THE HONG KONG
POLYTECHNIC UNIVERSITY
香港理工大學
Pao Yue-kong Library
包玉剛圖書館

Copyright Undertaking

This thesis is protected by copyright, with all rights reserved.

By reading and using the thesis, the reader understands and agrees to the following terms:

1. The reader will abide by the rules and legal ordinances governing copyright regarding the use of the thesis.

2. The reader will use the thesis for the purpose of research or private study only and not for distribution or further reproduction or any other purpose.

3. The reader agrees to indemnify and hold the University harmless from and against any loss, damage, cost, liability or expenses arising from copyright infringement or unauthorized usage.

IMPORTANT

If you have reasons to believe that any materials in this thesis are deemed not suitable to be distributed in this form, or a copyright owner having difficulty with the material being included in our database, please contact lbsys@polyu.edu.hk providing details. The Library will look into your claim and consider taking remedial action upon receipt of the written requests.

CUSTOMERS ACCOUNTING QUALITY

AND SUPPLIERS INVESTMENT EFFICIENCY

LI XIAOQIN

MPhil

The Hong Kong Polytechnic University

2020

The Hong Kong Polytechnic University

School of Accounting and Finance

Customers Accounting Quality

and Suppliers Investment Efficiency

LI XIAOQIN

A thesis submitted in partial fulfilment of

the requirements for the degree of

Master of Philosophy

July 2019

Certificate of Originality

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it reproduces no material previously published or written, nor material that has been accepted for the award of any other degree or diploma, except where due acknowledgement has been made in the text.

LI Xiaoqin

2019.5.5

Abstract

This research examines the relationship between customer-firms accounting quality and supplier-firms investment efficiency. We observe that higher-quality accounting information of customers reduces inefficient investments of suppliers. Accounting quality is measured by accrual quality and investment efficiency is measured by deviation from expected investment. The channels we propose are direct customer-supplier channel and external channel, by external channel, we mean that customer information exerts influence on supplier investment decision-making via third parties. Analyst, an important third party for the firms, are utilized to demonstrate our external channel. The results suggest that customer information is effective in investment efficiency improvement of suppliers, and more effective with analysts following.

Keywords: accounting quality, investment efficiency, suppliers, customers

Acknowledgement

Table of Contents

Section 1 Introduction

The implication of customer-supplier link has been documented by a large body of literature; association between accounting quality and firms' investment has also been studied by a line of literature mainly since Biddle and Hilary (2006). In this paper, we explore the relation between customer accounting quality and supplier investment efficiency.

Investment is a key driver of economy, in which firm level capital investment plays a significant role. Instead of analyzing accounting information & investment relation of firms own, we introduce important non-financial stakeholders, customers and suppliers, into the context, which helps to test the relation from the angle of information externality.

From supply chain management literature to accounting/finance literature, the link between customer and supplier has been shown to be significantly meaningful in many contexts. For instance, prior literatures suggest there are significant associations between customer R&D spending and supplier leverage (Kale and Shahrur, 2007), customer accounting quality and supplier cash holdings (Liu et al. 2013), customer bargaining power and supplier conservatism (Hui et al. 2012), customer bankruptcy filing and supplier stock return (Hertzel et al. 2008).

Only a few prior literatures study investment in the context of customer & supplier link. This line of literature focuses on customer characteristics and relationship-specific investments by supplier, in which relationship-specific investments generally means the investments dedicated to the business with particular firms and the value of the investments is lower outside the particular relationship (Raman and Shahrur, 2008). For example, Williams and Xiao (2017) document a significantly positive relationship between share price changes and relationship-specific investment of supplier. As suggested by Chen (2015), the likelihood and frequency of issuing

management forecast by firms are significantly and positively associated with suppliers' relationship-specific investments.

This research provides evidence for the relation between accounting quality of customers and investment efficiency of suppliers. Two main channels are proposed, customer information directly influence the investment decision-making of suppliers, and an external channel. In the direct channel, management of suppliers refer to customer information when make investment decisions, and better customer information better investment efficiency of suppliers.

In the external channel, customer information affects supplier investment decisions through third parties. Firstly, some of the third parties, like analysts and institutional investors, are able to exert influence on the investment-decision making process of suppliers, and the third parties normally take customer information into their consideration. With higher-quality customer information, we shall reasonably infer more positive influence from analysts and institutional investors to be imposed over suppliers' investment-decision making. Given accounting quality of customer, we shall expect the bigger amount of analyst following suppliers the higher investment efficiency of suppliers. Given analyst following, we shall expect the higher accounting quality of customer, the higher investment efficiency of suppliers. In this way, we infer that customer information with higher quality benefit investment efficiency of suppliers through an external path. Secondly, investors of suppliers could use customer information to verify the information of suppliers and to better evaluate the decisions of supplier managements. As a result, the information asymmetry between suppliers and their investors is mitigated, and suppliers have more access to external capital, which will ease the investment-internal cash flow sensitivity of suppliers. Investment-internal cash flow sensitivity is a frequently used measurement of investment efficiency; the lower the sensitivity the higher the investment efficiency. Within a neoclassical

setting, firms stop investing when marginal return is zero, and investment should be independent from internal cash flow status (Tobin 1969, Hayashi 1982, Biddle and Hilary 2006). With this channel, customer accounting information is expected to have influence on the total investment of suppliers. By the direct customer-supplier channel, it is only reasonable to expect the association between relationship-specific investment of suppliers and customer accounting information., such as Rama and Shahrur (2008) research. The new channel adds economic value to the accounting information usefulness of customer.

Raman and Shahrur (2008) document a significantly positive relation between relationship-specific investment by customers/suppliers and firms' earnings management, when use industry level data. With firm level data, they find similar result but only for relationship-specific investment by suppliers. In addition to the channel difference, we extend the analysis from investment level to investment efficiency, which means our research takes expected investment level into consideration. Raman and Shahrur (2008) show that when earnings management of customers increase, the relationship-specific investment of suppliers increase, while our research works on investment efficiency.

The usefulness of accounting information is a long-standing theme of accounting research, but the objects of the theme are mostly capital market characteristics. Only a few prior literatures examine accounting quality and firm level capital investment. Firm level capital investment is a key driver of economy development and a crucial determinant of economic productivity (Biddle and Hilary, 2006). A positive association between accounting quality and firms' investment efficiency is observed, especially in economies where stock market, instead of creditors, is the main financing source (Biddle and Hilary, 2006). By testing the association between investment and accounting quality conditional on the ex ante over/under-investment tendency of firms, Biddle

et al. (2009) further explain that better accounting quality increase investment efficiency through cutting both under-investment and over-investment. Cheng et al. (2013) further complete the line of literature with the evidence of causal relationship between accounting quality and investment efficiency. They justify the causal relationship by comparing the investment efficiency before and after the disclosure of material internal control weakness. We extend this relation to a non-financial stakeholder, supplier & customer background. Instead of looking at firms themselves, we analyze the accounting quality-investment efficiency issue from an external angle.

My main hypothesis is that higher accounting quality of customers would enhance investment efficiency of suppliers. We regress investment residual of suppliers on customer accrual quality, and also do a test conditional on the ex ante tendency of over/under-invest of supplier firms. The results support our hypothesis. In addition to the tests of the main hypothesis, this research uses conditional models to test the external channel. Following of supplier-only analysts and following of supply chain analysts are used as main dummy variables to test different changes in investment efficiency of suppliers, given the announcement by customers with different level of accounting quality.

In the USA, SEC requires listed companies to disclose customers that account for at least 10% of consolidated sales (Ellis, 2012), and based on which the customer-supplier pairs could be formed. Financial reporting data is obtained from compustat, stock data is collected from CRSP and analysts data comes from IBES. Accrual quality is used as the measurement for accounting quality, and deviation from expected level of investment is used as the proxy for investment efficiency. The result is consistent with the hypothesis.

This study contributes in three ways. Firstly, we provide evidence for the effect of customer accounting information over supplier investment decision-making, which could have real

implications for the regulators. Accounting information of customer firms might have more extensive impact over the market and social welfare than expected, for instance over the supply chain as analyzed in our study, so regulators might need to consider more comprehensively when draft the regulations or take actions to the firms. Secondly, external channel is used to demonstrate the effect of customer accounting quality over supplier investment. Prior studies mainly use the channel that customer information directly affect supplier. In addition, with the help of external channel, the usefulness of customer accounting data on supplier investment may have the potential to be extended to overall investment, while the direct channel is only able to explain the relationship-specific investment. Thirdly, we focus on the usefulness of accounting information on firm level investment and non-financial stakeholders (customer & supplier), which complements the mainstream researches that analyze accounting information and capital market characteristics.

The remainder of the paper is organized as following: section two provides related literature and develops the hypothesis; section three introduces the data, sample and research design; and section four demonstrates empirical results; finally, I give the conclusion remarks.

Section 2 Related Literature and Hypotheses Development

2.1 Investment efficiency and accounting quality

Efficient investment, or efficient capital allocation, refers to an allocation that maximize the value of the capital or allocate capital to "the most highly valued use", to facilitate which is one of the objectives of GAAP and an underlying role of accounting in general (Kothari et al. 2010, Gao and Yu 2018). Efficiency of firm-level capital investment is a significant factor that affects economic efficiency (Biddle and Hilary, 2006).

The relation between accounting characteristics and financial market characteristics have been documented by a big body of literature, while the usefulness of accounting data on non-financial market characteristic, like firm capital investment, attracts much less academic attention. (Biddle and Hilary, 2006)

Biddle and Hilary (2006) test two hypotheses: accounting quality is positively related to investment efficiency, and this relation is stronger in countries where stock markets is more dominant than creditors. Investment-internal cash flow sensitivity is used as the measurement of investment efficiency by Biddle and Hilary (2006). After doing an international test and two single-country tests, they find evidence to support both of the hypotheses.

In the 2006 paper, Biddle and Hilary only show the positive relationship between accounting quality and investment efficiency, but whether accounting quality relates to less under-investment or less over-investment is still an open question. This open question is addressed in their 2009 paper. The relationship between accounting quality and investment is examined conditional on the

firms' propensity of being under-invested or over-invested. The other setting in the 2009 paper is examining the relation between financial reporting quality and the deviation from expected investment level, in which expected investment level is based on a function of growth opportunity. In the two settings, they find that accounting information quality is correlated to both reduced under-investment and reduced over-investment. (Biddle et al. 2009)

An issue still not solved by Biddle et al. is the causal relation between investment efficiency and accounting quality. A more recent paper by Cheng et al. (2013) use Sarbanes-Oxley Act as exogenous shock to test the causal relation between the two mentioned above. Under the Act, firms have to disclose any material internal control weakness (ICW) with respect to the financial reports. The authors compare the investment efficiency before and after the ICW disclosure. Their results show that the investment efficiency is significantly better after the ICW disclosure, therefore, provide evidence for the causal relationship between financial reporting quality and investment efficiency.

Attestation of auditors is found to be related with investment efficiency. Conservatism provided, negative reports lead to overinvestment; aggressiveness provided, positive reports lead to underinvestment (Lu and Sapra, 2009). For private firms, relation between financial reporting quality and investment efficiency has also been shown to be empirically significant. Chen et al. (2011) show a significant positive effect from financial reporting quality to investment efficiency, and the effect decreases with incentive to restrain profit for tax consideration while increase with bank financing.

2.2 Customer and supplier relation

The theme of how customer characteristics and supplier characteristics relate to each other has been addressed by many researchers in recent years. Some of the literatures analyze the bidirectional relation between customer and supplier. For instance, Hui et al. (2012) show the influence of bargaining power of a firm's customer or supplier on the firm's accounting conservatism. They document a significantly positive relation between a firm's accounting conservatism and its suppliers' or customers' bargaining power over it, in which accounting conservatism is measured by the different timeliness of recognition of bad news and good news.

More of the supply chain literature talks about the effect of customers characteristics on suppliers. Kim et al. (2015) provide evidence for the effect of customers performance on suppliers' bank loan terms. They find that the earnings results of main customers is negatively related with interest rate and the stringency of non-price clauses of suppliers' bank loan, especially when the suppliers rely more on the customers for the sale of products.

Chen et al. (2014) document that bond yield spreads are significantly related to customers' and the firms' own macroeconomic risks. However, the risks of suppliers do not show a significant relation with the firms' bond yield spreads.

2.3 Customer accounting characteristics and supplier investment

In the line of literature regarding customer accounting quality and supplier investment, there is already few studies. Raman and Shahrur (2008) check the association between relationship-specific investment and earnings management in a customer-supplier context. In their research, investment is limited as relationship-specific. When they use industry-level proxy, relationship-specific investments by firms' suppliers and customers are found to be positively related to absolute value of discretionary accrual of the firms. When firm-level data are used, the above

positive relation only holds for suppliers' relationship-specific investment. The relation between customers' relationship-specific investment and firms' magnitude of discretionary accruals is negative, and this negative relation is weaker and even turn positive when the size or bargaining power of the firms over their customers are larger. My research differs from their research from many aspects as discussed in the introduction part. Firstly, my research explores a new channel, external channel, to demonstrate the relation, while Raman and Shahrur (2008) only use the channel of direct influence on supplier from customer information. Due to the limitation of the channel, they are only able to analyze the relationship-specific investment, while our research results could have the potential to apply to overall investment. Secondly, they analyze the investment level, while this research examines the investment efficiency.

Chen (2015) focus on the management forecast in a customer-supplier context. It is documented that the firms' likelihood and frequency of management forecast are significantly and positively related to relationship-specific investments of the firms' suppliers. Bargaining power of the firms over their customers weakens the positive association above. The channel in this paper is similar to that of Raman and Shahrur (2008), which is a direct influence between customer and supplier.

Using mutual fund outflow as an exogenous negative pressure on customers' stock price, Williams and Xiao (2017) show a positive association between customers' stock price movements and firms' relationship-specific investment. Effect of accounting quality on stock price has been documented by many researchers. As a result, Williams and Xiao (2017) results are consistent with our argument about the effect of accounting quality on investment.

Kale et al. (2015) observe a significantly negative relationship between risk-taking incentives of firms' CEO and customers'/suppliers' relationship-specific investment. The relation is stronger when the incentives could lead to higher cash-flow volatility of the firms.

2.4 Analyst following supply chain

Luo and Nagarajan (2015) study analysts' decision on supply chain specialization. They find that the decision is based on informational cost-benefit consideration, and the benefit comes from information complementarities along the supply chain etc. When analysts specialize in supply chain, the forecasts they provide for suppliers are better than those done by non-supply-chain analysts; however, the forecasts for non-supply-chain firms are inferior than those for the same firms done by non-supply-chain analysts. In addition, they test the effect of supply chain information on stock price of suppliers or whether investors take supply chain information into account when valued suppliers. The results show that supply chain information provided by analysts significantly improve the value efficiency of suppliers.

This stock price result contradicts with the research of Cohen and Frazzini (2008), who argue that investor limited attention lead to asset pricing inefficiency. They show that predictable abnormal return could be earned by utilizing the inattention of investors on supplier-customer information. However, as argued by Luo and Nagarajan (2015), Cohen and Frazzini do not control for the influence of supply-chain-specialization analysts. Including the contribution of the analysts, Luo and Nagarajan show a significant relation between supply chain information and supplier stock performance. And the result of Luo and Nagarajan is consistent with the hypothesis of my research. Given that customers information could significantly affect stock valuation of suppliers,

we may conjecture that customer accounting quality may relate to supplier investment efficiency via the channel of supplier stock performance.

Guan et al. (2015) argue that, compared with analysts only follow suppliers, analysts included both customers and suppliers in their portfolios provide better earnings forecast for suppliers. Another meaningful contribution from Guan et al (2015) is that they show that the improved forecast accuracy from covering firms' customers is at least the magnitude that cloud be achieved by covering the firms' industry peers. Analysts only follow suppliers would also take into account customer earnings news, but they use the information less efficiently than analysts cover both suppliers and customers. After incorporating customers earning news, the forecast accuracy of supply chain analysts improves significantly more than the suppliers-only analysts. This research shows the usefulness of accounting information of customers to suppliers' analysts, and in turn may benefit the stock performance of suppliers.

Based on the literature, a further direction could be explored is to examine the association between customer accounting quality and supplier investment efficiency, not limited to relationship-specific investment, and not only investment level but also efficiency.

2.5 Hypotheses development

H: Accounting quality of customers is positively related with suppliers' investment efficiency.

Two main channels are proposed for this hypothesis.

Firstly, higher accounting quality of customers reduces information asymmetry between suppliers and customers, and suppliers can make better decisions, which in turn benefits the investment efficiency of suppliers. We name it the direct channel.

The business operation relation between customers and suppliers exists naturally. Cohen and Frazzini (2008) check the time variation in operating income and sales data of customers and corresponding suppliers, and find that the correlation between their real operating activities are significantly larger when they are in a customer-supplier link than when they are not. Given the operation of suppliers and customers are significantly correlated, the usefulness of customer information to suppliers should be a reasonable inference. If customers provide better order and demand information, suppliers could make better decisions on production and inventory management (Ozer and Wei 2006, Clark and Hammond 1997 cited in Radhakrishnan et al. 2014). Radhakrishnan et al. (2014) document that quality of capital market information provided by customers is positively related with operating performance of suppliers. If the customers' earnings forecast accuracy is higher, the accuracy of following forecast of suppliers would also higher.

Secondly, we propose the external channel. Higher accounting quality of customers reduces information asymmetry between suppliers and their outside capital providers. Outsiders could better evaluate suppliers' information with higher-quality customer accounting data. Financing activities of suppliers can be benefited via mitigated adverse selection issue in capital market and mitigated agency issue.

Capital is an essential factor in investment decision-making. Prior literatures document two main problems that might negatively affect the external capital supplied or increase the cost of external capital. First, moral hazard or agency issue reduces the external capital supplied via incentive concerning. External capital dilutes ownership stake of management, which induce incentive issues. Thereby, the external capital is reduced ex ante. Second, adverse selection issue reduces external capital supplied through information problem. Investors concern that management might raise capital when the shares are overpriced, due to the information asymmetry

between they and managements. As a result, external capital supplied is reduced. (Jensen and Meckling 1976, Myers and Majluf 1984, Hoshi et al. 1991, Biddle and Hilary 2006)

This study proposes that, with higher quality customer information, investors could better monitor management thereby mitigating agency issue, and could better evaluate management financing decisions thereby mitigating adverse selection issue.

The other path of external channel is that influential third parties, such as institutional investors and analysts, impact the investment-decision making of suppliers. With better customer accounting information, we could reasonably infer that the third parties would have better impact on suppliers, and thus improve the investment efficiency of suppliers.

Channels proposed above are supported by a recent review paper by Roychowdhury et al. (2019), which summarizes the literatures about the influence of financial reporting over firms' investment. The paths of the influence were classified into two general categories. Firstly, financial reporting is able to make a change to the information asymmetry status. The impacted cost of adverse selection and moral hazard in turn affect investment of the firms. Secondly, there could be a learning benefit from financial reporting. Firms could learn from disclosure of related firms, and learn from the extra information collected and analyzed as required by regulations related to financial reporting.

Section 3 Data and Research Design

3.1 Data and sample

We obtain the accounting information and supply chain data from compustat and analysts data from IBES. In the USA, based on the ASC-280 (Accounting Standards Codification-topic 280, Segment reporting), public firms are required to disclose customers that account for at least 10% of consolidated sales (Ellis, 2012); relied on which, the customer-supplier pairs could be formed. For baseline test one, the sample contains 4431 firm-years, and 4377 firm-years for baseline test two, range from 1990 to 2014. For supplier analyst test, we include 2434 firm-years, but for the supply-chain analysts test, we only find 648 valid firm-years, which does not support a convincing regression, and the result comes out insignificant. A better test could be done for further research after sufficient data accumulated.

3.2 Measurements
3.2.1 Measurement of accounting quality

In this research, we use uncertainty in accruals to measure customer accounting quality (CAQ). We follow the cross-sectional regression in Dechow and Dichev (2002) model.

$$TCA_{j,t} = \Psi_{0,j} + \Psi_{1,j} CFO_{j,t-1} + \Psi_{2,j} CFO_{j,t} + \Psi_{3,j} CFO_{j,t+1} + \eta_{j,t}$$

where $TCA_{j,t}$ is the year t total current accruals for firm j, which equals to change in current asset deducts change in current liabilities and change in cash, and plus change in debt in current liabilities. $CFO_{j,t}$ is the operating cash flow of firm j in year t, which equals to net income before

extraordinary items minus total accruals. TCA minus depreciation and amortization expense results in total accruals. (Biddle and Hilary, 2006)

3.2.2 Measurement of investment efficiency

We use "Deviation from expected investment level" as the proxy of investment efficiency, the smaller the deviation the higher the investment efficiency.

Following the method used by Biddle et al. (2009), we use sales growth as the measure of growth opportunities, and regress investment on growth opportunity to get the residuals.

$$Investment_{i,t+1} = \beta_0 + \beta_1 * Sales\ growth_{i,t} + \varepsilon_{i,t+1}$$

where investment is the total investment, sales growth is the percentage change in sales from year t-1 to t, and ε is the measurement of deviation from expected investment level. According to the rank of residuals, the firm-years are sorted into quartiles. Bottom quartile consists of firm-years with the smallest residuals (negative), and represents under-investment. Top quartile is composed of firm-years with the biggest residuals (positive), and represents over-investment.

By using a multinomial logit model, we calculate the likelihoods that firms, with different accounting quality, fall into the bottom or top quartiles. (Biddle et al. 2009) According to the hypothesis, the firm-years with high CAQ should be less likely to fall into the bottom or top quartiles than the firm-years with low CAQ.

The other commonly used measurement for investment efficiency, 'Investment-cash flow sensitivity', will be tested in our further research. Low sensitivity signifies high investment efficiency. Following Biddle and Hilary (2006), the measurement for cash flow sensitivity of

investment (CFSI) is calculated by deducting unweighted arithmetic time-series average investment (AI) from cash-flow-weighted time-series average investment (CFWAI), which is first used by Hovakimian and Hovakimian (2005).

3.2.3 Control variables

In the regressions, mainly following Biddle et al. 2009, we control for Log-Asset, Mkt-to-Book, Slack, Std-CFO, Std-Inv, Std-Sales, Tangibility, OperatingCycle, Loss, K-structure, Z-score, CFOsale, and Dividend. Definitions could be found in Appendix A.

3.3 Models

3.3.1 Relation between customer accounting quality and supplier investment level conditional on likelihood of under/over investment of suppliers

$$\text{Investment}_{i,t+1} = \alpha + \beta_1 CAQ_{i,t} + \beta_2 CAQ_{i,t}*OverI_{i,t+1} + \beta_3 OverI_{i,t+1} + \beta_4 AQ_{i,t} + \beta_5 Gov_{i,t} + \beta_6 Gov_{i,t}*OverI_{i,t+1} + \beta_7 AQ_{i,t}*OverI_{i,t+1} + \sum \gamma_j Control_{j,i,t} + \varepsilon_{i,t+1}$$

where investment is the total investment of supplier scaled by prior year's total asset, CAQ is customer accounting quality measured by uncertainty in accruals, AQ is supplier accounting quality, OverI is a ranking variable of suppliers, which increases with the likelihood of over-investment. Gov is the measurement for corporate governance of supplier, including institutional ownership. (Biddle et al. 2009)

Corresponding to hypothesis, β1 represents the association between customer accounting quality and supplier investment level in the situation that the supplier is highly likely to under-invest, due to OverI equals to the lowest rank, one. (β1+ β2) measures the association when supplier is highly likely to over-invest. Based on the hypothesis, β1 is expected to be positive, and (β1+ β2) is expected to be negative. (Biddle et al. 2009)

3.3.2 Relation between customer accounting quality and supplier investment residual

$$\text{Residual-Inv}_{i,t+1} = \alpha + \beta_1 CAQ_{i,t} + \beta_2 Gov_{i,t} + \sum \gamma_j Control_{j,i,t} + \varepsilon_{i,t+1}$$

Residual-Inv is the absolute residual investment of suppliers, and the residual is measured by deviation from expected investment level. The smaller the residual the higher the investment efficiency. This regression does not conditional on over/under investment. We expect β_1 is negative, which means higher customer accounting quality lower supplier investment residual, thus higher supplier investment efficiency.

3.3.3 Conditional tests for external channel

To test the external channel, the conditional method is used. There might be various channels through which customers accounting information could affect the investment efficiency of suppliers. The external channel: path one, investors of supplier use customer information to evaluate the information of suppliers, and then the investment efficiency, measured by investment-cash flow sensitivity, of suppliers increases via reduced information asymmetry between investors and suppliers; path two, analyst exert better influence on supplier investment decision making with

higher quality information of customer. The external channel is an incremental contribution of this research.

Due to time limitation, in this research, we only test path two, and leave path one for our further research. To test this channel, three groups of observations are constructed, suppliers with no analysts following, suppliers with non-supply chain analysts following, and suppliers with supply chain analysts following. Prior literature has shown that analysts are able to reduce the information asymmetry between investors and firms, and contribute to the market efficiency. Among analysts, supply chain analysts use customer information more efficiently than non-supply chain analysts, and provide better forecast about suppliers based on customer information (Guan et al. 2015).

(1) Relation between customer accounting quality and supplier investment residual, taking supplier-analyst following into consideration

$$\text{Residual-Inv}_{i,t+1} = \alpha + \beta_1 CAQ_{i,t} + \beta_2 SAF_{i,t} + \beta_3 \, CAQ_{i,t} * SAF_{i,t} + \beta_4 AQ_{i,t} + \sum \gamma_j Control_{j,i,t} + \varepsilon_{i,t+1}$$

Residual-Inv is the absolute residual investment of suppliers, SAF is the quantity of analysts following the suppliers. We expect a negative β_3, which means given analyst following, supplier investment efficiency improves with customer accounting quality; or given customer accounting quality, supplier investment efficiency improves with number of analysts following supplier.

(2) Relation between customer accounting quality and supplier investment residual, taking supply-chain-analyst following into consideration

$$\text{Residual-Inv}_{i,t+1} = \alpha + \beta_1 CAQ_{i,t} + \beta_2 SAF_{i,t} + \beta_3 \, CAQ_{i,t} * SAF_{i,t} + \beta_4 SCAF_{i,t} + \beta_5 \, CAQ_{i,t} * SCAF_{i,t}$$
$$+ \beta_6 \, SAF_{i,t} * SCAF_{i,t} + \beta_7 \, CAQ_{i,t} * SAF_{i,t} * SCAF_{i,t} + \beta_8 AQ_{i,t} + \sum \gamma_j Control_{j,i,t} + \varepsilon_{i,t+1}$$

where SCAF is the number of analysts following the pair of customer and supplier at the same time.

Based on the hypothesis and channel design, β_7 is expected to be negative, which means that part of the incremental investment efficiency is accounted by the externality of customer information through analyst, instead of that supplier directly use customer information to improve the investment efficiency.

Section 4 Empirical Results

4.1 Descriptive statistics

In panel A of Table 1, we present the descriptive statistics of all the variables used in this paper. The average investment (scaled by prior year's total asset) across all firm-years equals 19.44% and the median equals 11.26%. The mean (median) residual investment equals -1.1 (-2.88), which is slightly smaller than zero. The accounting quality (accrual quality) has a mean (median) of 0.05 (0.04). These results are all consistent with prior researches. For analyst following, especially supply-chain analyst following, the numbers of observation are much smaller due to the data availability.

Panel B of Table 1 presents the Pearson correlation among the variables. The two investment efficiency measures, scaled investment and residual investment are positively correlated. On a univariate basis, firms' accounting quality is positive correlated to investment level and negatively correlated to residual investment, which is the deviation from the expected investment. The correlation between customer firms' accounting quality and supplier firms' investment efficiency is insignificantly different from zero. The possible explanation is that the correlation between customers' accounting quality and suppliers' investment efficiency is conditional on the firms' tendency to under-investment or over-investment.

4.2 Direct customer-supplier channel

Table 2 and table 3 present the baseline results of hypothesis test. In table 2, we test the impact of customer firms' accounting quality on supplier firms' investment level. Results show that customers' accounting quality is negatively associated with suppliers' investment level when

suppliers have strong propensity to over invest. The estimated coefficient on the interaction term CAQ*OverI is negative and significant in two columns. The t-statistics are -2.69 and -2.02. In terms of economic meaning, one standard deviation increase in CAQ would decrease investment by 3% among over-investment firms (top decile), and increase investment by 4.3% among under-investment firms (bottom decile). This result strongly supports our hypothesis that customers' accounting quality is positively related with suppliers' investment efficiency; to be specific, customers' accounting quality is negatively related with suppliers' investment level if they over invest, and positively related with suppliers' investment level if they under invest.

In terms of corporate governance variables, we find that IO, institutional ownership, is positively correlated with firms' investment level. One possible explanation would be that high institutional ownership improves the information environment and thus lowers the cost of capital and then leads to higher investment level. The coefficient on interaction term IO*Overl is significantly negative, which means for over-investment firms, institution investors would mitigate excessive inefficient investment. These findings suggest that the institutional ownership has different impact on firm's investment level depending on whether it is an over-investment firm or under-investment firm.

The analysis above has been conditional on the ex ante likelihood of under/over-investment by supplier firms. In our next step, we directly investigate the association between customer firms' accounting quality and supplier firms' investment efficiency without differentiating they are over or under investment firms. According to Biddle et al. (2009), investment is a function of growth opportunity (measured by sales growth), if we regress investment on sales growth, the residual should represent the deviation from expected investment. Following them, we compute the residual investment from the investment regression. Then we take the absolute value of this

residual investment as our investment efficiency measure. Bigger value of the absolute residual investment represents higher deviation from the expected level and then lower investment efficiency.

In Table 3, we report the results of directly testing the association between customer firms' accounting quality and supplier firms' investment inefficiency. We find that customers' accounting quality is negatively correlated with suppliers' investment inefficiency. The estimated coefficient associated with customers' accounting quality is negative and significant for two columns. The corresponding t-statistics are both -2.41. This result suggests that better customers' accounting quality, less suppliers' inefficient investment (as measured by deviation from expected level). When we turn to corporate governance variable, we find that the coefficient on institutional ownership is insignificant. Besides, most control variables in this model are statistically insignificant.

Overall, the results in table 2 and tables 3 provide strongly supporting evidence for our hypothesis that customers' accounting quality is positively related with suppliers' investment efficiency. Furthermore, our findings also suggest that customers' accounting quality may help to reduce both over and under investment of supplier firms.

4.3 External channel

In the previous analysis, we show evidence that customers' accounting quality is positively related with suppliers' investment efficiency. One possible mechanism is that supplier firm indeed directly use the information in their customers' financial reports when make investment decision. Customers' financial reports with higher accounting quality could provide more useful and

relevant information. Hence, customers' accounting quality is positively related with suppliers' investment efficiency. This is so called direct customer-supplier channel.

In this section, we investigate one of the two paths of external channel: analyst exert influence on the investment decision-making process of suppliers. With higher-quality customer information, we shall expect more positive influence from analysts to suppliers' investment-decision making. When the analysts following suppliers also absorb the customers' financial reports, higher-quality accounting information would help the analysts to do better job and provide more precise analysis. When the analysts communicate with managers of supplier firms, they would provide more valuable information to benefit the managers' investment decisions. That is the reason why we call it external channel. In this way, we may expect the positive relationship between customers' accounting quality and suppliers' investment efficiency becomes stronger if there are more analyst following. In addition, if the analysts follow the suppliers and customers simultaneously (supply chain analysts), the relationship should be even stronger.

Table 4 demonstrates the results of our analysis above. We find evidence that positive relationship between customers' accounting quality and suppliers' investment efficiency turns stronger when there are more analysts following the supplier firms. The estimated coefficient on the interaction term CAQ*SAF is negative and significant at the level of 10%. The t-statistics are -1.73 and -1.73. This result suggests that increase in analyst following would make the association between CAQ and deviated investment more negative. Since deviation from expected investment represents investment inefficiency, we would say increase in analyst following would make the positive association between CAQ and investment efficiency stronger.

Furthermore, we investigate whether this external channel effect would become stronger when the analysts follow the suppliers and customers simultaneously. Intuitively, for supply chain

analyst, they are familiar with both suppliers and customers, and they are able to better extract information from customers' financial reports and provide more relevant and useful information to suppliers, comparing with analysts who only follows suppliers. Then the improved accounting quality of customers should benefit suppliers more in this situation.

In table 5, we report the results of testing our conjecture above. The estimated coefficient on the cubic interaction term CAQ*SAF*SCAF is negative. However, the t-statistics is only -1.30, which means the result is statistically insignificant. One possible reason could be the insufficient observations. The supply chain analysts are only a small fraction of all financial analysts, besides, the analyst following data is missing for most observation. We expect the coefficient to be significantly negative if data problem could be solved in our further research.

To sum up, we find evidence to support our conjecture that analysts play a role in the relationship between customers' accounting quality and suppliers' investment efficiency. As an important external source of information, analysts provide valuable and relevant information to supplier firms' manager, and through this path, the positive association between customers' accounting quality and suppliers' investment efficiency could be strengthened.

Section 5 Conclusion

Firm-level investment efficiency is significantly related with economy development and social welfare. A line of literature analyzes the influence of accounting information quality over firms' own investment. In this paper, we extend the topic into a broader context, by exploring how accounting information of customers affect the investment of suppliers.

On the basis of prior literature, we hypothesize that accounting quality of customers is positively related with suppliers' investment efficiency. Four main models are constructed and carried out to test our hypothesis. Firstly, we regress the investment level of supplier on customer accounting quality, conditional on the likelihood of over/under invest. Results show that when suppliers have the propensity to overinvest ex ante, higher accounting quality of customers lead to less investment in suppliers; when suppliers tend to underinvest ex ante, higher accounting quality of customers corresponds to more investment in suppliers. Our hypothesis is supported by the results. Secondly, using residual investment to measure investment efficiency, we regress investment efficiency of suppliers directly on the customer accounting quality. The coefficient of customer accounting quality is significantly negative, which means higher accounting quality of customers lower the residual investment of suppliers and thus improve the investment efficiency.

In addition to the channel that suppliers directly utilize better customer information to improve investment decisions, we propose an external channel, which means customer information affects supplier investment efficiency through third parties, like analysts and investors. There are two sub-paths for the channel, the first path is that analyst exert better influence on supplier investment decision-making with better customer information. In our third model, we regress

residual investment of suppliers on number of analysts following suppliers and customer accounting quality, and the hypothesis is supported. Given customer accounting quality, more analyst following supplier, higher investment efficiency of suppliers; given analyst following, results show that higher accounting quality of customers higher investment efficiency of suppliers. Literature shows that when analyst follow both the supplier and the customer at the same time, they could give better forecast on suppliers and supply chain information issued by analysts significantly benefit the value efficiency of suppliers (Luo and Nagarajan 2015, Guan et al. 2015). If the improvement in supplier investment efficiency led by supply chain analysts (follow the supplier and customer at the same time) is significantly bigger than that led by supplier-only analysts, customer accounting information could be inferred to have a positive impact on supplier investment efficiency. We test this design in our fourth model and get the coefficient in the direction that support our conjecture, but the result is not significant. The possible cause is the very limited sample for the fourth model.

The external channel is one of our contributions to the line of literature, since prior studies mainly demonstrate the customer-supplier direct channel. Besides, our results show that customer accounting information could have a positive influence over investment decision-making of suppliers, which could have real implications for the regulators. Regulators might need to consider more comprehensively when make regulations or take actions to the firms, due to the extensive impact of customer information over the market and social welfare. Finally, from the angle of usefulness of accounting information, we focus on the usefulness of accounting information on firm level investment and non-financial stakeholders (customer & supplier), which complements the mainstream researches that analyze accounting information and capital market characteristics.

Due to time constraint, in this research, we did not carry out any robustness test. Limited by sample availability, result of our fourth model is insignificant. Besides, more proxies of accounting quality and investment efficiency could be tested. All of these issues could be explored in future studies.

Appendix

Appendix A Variable Definitions

Variable	Definition
Investment	Supplier firms' total investment scaled by prior year's total asset.
Residual_Inv	Regress investment on sales growth, the residual of which is used to measure deviation from expected investment. (Biddle et al. 2009)
AQ	Supplier firms' accounting quality measured by the accrual quality proposed by Dechow and Dichev (2002). Regress total current accrual on cash flow of t, t-1 and t+1; take the residual as the quality measure.
CAQ	Customer firms' accounting quality measured by the accrual quality proposed by Dechow and Dichev (2002). Regress total current accrual on cash flow of t, t-1 and t+1; take the residual as the quality measure.
Log-Asset	Log current year total asset
Std-CFO	Standard deviation of cash flow from operation scaled by total asset, over years t−5 to t−1.
Std-Inv	Standard deviation of Investment scaled by total asset, over years t−5 to t−1.
Std-Sales	Standard deviation of the sales scaled by total asset, over years t−5 to t−1.
Z-score	Distress risk measure developed Altman (1968). 3.3 times pretax income, plus sales, plus one quarter of retained earnings, plus half of working capital to total assets.

Tangibility	Property Plant Equipment divided by booking value of assets.
K-structure	Market leverage, calculated by long-term debt divided by the sum of equity market value and long-term debt.
CFOsale	Operating cash flow scaled by sales.
Slack	Cash divided by PPE.
TotalDividend	Dividend paid out.
Dividend	A dummy variable that takes the value of 1 if the firm paid dividend and 0 otherwise.
OperatingCycle	Signify firms' operating cycle.
Loss	A dummy variable that takes the value of 1 if net income before extraordinary items is negative and 0 otherwise.
SAF	The number of analysts following the supplier firm.
CAF	The number of analysts following the costumer firm.
SCAF	The number of analysts following the supplier and costumer firms at the same time, so called the supply chain analyst following.
Mkt-to-Book	Market value of equity to the its historical value.
OverI	OverI is a rank variable measures the ex ante probability of over investment, computed as the average of ranked measure of leverage and cash (multiplied by minus one).
IO	IO measures the institutional ownership percentage.

Tables

Table 1 Summary Statistics

Panel A - descriptive statistics

	Mean	STD	Min	Median	Max
Investment	19.44	25.30	-1.86	11.26	155.69
Residual_Inv	-1.10	28.74	-96.47	-2.88	139.79
AQ	0.05	0.04	0.00	0.04	0.48
CAQ	0.03	0.02	0.00	0.02	0.29
Log–Asset	5.22	2.10	-3.61	5.13	12.87
Mkt-to-Book	2.44	9.66	-0.20	1.50	940.04
CFOsale	-0.86	17.92	-882.16	0.07	139.12
TotalDividend	61.67	618.49	0.00	0.00	20,114.71
Dividend	0.28	0.45	0.00	0.00	1.00
Z-score	-0.46	6.35	-211.92	0.47	80.15
Tangibility	0.31	0.27	0.00	0.21	0.99
SAF	7.65	6.90	1.00	5.00	50.00
CAF	18.87	10.97	1.00	19.00	56.00
SCAF	1.64	3.28	0.00	0.00	33.00
Slack	9.00	117.02	-0.01	0.62	9,583.86
K-structure	0.18	0.23	0.00	0.08	1.00
OperatingCycle	4.60	0.84	-3.11	4.64	11.54
Loss	0.44	0.50	0.00	0.00	1.00
Std-CFO	0.51	9.21	0.00	0.09	684.91
Std-Inv	0.35	6.67	0.00	0.07	621.23
Std-Sales	1.09	24.21	0.00	0.20	1,510.68
IO	0.42	0.29	0.00	0.38	1.00

Panel B - Pearson correlation matrix

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII
Investment	1																					
Residual_Inv	0.35	1																				
AQ	0.25	-0.02	1																			
CAQ	0.04	0.02	0.07	1																		
Log-Asset	-0.18	-0.04	-0.37	0.05	1																	
Mkt-to-Book	0.14	0.08	0.27	0	-0.13	1																
Std-CFO	0.01	-0.01	0.08	-0.01	-0.05	0.01	1															
Std-Sales	-0.01	0.00	0.03	-0.01	-0.02	0.00	0.37	1														
Std-Inv	0.03	0.01	0.08	0.00	-0.04	0.01	0.2	0.21	1													
Z-score	-0.16	-0.11	-0.29	0.00	0.28	-0.28	-0.02	0	-0.01	1												
Tangibility	-0.02	0.04	-0.35	0.05	0.29	-0.07	-0.03	0	0.01	0.05	1											
K-structure	-0.18	0.00	-0.17	0.01	0.31	-0.08	-0.02	-0.01	-0.01	0	0.44	1										
CFOsale	-0.12	-0.03	-0.08	0.01	0.04	-0.03	-0.01	0.00	-0.01	0.04	0.04	0.03	1									
Slack	0.02	-0.02	0.09	0.02	-0.02	0.01	0.00	0.00	0.00	0.00	-0.08	-0.03	-0.07	1								
TotalDividend	-0.02	-0.01	-0.08	0.02	0.22	-0.01	0.00	0.00	0.00	0.02	0.09	0.00	0.01	0	1							
Dividend	-0.17	0.00	-0.28	0.00	0.38	-0.05	-0.02	-0.02	-0.02	0.09	0.32	0.18	0.03	0	0.16	1						
OperatingCycle	-0.03	-0.04	0.00	-0.04	-0.02	0.02	0.00	0.01	0.00	0.08	-0.19	-0.10	-0.06	-0.09	-0.01	-0.08	1					
Loss	0.23	0.04	0.34	0.03	-0.32	0.05	0.04	0.01	0.02	-0.24	-0.15	0.02	-0.07	0.01	-0.08	-0.28	-0.03	1				
SAF	-0.03	-0.04	-0.16	0.11	0.62	0.02	-0.03	-0.03	-0.03	0.11	0.13	0.02	0.02	-0.01	0.06	0.15	-0.01	-0.17	1			
CAF	0.02	0.00	0.02	-0.18	-0.01	0.00	-0.01	-0.01	0.00	0.00	-0.01	0.00	0.01	-0.02	-0.05	0.00	0.00	0.01	0.07	1		
SCAF	-0.06	-0.04	-0.11	0.03	0.42	-0.03	-0.03	-0.04	-0.04	0.08	-0.04	0.00	0.02	-0.02	0.07	0.14	0.01	-0.19	0.42	0.2	1	
IO	-0.09	-0.06	-0.13	0.04	0.51	-0.04	-0.03	-0.04	-0.03	0.15	-0.04	0.01	0.02	0.03	-0.04	0.06	-0.01	-0.18	0.45	0.05	0.38	1

Panel A reports the descriptive statistics of the variables included in this paper. Panel B reports Pearson correlations among the variables. Investmen is the total investment scaled by prior year's total asset. Residual_Inv is the residual when regress investment on sales growth (Biddle et al. 2009). AC and CAQ represent the supplier firms' and customer firms' accounting quality respectively, measured by the accrual quality proposed by Dechow and Dichev (2002). Log-Asset refers to the log of current year total asset. Mkt-to-Book is calculated as market value of total equity divided by its historica value. The three standard deviation measures are rolling window estimates over years t−5 to t−1. Std-CFO is the standard deviation of cash flow fron operation scaled by total asset. Std-Sales is the standard deviation of the sales scaled by total asset. Std-Inv is the standard deviation of Investmen scaled by total asset. Z-score is the distress risk measure developed by Altman (1968). Tangibility is computed as Property Plant Equipment dividec by booking value of assets. K-structure is the market leverage, calculated as long-term debt divided by the sum of equity market value and long-tern debt. CFOsale is the cash flow from operation scaled by sales. Slack is the ratio of cash to PPE. TotalDividend is the dividend paid out, and Dividenc

is a dummy variable that takes the value of 1 if the firm paid dividend and 0 otherwise. OperatingCycle indicates firms' operating cycle. Loss is a dummy variable equals to 1 when net income before extraordinary items is small than zero and equals to 0 otherwise. SAF CAF SCAF are three analysts following measures. SAF is the number of analysts following the supplier firm. CAF is the number of analysts following the costumer firm. SCAF is the number of analysts following the supplier and costumer firms at the same time, so called the supply chain analyst following. IO measures the institutional ownership.

Table 2 Baseline Results (conditional on over/under-investment tendency)

Predictors	(1)	(2)
CAQ	49.10***	49.10**
	(2.71)	(2.05)
CAQ*OverI	-7.724***	-7.724**
	(-2.690)	(-2.015)
AQ	39.34***	39.34**
	(3.84)	(2.23)
AQ*OverI	(0.00)	(0.00)
	(-0.00131)	(-0.000694)
IO	4.497***	4.497***
	(2.60)	(2.61)
IO*OverI	-0.554**	-0.554**
	(-2.356)	(-2.534)
Log-Asset	-0.407**	-0.407*
	(-1.977)	(-1.923)
Mkt-to-Book	2.508***	2.508***
	(21.42)	(7.89)
Std-CFO	0.650**	0.650**
	(1.97)	(2.13)
Std-Sales	-0.332***	-0.332***
	(-2.794)	(-2.633)
Std-Inv	-0.14	-0.14
	(-0.537)	(-0.922)
Z-score	0.299***	0.299***
	(5.63)	(2.97)
Tangibility	17.36***	17.36***
	(9.41)	(7.35)
K-structure	-3.658***	-3.658**
	(-2.639)	(-2.331)
CFOsale	-0.01	-0.01
	(-0.214)	(-0.139)
Slack	0.0109*	0.0109**
	(1.86)	(2.33)
Dividend	-0.88	-0.88
	(-1.276)	(-1.073)
OperatingCycle	-1.350***	-1.350**
	(-3.963)	(-2.019)
Loss	0.21	0.21
	(0.46)	(0.45)
Industry FE	Yes	Yes
Firm/Year Cluster	No	Yes
r2	9.95	9.95
N	4431	4431

This table reports the OLS regression result of the model predicting investment level. The dependent variable is the total investment scaled by prior year's total asset. AQ and CAQ represent the supplier firms' and customer firms' accounting quality respectively, measured by the accrual quality proposed by Dechow and Dichev (2002). OverI is a rank variable measures the ex ante probability of over investment, computed as the average of ranked measure of leverage and cash (multiplied by minus one). IO measures the institutional ownership. Log-Asset refers to the log of current year total asset. Mkt-to-Book is calculated as market value of total equity divided by its historical value. The three standard deviation measures are rolling window estimates over years t−5 to t−1. Std-CFO is the standard deviation of cash flow from operation scaled by total asset. Std-Sales is the standard deviation of the sales scaled by total asset. Std-Inv is the standard deviation of Investment scaled by total asset. Z-score is the distress risk measure developed by Altman (1968). Tangibility is computed as Property Plant Equipment divided by booking value of assets. K-structure is the market leverage, calculated as long-term debt divided by the sum of equity market value and long-term debt. CFOsale is the cash flow from operation scaled by sales. Slack is the ratio of cash to PPE. TotalDividend is the dividend paid out, and Dividend is a dummy variable that takes the value of 1 if the firm paid dividend and 0 otherwise. OperatingCycle indicates firms' operating cycle. Loss is a dummy variable equals to 1 when net income before extraordinary items is small than zero and equals to 0 otherwise. In this model, we include the Fama-French (1997) industry fixed-effects. We demonstrate the t-Statistics under the coefficients and heteroscedasticity was corrected for the s-Statistics. *, **, and *** signify the significance level at 10%, 5%, and 1% respectively.

Table 3 Baseline Results

Predictors	(1)	(2)
CAQ	-164.4**	-164.4**
	(-2.414)	(-2.414)
AQ	66.64	66.64
	(0.82)	(0.82)
IO	-1.28	-1.28
	(-0.281)	(-0.281)
Log-Asset	3.89	3.89
	(1.06)	(1.06)
Mkt-to-Book	0.50	0.50
	(0.50)	(0.50)
Std-CFO	3.09	3.09
	(1.13)	(1.13)
Std-Sales	-1.41	-1.41
	(-1.131)	(-1.131)
Std-Inv	-2.86	-2.86
	(-0.930)	(-0.930)
Z-score	-0.12	-0.12
	(-0.523)	(-0.523)
Tangibility	-12.79	-12.79
	(-0.739)	(-0.739)
K-structure	3.06	3.06
	(0.60)	(0.60)
CFOsale	0.58	0.58
	(0.94)	(0.94)
Slack	0.02	0.02
	(0.50)	(0.50)
Dividend	0.00	0.00
	(-0.535)	(-0.535)
OperatingCycle	0.31	0.31
	(0.09)	(0.09)
Loss	-5.467*	-5.467*
	(-1.883)	(-1.883)
FE	Yes	Yes
Firm/Year Cluster	No	Yes
r2	0.99	0.99
N	4377	4377

This table reports the fixed effect panel regression result of the model predicting investment efficiency. The dependent variable is the absolute residual investment. AQ and CAQ represent the supplier firms' and customer firms' accounting quality respectively, measured by the accrual quality proposed by Dechow and Dichev (2002). Log-Asset refers

to the log of current year total asset. IO measures the institutional ownership. Mkt-to-Book is calculated as market value of total equity divided by its historical value. The three standard deviation measures are rolling window estimates over years t−5 to t−1. Std-CFO is the standard deviation of cash flow from operation scaled by total asset. Std-Sales is the standard deviation of the sales scaled by total asset. Std-Inv is the standard deviation of Investment scaled by total asset. Z-score is the distress risk measure developed Altman (1968). Tangibility is computed as Property Plant Equipment divided by booking value of assets. K-structure is the market leverage, calculated as long-term debt divided by the sum of equity market value and long-term debt. CFOsale is the cash flow from operation scaled by sales. Slack is the ratio of cash to PPE. TotalDividend is the dividend paid out, and Dividend is a dummy variable that takes the value of 1 if the firm paid dividend and 0 otherwise. OperatingCycle indicates firms' operating cycle. Loss is a dummy variable equals to 1 when net income before extraordinary items is small than zero and equals to 0 otherwise. We demonstrate the t-Statistics under the coefficients and heteroscedasticity was corrected for the s-Statistics. *, **, and *** signify the significance level at 10%, 5%, and 1% respectively.

Table 4 External Channel Test (supplier analysts following)

Predictors	(1)	(2)
CAQ	7.956	7.956
	(0.0909)	(0.0909)
SAF	0.454	0.454
	(1.037)	(1.037)
CAQ*SAF	-11.47*	-11.47*
	(-1.726)	(-1.726)
AQ	-21.11	-21.11
	(-0.313)	(-0.313)
Log-Asset	-1.330	-1.330
	(-0.546)	(-0.546)
Mkt-to-Book	-2.300*	-2.300*
	(-1.677)	(-1.677)
K-structure	8.191	8.191
	(0.650)	(0.650)
Slack	-0.359**	-0.359**
	(-2.430)	(-2.430)
Z-score	1.901	1.901
	(0.752)	(0.752)
Tangibility	-23.06	-23.06
	(-1.081)	(-1.081)
CFOsale	0.797	0.797
	(1.116)	(1.116)
Std-Sales	-6.389	-6.389
	(-1.219)	(-1.219)
Std-Inv	1.055	1.055
	(0.397)	(0.397)
Std-CFO	-1.060	-1.060
	(-0.458)	(-0.458)
Dividend	0.000499	0.000499
	(0.484)	(0.484)
OperatingCycle	3.674	3.674
	(0.670)	(0.670)
Loss	-0.143	-0.143
	(-0.0432)	(-0.0432)
FE	Yes	Yes
Firm/Year Cluster	No	Yes
r2	1.61	1.61
N	2434	2434

This table reports the fixed effect panel regression result of the model predicting investment efficiency. The dependent variable is the absolute residual investment. AQ and CAQ represent the supplier firms' and customer firms' accounting quality respectively, measured by the accrual quality proposed by Dechow and Dichev (2002). SAF is the

number of analysts following the supplier firm. Log-Asset refers to the log of current year total asset. Mkt-to-Book is calculated as market value of total equity divided by its historical value. The three standard deviation measures are rolling window estimates over years t−5 to t−1. Std-CFO is the standard deviation of cash flow from operation scaled by total asset. Std-Sales is the standard deviation of the sales scaled by total asset. Std-Inv is the standard deviation of Investment scaled by total asset. Z-score is the distress risk measure developed Altman (1968). Tangibility is computed as Property Plant Equipment divided by booking value of assets. K-structure is the market leverage, calculated as long-term debt divided by the sum of equity market value and long-term debt. CFOsale is the cash flow from operation scaled by sales. Slack is the ratio of cash to PPE. TotalDividend is the dividend paid out, and Dividend is a dummy variable that takes the value of 1 if the firm paid dividend and 0 otherwise. OperatingCycle indicates firms' operating cycle. Loss is a dummy variable equals to 1 when net income before extraordinary items is small than zero and equals to 0 otherwise. We demonstrate the t-Statistics under the coefficients and heteroscedasticity was corrected for the s-Statistics. *, **, and *** signify the significance level at 10%, 5%, and 1% respectively.

Table 5 External Channel Test (Supply Chain Analyst following)

Predictors	(1)	(2)
CAQ	-51.67	-51.67
	(-0.428)	(-0.428)
SAF	-0.376	-0.376
	(-0.430)	(-0.430)
CAQ*SAF	9.162	9.162
	(1.105)	(1.105)
SCAF	1.472	1.472
	(0.518)	(0.518)
CAQ*SCAF	50.09	50.09
	(1.145)	(1.145)
SAF*SCAF	0.0226	0.0226
	(0.337)	(0.337)
CAQ*SAF*SCAF	-2.819	-2.819
	(-1.296)	(-1.296)
AQ	175.5	175.5
	(1.028)	(1.028)
Log-Asset	9.961	9.961
	(1.487)	(1.487)
Mkt-to-Book	-2.267	-2.267
	(-0.985)	(-0.985)
K-structure	-6.306	-6.306
	(-0.214)	(-0.214)
Slack	-0.217	-0.217
	(-1.286)	(-1.286)
Z-score	1.675	1.675
	(0.878)	(0.878)
Tangibility	29.28	29.28
	(0.636)	(0.636)
CFOsale	-0.311	-0.311
	(-0.883)	(-0.883)
Dividend	-0.00224	-0.00224
	(-1.363)	(-1.363)
OperatingCycle	-10.78*	-10.78*
	(-1.755)	(-1.755)
Std-Inv	-4.647	-4.647
	(-0.0733)	(-0.0733)
Std-CFO	80.73	80.73
	(1.032)	(1.032)
Std-Sales	-8.296	-8.296
	(-0.727)	(-0.727)
Loss	-4.005	-4.005
	(-0.827)	(-0.827)
FE	Yes	Yes
Firm/Year Cluster	No	Yes
r2	6.75	6.75
N	648	648

This table reports the fixed effect panel regression result of the model predicting investment efficiency. The dependent variable is the absolute residual investment. AQ and CAQ represent the supplier firms' and customer firms' accounting quality respectively, measured by the accrual quality proposed by Dechow and Dichev (2002). SAF is the number of analysts following the supplier firm. SCAF is the number of analysts following the supplier and costumer firms at the same time, so called the supply chain analyst following. Log-Asset refers to the log of current year total asset. Mkt-to-Book is calculated as market value of total equity divided by its historical value. The three standard deviation measures are rolling window estimates over years t−5 to t−1. Std-CFO is the standard deviation of cash flow from operation scaled by total asset. Std-Sales is the standard deviation of the sales scaled by total asset. Std-Inv is the standard deviation of Investment scaled by total asset. Z-score is the distress risk measure developed Altman (1968). Tangibility is computed as Property Plant Equipment divided by booking value of assets. K-structure is the market leverage, calculated as long-term debt divided by the sum of equity market value and long-term debt. CFOsale is the cash flow from operation scaled by sales. Slack is the ratio of cash to PPE. TotalDividend is the dividend paid out, and Dividend is a dummy variable that takes the value of 1 if the firm paid dividend and 0 otherwise. OperatingCycle indicates firms' operating cycle. Loss is a dummy variable equals to 1 when net income before extraordinary items is small than zero and equals to 0 otherwise. We demonstrate the t-Statistics under the coefficients and heteroscedasticity was corrected for the s-Statistics. *, **, and *** signify the significance level at 10%, 5%, and 1% respectively.

Reference

Biddle, G. C., & Hilary, G. (2006). Accounting quality and firm-level capital investment. The Accounting Review, 81(5), 963-982.

Biddle, G. C., Hilary, G., & Verdi, R. S. (2009). How does financial reporting quality relate to investment efficiency?. Journal of accounting and economics, 48(2-3), 112-131.

Bushman, R. M., Piotroski, J. D., & Smith, A. J. (2004). What determines corporate transparency?. Journal of accounting research, 42(2), 207-252.

Chen, F., Hope, O.K., Li, Q.Y., and Wang, X. (2011). Financial Reporting Quality and Investment Efficiency of Private Firms in Emerging Markets. The Accounting Review 86.4 (2011): 1255-288..

Chen, K. (2015). Supplier's Relationship-Specific Investment and Customer's Management Forecasts. Working paper.

Chen, T. K., Liao, H. H., & Huang, H. C. (2014). Macroeconomic risks of supply chain counterparties and corporate bond yield spreads. Review of Quantitative Finance and Accounting, 43(3), 463-481.

Cheng, M., Dhaliwal, D., & Zhang, Y. (2013). Does investment efficiency improve after the disclosure of material weaknesses in internal control over financial reporting?. Journal of Accounting and Economics, 56(1), 1-18.

Clark, T. H., & Hammond, J. H. (1997). Reengineering channel reordering processes to improve total supply-chain performance. Production and Operations Management, 6(3), 248-265.

Cohen, L., & Frazzini, A. (2008). Economic links and predictable returns. The Journal of Finance, 63(4), 1977-2011.

Dechow, P. M., & Dichev, I. D. (2002). The quality of accruals and earnings: The role of accrual estimation errors. The accounting review, 77(s-1), 35-59.

Ellis, J. A., Fee, C. E., & Thomas, S. E. (2012). Proprietary costs and the disclosure of information about customers. Journal of Accounting Research, 50(3), 685-727.

Francis, J. R., Khurana, I. K., & Pereira, R. (2005). Disclosure incentives and effects on cost of capital around the world. The Accounting Review, 80(4), 1125-1162.

Gao, R., Yu, X. (2018). How to measure capital investment efficiency: a literature synthesis. Accounting and Finance,2018,(0)

Guan, Y., Wong, M. F., & Zhang, Y. (2015). Analyst following along the supply chain. Review of Accounting Studies, 20(1), 210-241.

Hayashi, F. (1982). Tobin's marginal q and average q: A neoclassical interpretation. Econometrica: Journal of the Econometric Society, 213-224.

Hertzel, M. G., Li, Z., Officer, M. S., & Rodgers, K. J. (2008). Inter-firm linkages and the wealth effects of financial distress along the supply chain. Journal of Financial Economics, 87(2), 374-387.

Hoshi, T., Kashyap, A., & Scharfstein, D. (1991). Corporate structure, liquidity, and investment: Evidence from Japanese industrial groups. The Quarterly Journal of Economics, 106(1), 33-60.

Hovakimian, A. G.. Hovakimian, 2005. Cash flow sensitivity of the investment. Working Paper.

Hui, K. W., Klasa, S., & Yeung, P. E. (2012). Corporate suppliers and customers and accounting conservatism. Journal of Accounting and Economics, 53(1-2), 115-135.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. Journal of financial economics, 3(4), 305-360.

Jones, J. J. (1991). Earnings management during import relief investigations. Journal of accounting research, 193-228.

Kale, J., Kedia, S., & Williams, R. (2015). The Effect of CEO's Risk-Taking Incentives on Relationship-Specific Investments by Customers and Suppliers.

Kale, J. R., & Shahrur, H. (2007). Corporate capital structure and the characteristics of suppliers and customers. Journal of Financial Economics, 83(2), 321-365.

Kim, J. B., Song, B. Y., & Zhang, Y. (2015). Earnings performance of major customers and bank loan contracting with suppliers. Journal of Banking & Finance, 59, 384-398.

Kothari, S.P., Ramanna, K., Skinner, D.J. (2010). Implications for GAAP from an analysis of positive research in accounting. Journal of Accounting and Economics 50 (2010) 246–286

Li, F. (2008). Annual report readability, current earnings, and earnings persistence. Journal of Accounting and economics, 45(2-3), 221-247.

Liu, M., Ma, T., & Martin, X. (2013). The real effect of customer accounting quality-trade credit and suppliers' cash holdings. Working paper.

Luo, S., & Nagarajan, N. J. (2014). Information complementarities and supply chain analysts. The Accounting Review, 90(5), 1995-2029.

Lu, T., Sapra, H. (2009). Auditor Conservatism and Investment Efficiency. Accounting Review, 84.6 (2009): 1933-958

Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. Journal of financial economics, 13(2), 187-221.

Özer, Ö., & Wei, W. (2006). Strategic commitments for an optimal capacity decision under asymmetric forecast information. Management science, 52(8), 1238-1257.

Radhakrishnan, S., Wang, Z., & Zhang, Y. (2014). Customers' capital market information quality and suppliers' performance. Production and Operations Management, 23(10), 1690-1705.

Raman, K., & Shahrur, H. (2008). Relationship-specific investments and earnings management: Evidence on corporate suppliers and customers. The Accounting Review, 83(4), 1041-1081.

Roychowdhury, S., Shroff, N. and Verdi, R.S., 2019. The effects of financial reporting and disclosure on corporate investment: A review. Journal of Accounting and Economics, https://doi.org/10.1016/j.jacceco.2019.101246

Tobin, J. (1969). A general equilibrium approach to monetary theory. Journal of money, credit and banking, 1(1), 15-29.

Williams, R., & Xiao, S. (2017). The effect of stock prices on real investment in the vertical supply chain. Working paper.