou (2000), Chordia and Shivakumar (2006) and Mohanram and Rajgopal (2009) to test whether the Fama–French factors, price momentum and PIN are proxies for risk factors. Since GDP growth contains information of investment opportunities of the whole economy, if a risk factor represents the premium on systematic risk, i.e., compensation on the risk to the whole economy rather than some particular firms or industries, it should have a positive association with future GDP growth rate. However, in the context of this paper, the results show that there's no such association between LMS and GDP growth rate.

At last, I test whether LMS or LMS loadings affect the expected costs of capital. Compare with subsequent realized stock returns, ex-ante expected costs of capital are estimated using existing accounting information. Since ex-ante costs of capital have shown to be positively related to risk, correlation between LMS or LMS loadings and ex-ante costs of equity is a necessary condition to conclude that LMS and LMS loadings reflect systematic risk. Again, I couldn't find empirical evidence of this.

Overall, I interpret these results shown in this paper as documenting that based on the tests of rational asset pricing framework, cash cannot serve as a proxy of systematic risk.

This paper shed lights on the literature of cash anomaly. The topic on how cash holdings affect expected returns has drawn considerable attentions in the past several years. Excess cash holdings (Simutin, 2010), the level of cash holdings (Palazzo, 2012) and the change in cash holdings (Sodjahin, 2013) are found to have a positive relation with expected stock returns. Specifically, Simutin (2010) find that as a proxy for unexpected investment growth option, excess cash is positively associated with expected returns. Palazzo (2012) develops a rational model to show the positive relation between cash holdings and expected returns based on its relation with cash flow risk. Sodjahin (2013) argues that the change in cash holding is a proxy of the coming investment opportunity and the high return is a compensation for the risk that accompanies the new investment opportunity. Although they try to explain cash-return relation from a perspective of rational asset pricing theory that firms hold cash for future investment options, they didn't provide solid evidence on this with reasonable asset pricing methods. What's more, there are papers shown that cash-return relation is caused by investors' misinterpretation of the information contained in cash holdings (Li and Luo 2016, Lam et al. 2016). In this study, I explore in further by asking whether there is a pervasive systematic factor with respect to cash holdings directly associated with return variability.

In the next section, I describe the sample and replicate table 4 and table 5 in Palazzo's paper. Section 3 reports the construction of LMS factor and its correlation with existing Fama and French factors. Section 4 shows the results of

two-stage cross sectional regressions. Section 5 tests the correlation between cash and future GDP growth. Section 6 reports the relation between ex-ante cost of equity and LMS/LMS loading. Section 7 concludes.

2.2 Replication and Extension of Palazzo's paper

2.2.1 Data and Variables

Stock price, stock return and shares of common outstanding are taken from Center for Research in Securities Prices (CRSP) monthly return file; quarterly financial data are obtained from Compustat Quarterly; monthly risk-free interest rate, the three Fama French factors (R_M-R_F, SMB, and HML) and momentum factor returns (UMD) are gotten through Kenneth French's website. The sample is based on all NYSE/AMEX and NASDAQ firms with available data from both CRSP and Compustat quarterly with a period from July 1972 to December 2015. I filter and merge the datasets following the criteria below, most of which is borrowed from Palazzo's paper (Plazzo, 2012): 1) the data from CRSP and Compustat Quarterly are merged by PERMNO; 2) the first six digits of Compustat Committee on Uniform Security Identification Procedures (CUSIP) must be same with the first six digits of the CRSP CUSIP code or the CRSP name CUSIP (NCUSIP) code; 3) only ordinary common shares (share codes 10 and 11 in CRSP) are considered; 4) observations related to suspended, halted, or non-listed shares (exchange codes lower than 1 and higher than 3 are excluded) ; 5) stocks in the sample should have reported returns for at least 24 months in 5 years prior to portfolio formation; 6) utility firms (SIC codes between 4900 and 4949) and financial firms (SIC codes between 6000 and 6999) are excluded; 7) observations with a negative book-to-market ratio or a negative cash-to-assets ratio are excluded from the sample.

For the measurements, cash holding is calculated as cash and short term investments (item CHE) over total assets (item AT). Size is the market value of stock at portfolio formation. Book equity is stockholder's equity (item SEQQ), or common equity (item CEQQ) plus preferred stock par value (item PSTKQ), or asset (item ATQ) minus liabilities (item LTQ)) plus balance sheet deferred taxes and investment tax credit(item TXDITCQ) minus the book value of preferred stock (item PSTKRQ, or PSTKQ if PSTKRQ is not available). The book to-market ratio is calculated by dividing book equity by market capitalization measured at portfolio formation. Return is adjusted using delisting return on delisting day.

2.2.2 Replication of Palazzo's paper

To make this study comparable to Palazzo's, in this section, I replicate the results of the portfolio characteristics and spread of return by one-way sort (table 3 and table 4) in his paper. Palazzo (2012) shows that cash holdings could explain the cross sectional variation in excess return that cannot be explained by existing models such as classic capital asset pricing model (CAPM), Fama and French (1992) three factor model.

In particular, in table 3, Palazzo uses data over the periods from July 1972 to December 2009 and classifies the sample into 10 deciles in each month based on cash over total assets. In table 4, for portfolio construction, instead of rebalancing annually with annual accounting data, he constructs the portfolios based on quarterly accounting data. Following his paper, I use the quarterly accounting data available in month t in portfolio sorts starting at time t+i+1 if there has been an earnings announcement (item RDQ) in month t+i. For example, the first fiscal quarterly financial report (end in March) is announced on May 20, year t, then

these data are used to form portfolios starting from June, year t. I don't require i to be 1, 2 or 3 in order to make the sample more continuous in monthly frequency. For example, the first fiscal quarterly financial report (end in March) is announced on July 20, year t, then these data are used to form portfolios starting from August, year t, although the interval between March to August is 5 months. If RDQ is missing, I use the accounting data from the latest fiscal quarter that at least six months prior to portfolio formation. If financial reports of two consecutive quarters are announced in the same month, I will use the latest quarter to sort the portfolio. For example, the financial reports of the first and second fiscal quarter in year t are announced on July 5, year t and July 20, year t, then I'll use the information of the second quarter to sort the portfolio which starts in August, year t.

I first show the results based on a period exactly same with Palazzo's, i.e. from July 1972 to December 2009. Then I extend the sample period to 2015 since more data are available now and moreover this also could test the robustness and pervasiveness of the positive relation between return and cash holdings.

Table 1 Characteristics of the ten cash-to-assets portfolios

This table reports the average and median value (in the squared brackets) of the time series value of cross sectional mean values of firm characteristics across the ten portfolios which are rebalanced monthly based on cash over total assets. Column (1) to column (5) is summary statistics over periods from July 1972 to December 2009, which is the same as the time window in Palazzo's paper. Column (6) to column (10) is the statistics of the period from July 1972 to December 2015. For the portfolio construction, I use the quarterly accounting data available in month t in portfolio sorts starting at time t+i+1 if there has been an earnings announcement (item RDQ) in month t+i. N is the average firm number contained in each portfolio. CAR is cash over total assets. Market size is the market value of stock at portfolio formation. Book equity is stockholder's equity (item SEQQ), or common equity (item CEQQ) plus preferred stock par value (item PSTKQ), or asset (item ATQ) minus liabilities (item LTQ)) plus balance sheet deferred taxes and investment tax credit(item TXDITCQ) minus the book value of preferred stock (item PSTKRQ, or PSTKQ if PSTKRQ is not available). The BM (book to-market ratio) is calculated by dividing book equity by market capitalization measured at portfolio formation. Beta is the post-rank beta which is calculated with full period sample. Beta is the post-rank beta following Fama and French (1992).

Portfolio	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Palazzo's paper: Jul. 1972 to Dec. 2009					My statistics: Jul. 1972 to Dec. 2015				
	N	CAR	BM	Market Size	Beta	N	CAR	BM	Market Size	Beta
1	244	0.00	1.13	832.79	1.01	234	0.00	1.09	1132.63	1.02
		0.00	1.00	587.62	0.97		0.00	0.98	759.53	1.02
2	244	0.01	1.11	1320.81	1.03	234	0.01	1.07	2079.96	1.04
		0.01	1.02	577.24	1.01		0.01	0.97	1083.30	1.04
3	244	0.02	1.10	1525.62	1.04	234	0.03	1.05	2427.21	1.06
		0.02	0.98	921.98	1.02		0.02	0.93	1491.52	1.05
4	244	0.04	1.07	1415.38	1.07	234	0.04	1.02	2136.87	1.08
		0.03	0.96	749.23	1.04		0.03	0.90	958.81	1.08
5	244	0.06	1.01	1430.08	1.08	234	0.07	0.97	2097.51	1.10
		0.05	0.92	858.42	1.06		0.05	0.87	1071.79	1.11
6	244	0.09	0.96	1581.96	1.11	234	0.10	0.91	2372.43	1.12
		0.08	0.89	755.40	1.08		0.08	0.84	1134.17	1.12
7	244	0.14	0.88	1274.50	1.16	234	0.15	0.84	2076.74	1.17
		0.13	0.80	733.26	1.11		0.13	0.76	888.96	1.14
8	244	0.21	0.82	999.07	1.20	234	0.22	0.79	1485.63	1.20
		0.20	0.72	569.60	1.11		0.21	0.69	683.50	1.13
9	244	0.32	0.74	885.47	1.25	234	0.33	0.71	1308.09	1.25
		0.31	0.65	481.64	1.12		0.32	0.61	616.92	1.16
10	244	0.55	0.66	459.47	1.28	234	0.58	0.62	762.25	1.29
		0.59	0.60	332.78	1.16		0.60	0.56	372.24	1.26

Table 1 presents the results of the summary statistics of firm characteristics. Columns from (1) to (5) are over period from July 1972 to December 2009. Compared to Palazzo's paper, all the statistics are quite similar. In particular, book to market ratio, market value are decreasing with cash holdings, while post-rank market beta is increasing with cash holdings. This is also consistent with intuition that firms with more growth options, smaller size and more risk exposure tend to hold more cash. Columns from (6) to (10) report the summary over period from July 1972 to December 2015. The correlations between cash and book to market ratio, market value, post-rank beta are identical across these two different time windows.

Table 2 Equity returns and risk-adjusted returns across the ten cash-to-assets portfolios

This table reports average monthly excess returns (Ret-R_f), average monthly market risk adjusted return (Alpha), and average monthly Fama French three-factor alphas (Alpha) of equal-weighed and value-weighted cash holding decile portfolios. Each month, all common stocks are sorted into deciles using the cash holding breakpoints of the NYSE stock sample. Panel A reports results within a period from July 1972 to December 2009 which are comparable to Palazzo (2012). Panel B are the estimates within a more recent period that is within a period from January 1980 to December 2015, which is also the sample period for the later tests. The portfolios are held for one month. Returns and alphas are in percentage terms.

Panel A Equity returns and risk-adjusted returns across the ten cash-to-assets portfolios during July 1972 to Dec. 2009

	Equally Weighted				**Value-weighted**			
	CH1	CH5	CH10	ΔCH	CH1	CH5	CH10	ΔCH
Panel A.1 Excess return								
r_i^e	0.527	0.944	1.323	0.796	0.421	0.470	0.752	0.331
$t_{r_i^e}$	1.79	3.06	3.4	3.22	1.72	1.88	1.97	1.11
Panel A.2 Market risk adjusted return								
α	0.078	0.452	0.762	0.684	0.002	0.030	0.158	0.156
t_α	0.38	2.42	2.45	2.24	0.02	0.34	0.62	0.54
β_{MKT}	1.040	1.141	1.301	0.261	0.973	1.021	1.378	0.405
$t_{\beta_{\mathrm{MKT}}}$	15.37	18.6	18.22	2.46	27.89	21.2	15.49	3.64
Panel A.3 FF three factor risk adjusted return								
α	-0.346	0.120	0.857	1.203	-0.059	-0.066	0.574	0.633
t_α	-2.79	1.14	3.48	4.21	-0.43	-0.77	2.9	2.59
β_{MKT}	1.017	1.068	0.971	-0.046	1.004	1.048	1.063	0.059
$t_{\beta_{\mathrm{MKT}}}$	27.84	29.26	17.79	-0.63	32.01	23.42	17.23	0.72
β_{SMB}	0.888	0.940	1.290	0.402	-0.029	0.056	0.622	0.650
$t_{\beta_{\mathrm{SMB}}}$	8.4	9.27	13.51	2.19	-0.37	0.84	7.63	4.48
β_{HML}	0.588	0.415	-0.408	-0.996	0.113	0.159	-0.856	-0.969
$t_{\beta_{\mathrm{HML}}}$	6.74	5.28	-4.36	-6.72	1.47	2.77	-11.87	-7.77

Panel B equity returns and risk-adjusted returns across the ten cash-to-assets portfolios during Jan. 1980 to Dec. 2015

	Equally Weighted				**Value-weighted**			
	CH1	CH5	CH10	ΔCH	CH1	CH5	CH10	ΔCH
Panel B.1 Excess return								
r_i^e	0.592	0.965	1.330	0.737	0.470	0.578	0.806	0.336
$t_{r_i^e}$	2.2	3.47	3.77	3.27	2.12	2.54	2.35	1.26
Panel B.2 Market risk adjusted return								
α	0.042	0.368	0.653	0.611	-0.037	0.041	0.097	0.134
t_α	0.22	2.19	2.38	2.24	-0.33	0.54	0.43	0.52
β_{MKT}	1.054	1.143	1.296	0.242	0.971	1.027	1.358	0.387
$t_{\beta_{\mathrm{MKT}}}$	17.31	20.73	20.26	2.55	30.81	23.75	16.95	3.87
Panel B.3 FF three factor risk adjusted return								
α	-0.300	0.118	0.759	1.059	-0.095	-0.030	0.459	0.553
t_α	-2.54	1.29	3.5	4.08	-0.78	-0.39	2.53	2.49
β_{MKT}	1.016	1.055	0.972	-0.044	1.000	1.048	1.065	0.066
$t_{\beta_{\mathrm{MKT}}}$	30.54	31.13	19.44	-0.66	34.88	25.96	19.02	0.88
β_{SMB}	0.876	0.914	1.296	0.420	-0.017	0.046	0.628	0.645
$t_{\beta_{\mathrm{SMB}}}$	8.97	9.62	14.17	2.45	-0.23	0.73	8.1	4.68

β_{HML}	0.593	0.393	-0.408	-1.001	0.124	0.143	-0.851	-0.975
$t_{\beta_{\mathrm{HML}}}$	7.25	5.29	-4.64	-7.21	1.69	2.57	-12.3	-8.22

Table 2 presents the results of the difference in excess and risk adjusted returns between top and bottom deciles for both the equally weighted and value-weighted portfolios. Panel A reports the results over period from July 1972 to December 2009. Panel A.1, A.2 and A.3 report excess return, excess returns adjusted by CAPM model and excess return adjusted by Fama and French (1992) three factor model respectively.

The results are similar to Palazzo's paper in all respects. Firstly, the difference in excess returns, excess return adjusted by CAPM model and excess return adjusted by Fama and French (1992) three factor model between the top and bottom cash-to-assets deciles are all positive. For equally weighted portfolios, all return spreads are statistically significant, but for value weighted portfolios, only Fama French three-factor adjusted return spread is statistically significant. The magnitudes are also similar to his paper. For example, panel A.1 shows that the excess return is 0.796% per month for equally weighted and 0.331% for value weighted, comparable to 0.69% and 0.38% respectively in palazzo's paper. Secondly, differences in loadings on market size, growth options which is reported in panel A.3 are positive and significantly different from zero for both the equally weighted and the value-weighted portfolios. When the sample is extended to December 2015, all results remain similar.

2.3 Construction and Summary Statistics for Factor returns

So far, I have replicated palazzo's paper and shown that the results are quite similar to theirs', indicating that the following results are comparable and

suggestive to his arguments. In this section, I construct the cash factor using the same sample obtained in the section 2.

2.3.1 The Construction of LMS

Following the construction approach of Fama and French three factors, I create the cash-based factor which I call LMS (large amount minus small amount) as a zero-investment factor-mimicking portfolio. LMS is formed based on cash and size groups via independent sorts. In particular, in each month, all stocks with non-missing size, non-missing cash and positive book equity value are assigned into two size groups (S or B) based on whether the value of size is smaller or larger than the median value of their NYSE breakpoints. Also in each month, all stocks are sorted independently into three cash portfolios (S, M, or L) based on the 30% and 70% NYSE breakpoints. Taking intersections of two size portfolios and three cash portfolios, I form six portfolios which are called S/S, S/M, S/L, B/S, B/M, and B/L. The value-weighted monthly returns of these six portfolios are calculated for each month. The cash factor 'LMS' (large amount-small amount) is the difference between the weighted average of the returns on the two large amounts of cash portfolios (S/L and B/L) and the equal-weighted average of the returns on the two small amounts of cash portfolios (S/S and B/S): (S/L + B/L)/2-(S/S + B/S)/2.

Table 3 Time series relationship between cash factor (LMS) and Fama-French factors

The table documents summary statistics (Panels A), the correlations among the three Fama and French (1993) factors and the cash factor (LMS) (Panels B) and time series relationship between LMS and Fama-French five factors computed at the monthly level from July 1972 to December 2015. R_m-R_f is the excess return on the market portfolio. SMB is the return to size factor-mimicking portfolio. HML is the return to book-to-market factor-mimicking portfolio. RMW is return to operating profitability factor-mimicking portfolio. CMA is return to investment factor-mimicking portfolio. UMD is return to momentum factor-mimicking portfolio. LMS is the return to the cash holding factor-mimicking portfolio. The construction of the cash holding portfolio is explained in the text. The returns in Panel A are shown in percentages. Panel B contains the time-series correlations between the factor portfolios over the sample period. Figures below (above) the diagonal are Pearson (Spearman rank-order) correlations. Panel C presents the time series relationship between LMS and Fama-French five factors and also momentum factor.

Panel A summary statistics

Factor	N	Mean	Std Dev	t Value
R_m-R_f	522	0.522	4.577	2.61
SMB	522	0.165	3.124	1.21
HML	522	0.368	2.986	2.81
RMW	522	0.262	2.363	2.53
CMA	522	0.344	1.980	3.97
UMD	522	0.699	4.449	3.59
LMS	522	0.274	2.884	2.17

Panel B Correlations

	R_m-R_f	SMB	HML	RMW	CMA	UMD	LMS
mkt_rf	1	0.259	-0.330	-0.232	-0.339	-0.107	0.196
		<.0001	<.0001	<.0001	<.0001	0.0147	<.0001
SMB	0.271	1	-0.150	-0.297	-0.120	-0.014	0.164
	<.0001		0.0006	<.0001	0.006	0.7461	0.0002
HML	-0.318	-0.235	1	-0.091	0.686	-0.101	-0.536
	<.0001	<.0001		0.0371	<.0001	0.0205	<.0001
RMW	-0.256	-0.450	0.206	1	-0.153	0.149	-0.216
	<.0001	<.0001	<.0001		0.0004	0.0007	<.0001
CMA	-0.389	-0.125	0.700	0.040	1	-0.002	-0.351
	<.0001	0.0043	<.0001	0.3593		0.9681	<.0001
UMD	-0.143	-0.005	-0.166	0.094	0.019	1	0.073
	0.0011	0.9162	0.0001	0.0309	0.6569		0.095
LMS	0.208	0.357	-0.633	-0.570	-0.391	0.123	1
	<.0001	<.0001	<.0001	<.0001	<.0001	0.005	

Panel C Time-series regression of Cash Factor on other factors

Model $LMS=\alpha+\beta(r_m-r_f)+s\ SMB+h\ HML+ m\ UMD+ r\ RMW +c\ CMA+\varepsilon_i$

Model	α	β	s	h	m	r	c	Adj. R^2 (%)
3-factor	0.464	-0.027	0.212	-0.572				0.444
	4.82	-1.2	6.67	-16.96				
4-factor	0.451	-0.024	0.212	-0.567	0.014			0.444
	4.58	-1.05	6.66	-16.39	0.62			
5-factor	0.664	-0.065	0.023	-0.526		-0.579	-0.043	0.607
	7.98	-3.31	0.82	-13.71		-15.28	-0.72	

2.3.2 Summary Statistics of LMS and Fama-French Factors

The summary statistics of Fama French factors and cash factor is reported in panel A of table 3. The sample consists of 522 monthly time-series return over period of July 1972 to December 2015. The mean monthly time-series return to LMS is 0.27%, indicating a mean annual risk premium of about 3.24%. The return to LMS is different from zero with a significance level of 95%. The modest significance of risk premium does not provide strong evidence that cash is priced (Shanken and Weinstein, 2006).

Panel B of Table 3 reports the correlations between Fama French 5 factors, momentum factor and cash factor. The correlation table shows that the cash factor, i.e. LMS is positively related to market risk factor and size factor and negatively correlated with market to book ratio factor, investment factor and profitability factor. As for the magnitude, LMS is highly correlated with HML(r=-0.633) and RMW (r=-0.570), modestly correlated with SMB and CMA, and have low correlations with market risk premium(r=0.208) and UMD (r=0.123).

2.3.3 Time-series Regression of LMS on Fama-French Factors

Note that statistically significant spreads on cash are not sufficient evidence that cash is a priced risk factor since LMS may be subsumed by the existing Fama–French risk factors. Therefore, I test whether LMS is subsumed by regressing LMS on Fama and French 3 factors, 4 factors and 5 factors respectively. The idea is that if LMS can be fully explained by other factors, the estimated intercept which represents the unexplained part should be insignificant. Specifically, the model is as following:

$$\mathrm{LMS}_t = \alpha + \beta(R_m - R_f)_t + s\mathrm{SMB}_t + h\mathrm{HML}_t + m\mathrm{UMD}_t + r\mathrm{RMW}_t + c\mathrm{CMA}_t + \varepsilon_t.$$

The results are reported in Panel C, table 3. Overall, Panel C provides several implications. First, the intercept is significant in all model specifications, suggesting LMS can explain the variation in stock return that cannot be captured by existing factors. Second, UMD has little to do with LMS since the coefficient of UMD is insignificant and the adjusted R-square doesn't increase at all when UMD is augmented. Third, LMS is highly correlated with HML and RMW both in magnitude and in significance. This is consistent with the argument from corporate perspective, that, firms higher investment opportunity (lower book to market ratio), less profitability (more financial constraints) tend to hold more cash. Fourth, the explanation power increased from 44.4% of regression of LMS on Fama and French 3 factors to 60.7% of regression of LMS on Fama and French 5 factors.

2.3.4 Factor Loadings in Three-factor and Five-factor Models

From the last subsection, we know that LMS has little correlation to do with UMD, so in the rest tests, I use Fama and French 3 factor model and 5 factor model instead of the four factor model.

In this subsection, I investigate the effects of cash on contemporaneous equity returns, as manifest in the factor loadings and explanatory power of three-factor (the market risk premium, size premium, and value premium) and five-factor (the market risk premium, size premium, value premium, profitability premium and investment premium) asset-pricing models augmented with LMS. The models are illustrated as below:

$$R_{i,t} - R_{f,t} = \alpha + \beta\left(R_{m,t} - R_{f,t}\right) + sSMB_t + hHML_t + lLMS_t + \varepsilon_t$$

$$R_{i,t} - R_{f,t} = \alpha + \beta(R_{m,t} - R_{f,t}) + sSMB_t + hHML_t + cCMA_t + rRMW + lLMS_t + \varepsilon_t.$$

I begin by estimating the above two models for each of the 10565 firms with at least 18 monthly returns between July 1972 and December 2015. Then I take means of coefficient estimates and t-statistics for the 10565 regressions. If LMS proxy for new factor premium, it should have a significant effect on explaining the variations in returns. The coefficient of LMS should be positive and significant, and the explanatory power should be enhanced after LMS is augmented into these models.

Table 4 Firm specific regressions of contemporaneous excess return on factor returns
This table reports average coefficient estimates and average R^2 of 10491 time-series regressions of monthly contemporaneous firm level excess stock returns (stock return minus the risk-free rate) on the Fama–French factors and LMS (the cash factor). The first two columns are the estimates of Fama French 3 factors and cash factor, and the last two columns are the estimates of Fama French 5 factors and cash factor. R_m-R_f is the excess return on the market portfolio. SMB is the return to size factor-mimicking portfolio. HML is the return to book-to-market factor-mimicking portfolio. RMW is return to operating profitability factor-mimicking portfolio. CMA is return to investment factor-mimicking portfolio. UMD is return to momentum factor-mimicking portfolio. LMS is the return to the cash holding factor-mimicking portfolio. The data period is from July 1972 to December 2015. The firms included in the sample need to have at least 18 months data during the whole period.

	(1)		(2)		(3)		(4)	
	3 factor model augmented with LMS				5 factor model augmented with LMS			
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Intercept	-0.086	-2.8	-0.087	-2.65	0.123	3.25	0.101	2.49
R_m-R_f	1.017	108.03	0.991	101.53	0.945	84.26	0.933	81.49
SMB	1.016	73.66	0.994	71.1	0.967	63.84	0.958	62.37
HML	0.111	6.84	0.139	7.12	0.097	4.4	0.097	4
RMW					-0.316	-11.89	-0.310	-11.17
CMA					-0.106	-3.31	-0.095	-2.92
LMS			-0.030	-1.35			-0.055	-2.4
R^2	0.192		0.212		0.230		0.248	
N	10565		10565		10565		10565	

Table 4 presents the estimates of time-series regressions of stock excess returns on contemporaneous factor returns on firm level. Column (1) reports the estimates of Fama and French three-factor model. Column (3) reports the estimates of Fama and French five-factor model. Column (2) and column (4) are results when LMS is included.

The estimates under all model specifications show that all the Fama French factor loadings are significant at 99% level. For explanatory power, column (1) and column (3) show that the three factors and five factors explain an average of 19.2% and 23% of the total variation in the sample firms' excess returns. The rest columns report the mean coefficient estimates and statistics for regressions when LMS is included. Column (2) shows that the coefficient of LMS is negative with t-statistics of -1.35. Column (4) shows that the coefficient of LMS is negative with t-statistics of -2.4. What's more, the coefficients of other factors do not change much, and for explanatory power, when LMS is included, the figure of both models increases by around 2%. All these indicate LMS provides limited information in explaining stock return.

2.4 The Two-stage Cross-sectional Regression (2SCSR)

So far, I have shown that the cash premium 'LMS' is positive and marginally significant; LMS is not subsumed to other factors; LMS have limited power in explaining the variations in stock return time serially. In this section, I test whether the LMS is a priced risk factor using a two-stage cross-sectional regression approach (2SCSR). This method has been applied by previous papers to test whether a candidate variable is a priced risk factor. For example, Daniel and Titman (1997) use this method to test whether size and book to market ratio are priced; Core and Guay (2008) use this approach to test whether accrual quality is priced; Mohanram et al. (2009) use this approach to test whether PIN is priced. To apply this method, I first estimate factor loadings for LMS and other risk factors. Then I run a cross-sectional regression of returns on factor loadings to test whether the factor loadings can predict returns. Since Fama and French (1992) show that the estimated factor loadings for individual stocks are noisy, and it will

cause bias if use noisy factor loadings in Fama–Macbeth regression. To mitigate this concern, following previous studies (Khan, 2008), I do the tests at portfolio level instead of firm level.

2.4.1 The First Stage: Estimate Factor Loadings

In the first stage, I estimate factor loading by regression the excess return of a portfolio on Fama and French factors and LMS. LMS is defined as the equally weighted average of the value-weighted hedge returns (high CASH–low CASH) for two size groups. I conduct this analysis both for the Fama–French 3-factor model (Rm–Rf, SMB, HML) augmented with LMS, as well as for the Fama–French 5-factor model (Rm–Rf, SMB, HML, RMW, CMA) augmented with LMS. Specifically, the models are shown below.

$$R_{P,t} - R_{F,t} = b_0 + b_{q,R_{M,t}-R_{F,t}}(R_{M,t} - R_{F,t}) + b_{p,SMB}SMB_t + b_{p,HML}HML_t +$$

$$b_{p,LMS} + LMS_t + \varepsilon_{p,t};$$

$$R_{P,t} - R_{F,t} = b_0 + b_{q,R_{M,t}-R_{F,t}}(R_{M,t} - R_{F,t}) + b_{p,SMB}SMB_t + b_{p,HML}HML_t +$$

$$b_{p,RMW}RMW_t + b_{p,CMA}CMA_t + b_{p,LMS}LMS_t + \varepsilon_{p,t}.$$

Table 5 Portfolio time-series regressions of contemporaneous excess returns on factor returns

This table presents average coefficient estimates and average R^2 of time-series regressions. Panel A is for regressions of monthly contemporaneous portfolio value weighted excess stock returns (stock return minus the risk-free rate) on the three Fama–French factors and the LMS (Cash factor). Panel B is for regressions of monthly contemporaneous portfolio excess stock returns (stock return minus the risk-free rate) on the five Fama–French factors and the LMS (Cash factor). The first two columns consist of 9 (3*3) size and cash portfolios and 10 size portfolios; the next two columns consist of 30 (10*3) size and cash portfolios, and 27 (3*3*3) size, cash and LMS portfolios. R_m-R_f is the excess return on the market portfolio. SMB is the return to size factor-mimicking portfolio. HML is the return to book-to-market factor-mimicking portfolio. RMW is return to operating profitability factor-mimicking portfolio. CMA is return to investment factor-mimicking portfolio. LMS is the return to the cash holding factor-mimicking portfolio. T-statistics are computed based on the standard error of the portfolio-specific coefficient estimates.

Panel A: Fama French 3 factor model augmented with cash factor

	9 size-cash		10 size		30 size-cash		27 size-cash-lms loading	
Intercept	-0.024	0.068	0.030	0.063	-0.021	0.080	-0.043	0.055
	-0.32	1.82	1.33	2.18	-0.46	2.98	-0.92	1.11
R_m-R_f	1.065	1.060	1.077	1.075	1.084	1.078	1.070	1.064
	67.21	69.47	70	72.26	113.88	117.4	74.49	71.12
SMB	0.527	0.569	0.665	0.680	0.610	0.656	0.541	0.586
	2.92	3.16	4.51	4.61	7.27	8.01	5.33	6.03
HML	0.181	0.067	0.119	0.078	0.214	0.089	0.204	0.083
	1.59	1.11	2.61	1.62	3.59	2.72	2.89	1.84
LMS		-0.199		-0.071		-0.218		-0.211
		-1.39		-2.64		-2.84		-1.58
R^2	0.884	0.912	0.907	0.909	0.808	0.834	0.768	0.815

Panel B: Fama French 5 factor model augmented with cash factor

	9 size-cash		10 size		30 size-cash		27 size-cash-cash loading	
Intercept	-0.055	0.040	0.046	0.082	-0.050	0.057	-0.078	0.024
	-0.56	0.89	4.38	3.62	-0.83	1.99	-1.18	0.45
R_m-R_f	1.073	1.063	1.076	1.072	1.091	1.080	1.078	1.068
	72.11	93.39	73.94	80.89	104.41	122.73	87.16	87.29
SMB	0.578	0.581	0.675	0.676	0.664	0.668	0.596	0.599
	3.35	3.36	4.74	4.74	8.45	8.49	6.43	6.46
HML	0.094	0.019	0.028	-0.001	0.120	0.035	0.113	0.032
	0.88	0.32	0.77	-0.02	2.11	1.03	1.7	0.74
RMW	0.114	0.031	-0.024	-0.056	0.114	0.021	0.122	0.033
	1.1	0.46	-0.61	-1.3	1.85	0.59	1.42	0.7
CMA	0.015	0.009	0.012	0.010	0.003	-0.004	0.016	0.010
	0.46	0.27	0.56	0.44	0.17	-0.18	0.58	0.33
LMS		-0.143		-0.054		-0.161		-0.153
		-1.03		-2.03		-2.35		-1.14
R^2	0.902	0.920	0.914	0.915	0.828	0.842	0.792	0.824

Table 5 reports the average estimates of the coefficients and their t-statistics, along with the adjusted R^2. In a paper with similar research methodology, Core

and Guay (2008) claim that if the portfolios do not generate enough cross sectional variations in the factor to be tested, it would have systematically bias and show lower statistical power when testing whether the factor is a priced risk factor. To address this concern, I use four different sets of portfolios to make sure the results are robust: 9 size-cash groups (3*3), 10 size groups, 30 size-cash groups (10*3), and finally 27 size-cash-LMS groups (3*3*3). 9 size-cash groups are sorted based on the P30 and P70 NYSE breakpoints of size and cash. 10 size groups are sorted based on the NYSE decile breakpoints of size. 30 size-cash groups are based on NYSE decile breakpoints of size and the P30 and P70 NYSE breakpoints of cash. For 27 size-cash-lms groups, 9 size-cash groups are firstly sorted based on the P30 and P70 NYSE breakpoints of size and cash. Then each size-cash group is further sorted by the value of P30 and P70 of firm-level LMS loadings. All size groups and cash groups are sorted independently. Then for each portfolio, I compute the value weighted return within each month, getting 522 monthly returns over the period of July 1972 to December 2015.

Panel A of table 5 presents summary results of the time-series regressing of excess stock returns on Fama and French 3 factors and LMS at portfolio level. The first and second columns of the table present the average of estimates of 9 time-series regressions for the 9-size-cash portfolio. Similarly, the third and fourth columns are for the 10-size portfolio; the fifth and sixth columns are for 30-size-cash portfolio; the last two columns are for the 27-Size-Cash-LMS portfolio. The results show that both the magnitude and significance of the coefficients of FF factors are consistent with previous studies. The average loadings on the market risk premium, size premium and value premium is around 1, 0.6 and 0.2 respectively for all portfolio classifications. When LMS is added to the models,

the coefficients of market factor and size factor are almost the same as estimates of models without LMS while the coefficient of HML changes a lot. This is consistent with previous results of this paper that LMS has a high correlation with HML, so LMS and HML explain overlapping variations in stock return. The coefficient of LMS is negative and statistically significant only for 10-size portfolio and 30-size-cash portfolio, indicating cash affects stock return strongly conditional on size. The Fama and French factors explain an average of 88%, 91%, 81% and 77% of the time-series return variation in the four sets of portfolio returns. LMS factor contribute an increase in the explanatory power of the models with a range from 0.2% to 4.7%. Panel B of table 5 reports summary results of regressions of excess stock return on Fama and French 5 factors and LMS factor at portfolio level. From this table, we get similar information as for LMS.

2.4.2 The Second Stage: Fama-Macbeth Regressions

In the second stage, I conduct monthly Fama and MacBeth (1973) cross-sectional regressions of value weighted excess returns on factor loadings to ascertain whether LMS factor loadings predict returns within each of the four sets of portfolios. The model as below is estimated over period from July 1972 to December 2015:

$$\overline{R_{P,t}}\text{-}\overline{R_{F,t}}=\gamma_0+\gamma_1 b_{p,R_{M,t}-R_{F,t}}+\gamma_2 b_{p,\mathrm{SMB}}+\gamma_3 b_{p,\mathrm{HML}}+\gamma_4 b_{p,\mathrm{LMS}}+\varepsilon_{p,t}.$$

Table 6 Cross-sectional portfolio regressions of excess returns on factor betas

This table presents the Fama Macbeth estimates and R^2 of cross sectional regressions of value weighted monthly excess returns on Fama and French (1992) three factor loadings and cash holding factor loadings. Panel A presents the replication of Petkova (2006)'s estimates of regressing average 25 Size-BM portfolio excess returns on factor loadings. Panel B, C and D are estimates based on 9 Size-Cash portfolios, 10 Size portfolios, 30 Size-Cash portfolios and 27 Size-Cash-LMS portfolios respectively over period of July 1972 and December 2015. All the factor loadings are calculated with full-period data on a multivariate time-series regression of portfolio returns on the respective factors during the period of July 1972 and December 2015. b_{Rm-Rf} is the portfolio beta related to the RM_RF factor. b_{SMB} is the portfolio beta related to the SMB factor. b_{HML} is the portfolio beta related to the HML factor. b_{LMS} is the portfolio beta related to the CASH factor. T statistics are based on newy-west tests.

Panel A: 25 size and book to market portfolios Replication of Petkova (2006) over period July 1963 to December 2001						
	Intercept	b_{Rm-Rf}	b_{SMB}	b_{HML}	Adj R^2	
Petkova's estimate	1.15	-0.65	0.16	0.44	0.71	
FM t-stat	3.3	-1.6	1.04	3.09		
My Estimate	1.020	-0.529	0.180	0.475	0.55	
FM t-stat	3.203	-1.509	1.096	2.888		
Panel B: 9 size and cash holdings portfolios My estimate over the period July 1972 to December 2015						
	Intercept	b_{Rm-Rf}	b_{SMB}	b_{HML}	b_{LMS}	Adj R^2
Estimate	-2.075	2.597	0.124	-0.387		0.71
FM t-stat	-1.765	2.254	0.692	-1.838		
Estimate	-2.098	2.631	0.096	-0.301	0.190	0.78
FM t-stat	-1.808	2.323	0.499	-0.909	1.312	
Panel C: 10 size portfolios My estimate over the period July 1972 to December 2015						
Estimate	-0.440	1.062	0.004	0.336		0.63
FM t-stat	-0.589	1.422	0.016	0.660		
Estimate	-0.370	0.991	0.012	0.321	-0.248	0.71
FM t-stat	-0.392	1.025	0.056	0.611	-0.456	
Panel D: 30(10*3) size and cash holding portfolios My estimate over the period July 1972 to December 2015						
Estimate	-0.646	1.221	0.199	-0.350		0.41
FM t-stat	-1.129	2.133	1.199	-1.686		
Estimate	-0.920	1.523	0.099	-0.096	0.252	0.44
FM t-stat	-1.635	2.650	0.611	-0.409	1.715	
Panel E: 30(10*3) size and cash holding portfolios My estimate over the period July 1972 to December 2015						
Estimate	0.833	-0.215	0.207	-0.175		0.46
FM t-stat	1.556	-0.378	1.209	-0.727		
Estimate	0.927	-0.324	-0.353	0.160	0.274	0.52
FM t-stat	1.835	-0.601	-1.823	1.080	1.653	

The cross-sectional regressions are run for each of the 522 months from July 1972 to December 2015, and the parameters are averaged and t-statistics estimated using the Fama and MacBeth (1973) procedure. Table 6 presents Fama Macbeth

regression results. Including different Fama-French factors produces similar results for different. To save place, I tabulated only the results using the Fama-French 3-factor model (R_m-R_f, SMB, and HML) augmented with LMS. To show consistence over the tests, in the following tests, I also show estimates of regressions on the three Fama–French factors. To make sure the empirical approach correct, I replicate Table V, Petkova (2006) first. The first two rows of Panel A of Table 6 present results of the second stage in Petkova's (2006) with a sample period of July 1963 to December 2001 and the second two rows show my replication over the same period. The results are quite similar in that, the market loading is negative and marginally significant, the size (SMB) loading is positive but insignificant, and the book-to-market (HML) loading is positive and significant. This is also consistent with the literature.

Panels from B to E of Table 6 present the second stage results for 4 sets of portfolios: 9 size-cash portfolios, 10 size portfolios, 30 size-cash portfolios, 27 size-cash-LMS_loading portfolios. In each panel, the estimates for Fama–French 3-factor model are presented in the first two rows, followed by the results for Fama–French 3-factor model augmented with LMS. If LMS were a risk factor, it would be expected to have a positive coefficient. However, the estimated coefficients on the LMS beta are negative and not statistically significant from zero in all of the models. The estimated coefficients on the market are positive and significant when portfolios are sorted based on size and cash, indicating that size-cash portfolios create the most variation in market risk premium. This is also consistent with table 1 that cash holdings are increasing when firm risk increases. The coefficients on size and book-to-market factor betas are insignificant in these specifications. Previous studies show that the coefficient on HML beta is positive,

but in this paper, it is not the case, which may because of the variation in the beta loadings of HML factor is not significant since portfolios are not sorted based on book-to-market ratio in this paper.

Overall, the results from the two-stage cross-sectional regressions are consistent with previous tables/studies and cast doubt on whether LMS is a priced risk factor.

2.5 LMS and Future GDP Growth Rate

In this section, I will discuss the relation between LMS and GDP growth rate. Chen (1991) shows that in intertemporal market equilibrium, the state variables that are priced are those that can forecast changes in the investment and consumption opportunity sets. The predictive power of the proposed new factor on future GDP growth has been used by various scholars to test whether there is a risk effect of the underlying variable on stock returns. For example, Liew and Vassalou (2000) use this approach to examine whether there is low value risk and small size risk; Chordia and Shivakumar (2006) use this approach to evident earnings momentum is a risk factor; Mohanram(2009) use this approach to examine whether PIN is a priced risk factor. In this paper, if LMS is a risk factor in an inter-temporal asset-pricing model such as Merton (1973), it would have a positive relation with GDP growth rate.

Following Chen (1991) and Liew and Vassalou (2000), I regress future GDP growth on lagged values of the Fama–French factors as well as LMS. The specific model is shown below:

$$\mathrm{GDPGrowth}_{t+1,t+12} = \alpha + \beta(R_M - R_F)_{t-11,t} + sSMB_{t-11,t} + hHML_{t-11,t} + mUMD_{t-11,t} + lLMS_{t-11,t} + \varepsilon_t.$$

The dependent variable is the continuously compounded growth in real GDP over months from t+1 to t+12 and the explanatory variables include the value-weighted

excess market return(R_m-R_f), SMB, HML, UMD and LMS, all of which are compounded over months t-11 to t. GDP data is available from the U.S. Bureau of Economic Analysis. Since data of GDP growth rates are available at quarterly frequency, consecutive annual growth rates have three overlapping quarters, inducing serial correlation in the residuals of our regressions. To address this concern, I use the Newey and West (1987) estimator and set the parameter q equal to three.

Table 7 Future GDP Growth on Fama–French factors and the CASH factor.
This table presents the regression coefficients from regressing real GDP growth on the Fama–French factors and the CASH factor. GDP growth is the future 12-month-ahead compounded growth rate. R_m-R_f is the excess return on the market portfolio. SMB is the return to size factor-mimicking portfolio. HML is the return to book-to-market factor-mimicking portfolio. UMD is return to momentum factor-mimicking portfolio. LMS is the return to the cash holding factor-mimicking portfolio. All these factors are annually compounded from the monthly factors over month t-11 and month t. Since data on GDP is reported quarterly, the regressions are based on quarterly data. GDP data is obtained from the US Bureau of Economic Analysis. Since the calculation of compounded factors need data of previous 11 months data. The final sample used of this test is from December 1972 (Q4, 1972) to December 2015 (Q4, 2015). Panel A is the replicate of Mohanram et al.'s respective results over December 1984 to December 2002. Panel B is the main estimates of this test in this paper. Since the regressions use overlapping data, the t-statistics, which are reported in parentheses, are based on Newey–West standard errors.

Model: $GDPGrowth_{t+1,t+12} = \alpha + \beta(R_m-R_f)_{t-11,t} + sSMB_{t-11,t} + hHML_{t-11,t} + mUMD_{t-11,t} + lLMS_{t-11,t} + \varepsilon_t$

Panel A: Replicate Mohanram et al.(2009) over period December 1984 to December 2002

	α	β	s	h	m		Adj R^2
Fama-French 3 factor	0.148	0.204	-0.111	0.097			0.162
	7.84	2.65	-0.83	1.32			
Fama-French 4 factor	0.175	0.195	-0.058	0.049	-0.157		0.231
	15.49	2.81	-0.6	0.71	-2.2		

Panel B: My estimates over period December 1972 to December 2015

	α	β	s	h	m	l	Adj R^2
Fama-French 3 factor	0.117	0.207	0.132	0.190			0.123
	6.96	2.91	1.15	2.3			
Fama-French 4 factor	0.120	0.203	0.130	0.184	-0.018		0.118
	5.79	2.73	0.94	1.84	-0.24		
LMS	0.145					0.031	-0.005
	7.3					0.4	
Fama-French 3 factor and LMS	0.108	0.212	0.119	0.268		0.136	0.134
	4.7	2.83	0.83	1.71		0.82	
Fama-French 4 factor and LMS	0.113	0.204	0.113	0.264	-0.042	0.152	0.133
	4.62	2.63	0.8	1.68	-0.59	0.99	

Table 7 presents the results. Because GDP growth rates are observed at quarterly frequencies, the regressions use quarterly data. The time series sample is constituted with 173 quarters over period December 1972 to December 2015. Panel A reports the replication results of table 6, Mohanram et al. (2009) over period December 1984 to December 2002. I get very similar results to theirs that only the coefficient of market premium is significantly different from zero. Panels from B to E show the results using four different portfolios with LMS included in the model. Under all sample sets, I find that the coefficients on LMS are positive but not significant. Further, the adjusted-R^2 of the regression is only about -0.5% when LMS is included by itself. FF factors can explain around 12% variations in GDP growth rate and this figure increases by only about 1% when LMS is augmented. These results suggest that LMS fails a macro-economic test of whether it is a risk factor.

2.6 LMS and ex-ante Expected Cost of Equity

Another possible way to assess whether LMS is a priced risk factor is to examine whether a higher LMS is associated with a higher ex ante cost of capital (i.e., implied cost of capital, ICOE). Because of their nature as proxies for expected returns, ICOE can be used as the risk-related compensation. If the relation between LMS and future return is attributable to market mispricing, then the relation between LMS and the ICOE would not be pronounced. On the contrary, if LMS is a priced risk factor, then we would expect a higher LMS to be associated with higher ICOE. In particular, I use the following model to conduct the firm-level regressions of ante cost of capital measures on CASH and the control variables:

$$RP_{i,t} = \alpha + \beta\ Beta_{i,t} + sLSIZE_{i,t} + bLBM_{i,t} + dLDM_{i,t} + cCASH_{i,t} + \varepsilon_{i,t}\ ,$$

where RP represents the risk premium, calculated as ICOE minus risk free rate; Beta represents the market risk loadings calculated over period from July 1972 to December 2015; LSIZE is calculated as the natural log of market value; LBM is the natural log of book to market ratio; LDM is the natural log of 1 plus long-term debt over market value; CASH is cash and short-term investments over total assets. Following Ohlson and Juettner-Nauroth (2005) model, I estimate ICOE with the following model:

$$r_e = A + \sqrt{A^2 + \frac{eps_1}{P_0}(g_2 - (\gamma - 1))},$$

Where $A = \frac{1}{2}(\gamma - 1) + \frac{dps_1}{P_0}$ and $g_2 = \frac{eps_2 - eps_1}{eps_1}$, eps_1 and eps_2 are consensus estimates of 1-year-ahead and 2-year-ahead annual eps, g_2 is the average of short-term growth rate (eps_2/eps_1-1), dps_1 is the estimated dividend in the next period assuming historical payout and g is the estimate of the long run economy-wide growth rate. (γ-1) is set as R_f -3%, where R_f is the yield on 10-year notes.

Since the estimated ICOE is in an annually frequency, I do this tests using annual data. The annual accounting data is obtained from compustat annual industrial. EPSs are obtained from I/B/E/S Summary. 10-year notes yield is obtained from CRSP Index. After merging all the variables together, I keep only firms that are used in previous tests in order to make the sample firms consistent in all tests. The final sample is constructed with 70805 firm-year observations from fiscal year 1974 to fiscal year 2015. The accounting variables are all winsorized at 1% and 99% level in each fiscal year.

Table 8 Regression of RP on cash

This table presents the estimates of regressions of RP on cash and control variables. The sample period is from fiscal year 1974 to fiscal year 2015. Implied Cost of Capital estimates are calculated using stock prices and earnings forecasts as of the end of the previous year, based on the Ohlson and Juettner-Nauroth (2005) OJ model. Risk Premia, RP, are calculated from implied cost of capital estimates by subtracting out the risk free rate. LSIZE is calculated as the natural log of market value; LBM is the natural log of book to market ratio; LDM is the natural log of 1 plus long-term debt over market value; CASH is cash and short-term investments over total assets. Panel A presents mean value of RP, beta, log of size, log of long term debt, log of book-to-market ratio and cash over total assets. Panel B presents the correlations of these variables. Panel C presents the estimates of cross-sectional Fama-Macbeth regression of RP on risk factors.

Panel A: Mean of RP and Risk Factors

	RP(%)	Beta	LSIZE	LDM	LBM	CASH
	15.593	1.157	5.942	0.243	-0.685	0.145

Panel B: Correlation of RP and Risk Factors

	RP	Beta	LSIZE	LDM	LBM	CASH
RP	1	0.072	-0.314	0.197	0.190	-0.054
		<.0001	<.0001	<.0001	<.0001	<.0001
Beta	0.078	1	0.036	-0.043	-0.107	0.217
	<.0001		<.0001	<.0001	<.0001	<.0001
LSIZE	-0.342	0.040	1	-0.142	-0.361	0.004
	<.0001	<.0001		<.0001	<.0001	0.3339
LDM	0.153	-0.077	-0.051	1	0.456	-0.378
	<.0001	<.0001	<.0001		<.0001	<.0001
LBM	0.227	-0.083	-0.356	0.469	1	-0.330
	<.0001	<.0001	<.0001	<.0001		<.0001
CASH	-0.065	0.192	0.022	-0.551	-0.309	1
	<.0001	<.0001	<.0001	<.0001	<.0001	

Panel C: Regression of RP and risk factors

	Intercept	Beta	LSIZE	LDM	LBM	CASH	Adj R^2
Annual FM	20.367	1.702	-1.283	4.347	0.892	-0.399	0.159
	26.34	12.99	-15.7	23.32	3.98	-0.91	

Panel A of Table 8 presents the mean value of key variables. The mean value of RP, Beta, LSIZE, LDM, LBM and CASH is around 15.59%, 1.157, 5.94, 0.234, -0.685 and 0.145 respectively. Panel B shows the correlations between these variables. It is shown that RP is positively related to Beta, long-term leverage, book to market ratio, and negatively related to size and cash. Panel C shows the estimates of Fama Macbeth regression. The coefficient of CASH is negative and is not significantly different from zero, indicating that there is no association between CASH and ICOE. The inconsistent relationship between CASH and ex-

ante risk provide extra evidence that CASH cannot be considered a reliable proxy of systematic risk. As for the coefficients of other variables, market beta, book to market ratio, long-term debt increase the cost of equity, while size decreases it. This is consistent with previous studies (Mohanram, 2009), and also consistent with the intuition that firms with higher systematic risk, lower growth options, higher leverage tend to have higher costs of equity, while firms with bigger size tend to have lower costs of equity.

2.6.1 LMS loadings and ex-ante Expected Cost of Equity

Since LMS loading represents the risk exposure to LMS, and ex-ante costs of equity is also proxy for the expected risk, we should see a positive correlation between LMS loading and ex-ante costs of equity if LMS is the risk compensation on large amount of cash. To test this argument, I run the cross-sectional Fama Macbeth regressions following the model as:

$$RP_{i,t} = \alpha + \gamma_1 b_{i,R_m - R_f} + \gamma_2 b_{i,\mathrm{SMB}} + \gamma_3 b_{i,\mathrm{HML}} + \gamma_4 b_{i,\mathrm{LMS}} + \varepsilon_{i,t}$$

,where the independent variables are firm-level factor loadings calculated over full sample period from July 1972 to December 2015 for firms with at least 18 months during this period.

Table 9 regressions of RP on risk factor loadings

This table presents the estimates of regressions of RP on factor loadings. The sample period is from fiscal year 1974 to fiscal year 2015. Implied Cost of Capital estimates are calculated using stock prices and earnings forecasts as of the end of the previous year, based on the Ohlson and Juettner-Nauroth (2005) OJ model. Risk Premium, RP, are calculated from implied cost of capital estimates by subtracting out the risk free rate. LMKT, LSMB, LHML, LLMS are the firm-level factor loadings with regard to market risk premium, SMB, HML, LMS. Thet are the coefficients estimates of regressing excess return on these factors over full period for firms with at least 18 months observations. Panel A presents the correlations between RP and factor loadings. Panel B presents the estimates of cross-sectional Fama-Macbeth regression of RP on risk factor loadings.

Panel A: Correlation of RP with factor loadings

	RP	LMKT	LSMB	LHML	LLMS
RP	1	0.051	0.154	0.046	0.024
		<.0001	<.0001	<.0001	<.0001
LMKT	0.062	1	0.055	0.169	-0.013
	<.0001		<.0001	<.0001	0.0005
LSMB	0.181	0.071	1	0.059	-0.060
	<.0001	<.0001		<.0001	<.0001
LHML	0.074	0.140	0.091	1	0.472
	<.0001	<.0001	<.0001		<.0001
LLMS	0.007	-0.019	-0.077	0.335	1
	0.0802	<.0001	<.0001	<.0001	

Panel B: Regression of RP on factor loadings

	Intercept	LMKT	LSMB	LHML	LLMS	Adj R^2	N
Annual FM	12.832	1.011	2.092	0.644	0.127	0.058	42 years
	16.6	4.45	12.37	3.56	1.26		

Panel A, table 9 presents the correlation between RP and the factor loadings, suggesting a positive correlation of RP and the factor loadings. Panel B, table 9 reports the estimates of the Fama-Macbeth cross-sectional regression. The coefficients of market loading, SMB loading and HML loading is positive and significant, while the coefficient of LMS loading is not significant. This test does not support that LMS is a risk factor, indicating that cash-return relation is not because of systematic risk captured by cash. And high cash level cannot suggest high systematic risk.

2.7 The potential Mispricing Explanation of Cash-return Relation

So far, I have provided evidence that cash-return relation is not due to the systematic risk related to cash holdings. In this chapter, I will explore the potential

behaviour explanation. As mentioned, the cash-return relation may due to the limited attention of investors on cash information. The investors may interpret firms with higher cash holdings as firms with more agency problems since managers in firms with more agency problems tend to hold more cash to get private perquisites. In this case investors tend to undervalue the stock prices of firms with more cash holdings. And hence stocks of firms with more cash holdings tend to get higher subsequent return. I'll use two methods to provide evidences of mispricing explanation by using institutional investors as sophisticated investors. The first is to test the trading behaviour of institutions in relation to cash. The second is to test the differences in return spread by cash between firms with more institutional investors and less institutional investors.

2.7.1 Trading Behaviour of Institutions pre-anomaly of Cash

Institutional investors are proved to be sophisticated investors. Sophisticated investors have the ability to predict stock return and they would sell a stock if it is overpriced and buy it if it gets undervalued. So I first test whether there are more institutional investors invest on long leg of pre-anomaly portfolios. If institutional investors increased before cash anomalies are formed, the cash holding anomaly is more likely to be because of the mispricing effect. In this test, two measures of institutional investors are considered. The first is the number of institutional investors. The second is the number of shares held by institutional investors. The data of institutional investors are available at quarterly frequency and are obtained in file s34 in Thomson Reuters.

Table 10 reports the results of the change of institutions pre-anomaly. Panel A is the summary statistics of institutions and change in institutions. It's shown that averagely there are around 83 institution investors per firm. The shares held by

institutions account for around 41% of the total shares. Panel B shows the changes in institutional investors for cash holding anomaly stocks. I first sort the sample into three portfolios based on cash over total assets in quarter q. Then I calculate the change in institutions from the beginning of quarter q to the end of quarter q. The zero-investments on long in high cash portfolio and short in low cash portfolio earn an average return of 0.6%. Both change in number of institutions and change in shares of institutions show monotonically decreasing from the long leg of cash portfolio to short leg of cash portfolio, suggesting that the institutions tend to invest more on high cash portfolio to get higher subsequent return.

Table 10 Summary of change of institutional investments pre-anomaly

The table reports the changes of institutional invests and the difference between long and short leg based on cash holdings during the calendar quarter prior to anomaly portfolio formation over the period of July 1980 to December 2015. Panel A presents the summary statistics of four institutional ownership variables including the number of institutional investors (#inst(q)), the percentage of institutional shares (%inst(q)), the change in the number of institutional shareholders (Δ#inst(q-1 to q), calculated as number at the end divided by the number at the beginning of period minus one) and the change in percentage of institutional shares (Δ%inst(q-1 to q), calculated as end of period percentage minus beginning). The institutional investor variables are winsorized at the 1% level in both tails. Panel B reports the changes in institutional investor base for cash holding anomaly strategy. The statistics of panel C are the time-series mean and t-statistics.

Panel A: Summary statistics for institutional ownership pre-anomaly

	Mean	Std.	P25	Median	P75
#inst(q)	83.2	128.9	11.0	35.0	105.0
%inst(q)	40.9%	29.4%	14.3%	37.2%	64.9%
Δ#inst(q-1 to q)	4.0%	21.6%	-5.9%	0.0%	9.4%
Δ%inst(q-1 to q)	0.2%	5.9%	-1.6%	0.0%	2.1%

Panel B: Changes in institutional investor base for cash holding anomaly stocks

	Che/at(q)	Δ#inst(q-1 to q)	Δ%inst(q-1 to q)	Excess retun(monthly)
Long	0.40	4.77%	0.30%	1.31
Neut	0.09	3.83%	0.12%	1.03
Short	0.02	3.35%	0.04%	0.70
L-S	0.38***	1.43%***	0.25%***	0.60***

2.7.2 Comparison of Return Spread by Cash between HIO and LIO

If the cash prediction of returns is due to the mispricing caused by investors' limited attention of the cash implications on firm performance, it should be expected that there would be less cash mispricing for firms held by more institutional investors who are more informed and sophisticated in reading

accounting information. This mechanism has been used to test the accrual mispricing due to investors' limited attention by Collins, Gong and Hribar (2003). I use institutional ownership to proxy for institution investors. I divide the sample into 25 (5*5) portfolios based on cash and institutional ownership and aim to find the differences in abnormal returns spread by cash between high institutional investor group (i.e., HIO) and low institutional investor group (i.e., LIO).

Table 11 reports the results showing how institutional investors affect the return spread across cash holding quintiles. LIO indicates the group with lowest quintile of institutional investors. MIO indicates the group with medium quintile of institutional investors. HIO indicates the group with highest quintile of institutional investors. The abnormal returns include excess return, excess return adjusted by market risk and excess return adjusted by Fama French 3 factors. In the LIO, these three variables get values of 1.096%, 0.992% and 1.189% respectively with significance at 99% level. While in the HIO, they are 0.314%, 0.079% and 0.560% and are not statistically significant. The values in MIO are in between the respective values in HIO and LIO. Panel D shows the differences in abnormal return spread by cash between HIO and LIO. The differences are all statistically significant; indicating that return spread by cash in firms with more institutional ownerships is lower than that in firms with less institutional ownerships. These results suggest that the return spread by cash is due to a mispricing effect due to limited attention of investors on cash information.

Table 11 Institutional investors and return spread across cash holding quintiles

This table reports cash holdings, excess return and risk adjusted return on portfolios sorted by cash holdings quintiles and institutional quintiles independently. 'Diff (5-1)' represents the difference in cash holdings and abnormal returns between highest quintile cash holdings firms and lowest quintile cash holding firms. Panel A, Panel B and Panel C reports the average value of cash and abnormal return across cash holding quintiles in firms with lowest quintile, medium quintile and highest quintile of institutional investors respectively. '$Diff_{low}$-$Diff_{high}$' is the Difference in abnormal returns spread by cash between HIO and LIO.

Quintiles	Cash	Ret-R_f	α_{mkt}	$\alpha_{3factor}$
Panel A Lowest quintile of Institutional Investors (LIO)				
1	0.008	0.564	0.065	-0.096
2	0.034	0.619	0.077	-0.022
3	0.090	1.232	0.692	0.563
4	0.209	1.300	0.708	0.683
5	0.513	1.660	1.057	1.093
Diff(5-1)		1.096	0.992	1.189
T-statistics		5.17	3.87	4.9
Panel B Medium quintile of Institutional Investors (MIO)				
1	0.008	0.506	-0.172	-0.464
2	0.034	0.831	0.115	-0.188
3	0.088	0.997	0.280	0.052
4	0.214	1.131	0.385	0.348
5	0.523	1.262	0.475	0.591
Diff(5-1)		0.756	0.647	1.055
T-statistics		2.98	1.98	3.65
Panel C Highest quintile of Institutional Investors (HIO)				
1	0.009	0.703	0.058	-0.129
2	0.035	0.855	0.204	0.059
3	0.091	0.826	0.150	0.044
4	0.203	0.954	0.193	0.237
5	0.446	1.017	0.137	0.430
Diff(5-1)		0.314	0.079	0.560
T-statistics		1.18	0.24	2.34
Difference in abnormal returns spread by cash between HIO and LIO				
$Diff_{low}$-$Diff_{high}$		0.782	0.914	0.630
		2.99	2.85	2.39

2.8 Conclusion

This paper tries to test whether cash-return relation is caused by systematic risk. Palazzo (2012) finds a positive correlation between cash and equity return. He claims that cash holdings have a link with systematic risk, and therefore, firms with more cash have higher stock return for compensation on the systematic risk embedded within them. This argument is interpreted in the paper of Simutin(2010) that cash could serve as a proxy of systematic risk. However, none of them empirically verify this argument with the methodology used in the literature. Recently, there are papers studying the cash-return relation from behaviour

finance perspective, finding evidence supporting a mispricing explanation story and also casting doubt on whether the relation between cash and return really exists. So this paper tries to follow the systematic methodology in the literature to test whether cash could be proxy for systemic risk in explaining the variations in stock returns. First, the two-stage cross-sectional regression show that LMS loading is not priced. Second, LMS is not correlated with the macro-economy growth rate, which is not consistent with the intertemporal asset pricing theory. Third, both cash and LMS loading are not associated with the implied costs of equity, which typically have a positive correlation with systematic risk. I further explore the potential mispricing explanation and find supporting evidences. First, it is found that sophisticated investors tend to buy in more stocks in firms with more cash than stocks in firms with less cash, consistent with the argument that sophisticated investors get can earn higher return by recognizing mispriced stocks. Second, it is found that the cash-return relation in firms with more sophisticated investors are less pronounced than in firms with less sophisticated investors, consistent with the view that sophisticated investors help correct mispricing effect.

Chapter 3: The Effects of Sovereign Funds on Corporations: Evidence of Cash Policies in Singapore

3.1 Introduction

The decision of whether and how much to hold internal funds, including cash and short term investments, is an essential issue in the conflict between shareholders and managers, according to Jensen and Meckling (1976) and Jensen (1986). Recently, the issue of cash holdings has received great scrutiny as corporations around the globe hold increasingly large amounts of cash. As Duchin *et al*. (2017) illustrate, this phenomenon is recent: "Apple, for example, holds $121 billion, or 70% of its book assets, in financial assets." An article in Bloomberg by Sarah Frier reports: "U.S. companies outside of the finance industry are holding more cash on their balance sheets than ever, with $1.64 trillion at the end of 2013."

Researchers are starting to link corporate cash holdings to governance and agency problems. Harford, Mansi, and Maxwell (2008) find that U.S. firms with weaker corporate governance structures have smaller cash reserves. Gao, Harford, and Li (2013) show that agency conflicts dominate financing constraints, as managers hold more cash to increase their perquisite consumption. Duchin *et al*. (2017) find that U.S. industrial firms with poor governance hold substantial risk assets, such as debt or equity, an alternative form of cash holding. These papers suggest that agency problems[5] can explain cash holdings, because managers hoard cash either to extract private benefits or to spend it inappropriately.

[5] Alternative factors also explain corporate cash holding. For example, firms may hold more cash for a precautionary motive in case they cannot raise capital at a low cost (Kaynes, 1936). Opler *et al*. (1999) and Sufi (2009) show that financial constraints can determine the amount of cash holdings, since constrained firms seem to hold more cash than non-constrained ones.

Different from the U.S., in Asia or Europe state ownership is widespread in the corporate world. For example, Bortolotti and Faccio (2009) show that the state remained the largest ultimate owner of about one-third of 141 privatized firms in developed countries from 1996 to 2000. Jones *et al.* (1999) also report that governments maintained a controlling stake in the majority of state-owned enterprises (SOEs) from 59 countries from 1977 to 1999. State owned enterprises have long been criticized as low-efficiency and burdened by severe agency problems due to their ownership structures (Dewenter and Malatesta, 2001; Megginson and Netter, 2001; Claessens and Djankov, 2002). The key issue is lack of efficiency in SOEs. No previously published literature, however, links government ownership to agency problems and corporate cash holding.

In this research, therefore, we explicitly study the corporate cash holding problems associated with agency problems and corporate governance and link cash holding to Sovereign Wealth Funds' monitoring role. Sovereign Wealth Funds are established to invest and hold SOEs on government behalf and they are delegated monitoring vehicles. One important question is whether Sovereign Wealth Funds exert impact on portfolio firms by reducing cash-related agency problems in SOEs that notoriously lack effective monitoring.

We form the following two hypotheses related to Sovereign Wealth Funds' control of agency problems and effect on management of cash reserves. Our first hypothesis posits that *Sovereign Wealth Funds have an important effect on the corporate cash holdings.* If Sovereign Wealth Funds effectively oversee firms on behalf of the governments, they should exert great impact on firms' corporate policies. Due to the monitoring role of Sovereign Wealth funds to reduce cash-related agency problems, the related firms will hold significantly more cash than

comparable firms. Our second hypothesis, the *spending hypothesis* borrowing from Harford, Mansi, and Maxwell (2008) posits that *Sovereign Wealth Funds will have effect on their portfolio firms by making them to spend substantially less in investment or acquisitions while spending more on cash dividend payouts*.

Singapore has been heralded as an extraordinary example of achieving some efficiency, although the state has prevalent ownership in corporations. The Singapore government indirectly holds SOEs via its sovereign fund, Temasek Holdings, to which it delegates the oversight role. Many countries, including Malaysia, China, and Indonesia have attempted to adopt Singapore's practice of establishing their own sovereign funds to oversee the massive state-owned enterprises. The corporations owned by Temasek are labeled as government linked corporations (GLCs) in Singapore. It is, therefore, important to understand the effect that sovereign funds exert on state-owned corporations. As the role model for SOEs, GLCs in Singapore offer an ideal setting to study the question posed in our research.

We scrutinize GLCs by examining their corporate policies, including investment, acquisition, payout, and especially cash holding. The empirical analysis sheds light, from the perspective of cash holding, on the effect of sovereign funds with a delegated monitoring role on SOEs.

We collect a comprehensive sample of Singapore's listed firms and the voting rights of Temasek in each firm from 2004 to 2013. We find that, on average, GLCs hold more cash than otherwise similar non-GLCs, which is contrary to the findings reported by Chinese firms by Megginson *et al*. (2014). Specifically, we observe that GLCs hold 5%-12% more cash on average than other firms. We use the percentage of voting rights owned by Temasek and find similar results.

However, the effect of Temasek on cash holdings depends on corporate governance, especially transparency. For GLCs, the positive effect of Temasek on cash comes from firms with stronger corporate governance. For GLCs with weaker governance, Temasek's cash effect is negative. These findings suggest that Temasek is able to cast a discerning and observable effect on GLCs' cash policies by allowing firms with low-level agency problems to hold more cash while reducing cash for firms without sound governance in place.

We further explore the channels through which Temasek casts their effect on corporate cash holdings. Firstly, we explore whether this effect comes from investment opportunity or financial constraints, such as firm size or Tobin's Q. We find that a GLC's foreign revenues and low expenditures mainly explain their high level of cash holdings. This suggests that GLCs save cash from foreign revenues, spend less on acquisition or investment. We then explore how Temasek Holdings affect the spending of excessive cash. It's found that in good governed firms Temasek Holdings reduces CAPX, indicating that Temasek Holdings firms hold more excessive cash by monitoring managers and reducing their aggressive expenditure of cash on CAPX. We also find that Temasek Holdings affect the expenditure of excessive cash by increasing stock repurchases while reducing dividend payouts in bad governed firms, consistent with its marginal negative effect on cash holdings in bad governed firms. The cash effect of Temasek, however, may have some undesired consequences on subsequent firm performance when GLCs hold excessive cash.

Our paper is the first to look at the effect of Sovereign Wealth Funds on corporate policies especially cash holdings. This paper extends the literature on cash holding, corporate governance, ownership, and corporate policies. The findings indicate

that sovereign funds exert significant influence on corporate cash policies. Due to the presence of Temasek Holdings as the active shareholder, GLCs hold more cash only when they carry sound corporate governance practices. There are several alternative explanations for holding more cash, e.g., financial constraints (Borisova *et al*., 2012) or precautionary saving (Duchin *et al.,* 2013). We show that our findings are not likely to be driven by these alternative explanations when we control for these factors. GLCs, on average, spend less in expenditures, including investment or acquisition, while paying out more dividends to shareholders. Our research sheds new light on the effect of state ownership on a firm's financial decisions in general.

Our research also contributes to the literature on the effect of state ownership, cash, and performance. For example, Megginson *et al*. (2014) find that state ownership in China has a negative impact on cash because SOEs have a "soft budget constraint," as SOEs can count on the government to get funding to mitigate financial constraints. Kusnadi *et al*. (2015) find that non-state-controlled firms in China hold less cash than state-controlled firms because of political extraction due to higher tax rates and more expensive bank loans. Fan, Wong, and Zhang (2007) show that performance measures are negatively related to the level of state ownership among Chinese firms. La Porta, Lopez-de-Silanes, and Shleifer (2002) use international data to find that government ownership of banks is relatively inefficient. Dittmar, Mahrt-Smith, and Servaes (2003) show that firms in countries with strong investor protection hold less cash. Unlike SOEs in other countries where government is the direct stakeholder, Temasek in Singapore acts as a sovereign fund that directly owns the shares and oversees its corporations; while government indirectly controls corporations via Temasek. This delegated

monitoring and controlling role of Temasek allows it to exert great influence on the corporate finance and governance of GLCs. Our research thus provides important insight on how governments around the world can monitor SOEs through sovereign funds as delegated monitoring roles.

The rest of paper is organized as follows. Section 2 provides a brief introduction of backgrounds for GLCs and Temasek Holdings and forms a hypothesis. Section 3 presents the data and summary statistics used in this paper. Section 4 presents the main empirical results. Section 5 summarizes and concludes the paper.

3.2 Background

GLCs, created by the Singapore government in late 1960s, promote the industrialization and development of strategic industries in the economy. Pioneering GLCs focus on pivotal industries such as shipping, aviation, or finance. GLCs operate fully as for-profit commercial entities, the same as private sector companies. Unlike SOEs in other countries, GLCs in Singapore do not receive any subsides or preferential treatment from the government.

Temasek Holdings was formed in 1974 as a private holding company wholly owned by the Ministry of Finance. At that time, 36 companies were transferred to Temasek's control from the Ministry of Finance. Currently, Temasek Holdings directly holds more than 20 first-tier listed GLCs in our sample. The first-tier GLCs can directly or indirectly hold other public or private firms; therefore, the total number of GLCs is around a hundred. Temasek has invested in a wide range of sectors, including financial services, telecommunications media and technology, transportation and industrials, consumer and real estate, energy and resources, and life sciences and agriculture[6]. In this paper, we use the time series information of

[6]See more on http://www.temasekreview.com.sg/major-investments/index.html.

Temasek's voting rights for each firm to identify whether a firm is GLC or not. Since GLCs are not fully owned or controlled by the government, their objectives are to maximize the shareholder's value. Temasek serves like an influential monitor. Voluminous research shows that GLCs perform better (Ramirez and Ling, 2004; Ang and Ding, 2006) and have better governance (Mak and Li, 2001; Yuanto, 2011) than other firms in Singapore.

3.3 Data and Summary Statistics

3.3.1 The Database

The main database used in this paper is the S&P Capital IQ (McGraw Hill Financial) database. The Capital IQ database provides annual historical financial statements for Singapore Stock Exchange (SGX) listed companies. These financial statements consist of 12 different Statements: Key Stats, Income Statement, Balance Sheet, Cash Flow, Multiples, Historical Capitalization, Capital Structure Summary, Capital Structure Details, Ratio, Supplemental, Pension OPEB, and Segments. These statements are each downloaded, and the required financial data is then extracted. In our sample, we only consider firms listed on the SGX main board with headquarters situated in Singapore and exclude firms that are defined as funds or trusts. The firm's industry classifications are based on the Fama-French 17 industry classification using their respective 4-digit SIC code. We also exclude financial firms and utility firms since they obey different disclosure regulations, and their liquidity positions are different from the rest. Considering the impact of extreme value and outliers, we winsorize all firm characteristics at the 1st and 99th percentiles. The final sample consists of 485 unique firms with 4,195 firm-year observations from 2004 to 2013. Finally, we

collect the data from the corporate governance index of firms in Singapore from the Corporate Governance Centre at Singapore Management University.[7]

In addition to the firm's annual financial statements, we collect Temasek's ownership of listed SGX firms in terms of percentage of common equity owned by Temasek Holdings (Private) Limited. Although Temasek Holdings is a private company and, therefore, not required to disclose their portfolio holdings, public firms, on the other hand, are required to disclose their ownership structure. Since we are interested in the influence of Temasek on GLCs, we utilize the voting rights held by Temasek instead of the cash flow rights. As documented in Lin *et al*. (2011), large shareholders can exercise effective control over a company with a relatively small direct stake in the cash flow rights by using pyramid ownership structures and cross-holdings. In order to compute voting rights, we sum all the voting rights held by Temasek up to the secondary chain of corporate control using a threshold of 10%, indicating a major shareholder. For example, suppose Firm A owns 50% of firm B, and Firm B owns 20% of Firm C; the cash flow rights of Firm A onto C are 10% (=50% times 20%), and the voting rights of Firm A onto C are 20% (since 50% implies that Firm A has full control over Firm B). Voting rights are censored to 0 if less than 1%. We also use a Temasek dummy to indicate GLCs, which take the value one if Temasek has voting rights (Temasek Voting Rights >0) and takes the value zero otherwise. Evidence shown using the Temasek indicator variable is robust for both the cash flow rights and the voting rights variable.

[7]This corporate index begins with the Singapore Management University, the Sim Kee Boon Institute, from the year 2007, based on the OECD principles of Corporate Governance to identify listed companies. It is the mostly widely used index in both academia and industry. Each year the Securities Investors Association Singapore (SIAS) presents an Investors' Choice Award (ICA) based on the score.

3.3.2 Cash Holding

The main focus of the regression's dependent variable is a firm's cash holding, since larger firms tend to hold more cash than smaller firms. We, therefore, use a firm's Cash Ratio, which is calculated as the Total Cash and Short Term Investments scaled by Net Assets. Net Assets is the Total Assets less Total Cash and Short Term Investments, similar to Yun (2009), who points out that scaling by total assets will cause mechanical negative correlation between size and cash. Alternatively, we measure cash as 'cash over total assets' which is also extensively used in the literature. Our results are robust to either of the measures.

3.3.3 The Corporate Governance Index

Using an index measure of corporate governance to estimate the degree of agency problems of firms has been popular since the publication of Gompers, Ishii, and Metrick (2003). Similarly motivated, Singapore Management University's Sim Kee Boon Institute for Financial Economics (SKBI) developed an index for companies listed in the Singapore Stock Exchange (SGX) based on the Singapore Code of Corporate Governance, namely the Singapore Corporate Governance Index (CGI). This index is a weighted average questionnaire score of five different categories: Rights of Shareholder, Equitable Treatment of Shareholders, Roles of Stakeholders, Disclosure and Transparency, and Board Responsibilities and Composition. The resulting CGI sample provided by SKBI consists of 2534 firm-year observations from 2007 to 2013 and ranges from 0 to 100. A higher score indicates that a firm practices better corporate governance.

3.3.4 Firm Characteristics

Motivated by Gao *et al*. (2013), the following firm characteristics that may explain variations in a firm's cash holdings are included as controls in the

regressions: Firm Size, Cash Flow, Revenue Growth, Leverage, Net Working Capital, Capex, Acquisition, R&D, Dividend Dummy, Payout Ratio, Tobin's Q, Foreign Revenue, and Multinational Corporation (MNC). Size is the natural logarithm of net assets. Cash Flow is the operating cash flow scaled by net assets, where operating cash flow is computed as EBITDA minus Total Interest Expense minus Income Tax Expense. Revenue Growth is the percentage of change in Revenue. Leverage is the Long-Term Debt scaled by Net Assets. Net Working Capital is Current Assets minus Current Liabilities minus Total Cash and Short Term Investments, scaled by Net Assets. Capex is Capital Expenditure scaled by Net Assets. Acquisition is the Acquisition Expenditures scaled by Net Assets. R&D is the R&D Expenditure scaled by Net Assets. Payout Ratio is calculated as Dividend over Net Income. Tobin's Q is calculated using Total Assets minus Total Common Equity plus the Market Value of Equity scaled by Total Assets. Foreign Revenue is the Total Revenue minus Revenue Earned in Singapore scaled by Total Revenue. MNC is an indicator variable that takes the value one, if a firm’s Foreign Revenue is equivalent to or more than 20%, and zero otherwise. Other cutting off values that qualify a firm as MNC, such as 10%, are also used, and the results are consistent. In addition, for all regressions, we control for year and industry fixed effects.

3.3.5 Summary Statistics and Univariate Analysis

Table 1 provides the summary statistics of the main variables in the full sample and in the sub-sample (Temasek-owned versus non-Temasek-owned). For each statistical summary, we report the number of observations and the mean value of the variables. The difference in the mean is reported in columns 7.In the full sample, the cash over total assets of firms in Singapore is around 20%, which is

comparable to the average cash ratio of listed firms in the U.S. as shown in Gao, Harford and Li (2013) that this number is around 20% in each year from 2001 to 2011.. As for the firm characteristics, firms in Singapore are less leveraged, have less net working capital, and spend less on capital expenditure and R&D investment, but they give more dividend payout as compared to firms listed in the U.S. Most firms listed in Singapore pay dividends. In the U.S., only around 33% of public firms pays dividend (Gao, Harford and Li (2013)), whereas, in this sample, 65% of public firms pay dividends.

Columns 2-7 of Table 1 report and compare the financial characteristics of GLCs and Non-Temasek-owned firms. As for GLCs or Temasek-owned firms, they, on average, hold less cash but are much larger in size than non-Temasek-owned firms. On average, Temasek-owned firms have net assets about twice the amount of non-Temasek firms. The univariate comparison provides a simple impression that GLCs have less cash without controlling for firm characteristics related to financial constraints or investment opportunities. In addition, within Singapore, 84% of Temasek-owned firms pay dividends compared to 64% of non-Temasek-owned firms. Similarly, the payout ratio of GLCs is, on average, larger than for non-Temasek firms. In terms of investment opportunities, GLCs have a higher Tobin's Q than non-Temasek firms, suggesting that they have more growth opportunities for investment. Lastly, using the CGI measure for corporate governance, Temasek-owned firms, on average, practice better corporate governance than non-Temasek-owned firms. This is consistent with the findings by Sim *et al*. (2014).

Table 1 Summary statistics

The sample consists of 4195 firm-year observations from 2004 to 2013, collected from Capital IQ. The firm's industry classification is based on the Fama French 17 industry classification using their respective 4-digit SIC code. Cash is the Total Cash and Short Term Investments scaled by Net Assets where the Net Assets are computed as Total Assets less Total Cash and Short Term Investments.Cash_At is computed as cash over total assets. Industry-adjusted cash is the industry-median-adjusted cash scaled by Net Assets. Δcash is the change in cash ratio. Size is the natural log of Net Assets. Cash Flow is the operating cash flow scaled by Net Assets, where operating cash flow is computed as EBITDA minus Net Interest Expense minus Income Tax Expense. Revenue Growth is the percentage change in Revenue. Leverage is the Long-Term Debt scaled by Net Assets. Net Working Capital (NWC) is Current Assets minus Current Liabilities minus Total Cash and Short Term Investments and scaled by Net Assets. Capex is Capital Expenditure scaled by Net Assets. Acquisition is the Acquisition Expenditures scaled by Net Assets. R&D is the R&D Expenditure scaled by Net Assets. Dividend Dummy is an indicator variable that takes the value 1, if the firm pays dividend, and zero otherwise. Tobin's Q is calculated using Total Assets minus Total Common Equity plus Market Value of Equity scaled by Total Assets. Foreign Revenue is the Total Revenue minus Revenue earned in Singapore scaled by Total Revenue. MNC is an indicator variable that takes the value 1, if the firm Foreign Revenue is more than 20%, and zero otherwise. The Corporate Governance Index (CGI) is the CGI index of all SGX listed firms provided by SKBI (SMU). The CGI is a continuous number that ranges from 0 to 100. All continuous variables are winsorized at the 1% and 99% levels. Superscript ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

	Full Sample		Non-Temasek		Temasek		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variable	Obs	Mean	Obs	Mean	Obs	Mean	Difference
Cash	4,178	0.3444	3,933	0.3510	245	0.2380	0.1130***
Cash_At	4,180	0.2000	3,936	0.2014	245	0.1774	0.0240**
Industry Adjusted Cash	4,178	0.1554	3,933	0.1617	245	0.0537	0.1080***
ΔCash	4,169	0.0348	3,924	0.0355	245	0.0222	0.0133
Firm Characteristics							
Size	4,178	4.9226	3,933	4.7765	245	7.2684	-2.4919***
Cash Flow	4,149	0.0798	3,904	0.0773	245	0.1200	-0.080***
Revenue Growth	3,981	0.1763	3,738	0.1778	243	0.1541	0.0237***
Leverage	4,182	0.1509	3,937	0.1498	245	0.1675	-0.0177*
NWC	4,178	0.021	3,933	0.0267	245	-0.0720	0.0987***
Capex	4,121	0.0678	3,876	0.0673	245	0.0749	-0.0076
Acquisition	4,178	0.0086	3,933	0.0086	245	0.0097	-0.0011
R&D	4,178	0.0008	3,933	0.0008	245	0.0008	0.0000
Dividend Dummy	4,195	0.6529	3,950	0.6410	245	0.8449	-0.2039***
Payout Ratio	4,195	0.3393	3,950	0.3298	245	0.4927	-0.1630***
Tobin's Q	3,937	1.3395	3,693	1.3145	244	1.7184	-0.4039***
Foreign Revenue	4,195	0.5732	3,950	0.5752	245	0.5401	0.0351
MNC	4,195	0.7213	3,950	0.7246	245	0.6694	0.0552*
Corporate Governance Measure							
CGI_VW	2,534	62.6262	2,370	62.0672	164	70.7044	-8.6373***
CGI_EW	2,534	61.1523	2,370	60.5383	164	70.0247	-9.4864***

Table 2 Correlation matrix

The sample consists of 4195 firm-year observations from 2004 to 2013, manually collected from Capital IQ. All continuous variables are winsorized at the 1% and 99% levels. P-values are reported in brackets.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1 TEMASEK Dummy$_t$	1.00												
2 Cash$_t$	-0.05	1.00											
	[0.00]												
3 CGI(VW)$_{t-1}$	0.22	-0.09	1.00										
	[0.00]	[0.00]											
4 Size$_t$	0.37	-0.40	0.33	1.00									
	[0.00]	[0.00]	[0.00]										
5 Cash Flow$_t$	0.06	0.12	0.12	0.05	1.00								
	[0.00]	[0.00]	[0.00]	[0.00]									
6 Tobin's Q$_t$	0.08	0.24	-0.02	-0.17	-0.09	1.00							
	[0.00]	[0.00]	[0.42]	[0.00]	[0.00]								
7 Leverage$_t$	0.03	-0.27	0.02	0.20	-0.24	0.08	1.00						
	[0.09]	[0.00]	[0.36]	[0.00]	[0.00]	[0.00]							
8 NWC$_t$	-0.06	-0.34	0.00	0.12	0.20	-0.40	-0.14	1.00					
	[0.00]	[0.00]	[0.93]	[0.00]	[0.00]	[0.00]	[0.00]						
9 Capex$_t$	0.02	0.08	0.10	-0.03	0.19	0.13	-0.02	-0.22	1.00				
	[0.18]	[0.00]	[0.00]	[0.04]	[0.00]	[0.00]	[0.22]	[0.00]					
10 Acquisition$_t$	0.01	0.00	0.02	0.04	0.00	0.09	0.00	-0.05	-0.01	1.00			
	[0.62]	[0.94]	[0.40]	[0.02]	[0.76]	[0.00]	[0.88]	[0.00]	[0.71]				
11 R&D$_t$	0.00	0.05	-0.01	0.05	0.04	0.05	-0.05	0.00	0.03	0.00	1.00		
	[0.99]	[0.00]	[0.53]	[0.00]	[0.02]	[0.00]	[0.00]	[0.79]	[0.08]	[0.95]			
12 PayoutRatio$_t$	0.05	0.05	0.08	0.04	0.08	-0.03	-0.07	0.05	0.00	-0.01	0.02	1.00	
	[0.00]	[0.00]	[0.00]	[0.02]	[0.00]	[0.09]	[0.00]	[0.00]	[0.84]	[0.42]	[0.24]		
13 Foreign Revenue$_t$	-0.02	-0.10	-0.03	0.11	-0.02	-0.07	0.01	0.06	0.02	0.02	0.11	0.00	1.00
	[0.18]	[0.00]	[0.18]	[0.00]	[0.19]	[0.00]	[0.45]	[0.00]	[0.31]	[0.15]	[0.00]	[0.80]	

3.3.6 Correlation Matrix

Table 2 presents the correlation matrix for the main variables used in the study. We can see that the Temasek dummy is positively correlated with the Value-Weighted CGI, Size, Cash Flow, Leverage, Capital Expenditure, Payout Ratio, Tobin's Q, and negatively correlated with Lagged Cash Ratio, or Net Working Capital. Thus, we should control for these variables when doing the multivariate analysis.

3.4 Empirical Results

3.4.1 Determinant of Cash Holding

Determinants of corporate cash policy and how cash policy eventually affects firm value are interesting and important matters that attract the attention of academic researchers and regulators to explore. Using similar empirical exercises as Gao *et al*. (2013), Harford *et al*. (2008), and Sufi (2009), respectively, we aim to shed new light on the how sovereign funds affect cash holdings by examining the determinants of cash policy in Singapore related to ownership structure, financial constraints, and investment opportunities.

Table 3 presents the cross-sectional pooled regression results on cash holdings. The explanatory variables are chosen according to the prior literature. The dependent variable is Cash Ratio, measured by the nature logarithm of total cash holdings scaled by net assets. We also use cash over total assets as the dependent variable and the results are similar. To save space, we only tabulate the results when cash is measured by the log of cash over net assets. In addition to the explanatory variables mentioned in the data section, industry and year fixed effects are included to control for the industry-adjusted and year-adjusted unobserved effect.

Table 3 Determinants of cash holdings

This table examines the determinants of cash holdings of firms listed in SGX. In column 1, we regress the nature logarithm of cash divided by net assets on various firm characteristics in year *t*. In Column 2 to Column 5, we examine the logarithm of cash holdings of Temasek's publicly-listed firms relative to firms listed on SGX. To do this, we regress Cash on the Temasek dummy, various firm characteristics, and alternative liquidity. Columns 2-3 are regressions with the Temasek dummy as an independent variable, whereas Columns 4-5 are regressions with Temasek Voting Rights (Temasek VR) as an independent variable. The sample consists of 4195 firm-year observations from 2004 to 2013, collected from Capital IQ. The firm's industry classification is based on the Fama French 17 industry classification using their respective 4-digit SIC code. The standard errors are clustered at the industry level. Superscript ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

Ln $Cash_t$	(1)	(2)	(3)	(4)	(5)
TEMASEK $Dummy_{t-1}$		0.606***	0.379***		
		(0.073)	(0.072)		
TEMASEK VR_{t-1}				0.011***	0.007***
				(0.001)	(0.001)
$Size_t$	-0.201***	-0.286***	-0.225***	-0.282***	-0.220***
	(0.011)	(0.014)	(0.013)	(0.014)	(0.013)
Cash $Flow_t$	1.172***		1.207***		1.214***
	(0.149)		(0.163)		(0.163)
Tobin's Q_t	0.048**		0.043**		0.046**
	(0.020)		(0.018)		(0.018)
$Leverage_t$	-2.141***		-2.080***		-2.080***
	(0.122)		(0.128)		(0.129)
NWC_t	-0.587***		-0.567***		-0.569***
	(0.067)		(0.069)		(0.069)
$Capex_t$	-0.195		-0.020		-0.031
	(0.216)		(0.230)		(0.229)
$Acquisition_t$	0.397		0.257		0.224
	(0.446)		(0.465)		(0.468)
$R\&D_t$	14.455***		14.309***		13.933***
	(3.427)		(3.664)		(3.674)
Payout $Ratio_t$	0.071***		0.063***		0.063***
	(0.015)		(0.015)		(0.015)
Foreign $Revenue_t$	0.012		0.002		0.000
	(0.042)		(0.044)		(0.044)
Constant	-0.773***	-0.198	-0.289**	-0.210*	-0.306***
	(0.104)	(0.121)	(0.113)	(0.121)	(0.113)
Year	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes
N	3881	3693	3500	3693	3500
adj. R-sq	0.306	0.165	0.315	0.164	0.314

The regression results of the determinants on cash holding are reported for the whole sample in Column 1. Larger firms hold less cash which supports the economies of scale theory. Similarly, firms with greater cash flow, greater investment opportunities, less net-working capital, and less debt hold more cash.

Firms that spend more on capital expenditures hold less cash. These two findings are consistent with the spending hypothesis. Firms that do more research and development hold more cash, supporting the financing constraint story. Overall these estimates suggest that the determinants of cash holding for Singapore firms are comparable to U.S. firms shown by Harford *et al*. (2008).

There are some unique findings on the cash holdings of Singapore firms. Different from U.S. evidence, firms that pay more dividends hold more cash, which contradicts the financial constraint story. Moreover, multinational firms or firms with greater Foreign Revenue do not hold more cash. One possible explanation is the difference in corporate tax laws between the U.S. and Singapore. In the U.S., foreign cash is taxed when companies repatriate back to the U.S. The study by Foley *et al*. (2007) finds that, due to this repatriation tax, U.S. MNCs with greater foreign cash hold more cash. In contrast, Singapore does not practice double taxation on the same revenue. Secondly, Singapore adopts one of the lowest corporate tax rates of 17% (Menon and Associates 2014). Consistent with the repatriation tax story, no relationship is found between foreign cash and cash holdings for Singapore firms.

Column 2 to Column 5 in Table 3 present the cash model regression results with the Temasek dummy and voting rights as additional explanatory variables. Column 2 indicates that Temasek-owned firms hold 60.6% more cash (log of cash holding) than non-Temasek firms of similar size. If we change the dependent variable from the logarithm of cash to the cash over total assets in Table 4, the Temasek-owned firms still hold 8.8% more cash holding than peer firms. This difference is both economically and statistically significant. The Temasek effect on cash remains when we use Temasek ownership instead of the Temasek dummy

variable. Economically, every 1% increase in Temasek voting rights leads to a 0.7% increase in log of cash holdings.

3.4.2 GLCs and Cash Holdings

The management of cash is largely related to the monitoring of agency conflicts. Sim *et al.* (2014) and Ang and Ding (2006) provide evidence that GLCs practice better corporate governance. Corporate governance is shown to cast a significant effect on corporate cash holdings. Harford *et al*. (2008) find that firms with weaker corporate governance tend to hold less cash, because managers tend to spend the excess cash on unprofitable projects and on repurchases. Temasek-owned firms are shown to adopt good governance, which we further explore in the next section.

Table 4 Temasek holding, corporate governance, and cash holdings

This table examines how corporate governance affects the relationship between Temasek ownership and subsequent cash holdings. The dependent variable here is the logarithm of cash over net assets. To do this, we add corporate governance indices and their interaction terms with the Temasek dummy into the regression model. The governance indices are called CGIA, CGIB, CGIC, CGID, and CGIE, respectively, in the table which represent five aspects of corporate governance: Rights of Shareholders, Equitable Treatment of Shareholders, Role of Stakeholders, Disclosure and Transparency, and Board Responsibilities. CGIEW and CGIVW are equal weighted and value weighted for 5 indices. Since the governance measures are available from 2008, the sample consists of around 2096 observations. The firm's industry classification is based on the Fama French 17 industry classification using their respective 4-digit SIC code. The standard errors are clustered at the industry level. Superscript ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ln $Cash_t$	CGIEW	CGIVW	CGIA	CGIB	CGIC	CGID	CGIE
TEMASEK $Dummy_{t-1}$	-0.737	-1.480**	-0.431	-1.076	-0.078	-0.684	0.726*
	(0.534)	(0.626)	(0.415)	(0.742)	(0.212)	(0.640)	(0.399)
TEMASEK $Dummy_{t-1}$*CGI_{t-1}	0.016**	0.026***	0.022**	0.016**	0.006**	0.013*	-0.005
	(0.008)	(0.009)	(0.011)	(0.008)	(0.003)	(0.008)	(0.005)
CGI_{t-1}	0.002	0.001	-0.000	-0.003	0.003**	0.002	0.002
	(0.002)	(0.002)	(0.003)	(0.002)	(0.001)	(0.002)	(0.002)
$Size_t$	-0.247***	-0.247***	-0.242***	-0.239***	-0.254***	-0.245***	-0.244***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Cash $Flow_t$	1.551***	1.556***	1.553***	1.570***	1.575***	1.544***	1.528***
	(0.202)	(0.202)	(0.202)	(0.201)	(0.211)	(0.202)	(0.204)
Tobin's Q_t	0.086***	0.085***	0.086***	0.083***	0.077***	0.087***	0.087***
	(0.027)	(0.027)	(0.027)	(0.027)	(0.028)	(0.027)	(0.027)
$Leverage_t$	-1.967***	-1.957***	-1.990***	-1.987***	-1.942***	-1.993***	-1.994***
	(0.164)	(0.163)	(0.164)	(0.164)	(0.165)	(0.164)	(0.165)
NWC_t	-0.479***	-0.475***	-0.475***	-0.481***	-0.468***	-0.486***	-0.479***
	(0.069)	(0.068)	(0.069)	(0.069)	(0.070)	(0.069)	(0.069)
$Capex_t$	-0.147	-0.110	-0.156	-0.111	-0.173	-0.176	-0.182
	(0.332)	(0.331)	(0.332)	(0.330)	(0.337)	(0.332)	(0.333)
$Acquisition_t$	0.179	0.185	0.117	0.048	0.101	0.068	0.089
	(0.718)	(0.718)	(0.724)	(0.726)	(0.709)	(0.721)	(0.722)
$R\&D_t$	14.957***	15.527***	14.936***	15.429***	15.519***	14.342***	14.377***
	(4.570)	(4.613)	(4.533)	(4.584)	(4.572)	(4.530)	(4.511)
Payout $Ratio_t$	0.056***	0.056***	0.058***	0.057***	0.057***	0.057***	0.057***
	(0.015)	(0.014)	(0.015)	(0.014)	(0.015)	(0.014)	(0.015)
Constant	-0.563***	-0.524***	-0.442**	-0.144	-0.423***	-0.595***	-0.436**
	(0.194)	(0.201)	(0.207)	(0.214)	(0.161)	(0.186)	(0.173)
Year	Y	Y	Y	Y	Y	Y	Y
Industry	Y	Y	Y	Y	Y	Y	Y
N	2096	2096	2084	2087	2071	2089	2087
adj. R-sq	0.337	0.339	0.338	0.337	0.337	0.337	0.335

In Table 4, we introduce an interaction term of corporate governance and Temasek dummy. The governance indices are named CGIA, CGIB, CGIC, CGID, and CGIE, which represent five aspects of corporate governance, respectively. They are the Rights of Shareholders, the Equitable Treatment of Shareholders, the

Role of Stakeholders, Disclosure and Transparency, and Board Responsibilities. CGIEW and CGIVW are equal weighted and value weighted measures of these five indices. Different from U.S. evidence, corporate governance is not related to cash holding in Singapore. The interaction term between the Temasek dummy and the corporate governance index has a positive and significant coefficient estimate, suggesting that GLCs with good corporate governance hold significantly more cash. This finding is consistent with Harford *et al.* (2008) who show that firms' governance has a positive relation with cash holdings. We contribute this to the mechanism that GLCs with good governance hold more cash, due to the presence and oversight of Temasek Holdings. Another piece of evidence indicates that our finding is consistent with Gao *et al*. (2013). For example, the coefficient of the Temasek dummy has negative and significant coefficient estimates. This evidence suggests that Temasek Holdings plays an important monitoring role overall and reduces corporate cash to lower agency problems related to free cash flow overall while Temasek allows well governed portfolio firms to hold substantial more cash. We use alternative measures to capture the presence of Temasek, such as its voting rights in firms, and find similar evidence. The results are quite similar when we use cash over total assets as the alternative dependent variables,

The results reported in Table 4 thus support our hypothesis that Temasek-owned firms, in general, have lower cash holdings, suggesting a strong monitoring role of Temasek Holdings via reducing the free cash flow of GLCs. However, Temasek is exerting effective monitoring by differentiating a firm's corporate governance quality. GLCs practicing high standard of corporate governance hold substantially more cash, suggesting that Temasek Holdings is not concerned with agency conflict due to abundance of cash. On the other hand, GLCs with a low standard

of corporate governance hold substantially less cash, since Temasek Holdings closely monitors managers by pushing cash to a very low level.

The next session investigates why Temasek owned firms hold more cash in general. We run tests using a Temasek subsample and compare the results with tests using a non-Temasek subsample and report the F-statistics associated with the Chow-test for different coefficients of the same financial variable across these two samples. The regression results are reported in Table 5.

Table 5 Determinants of cash with Temasek holding

This table compares the prime drives of the cash holdings between Temasek's publicly-listed firms and non-Temasek firms listed on SGX. To do this, we regress the logarithm of cash on the firm characteristics in year *t* within Temasek and non-Temasek firms, respectively. Column 1 is the regression estimates for non-Temasek firms, and Column 2 is regression estimates for Temasek firms. Column 3 presents the F-statistics of the Chow test of the difference of coefficients reported in Column 1 and Column 2. The non-Temasek sample consists of 3637 firm-year observations from 2004 to 2013, and the non-Temasek sample consists of 244 firm-year observations from 2004 to 2013, collected from Capital IQ. The firm's industry classification is based on the Fama French 17 industry classification using their respective 4-digit SIC code. The standard errors are clustered at the industry level. Superscript ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

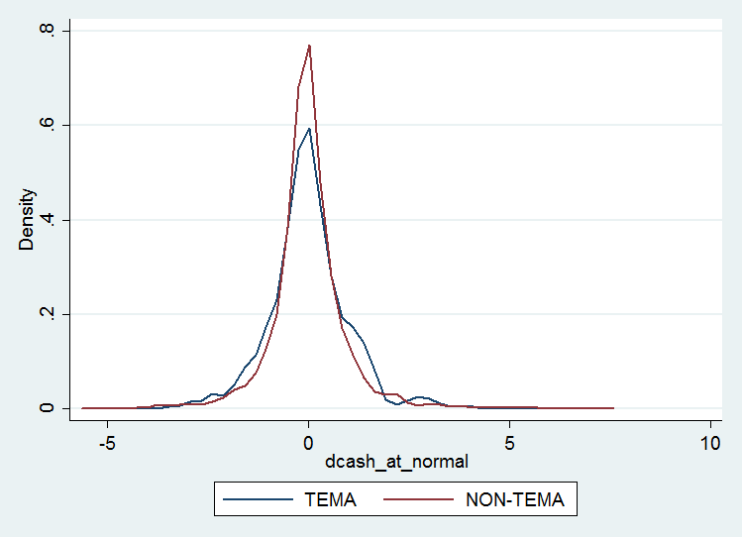
	Temasek=0	Temasek=1	F-statistics (2)-(1)
Ln $Cash_t$	(1)	(2)	(3)
$Size_t$	-0.236***	-0.123***	10.13***
	(0.013)	(0.037)	
Cash $Flow_t$	1.176***	0.498	2.90*
	(0.149)	(0.737)	
Tobin's Q_t	0.041**	-0.079	4.15**
	(0.020)	(0.059)	
$Leverage_t$	-2.093***	-0.542	2.99*
	(0.126)	(0.489)	
NWC_t	-0.562***	-1.343***	4.55**
	(0.067)	(0.338)	
$Capex_t$	0.104	-3.836***	18.53***
	(0.224)	(0.803)	
$Acquisition_t$	0.491	-0.267	0.31
	(0.462)	(1.131)	
$R\&D_t$	16.027***	-44.432***	8.02***
	(3.496)	(11.276)	
Payout $Ratio_t$	0.073***	-0.068	6.01**
	(0.015)	(0.053)	
Foreign $Revenue_t$	-0.000	0.353***	7.81***
	(0.044)	(0.113)	
Constant	-0.619***	-1.324***	
	(0.110)	(0.392)	
Year	Yes	Yes	
Industry	Yes	Yes	
N	3637	244	
Adj. R-sq	0.324	0.303	

In Table 5, it is evident that the primary drivers of cash holdings are significantly different between GLCs and other firms. For non-Temasek-owned firms, cash holdings are positively related to Cash Flow, Tobin's Q, R&D Expense, and Dividend Payout, while it is negatively related to Firm Size, Leverage, or Net Working Capital. In contrast, for Temasek-owned firms, cash holdings are largely dependent on investment factors such as Net Working Capital, Capital Expenditure, and R&D Expense. The estimated coefficients between the two subsamples are statistically different as reported in Column 3. For non-GLCs, the factors explaining cash holding are mostly related to precautionary motivation. In contrast, for GLCs, the factors explaining cash holding are mostly related to investment expenditures or opportunities. These tests suggest that Temasek GLCs are less likely to be affected by financial constraint consideration. Temasek's main monitoring role on GLCs regarding corporate cash reserves should be about corporate expenditures.

Cross-sectional tests show that corporate policies on cash holdings in Temasek-owned firms are centered on firms' investment expenditures. One concern with the cross-sectional tests is the omitted firm-specific effects. To address this question, we follow Hartford et al. (2008) and regress the change in cash holdings on the change in the variables pertinent to cash policies. To verify this regression, we plot the distribution of the change of cash across these two subsamples. The change of cash is defined as ΔCash ($Cash_t$-$Cash_{t-1}$) normalized by the industry mean value and scaled by the industry standard deviation. The result is presented in Figure 1. The figure shows that the distribution of ΔCash of Temasek firms have fatter tails than the distribution of non-Temasek firms, i.e., the probability of large ΔCash (both positive and negative) for Temasek firms is higher than the

probability of large ΔCash for non-Temasek firms, suggesting Temasek firms are more likely to accumulate cash.

Figure 1. The probability density function (pdf, hereafter) of changes normalized in cash holdings.
This figure plots the pdf of change in cash holdings in the sample, which is constituted by Singapore listed firms from 2004 to 2013. Normalized Cash over Total Assets is Cash over Total Assets minus the Industry Median Value. The red line represents the pdf of non-Temasek Holdings firms, and the blue line represents the pdf of Temasek Holdings firms.



We further examine to the determinants of corporate expenditures. We run multivariate regressions in which the dependent variables are expenditures such as CAPEX, acquisitions or payouts such as dividends and stock repurchases and independent variables of interest are Temasek dummy and Temasek Voting Rights. The regression results are reported in Table 6. Other independent variables include cash, size, and investment opportunities.

Table 6 Temasek holding and corporate expenditures

This table examines the effect of Temasek Holdings on subsequent corporate expenditures. The dependent variables are corporate expenditures, including: Capital Expenditure (Capex), Acquisition, and Payout Ratio. Columns 1-3 are regressions with a Temasek dummy as an independent variable, whereas Columns 4-6 are regressions with Temasek Voting Rights (Temasek VR) as an independent variable. The sample consists of 4195 firm-year observations from 2004 to 2013, collected from Capital IQ. The firm's industry classification is based on the Fama French 17 industry classification using their respective 4-digit SIC code. The standard errors are clustered at the industry level. Superscript ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	$Capex_t$	$Acquisition_t$	Payout $Ratio_t$	$Capex_t$	$Acquisition_t$	Payout $Ratio_t$
TEMASEK $Dummy_t$	-0.025***	-0.005*	0.118**			
	(0.006)	(0.003)	(0.057)			
$TEMASEKVR_t$				-0.000***	-0.000	0.002*
				(0.000)	(0.000)	(0.001)
$Size_t$	-0.002	0.002***	0.013	-0.002*	0.002***	0.015
	(0.001)	(0.000)	(0.009)	(0.001)	(0.000)	(0.009)
CF_t	0.088***	-0.002	0.425***	0.088***	-0.002	0.427***
	(0.012)	(0.003)	(0.050)	(0.012)	(0.003)	(0.050)
Tobin Q_t	0.007***	0.003***	0.005	0.007***	0.003***	0.006
	(0.001)	(0.001)	(0.008)	(0.001)	(0.001)	(0.008)
$Leverage_t$	0.011	-0.008**	-0.247***	0.010	-0.008**	-0.247***
	(0.010)	(0.004)	(0.075)	(0.010)	(0.004)	(0.075)
Revenue $Growth_t$	0.010***	0.004***	-0.142***	0.009***	0.004***	-0.142***
	(0.003)	(0.002)	(0.022)	(0.003)	(0.002)	(0.022)
Constant	0.062***	-0.004	0.271***	0.062***	-0.003	0.264***
	(0.009)	(0.004)	(0.076)	(0.009)	(0.004)	(0.075)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
N	3420	3442	3442	3420	3442	3442
adj. R-sq	0.149	0.032	0.030	0.149	0.031	0.030

From Columns 1 and 2 in Table 6, Temasek-owned firms have lower capital expenditure as well as lower acquisition activities than non-GLCs. Column 3 in Table 6 shows a positive significance effect of Temasek Holdings on dividend payout policy. This suggests that the presence of Temasek Holdings firms is associated with more dividend payout for Temasek portfolio firms.

3.4.3 GLCs and Their Investment and Payout Decisions on Excess Cash

In this section, we examine why GLCs hold more cash than other similar public firms by analyzing how Temasek-owned firms use excess cash. Here we define excess cash as the firm's unexplained cash holdings from reduced-form regression residuals. First, we calculate each other's residuals of cash holdings by regressing cash on firm-specific characteristics from Column 3 of Table 3. We focus on several possible decisions a firm makes with excess cash (proxied as positive cash residuals). First, a firm can use its excess cash to make investments. We investigate this possibility relating excess cash to capital expenditures and acquisition expenditures. Second, a firm can return the excess cash back to the shareholders in the form of dividends or stock repurchases.

We examine the joint effect of Temasek and excess cash on the firm's future expenditures or investment decisions. Since it is possible that a firm's investment levels and Temasek ownership are jointly co-determined, we mitigate this problem by following Harford, Mansi, and Maxwell (2008) and focus on the change in the underlying investment decisions by controlling for the previous year's investments and relate them to the pre-existing Temasek holding status of the firm. Hence, the dependent variable is one of the three expenditures decisions, and the main explanatory variable is the lagged Temasek variable and the interaction variable between lagged Temasek and excess cash. The other control

variables include: lagged dependent variable, lagged excess cash, lagged change in excess cash, lagged size, net working capital, leverage, and revenue growth. The regressions control for year and industry fixed effects.

Table 7 Temasek, cash holdings and investment and payout decisions

This table examines Temasek's decisions regarding investments and payout decisions. For investment decisions, the dependent variables are Capital Expenditure ($Capex_t$) and $Aquisition_t$. For Payout decisions, the dependent variables are Payout Ratio ($PayoutRatio_t$) and Share Repurchase (ShareRept). Columns 1-4 are regressions with the Temasek dummy as an independent variable, whereas Columns 5-8 are regressions with Temasek Voting Rights (Temasek VR) as an independent variable. The firm's excess cash (E.Cash) is the saved residue from the regression of Column 3 in Table 3. The sample consists of 4195 firm-year observations from 2004 to 2013, collected from the Capital IQ. The firm's industry classification is based on the Fama French 17 industry classification using their respective 4-digit SIC code. The standard errors are clustered at the industry level. Superscript ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

	Temasek Dummy				Temasek VR			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$Capex_t$	$Acquisition_t$	$Payout_t$	$ShareRep_t$	$Capex_t$	$Acquisition_t$	$Payout_t$	$ShareRep_t$
$TEMASEK_{t-1}$ *$E.Cash_{t-1}$	-0.015***	0.001	-0.120**	-0.003	-0.000**	-0.000	-0.003**	-0.000
	(0.004)	(0.003)	(0.058)	(0.013)	(0.000)	(0.000)	(0.001)	(0.000)
$TEMASEK_{t-1}$	-0.003	0.001	0.152**	-0.003	-0.000	0.000	0.003**	-0.000
	(0.004)	(0.003)	(0.066)	(0.023)	(0.000)	(0.000)	(0.001)	(0.000)
$Capex_{t-1}$	0.588***				0.590***			
	(0.026)				(0.026)			
$Acquisition_{t-1}$		0.147***				0.148***		
		(0.035)				(0.035)		
$Payout\ Ratio_{t-1}$			0.085***				0.086***	
			(0.025)				(0.025)	
$Share\ Repurchase_{t-1}$				0.379***				0.381***
				(0.141)				(0.140)
$E.Cash_{t-1}$	0.001	0.002**	0.099***	0.007*	0.000	0.002**	0.097***	0.008*
	(0.001)	(0.001)	(0.025)	(0.004)	(0.001)	(0.001)	(0.025)	(0.004)
$\Delta E.Cash_{t-1}$	0.005**	0.001	-0.041	-0.008	0.005**	0.001	-0.040	-0.008
	(0.002)	(0.001)	(0.028)	(0.005)	(0.002)	(0.001)	(0.028)	(0.005)
$Size_{t-1}$	-0.001	-0.000	0.006	0.001	-0.001	-0.000	0.008	0.002
	(0.001)	(0.000)	(0.010)	(0.006)	(0.001)	(0.000)	(0.010)	(0.006)
NWC_t	-0.027***	-0.003*	0.140***	0.011	-0.027***	-0.003*	0.139***	0.012
	(0.005)	(0.002)	(0.034)	(0.021)	(0.005)	(0.002)	(0.034)	(0.021)
$leverage_t$	-0.015*	0.001	-0.292***	0.012	-0.015*	0.001	-0.297***	0.011
	(0.008)	(0.004)	(0.085)	(0.022)	(0.008)	(0.004)	(0.086)	(0.021)
$Revenue\ Growth_t$	0.004*	0.005***	-0.147***	0.009	0.004*	0.005***	-0.147***	0.009
	(0.002)	(0.002)	(0.033)	(0.006)	(0.002)	(0.002)	(0.033)	(0.006)
Constant	0.040***	0.009**	0.392***	-0.006	0.040***	0.009***	0.384***	-0.011
	(0.007)	(0.003)	(0.106)	(0.040)	(0.007)	(0.003)	(0.106)	(0.038)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2842	2852	2852	206	2842	2852	2852	206
adj. R-sq	0.496	0.049	0.038	0.168	0.495	0.049	0.038	0.171

Table 7 reports the result of the tests. Results from Model 1 and 2 suggest that Temasek firms, on average, do not have less capital expenditure and acquisition. However, with excess cash, they spend significantly less on capital expenditure. These results are robust when we use Temasek Voting Rights instead of the Temasek dummy. Excess cash is negatively associated with the payout ratio for Temasek firms. This result is similar when using Temasek Voting Rights instead of the Temasek dummy. It suggests that Temasek-owned firms may hoard cash despite having excess cash. This suggests that Temasek's main approach in containing agency problems takes place via reducing investment or expenditures.

As previous evidence showing, sovereign funds on the one hand reduce free cash flow in bad governed firms and on the other hand can exert the governance's positive effect on cash in good governed firms. In this case, how cash expenditure is affected by Temasek Holdings should also be different across governance. Therefore, we do the similar tests to table 7 within subsamples divided by corporate governance. Table 8 reports the results across subsamples by CGI_VW. In each year, a firm is classified to good governance groups if its CGI VW is higher than the median value. Otherwise it is classified as a bad governed firm. We also use CGI_EW to classify subsample groups and get similar results.

Table 8 Temasek, cash holdings and investment and payout decisions: subsample tests

This table examines Temasek's decisions regarding investments and payout decisions based on Corporate Governance Index. Each year, we classify firms below the median of value weighted CGI index into poor governance group, and other firms to be good governance group. For investment decisions, the dependent variables are Capital Expenditure ($Capex_t$) and $Aquisition_t$. For Payout decisions, the dependent variables are Payout Ratio ($PayoutRatio_t$) and Share Repurchase ($ShareRep_t$). Columns 1-4 are regressions with the Temasek dummy as an independent variable, whereas Columns 5-8 are regressions with Temasek Voting Rights (Temasek VR) as an independent variable. The firm's excess cash (E.Cash) is the saved residue from the regression of Column 3 in Table 3. The sample consists of 4195 firm-year observations from 2004 to 2013, collected from the Capital IQ. The firm's industry classification is based on the Fama French 17 industry classification using their respective 4-digit SIC code. The standard errors are clustered at the industry level. Superscript ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

	Poor Governance				Good Governance			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$Capex_t$	$Acquisition_t$	$Payout_t$	$ShareRep_t$	$Capex_t$	$Acquisition_t$	$Payout_t$	$ShareRep_t$
$TEMASEK\ Dummy_{t-1}$ *$E.Cash_{t-1}$	-0.009	-0.003	-0.329***	0.031***	-0.014***	0.002	-0.107	0.012
	(0.009)	(0.003)	(0.095)	(0.009)	(0.004)	(0.004)	(0.086)	(0.009)
$TEMASEK\ Dummy_{t-1}$	0.024	-0.007**	-0.258**	0.112**	-0.005	0.005	0.283**	-0.023
	(0.016)	(0.003)	(0.113)	(0.048)	(0.005)	(0.004)	(0.124)	(0.027)
$Capex_{t-1}$	0.551***				0.561***			
	(0.049)				(0.041)			
$Acquisition_{t-1}$		0.060				0.119**		
		(0.044)				(0.057)		
$Payout\ Ratio_{t-1}$			0.114				0.047**	
			(0.071)				(0.023)	
$Share\ Repurchase_{t-1}$				0.380***				0.120
				(0.125)				(0.128)
$E.Cash_{t-1}$	0.000	0.002**	0.138***	0.004	0.003	0.002	0.103*	0.005
	(0.002)	(0.001)	(0.051)	(0.009)	(0.002)	(0.001)	(0.053)	(0.005)
$\Delta E.Cash_{t-1}$	0.007**	0.001	-0.066	0.006	0.004	0.002	-0.070	-0.010
	(0.003)	(0.001)	(0.072)	(0.009)	(0.003)	(0.002)	(0.050)	(0.008)
$Size_{t-1}$	-0.001	-0.000	-0.008	0.001	-0.002*	-0.001*	-0.000	0.004
	(0.002)	(0.001)	(0.018)	(0.008)	(0.001)	(0.001)	(0.024)	(0.007)
NWC_t	-0.028***	-0.001	0.216***	-0.017	-0.026***	0.001	0.151**	0.035
	(0.009)	(0.002)	(0.060)	(0.025)	(0.008)	(0.002)	(0.066)	(0.039)
$leverage_t$	-0.032**	0.009	-0.235	-0.003	0.010	0.008	-0.301	0.011

	(0.013)	(0.006)	(0.155)	(0.049)	(0.014)	(0.007)	(0.208)	(0.029)
Revenue Growth$_t$	0.005*	0.006**	-0.147**	-0.024	0.000	0.005	-0.233***	0.019**
	(0.003)	(0.003)	(0.059)	(0.028)	(0.005)	(0.003)	(0.065)	(0.007)
Constant	0.030***	0.004	0.554**	-0.023	0.041***	0.010**	0.420**	-0.010
	(0.010)	(0.005)	(0.266)	(0.056)	(0.011)	(0.005)	(0.170)	(0.054)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	974	977	977	53	1011	1013	1013	116
adj. R-sq	0.448	0.065	0.042	0.25	0.506	0.024	0.022	-0.009

Columns 1 to 4 are empirical results within bad governed firms. In bad governed firms, sovereign funds, i.e., Temasek Holdings have no impact on CAPX or acquisitions, indicating that Temasek Holdings neither reduce nor increase investments if firms' governance is poor. As for the payouts, Temasek Holdings reduce the dividend payout ratio but increase repurchases of stocks, indicating that Temasek Holdings firms tend to return cash to shareholders via stock repurchases. Harford et al. (2008) show that bad governed firms tend to use more flexible payouts, i.e. repurchases rather than dividends which is stickier. Temasek Holdings make this phenomenon even more pronounced. Columns 5 to 8 are empirical results with good governed firms. It's shown that in good governed firms, sovereign funds reduce CAPX, supporting our story that good governed firms with more sovereign funds hold more cash because sovereign funds help monitor managers to reduce excessive spending of cash on capital expenditure. Also, in good governed firms, sovereign funds have no impact on dividends payout or stock repurchases.

3.4.4 GLCs, Excess Cash and Profitability

In this section, we study the effect of excess cash on Temasek-owned firms' profitability. We are interested to understand, during this period, if decisions affect the next period's profitability. To measure profitability, we use three different measures: Tobin's Q, Return on Equity (ROE), and Return on Assets (ROA). As for the main independent variable, we examine the relationship between Temasek firms' profitability and the interaction of Temasek with excess cash. Other control variables in the cross-sectional analysis include: the lagged dependent variable, dependent variable, lagged excess cash, lagged change in

excess cash, lagged size, net working capital, leverage, revenue growth, and year and industry fixed effects. Table 8 presents the regression results.

Table 9 Temasek's cash holdings in relation to subsequent profitability
This table examines Temasek's firms' profitability in relation to holding excess cash. The dependent variables are all different profitability measures, namely the Return on Equity (ROE), Return on Assets, and Tobin's Q. Columns 1-3 are regressions with the Temasek dummy as an independent variable, whereas columns 4-6 are regressions with Temasek Voting Rights (Temasek VR) as an independent variable. The firm's excess cash (E.Cash) is the residue from the regression in Table 4. The sample consists of 4195 firm-year observations from 2004 to 2013, collected from Capital IQ. The firm's industry classification is based on the Fama French 17 industry classification using their respective 4-digit SIC code. The standard errors are clustered at industry level. Superscript ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

	Temasek Dummy			Temasek VR		
	(1)	(2)	(3)	(4)	(5)	(6)
	ROA_t	ROE_t	TOBIN's Q_t	ROA_t	ROE_t	TOBIN's Q_t
$TEMASEK_{t-1}$ *$E.Cash_{t-1}$	-0.015***	-0.065***	-0.064	-0.000**	-0.001**	0.000
	(0.006)	(0.021)	(0.048)	(0.000)	(0.001)	(0.001)
$TEMASEK_{t-1}$	0.022***	0.051***	0.241***	0.000***	0.000	0.004**
	(0.007)	(0.020)	(0.080)	(0.000)	(0.000)	(0.002)
ROA_{t-1}	0.508***			0.509***		
	(0.048)			(0.048)		
ROE_{t-1}		0.264***			0.267***	
		(0.074)			(0.074)	
TOBIN's Q_{t-1}			0.640***			0.642***
			(0.056)			(0.056)
$E.Cash_{t-1}$	0.002	0.012	-0.025	0.001	0.010	-0.030
	(0.003)	(0.011)	(0.027)	(0.003)	(0.010)	(0.027)
$\Delta E.Cash_{t-1}$	0.011**	0.003	-0.015	0.011**	0.003	-0.015
	(0.005)	(0.016)	(0.038)	(0.005)	(0.016)	(0.038)
$Size_{t-1}$	0.003*	0.016***	-0.054***	0.004**	0.018***	-0.050***
	(0.002)	(0.006)	(0.016)	(0.002)	(0.006)	(0.016)
NWC_t	0.074***	-0.017	-0.663***	0.073***	-0.019	-0.663***
	(0.026)	(0.050)	(0.129)	(0.026)	(0.050)	(0.129)
$Leverage_t$	-0.038	0.119	0.396	-0.039	0.114	0.394
	(0.023)	(0.075)	(0.260)	(0.024)	(0.075)	(0.261)
Revenue $Growth_t$	0.034***	0.053***	-0.071**	0.034***	0.053***	-0.071**
	(0.006)	(0.014)	(0.031)	(0.006)	(0.014)	(0.031)
Constant	0.016	-0.045	0.782***	0.015	-0.052	0.766***
	-0.017	-0.054	-0.108	-0.017	-0.054	-0.105
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
N	2852	2852	2851	2852	2852	2851
adj. R-sq	0.393	0.104	0.512	0.393	0.102	0.511

The coefficients on the interaction term between excess cash and the Temasek dummy are negative in 5 out of 6 of the models, and the coefficients are

economically significant when profitability is measured by ROE and ROA. This suggests that holding on to excess cash may result in the reduction in a firm's future profitability.

3.5 Conclusion

In this study, we ask the general question of the monitoring role of Sovereign Wealth Funds in portfolio firms. We investigate this question with Temasek Holding and Singapore listed firms as the case. One main reason of focusing on Singapore is that Temasek practices have been heralded as the role model of Sovereign Funds and many countries start to adopt Singapore's approach of overseeing SOEs.

We study the effect of Temasek on corporate cash reserves and show that their influence is important. The empirical evidence shows that Temasek-owned firms or GLCs, on average, hold more cash than non-Temasek-owned firms. However, a careful examination reveals that Temasek's positive cash effect concentrates in GLCs with higher governance quality. This suggests that Temasek Holdings may cast a discerning effect on corporate cash holdings: Temasek reduces corporate cash holdings for weaker-governed GLCs but allows well-governed GLCs to hoard more cash reserves. Consistent with this view, we find that Temasek-owned firms do not spend more on investments or acquisitions but do pay more dividends. The main objective of Temasek Holdings is to contain agent problems by reducing spending.

Our research suggests that Temasek Holdings, the reputable sovereign fund, exerts a great impact on state-owned enterprises through affecting corporate cash reserves, expenditures, and payout policies to contain agency problems. The findings here highlight the important monitoring role of Sovereign Wealth Funds

in state-owned enterprises in general. Our research provides important policy implication on how Sovereign Wealth Funds can effectively monitor portfolio firms through influencing corporate cash and other financial policies.

Since Temasek holdings finally worsen the accounting performance by holding excess cash, it needs to be further explained the reasons. One way is to test whether the investments reduced by Temasek firms are bad projects.

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Appendix

Appendix A. Financial Variable Description

Table 1 Financial variable description

Panel A. Financial variables		
variable	Description	Calculation
Car	Cash holdings	CHE/NAT
NAT	Net asset	AT-CHE
MB	Market-to-book ratio	(AT-CEQ+CSHO*PRCC_F)/AT
RD /Sale	R&D to sale ratio	XRD/SALE
NWCAP	Net Working Capital	WCAP/NAT
RealSize	Firm size in 1994 dollar	log(AT*CPI Adjustment Ratio)
CAPX	Capital expenditure	CAPX/AT
Divdummy	Dividend indicator	1 if DVC>0, otherwise 0
CFO	Cash flow from operation	(EBIT+DP-XINT-TXT-DVC)/NAT
Indsigma	Industrial cash flow volatility	Avg(STD(CFO_{t-20} ~ CFO_t))
Leverage	Debt to asset ratio	(DLC+DLTT)/AT
Aqc	Acquisition to asset ratio	AQC/NAT
Panel B. Variables used to construct earnings transparency		
variable	Description	Calculation
Ibe	Earnings per share	IB/CSHO
EP_t	Earnings to price ratio	Ibe/Lag(PRCC_F)
EP_{t-1}	Lagged earnings to price ratio	Lag(Ibe)/Lag(PRCC_F)
ΔEP	Change in earnings to price ratio	EP_t- EP_{t-1}
Ret	Compounded annual return	Return on a share over the 12 months extending from 9 months prior to the fiscal year-end to 3 months after the fiscal year-end

Appendix B. The Determinants of Earnings Transparency

Table 1 The determinants of earnings transparency

This table reports the estimates of earnings transparency determinants. Column 1 shows the estimates of regressing earnings transparency on accounting based earnings quality such as accrual quality, discretionary accruals and absolute abnormal accruals. Column 2 shows the results of regressing earnings transparency on corporate governance proxy by institutional ownership. Column 3 shows the results of regressing earnings transparency on MNC. Column 4, column 5 and column 6 show the estimates of regressing earnings transparency on information asymmetry measures such as bid-ask spread and number of analyst. Column 7 is the estimates when all the variables above are included in the regression. All variables are winsorized at 1% and 99% level. Superscript ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Accounting based earnings quality	Accrual quality	-0.158**						-0.563***
		(0.063)						(0.187)
	Discretionary accruals	0.179**						0.528**
		(0.071)						(0.210)
	Abs_abn_acc	-0.053***						-0.019
		(0.015)						(0.048)
Corporate governance	Institutional ownership		0.014***					0.001
			(0.005)					(0.020)
MNC	MNC			-0.005*				-0.000
				(0.003)				(0.008)
Information Asymmetry	bid-ask spread				-0.003**		-0.002	-0.015**
					(0.001)		(0.002)	(0.006)
	Analyst number					0.002***	0.003***	0.003***
						(0.000)	(0.000)	(0.001)
	MB	-0.017***	-0.014***	-0.015***	-0.015***	-0.016***	-0.017***	-0.026***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)
	Realsize	0.019***	0.014***	0.015***	0.015***	0.010***	0.007***	0.004
		(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.006)
	CF	-0.080***	-0.069***	-0.075***	-0.063***	-0.048***	-0.035***	0.010
		(0.011)	(0.006)	(0.008)	(0.009)	(0.009)	(0.011)	(0.046)
	Nwcap	0.034***	0.031***	0.045***	0.035***	0.028***	0.036***	0.043
		(0.009)	(0.006)	(0.008)	(0.011)	(0.009)	(0.013)	(0.032)
	Capx	0.077***	0.078***	0.083***	0.115***	0.085***	0.121***	0.231***
		(0.019)	(0.013)	(0.015)	(0.022)	(0.017)	(0.026)	(0.067)

Leverage	-0.038***	-0.023***	-0.017**	-0.028***	-0.019***	-0.022**	-0.046**
	(0.008)	(0.006)	(0.007)	(0.009)	(0.007)	(0.010)	(0.022)
RD/Sales	-0.002	0.001	0.001	0.001	0.001	0.001	0.035**
	(0.003)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.016)
Dividend	0.018***	0.018***	0.018***	0.022***	0.019***	0.022***	0.034***
	(0.003)	(0.002)	(0.003)	(0.004)	(0.003)	(0.004)	(0.009)
Constant	0.443***	0.439***	0.434***	0.342***	0.440***	0.373***	0.538***
	(0.009)	(0.006)	(0.007)	(0.015)	(0.009)	(0.020)	(0.054)
Firm	Y	Y	Y	Y	Y	Y	Y
Industry	Y	Y	Y	Y	Y	Y	Y
Observations	53,484	94,559	69,041	50,209	65,719	39,615	9,561
R-squared	0.387	0.383	0.411	0.380	0.391	0.392	0.431

Appendix C. The Change of Effect of Earnings Transparency on Cash Holdings

Table 1 The impact of earnings transparency on cash holdings before and after SOX
This table reports the change of the impact of earnings transparency on corporate cash holdings. The dependent variable is the natural log of cash over net assts. Yeardummy equals to 1 if fiscal year is less than 2002, else it equals to 0. The sample of column 1 includes observations available both in COMPUSTAT and CRSP from 1980 to 2013 except 2002. The sample of column 2 includes observations available both in COMPUSTAT and CRSP from 2003 to 2013. The sample of column 2 includes observations available both in COMPUSTAT and CRSP from 1980 to 2001. All columns present estimates from OLS regressions including year and firm fixed effects with standard errors clustered at the firm level. The standard errors are under the coefficients. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

	(1)	(2)	(3)
VARIABLES	Log(Cash/Nat)	Log(Cash/Nat)	Log(Cash/Nat)
Sample Period	whole sample except year 2002	fyear>2002	fyear<2002
$Trans_{t-1}$	0.039	-0.044	-0.147***
	(0.045)	(0.040)	(0.033)
$Trans_{t-1}$*Yeardummy	-0.214***		
	(0.056)		
MB	0.076***	0.094***	0.059***
	(0.007)	(0.012)	(0.007)
RealSize	-0.072***	-0.103***	-0.002
	(0.019)	(0.035)	(0.023)
CF	0.282***	0.344***	0.396***
	(0.071)	(0.109)	(0.089)
NWCAP	-2.753***	-2.526***	-2.809***
	(0.083)	(0.159)	(0.094)
CAPX	-2.612***	-3.208***	-2.323***
	(0.135)	(0.293)	(0.143)
Leverage	-2.844***	-1.836***	-3.125***
	(0.080)	(0.135)	(0.094)
Indsigma	0.064	0.043	0.032
	(0.075)	(0.103)	(0.089)
RD/sales	0.076***	0.059***	0.079***
	(0.012)	(0.012)	(0.017)
Aqc	-1.297***	-1.831***	-0.973***
	(0.086)	(0.117)	(0.116)
Divdummy	0.040	0.033	-0.002
	(0.027)	(0.041)	(0.035)
Constant	-0.880***	-0.836***	-1.056***
	(0.073)	(0.242)	(0.083)
Year	Y	Y	Y
Firm	Y	Y	Y
Observations	78,119	24,059	54,060
R-squared	0.751	0.845	0.754

Appendix D. The Construction of Accounting-based Earnings Quality

C.1 Construction of Accrual quality

Accrual quality (hereafter, AQ) is the standard deviation of residuals from adjusted Dechow-Dichev(2002) (hereafter, DD) model (Mcnichols,2002) relating current accruals to lagged, current, and future cash flows from operations, augmented with the fundamental variables from modified Jones model, PPE and change in revenues.

Specifically, the model is as below.

$$TCA_{j,t} = \phi_{0,j} + \phi_{1,j}CFO_{j,t-1} + \phi_{2,j}CFO_{j,t} + \phi_{3,j}CFO_{j,t+1} + \phi_{4,j}\Delta REV_{j,t} + \phi_{5,j}PPE_{j,t} + v_{j,t}$$

, where $TCA_{j,t} = TA_{j,t}+DEPN_{j,t}$; $CFO_{j,t} = EBIT_{j,t} - TA_{j,t}$; $TA_{j,t} = \Delta CA_{j,t} - \Delta CL_{j,t} - \Delta CASH_{j,t} + \Delta STDEBT_{j,t}$.

The meanings of notations are as follows. $TCA_{j,t}$ is total current assets of firm j in year t; $CFO_{j,t}$ is cash flow from operation of firm j in year t; $\Delta REV_{j,t}$ is revenue change of firm j in year t; $PPE_{j,t}$ is gross value of PPE of firm j in year t; $DEPN_{j,t}$ is depreciation and amortization expense in year t; $EBIT_{j,t}$ is earnings before interest and tax of firm j in year t; $\Delta CA_{j,t}$ is change in current assets of firm j in year t, $\Delta CL_{j,t}$ is change in current liabilities of firm j in year t; $\Delta CASH_{j,t}$ is change in cash and equivalents of firm j in year t; $\Delta STDEBT_{j,t}$ is change in debt in current liabilities of firm j in year t. All variables are scaled by total assets in year t-1.

I estimate the adjusted DD model using 15-industry classification in order to be consistent with this paper and require there are at least 20 firms in year t. I get firm-specific residuals annually, and calculate standard deviation of residuals for each firm year with current and previous 4 years data.

C.2 Construction of Absolute abnormal accruals

Following Francis et al. (2005) and Sun et al. (2012), the absolute abnormal accruals is generated following the modified Jones (1991) approach.

First, we estimate the following regression for each industry group classified by Barth (1998) and similarly require there are at least 20 firms in each year.

$$TA_{i,t}/Asset_{i,t-1} = \beta_1 * 1/Asset_{i,t-1} + \beta_2 * \Delta Rev_{i,t}/Asset_{i,t-1} + \beta_3 * PPE_{i,t}/Asset_{i,t-1} + \varepsilon_{i,t},$$

where $TA_{i,t}$ is the total accruals of firm i in year t; $\Delta Rev_{i,t}$ is changes in revenue of firm i in year t; $PPE_{i,t}$ is gross value of PPE of firm i in year t and the calculations are same with those illustrated in accrual quality part; $Asset_{i,t-1}$ is the total assets of firm i in year t-1.

The parameters estimated in the first step are used to estimate the firm-specific normal accruals (NAs) as a percentage of last year's total assets:

$$NAs_{i,t} = \widehat{\beta_1} * 1/Asset_{i,t-1} + \widehat{\beta_2} * \Delta Rev_{i,t}/Asset_{i,t-1} + \widehat{\beta_3} * PPE_{i,t}/Asset_{i,t-1} + \varepsilon_{i,t}.$$

The absolute abnormal accruals (Abs_Abn_Acc) in year t equals to the absolute value of $TA_{i,t}/Asset_{i,t-1} - NAs_{i,t}$.

Appendix E. Industry Classification

Table 1 Industry classification
This table presents the distribution of Temasek firms and non-Temasek firms in each of the 17 industries (excluding financial and utility firms). A firm's industry classification is based on the Fama-French 17 industry classification using their respective 4-digit SIC code.

		Non-Temasek				TEMASEK	
INDUSTRY	Freq.	Percent	Cum.	INDUSTRY	Freq.	Percent	Cum.
1 Food	296	7.49	7.49	1 Food	17	6.94	6.94
2 Mines	84	2.13	9.62	3 Oil	29	11.84	18.78
3 Oil	171	4.33	13.95	5 Durables	3	1.22	20
4 Clothings	70	1.77	15.72	8 Construction	5	2.04	22.04
5 Durables	297	7.52	23.24	11 Machn	29	11.84	33.88
6 Chems	65	1.65	24.89	12 Automobile	2	0.82	34.69
7 Consumer	40	1.01	25.9	13 Transport	105	42.86	77.55
8 Construction	504	12.76	38.66	15 Retail	6	2.45	80
9 Steel	117	2.96	41.62	17 Other	49	20	100
10 FabPr	80	2.03	43.65				
11 Machn	619	15.67	59.32				
12 Automobile	52	1.32	60.63				
13 Transport	242	6.13	66.76				
15 Retail	213	5.39	72.15				
17 Other	1,100	27.85	100				
Total	3950	100		Total	245	100	