MANAGERIAL ABILITY, MARKET COMPETITION AND TRADE CREDIT

An empirical study on the relationship between managerial ability and trade credit and the moderating effect of market competition

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Abstract:

This thesis aims to first estimate the relationship between managerial ability and trade credit and then examine the moderating effect of market competition on this relationship. We construct a sample consisting of 24,081 firm-year observations within 4,259 US firms and employ two-dimensional fixed effects regression models to test them. We find out there is a significant positive relationship between managerial ability and getting trade credit measured by accounts payable and there is a significant negative relationship between managerial ability and granting trade credit. However, our result does not show a statistically significant support to the moderating effect of market competition on the relationship between managerial ability and trade credit. And we also conduct several robustness tests to support our regression results. Our thesis contributes to fill the gap in the study of trade credit from the perspective of management heterogeneity.

Keywords:

Management heterogeneity, Managerial ability, Market competition, Trade credit

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1 Introduction

"The rationale of trade credit is to maintain control."

(Huyghebaert et al., 2007)

Trade credit is one of the main ways of doing trade between suppliers and customers. A company can both act as a supplier to its customers and a customer to its suppliers, so the company can either grant or get trade credit when there is a time difference between goods or service delivery and the payment, and thus creating the account payable and account receivables in one company's accounting records. Although finance markets develop very fast and relatively mature in modern times, trade credit is still a major way to raise funds. According to a statistic of accounting data from G7 Countries conducted by Rajan and Zingales (1995), account receivable takes up 17.8% of the total assets in the US, and the percentage is even higher in Germany (26.9%), France (28.9%) and Italy (29%). Trade credit is even more critical for companies in other countries with less-developed financing environment. Many scholars have studied this area, and most of them focus on the motivations behind the trade credit and the impact trade credit has on firm outcomes.

Trade credit involves not only commercial activities as its name "trade" suggests but also operating and financing activities. There are quite a lot of literature studied on the different theoretical motivation behind the usage of trade credit, often classified as operational, commercial and financial perspective (García-Teruel and Martínez-Solano, 2010; Martinez-Sola et al., 2014). The quote we used, in the beginning, stresses that retaining control is the rationale of trade credit (Huyghebaert et al., 2007), and therefore firms need to take care of all the three aspects when considering trade credit. According to agency theory, managers are the ones who take the primary responsibility to make corporate decisions and control, including but not limited to purchases, sales, and capital structure. Therefore, managers can play a very important role in receiving and granting trade credit. Nevertheless, existing empirical researches that try to explain corporate behavior and performance generally depend on firm-, industry-, or market-level features and angles rather than the

possible role of individual managers that could play (Bertrand and Schoar, 2003).

Different from the existing literature, this thesis investigates factors that affect trade credit from a perspective of management heterogeneity. As in upper echelon theory proposed by Hambrick and Mason (1984), the upper echelon in an organization has two aspects of characteristics: psychological characteristics, and individual observable characteristics. The more unobservable psychological traits can be, in turn, crafted by more observable demographic traits, and thus both the demographic characteristics and the psychological characteristics have an impact on decision-making. Nowadays, more and more scholars are aware of the influence of manager-specific characteristics on firm behaviors and outcomes. After Bertrand and Schoar (2003) show the manager fixed effects on corporate decision, studies follow up their work and investigate how those characteristics, especially psychological factors, attribute to financial decisions (Hu and Liu, 2015). Engelberg et al. (2012) conclude that social connections reduce information asymmetry, leading to better information flow and easier performance monitoring. They also find that interest rates reduced significantly when the management team of a firm is personally connected to members of the bank through previous college educations or working experience. Ben-David et al. (2007) study the effects of miscalibration on investment behavior and find that firms with overconfident CFOs actively choose more favorable prediction factors, are more aggressive in their investment decisions. Cain and McKeon (2016) examine the relationship between personal risk-taking, corporate risk-taking, and total firm risk. Inspired by these studies, to further investigate instead of only considering one or two characteristics of one certain individual manager, we want to capture a complete picture of managerial ability from a whole firm management team level. Thus, we choose to learn from the method developed by Demerjian et al. (2012) to quantify managerial ability to get a more comprehensive picture of managerial ability or talent and to see how this relates to corporate behaviors, which includes getting or granting of trade credit.

According to the upper echelon theory again, it is the “objective situation” from both external and internal of the organization that influences upper echelon characteristics and further

affects the organization' s strategy and outcomes (Hambrick and Mason, 1984). So, besides the internal management ability perspective discussed above, we also want to study trade credit from an external perspective. Moreover, we also notice that there is no consistent conclusion on how product market power influences the supply and demand for trade credit. Meltzer (1960) first states a positive relationship between market power and trade credit extension. However, Fabbri and Klapper (2016) state, oppositely, that suppliers with weak bargaining power towards their customers are more likely to extend trade credit. It would be interesting to test the inconsistent conclusions based on the moderating effect of market competition on the relationship between managerial ability and trade credit.

Thus, to fill the research gap of studying trade credit from a perspective of management heterogeneity and to further study by adding an interesting external moderating effect, we put up following research questions in this thesis:

> *What is the relationship between managerial ability and trade credit? And is there a moderating effect of market competition on the relationship between managerial ability and trade credit? If so, how does this moderating effect look like?*

To answer the research questions, we first learn from Demerjian et al. (2012) to do the Data Envelopment Analysis (DEA) and run Tobit regression to quantify the managerial ability. Then we employ year and firm two-dimensional fixed effects regressions to study the relationship between managerial ability and trade credit where trade credit is represented by accounts payable and accounts receivables, respectively. Based on this two-dimensional fixed effects regression model, we add an interaction term of managerial ability and market competition to further study the moderating effect mentioned in the second research question. And we also conduct several robustness tests to support our regression results.

This thesis contributes to the existing literature in several ways. First, we investigate what influence trade credit in a way of combining both internal and external environment perspective. The internal perspective is a new perspective of management heterogeneity and

to our knowledge, there is no previous researches have studied the impact of managerial ability measured by method learned from Demerjian et al. (2012) on trade credit. Second, many researchers directly use the managerial ability score calculated by Demerjian et al. in 2009 or the newest version in 2016, which restricts the time scale and company observations of many studies. By conducting our own calculation, we extend the time period to year 2018 and can provide more new observations and possible insights. Third, we try to provide more empirical evidence to the inconsistent arguments about the relationship between market competition and trade credit in our setting that bases on the moderating effect of market competition. Overall, the implications of our findings indicate that there is a significant positive relationship between managerial ability and getting trade credit and a significant negative relationship between managerial ability and granting trade credit. And there is no significant moderating effect of market competition acting on the relationship between managerial ability and trade credit.

The rest of this thesis is structured as following. Section 2 contains a literature review of theories and notions relevant to our research topic and leads to the development of our hypotheses. Section 3 explains our research design, data construction and applied models. Section 4 presents the empirical results of two two-dimensional fixed effects models and related robustness tests. After showing the results, we provide some analysis and discussion to further interpret the results in Section 5. The last section consists of conclusion, contribution, future research suggestion and limitation.

2 Literature Review and Hypothesis Development

2.1 Literature Review

2.1.1 Trade Credit

This thesis mainly aims to see how managerial ability influences trade credit, which leads us to start with previous papers about what factors influence the usage of trade credit, although papers investigating what factors are influenced by trade credit are also in big amounts. There are quite a lot of literature studied on the different theoretical motivation behind the usage of

trade credit, often classified as operational, commercial and financial perspective (García-Teruel and Martínez-Solano, 2010; Martinez-Sola et al., 2014). The operational motivations are often related to reduce transaction fees, decrease operating expenses by the possibility of predicting the product and payment flows to achieve cost efficiency (Ferris, 1981; Emery, 1984; Wilson and Summers, 2002). As for commercial motivation, trade credit can boost long-term business partnership (Petersen and Rajan, 1997; Wilson and Summers, 2002) through being used to confirm product quality (can be seen as signaling mechanism from neoclassical view of trade credit) and it simulate sales (Lee and Stowe, 1993; Long et al., 1993).

The financial motivation can be explained by market imperfection theory which states financial markets are imperfect and associated with agency conflict costs, moral hazards, and information asymmetry (Myers and Majluf, 1984). Biais and Gollier (1997) find that trade credit can buffer information asymmetry by providing more private information of seller in lending relationship and it can be transmitted the firm's creditworthiness to financial institutions, and therefore aid the firm to get more fund from traditional financing channels, which can also be seen as "signaling hypothesis" from the neoclassical theory view. There are also some studies to take ''substitution hypothesis'' to say that, standing on the receiving firm's position, trade credit and bank loans would be (imperfect) substitute channels of financing, especially when in tight monetary conditions (Meltzer, 1960; Schwartz, 1974) and when firms in financial distress (Molina and Preve, 2012). Carvalho and Schiozer (2015) also point out trade credit can work as a complement to bank loans. These two hypothetical perspectives are both related to trade credit having informational advantages and liquidity advantages (Petersen and Rajan, 1997; Frank and Maksimovic, 2004; Fabbri and Menichini, 2010; Carvalho and Schiozer, 2015) over banks. However, trade credit is a relatively costly means of financing source (Huyghebaert et al., 2007), whereas bank loan is considered to be a cheaper means of financing source (Wilson and Summers, 2002). Thus, the substitution relationship between trade credit and bank loans are usually involuntary. During the financial crisis, banks are under liquidity pressure and are less capable and willing to offer additional loan. Thus, firms under financial constraint have to turn to more expensive trade credit for

external financing (Love and Zaidi, 2010).

It is worth noting that both commercial motivation and financial motivation involve information asymmetry. By telling the story of "lemon market", Akerlof (1970) illustrates there are counteracting instruments for information asymmetry and one of the mains is the firms' brand established by long-term good quality. Akerlof (1970) also applies this story to credit market where providers without enough information are more likely to deny lending. It is interesting to take this lens into trade credit because trade credit requires easing of information asymmetry while at the same time can be used as a counteracting instrument of asymmetric information.

Although trade credit can play a signaling role in indicating good quality of products and stableness of creditworthiness, the benefits of this signaling role always come at certain costs. From the incomplete contract theory point of view, trade credit has the features of incomplete contract and relying more on the self-implementation mechanism and thus is related to certain operational and financial risk as well. As Hertzel et al. (2008) find, losses on uncollectible accounts will increase with the default of customer payments and the financial contagion effect amplifies the financial risks caused by defaults of core customer payments in the supply chain. Meanwhile, what cannot be ignored is that the supplier can use trade credit to do price discrimination which compensates the risks of late payments from buyers by higher price. Therefore, it is very important for a firm to trade off trade credit from operational concern and financial concern, which may involve pecking order theory which provides a traditional preference order for a firm to get fund for their capital structure.

Pecking order theory developed by Myers (1984) states internal financing is preferred first because of its lowest subsequent cost. Then it is followed by issuing debt over equity, because debt has lower default risk and even in scenario of default or bankruptcy creditors will ask for lower return since they have already had priority claims. Few firms can have good financial performance and rely totally on internal fund. Since trade credit can be seen as substitute channel for bank loan or a signal for credit risk, it can play a considerable role when deciding

capital structure. As Hill et al. (2012) underline, trade credit management bearing risks is vital for corporate financing policy and its efficiency affects firm performance greatly. And from the agency theory point of view, it is the management team that takes the main responsibility to decide capital structure, but most literature on trade credit observe firm as a whole. There are few previous literature breaks in detail into managerial aspect to study trade credit.

2.1.2 Managerial Ability Matters

The premier foundational research regarding the issue of "managerial ability matters" is the one conducted by Hambrick and Mason (1984). They develop upper echelon theory and uncover the impact of manager characteristics, such as age, professional background and education background, on the organizational outcomes – both strategic choices and performance levels.

There are two different theoretical views on the matter of "managers matter" as Bertrand and Schoar (2003) summarize, who empirically prove that there exist a manager's fixed effects in various corporate decisions. They stress that the neoclassical assumption of any empirical studies on corporate decisions is quite narrow because this assumption states that top managers are homogeneous and selfless inputs to firms' production and refers different managers being perfect substitutes for each other. Oppositely, standard agency theory recognizes that managers have discretion inside firm and, thus, can change corporate decisions to advance their own benefit (Bertrand and Schoar, 2003). This study has inspired many other related empirical studies and most of them focus on managers' psychological characteristics like overconfidence and individual perception of risk (e.g. Malmendier and Tate, 2008; Malmendier et al., 2011 and Graham et al., 2013) and managers' experience (e.g. Hu and Liu, 2015), personalities and personal values (e.g. Hambrick 2007). Bertrand and Schoar (2003) measure manager fixed effects by managers' different preferences, risk aversion, skill levels, opinions, age, and educational background, and find out they hugely affect corporate decisions including investment policy, financial policy and cost-cutting policy which can relate to the trade credit decision. So inspired as well, we can roughly

predict that the relationship between managerial ability and trade credit does exist.

Similar viewpoints can be found in organizational behavior theory, which holds that the ability of managers is the presentation of the stable psychological characteristics of managers in business management activities, and the subjective condition of being competent to lead the tasks of enterprises. The ability of managers, which is inseparable from business decisions, is manifested in the fact that managers will keenly protect firms against uncertain environment, dig up valuable opportunities, integrate internal and external resources, and promote the sustainable development of enterprises (Bianchi, 2010).

Besides the focuses on managers' psychological factors and backgrounds, previous studies also show manager specific characteristics, including ability and talents, affect firms' performance outcome (Demerjian et al., 2012). And managers' comprehensive factors like ability and talents can in fact be measured. Although the measurement of managerial ability has developed in many aspects over the years, scholars still have concerns in the relativities of the factors taken into account when measuring managerial ability. Demerjian et al. (2012) raise concern that previous researches focus on wider but less precise measurement of ability such as taking firm size, past abnormal performance, compensation, tenure, media mentions, education, or manager fixed effects as proxies, resulting in a lot of noise through counting in significant factors outside management's control. For example, the use of press citations as a measurement of managerial ability (Milbourn, 2003; Rajgopal et al., 2006) and the use of shocks to the firm as the measurement of managerial ability (Chang et al., 2010). And as for method of manager fixed effects, it is restricted to use in a relatively small sample of firms and cannot actually calculate the ability at a stand-alone level. To overcome these deficiencies, they develop a new measure for managerial ability. And this model Demerjian et al. (2012) developed has since then been accepted by most scholars (Andreou et al., 2013).

Given that Demerjian et al. (2012) use Data Envelopment Analysis (DEA) method to estimate how efficiently, compared to their industry peers, managers use their firms' resources, this measure aims to capture the ability of the whole management team of a firm instead of the

individual manager characteristics like other papers such as those studying CEO's psychological factors we discussed above. This measure of managerial ability is also positively related to several alternative measures of ability such as CEO salary and tenure, and the outcome managerial ability scores show an economically significant manager-specific component (Demerjian et al., 2012). Since management team is consist of individual managers, those papers from the individual manager perspective we discussed above still provide us fair theoretical backgrounds.

More relevant researches using the same method to quantify managerial ability are as following and most of them relate back to information asymmetrical issue discussed in the trade credit part above -- high managerial ability means high ability to access to, predict, interpret, provide and explain more both internal and external information. Demerjian et al. (2013) find a positive relationship between managerial ability and earnings quality because able managers forecast more accurate earnings information and report high-quality earnings. Andreou et al. (2015) argue that higher-ability managers may reduce the information asymmetry gap with the markets under financial crisis. Sun (2016) concludes a significant negative relationship between managerial ability and goodwill impairment. Franco et al. (2017) document higher managerial ability helps lower the bank-loan pricing, especially if the firm is of high information risk. Others study the impact of managerial ability concerning factors such as firm performance (Baik et al., 2013), CSR and environmental behavior (Sun, 2019; Yuan et al., 2019), corporate investment and risk-taking behavior (Salehi et al., 2020; Yung and Chen, 2018), credit risk rating (Cornaggia et al., 2017; Bonsall IV et al., 2020) and corporate innovation behavior (Chen et al., 2015; Cho et al., 2016).

There are other studies about managerial heterogeneity that potentially lead us to see how trade credit reacts to managerial ability. CEOs who have more diverse career experiences can accumulate social connections to mitigate information asymmetry and thus have greater chances to get external funds including both bank loans and trade credit (Hu and Liu, 2015). McNichols (2002) and Plumlee and Yohn (2010) reason their studies on the prediction that managers of higher ability are more knowledgeable of their client and macroeconomic

environment during the estimation of bad debt expense and more capable of understanding and using complicate standards.

2.1.3 Market Competition and Trade Credit

Market competition has a strong impact on the successful operation of firms. Higher market competition not only puts pressure on the firm to provide better products and services to its customers from operational perspective, but also puts pressure on the firms' financial condition from financial perspective. In competitive market, firm are exposed to higher liquidation risk (Hou and Robinson, 2016). Moreover, when the market is competitive because many firms supply homogenous goods, profit margins will be reduced. Under the pressure, firms financing contract are very important to the firms' performance, making trade credit terms vital for a healthy financial structure.

Fisman and Love (2020) have identified price discrimination as the motivation behind trade credit provision by suppliers. Their study is built on Brennan et al.'s (1988) study, which concludes that there is incentive for suppliers to discriminate among cash and credit customers in market with low competition. This is more common when suppliers can observe that credit customers have a lower demand elasticity than cash customers, and when there is adverse selection in the credit market. Moreover, price discrimination behavior is also subject to the nature of different industries. Specifically, trade credit could be used as a strategic instrument by suppliers in less competitive market.

To explain the effects of market competition on trade credit, the concept of switching cost is introduced to draw a connection between market competition and bargaining power. Porter (1980) defines switching costs as the one-time cost that associate with the process of switching from one supplier to another. Intense market competition lowers switching cost, meaning that it is easy and cheap for customers to change from one supplier to another. Thus, the degree of competition in the market determines suppliers' bargaining power. Suppliers in this situation are in weak positions. They face the dilemma of enforcing timely payments for

their products on one hand and providing favorable payment terms to customers in order to prevent existing customers from switching to competitors and to attract new customers on the other hand.

Fabbri and Klapper (2016) agree with the above argument. They find that firms are more likely to grant trade credit and provide more favorable trade credit terms to their customers when they are operating in market with more intense competition. More specifically, they show that suppliers with weak bargaining power towards their customers are more likely to hold a larger percentage of their goods sold on credit and to give extension on trade credit to their customers. Wilner (2000) predicts the same relationship between bargaining power and trade credit. The model developed by Wilner (2000) predicts that suppliers holding lower the bargaining power, the more favorable the trade credit is to its customers.

The studies on the relationship between market competition and trade credit are far from drawing one consistent conclusion. The following scholars discover logical and significant relationship that support their argument for the positive correlation between market competition and trade credit – intense market competition increase the use of trade credit.

The impact of market competition on trade credit is also influenced by the accessibility of finance. Previous literature has shown the difficulty for firms in competitive market to gain finance. Some scholars emphasize the effect of market competition on firm's credit risk. Valta (2012) associates market competition with cost of financing. Valta (2012) finds that market competition is positively correlated with a higher cost of bank debt. The cost of bank debt is higher for firms operating in competitive markets because banks incorporate the risks of product competition when pricing financial contracts. Moreover, this relationship is even more significant for small firms in competitive market. Based on substitution hypothesis, an increasing cost of debt will lead to firms seeking trade credit as substitute (Petersen and Rajan 1997). Chen et al. (2019) support the substitution hypothesis, concluding that firms will increase their trade credit when bank credits are not available. Hence, small firms in competitive market under the pressure of higher credit risk and higher cost of bank debt tend

to take on more trade credit.

Market competition also influences accounting conservatism greatly. Using a sample of 99,315 firm-year observations over the period 1964-2006, Dhaliwal et al. (2014) find a positive complementary relationship between market competition and accounting conservatism. This is supportive of the plausible explanations that market competition improves the flow of information, limiting managements' ability to conceal unfavorable news, and that market competition enables more efficient contracting. Accounting conservatism in turn influences the firms' trade credit decisions. Dai and Yang (2015) study the effect of accounting conservatism on trade credit using a sample of listed Chinese companies during the 2003-2012 period. They find that firms that are more conservative carry more trade credit. Accounting conservatism can alleviate the challenge of information asymmetry and help build a more transparent communication between suppliers and customers.

One previous study conducted by Salehi et al. (2017) finds a negative relationship between product market competition and managers making risky investment and discusses about the moderating effect of managerial ability on the relationship between product market competition and investment decision. They find no such a moderating effect of managerial ability acts to the relationship between product market competition and over-investment proxied by positive FCF and conclude that product market competition can be used as a governance tool for risk taking. This research is relatively related to our second research topic because we could infer from it that managers may matter not that much when market competition is stiff.

2.2 Hypotheses Development

We start by looking at one of the characteristics of trade credit. According to incomplete contract theory, due to individual's limited rationality, information incompleteness and transaction uncertainty, the cost of clarifying all special powers is too high to draft a complete contract, and thus an incomplete contract is often inevitable to exist. When firms use or invest

in trade credit, it is more like they get involved in this kind of incomplete contractual relationship because compared with formal financing system and channel, trade credit is informal and relies more on the self-implementation mechanism of contract rather than the third-party implementation mechanism or standardized integration mechanism to avoid the risk of fraud and ensure the validity of the contract. And the self-implementation mechanism of contract is based on mutual trust, patience and good credibility. In other word, trade credit requires good self-consciousness and trust between the contract parties to reduce information asymmetry and improve morality level in order to further improve the efficiency of trade credit contract. Management team with higher managerial ability are expected to be more forward-looking and pay more attention to establish both formal and informal systems, including trust culture and trustworthy image. Van Den Bogaerd and Aerts (2015) state a significant positive relationship between a firm's overall media image and its trade accounts payable level. So, this trust and image mechanism established by competent managers will convince external parties including trade credit providers that their firms will comply with the contract even if the incomplete contract requires more morality. This will further increase the level of trust from suppliers and help these firms get more trade credit.

Besides building up a good firm image and corporate culture, another way to alleviate information asymmetry and boost trust with trading partners is to provide more transparent information of high quality. Giannetti et al. (2004) conclude that if a firm has more information advantage on business partners' operating activities, accounting information, core competence and industry competition status, they will have more lasting business relationship. This is also the reason why firms with information advantage are more willing to give out lower-cost payment and deferral payment. This is where management team plays a significant role - firms with higher managerial ability are able to provide higher quality accounting information to their business partners, giving them desirable information advantage. Raman and Shahrur (2008) find that the expectations of trading partners of a firm's prospects are influenced by corporate accounting information. The ability of managers plays an important role in firms' accounting quality. Management team of higher managerial ability is equipped with advanced professional knowledge and deeper perspectives on its own

firm, business, industry and economic and environmental information. Thus, they can communicate firm's policy, status and changes better with outside market through publishing more frequent and accurate earnings forecast and reporting higher-quality earnings (Baik et al., 2011; Demerjian et al., 2013). Hasan (2020) also finds managerial ability can improve the readability of 10-K reports. Therefore, high managerial ability can increase the chances of being granted trade credit by providing high-quality accounting information.

Management team of higher managerial ability can get more trade credit not only by providing accounting information of high quality but also by building a strong market position. Summers and Wilson (2003) summarize that firms with higher negotiating position, such as controlling market power, receive more preferential trade credit. Giannetti et al. (2011) find that the market position of both buyers and sellers will affect trade credit terms, and more preferential terms will generally be provided to companies with high market positions. The relative market position with suppliers and the bargaining power deriving from this relative market position determine whether and how much trade credit a firm can obtain. Firms with high managerial ability are able to build this high market position through better business performance, such as taking up more market share and, therefore, gaining more bargaining power which can "force" suppliers to give more trade credits to them.

Man et al. (2002) state that managerial abilities include conceptual ability, opportunity ability, strategy ability, relationship ability, organizational ability and commitment ability. In addition to firm performance, managers' social connection can also be a resource of bargaining power, which can be used to gain more trade credit. According to the resource-based view, social connections formulate valuable organizational resources (Granovetter, 1985) because they expand sources of information and increase information quality, relevance, and timeliness (Adler and Kwon, 2002). Moreover, it is always easier to ask for something from somebody that one maintain a good relationship with. Hu and Liu (2015) argue for the significant role social connections plays in getting external funding resources. Trade credit can also be seen as one form of external fund to a firm. So, a firm with high managerial ability means its management team can have a high relationship ability and thus have more information and

connection as resources to bargain and lever more trade credit.

We argue management team of high ability can craft trust culture and trustworthy image, provide high quality accounting information to moderate information asymmetry, build strong market position and lever their social connection as a resource to bargain for getting more trade credit. Thus, we propose Hypothesis 1: There is a positive relationship between managerial ability and getting trade credit.

Although providing trade credit could help prompt sales and work as signal or assurance of goods quality and a good manager may have ability to bargain to price late-payment higher if buyers want to use trade credit, it is at the cost of bearing greater risks. From an operational and financial perspective, granting trade credit means increasing costs and increasing risks. As Jain (2001) documents, the provision of trade credit will not only generate opportunity cost resulting from customers occupying working capital but also increase administrative expense resulting from customer qualification assessment before the provision, and accounts management after the provision. The study of Grau and Reig (2014) also shows granting more trade credit in crisis time can make a firm less efficient and profitable. And Deloof (2003) concludes a direct linkage that managers can create value for shareholders by decreasing the collection days for accounts receivable and inventories to a reasonable minimum. Therefore, we expect more capable managers to control risk better and to be able to decrease this kind of risk by providing less trade credit. More reasoning develops as follow.

A good management team with higher managerial ability can implement a good quality management such that there will be no need for them to grant trade credit out of signaling product quality. It is because they are thought to be more knowledgeable to predict the product demand and to be more sensitive to business and technology trend, and industrial, economic and environmental information than their less capable counterparty (Demerjian et al., 2012). Thus, they are able to make more wise investment in R&D and advertising. Based on the view that the more R&D and intangible assets, such as reputation from advertising, the

more investment is made in the quality and specificity of the product (Grau and Reig, 2018), firms with higher managerial ability can have a higher product quality and better product reputation. Unlike the emerging firms with low market share that will be interested in publicizing their product, proving their quality and creating a reputation by providing deferred payment to customers (Bastos and Pindado, 2007; García-Teruel and Martínez-Solano, 2010; Grau and Reig, 2014), firms with higher managerial ability do not need to take the risk of granting trade credit to attract customer when already having products well-managed of high quality.

If suppliers have lower bargaining power relative to their customers, there will be more possibilities of extending trade credit and offering longer payment periods before imposing penalties (Fabbri and Klapper, 2016). Vice versa, firms with high managerial ability can maintain high product quality and good reputation. This establishes their high market position and bargaining power, thus, putting less pressure on management to grant more trade credit. Additionally, higher managerial ability can equip managers with higher personal bargaining ability which could make the trade credit contracts they grant with higher price and shorter payments periods. So, when more able management team deal with the trade-off in trade credit, they have the "confidence" and ability to get the most benefits out of trade credit contracts while minimizing the risk of granting trade credit.

Thus, we propose Hypothesis 2: There is a negative relationship between managerial ability and granting trade credit.

As discussed and reasoned above, we think firms with higher market position and bargaining power can get more trade credit and feel relatively less in need of granting trade credit. We argue that management team with higher managerial ability would make the firm a beneficiary rather than a risk-bearer during trade credit transaction. However, it is very challenging to gain an outstanding market position when the firm is in an industry of intensive market competition. This can reduce the original positive relationship between managerial ability and the receiving of trade credit, as well as the original negative

relationship between managerial ability and the offering of trade credit.

When market competition is strong, switching cost is low. It is hard for a firm to stand out and to have a stronger bargaining power against its suppliers. For example, when the firm and its suppliers cannot agree on the deferral payments, its suppliers can easily turn to other customers with similar market share and ordering amount as this firm because, within a competitive market, every player in this market have similar market share and buying power. The more intensive competition is in an industry, the more equal market position and power each player has, which can thus create more even power for its upstream and downstream players. All in all, it is hard even for management team with high managerial ability to build up high market position and freely use his or her social connection as a resource of bargaining power to ask for more trade credit in a competitive industry environment. The same is true for granting the trade credit. Even management team of high managerial ability sometimes have to make concession in external intensive industry competition, such as to bear more risk of providing trade credit than in a not competitive market.

On the other hand, according to our literature review, market competition may boost the use of trade credit because it helps information flow and mitigate information asymmetry and thus can create more transparent environment to contract efficiently. Chhaochharia et al. (2012) document competitive industries improve firms' efficiency and make them conduct less financial fraud. With more knowledge and efficient contract relationship to buyers, suppliers may be more willing to provide more trade credit. Huang and Lee (2013) conclude that the product market competition can be used as an estimate for firm's credit risk, implying that small firms in competitive markets have higher credit risk. From substitution hypothesis point of view, we argue firms under this competitive condition are more restricted to access other formal financial channel such as bank loan and have to turn more to trade credit for funding.

Therefore, we propose Hypothesis 3: Market competition will have moderating effect on both the original positive relationship between managerial ability and getting trade credit and the

original negative relationship between managerial ability and granting trade credit.

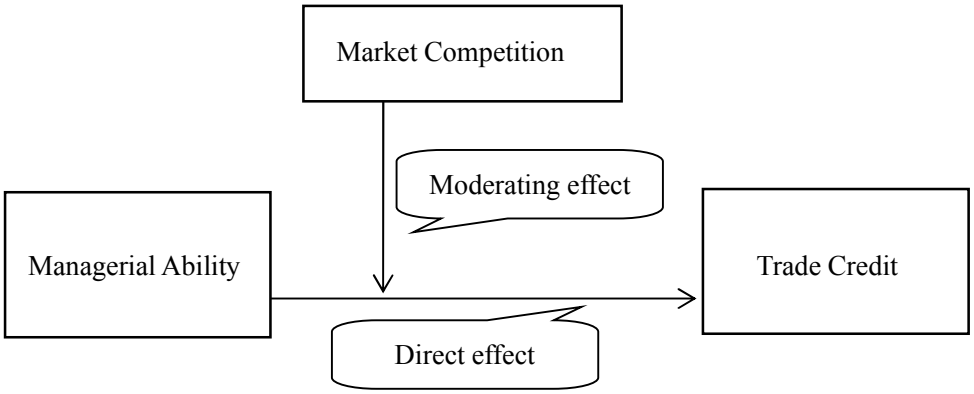

Figure.1. Hypothesized Conceptual Model

3 Methodology

This section starts with a brief description of our research design, followed by an introduction to how we collect samples from the data source we use. Next, we explain in detail about quantifying our independent variables – mainly managerial ability and market competition indicator. We also explain our dependent variable – trade credit and then move on to a presentation of control variables (see **Table 11** in Appendix for all variable description). In the end of this part, we also show the regression models applied.

3.1 Research Design

In this thesis, we want to investigate factors that influence trade credit from both internal and external environment angles of corporate governance. The internal perspective is a new perspective of management heterogeneity. We want to examine how managerial ability has impact on trade credit. Then we want to add the external environmental lens to see that whether there is a difference in the association between managerial ability and trade credit when facing different degrees of market competition. To achieve this, we start with developing several hypotheses from theory in Section 2.2 which are testable propositions on the relationship we want to examine. To test these hypotheses, we conduct a quantitative study, utilizing multivariate regression analysis models firstly only controlling time fixed

effects and then controlling both time and firm fixed effects. The purpose of controlling fixed effects is mainly to solve the endogenous problem resulting from missing variables which may relate to other independent variables and also have impact on dependent variable. Specifically, the control of firm fixed effects is to prevent endogenous problems that do not change with time from being exist in each individual sample. For example, factors that cannot be observed by us such as a firm's potential and reputation may have an impact on a firm's trade credit. Similarly, the control of year fixed effects is to prevent the existence of endogenous problems that do not vary with individuals, for instance economic cycles and macroeconomic changes. The results of these model tests will then be further analyzed in section 4. Meanwhile steps of alleviating statistical concerns and adding robustness tests are taken. When all the processes described above are completed, this study will response the hypotheses that developed in the first place to get a conclusion.

3.2 Data Source and Sample Construction

All the data needed in this study come from North America Fundamental Annual in Compustat - Capital IQ and CRSP in Wharton Research Data Services (WRDS). We collect 2008-2018 US data from it and formulate a 10-year period of observation (2009-2018) because some estimations need the accounting variables at opening balance. The initial requiring 2008-2018 US data from the database is 101,452 firm-year observations, without clicking "FS" in "Industry Format" in the "pre-selected" section of the database. And following Demerjian et al. (2012), we further clean out firms in financial and real-estate industry which have GIC Sector two-digit number 40 and 60 respectively to get 85,110 firm-year observations and thus we formulate 9 industries classification for our empirical tests. After deleting all the missing value (including those with a missing industry categorization), we finally get 24,081 firm-year observations within 4,259 firms (see **Table 1**).

Table 1 Sample Size within Industry

2-digit GIC Sector	Industry Name	Firm-year Observations	Number of Firms
10	Energy	580	114
15	Materials	1524	254
20	Industrials	3527	555
25	Consumer Discretionary	4001	681
30	Consumer Staples	1406	247
35	Health Care	4825	956
45	Information Technology	7232	1270
50	Communication Services	929	169
55	Utilities	57	13
sum		24081	4259

Table 1 presents the sample size within 9 industries classified according to 2-digit sector in 2018 GICS (Global Industry Classification Standard)

All variables used in this study are winsorized to the 1st and 99th percentile to limit the impact of extreme values in the statistical data and to reduce the effect of possible spurious outliers. We also conduct regression without winsorizing and get the same outcome for both two models. (see tables in Section 4.2)

3.3 Independent Variable

3.3.1 Measuring Managerial Ability

There are a few ways to take firm size, past abnormal performance, compensation, tenure, media mentions, education, or manager fixed effects as proxies to quantify managerial ability, but most of them have a lot of noise that taking in significant factors which managers cannot actually control (Demerjian et al., 2012). Demerjian et al. (2012) produce a different measure for managerial ability and they validate it in their article by demonstrating that, compared with five other measures of managerial ability (historical stock returns, historical industry-adjusted ROA, CEO compensation, CEO tenure, and media citations), this new measure is not only strongly associated with manager fixed effects but also better at explaining stock price reactions to CEO turnovers and changes in future firm performance. This measure has been accepted by most scholars and many researches utilize it including accounting research (Baik et al., 2011; Demerjian et al., 2013), finance research

(Albuquerque et al., 2013), and management research (Attig and Cleary, 2014).

This measure is based on the concept that more able managers understand technology and industry trends better, predict the product demand more reliably, invest in higher-value projects, and manage employees more efficiently than their less able counterparts (Demerjian et al., 2012). The basic logic of Demerjian et al. (2012) is capturing managerial ability by calculating the efficiency that managers using firms' resources to generate revenue.[1]High efficiency means high ability of a firm management team that can make more revenue while using the same or fewer resources than their peers in the same industry. And therefore, it is very important to note that this measure is based on company performance not individual manager traits i.e. the managerial ability in this method is at firm specific level (the whole management team of a firm) not a measure of individual CEO ability. To formulate the efficiency that are only attributed to managers (management team of one firm), Demerjian et al. (2012) develop a two-step approach. The first step is to use Data Envelopment Analysis (DEA) method to calculate the efficiency of the total firm and the second step is to take the estimated residuals in Tobit regression to separate the efficiency attributed to managers themselves from the total firm efficiency.

3.3.1.1 Step 1: DEA

The basic logic of calculating efficiency is taking the ratio of outputs to inputs. Data Envelopment Analysis (DEA) is a statistical procedure to calculate the relative efficiency of separable entities. It is the separable entities, called "decision-making units" (DMUs), that convert certain inputs (labor, capital, etc.) into outputs (revenue, income, etc.):

$$\frac{\sum_{i=1}^{s} u_i y_{ik}}{\sum_{j=1}^{m} v_j x_{jk}} \quad k = 1, \dots, n. \qquad (1)$$

In Equation (1), s is outputs, m is inputs, and n is the number of DMUs. Each firm is

[1] The resource that one firm used to generate revenue may relate to trade credit, which may raise a little concern that whether firm efficiency and trade credit have mechanical relationship. We argue this measure has already controlled the cash flow by using $\text{FreeCashFlowIndicator}_i$ in Tobit regression see Equation (3), and thus there is little possibility that the residual representing the managerial ability estimated from this regression includes the impact from trade credit.

considered as a DMU. u and v denote the weights for the outputs and inputs respectively. These weights are assigned for each output and input in the calculation of efficiency score. y and x represent the quantities of outputs and inputs.

"Given a collection of points in a multidimensional space, DEA fits a piecewise linear envelope or frontier to the given data. The envelope indicates a normative ideal given the existing data. Points located on the envelope are optimally efficient, while points below the envelope are inefficient. DEA evaluates all points with respect to their deviation from the frontier. The values of the points on the frontier equal 1, and the values of other points which operate beneath the frontier are between 0 and 1" (Sun, 2016). So, DEA has advantages in following ways. First, DEA allows different firms to optimize across different outputs and inputs. Unlike other parametric methods, DEA provides an ordinal ranking of relative efficiency compared to frontier (the best performance that can be practically achieved) instead of average performance, and thus can avoid the disproportion caused by inefficient industry peers. Second, unlike other efficiency measures such as ROA where weights are set and assume all inputs and outputs are equally valuable among DMUs, DEA is more dynamic and without stiff assumption.

Derived from the method proposed by Demerjian et al. (2012), we also choose DEA approach to evaluate total firm efficiency by industry and by year. The inputs should not only link to the generation of revenue but also be affected by managerial ability out of managers' discretion. For example, the reason to first take acquired assets into consideration is that the management team has lots of latitude in asset purchase and retirement decisions and a management team with higher capability is expected to make better purchase decisions (Demerjian et al., 2012). The inputs we choose to solve the optimization problem run by DEA are cost of goods sold; selling, general and administrative expenses; property, plant and equipment; research and development cost; goodwill; and other intangibles and the output is sales[2]:

[2] Due to availability of data, in order to retain as many representative samples as possible, we exclude operating lease as one inputs, compared to original method, and the influence on the DEA results is negligible, because according to Demerjian et

$$\max_{v} \theta = (\text{Sales})/(v_1\text{COGS} + v_2\text{SG\&A} + v_3\text{PPE} + v_4\text{R\&D} + v_5\text{Goodwill} + v_6\text{OtherIntangible} \quad (2)$$

In Equation (2), Sales is total revenue; COGS is cost of goods sold; SG&A is selling, general and administrative expenses; PPE is property, plant and equipment; R&D is the research and development expense; Goodwill is the purchased goodwill and OtherIntangible is calculated as intangible assets minus goodwill. Each of the asset-natural variables are at the opening balance, because it is managers' past decisions on these assets that are expected to affect revenues for each current period (Demerjian et al., 2012). We use an added-on application in Excel called DEA-SOLVER Pro5 to finish DEA calculation above and get the total firm efficiency scores ($\text{Firm Effieciency}_i$) from it.

3.3.1.2 Step 2: Tobit Regression

The next step is to separate the efficiency attributed to manager-specific characteristics and that attributed to firm-specific characteristics from the total firm efficiency gotten from DEA results. To achieve this, we also learn from Demerjian et al. (2012) to run Tobit regression by industry and with year fixed effects. We take the total firm efficiency (scores from DEA) as dependent variable and four firm-specific variables (firm size, market share, cash availability, firm age)[3] as independent variables:

$$\text{Firm Effieciency}_i = \gamma + \beta_1 \ln(\text{Total Assets})_i + \beta_2 \text{MarketShare}_i + \beta_3 \text{FreeCashFlowIndicator}_i + \beta_4 \ln(\text{Age})_i + Year_i + \epsilon_i \quad (3)$$

al., (2012) empirical results are qualitatively and quantitatively similar if operating leases from the DEA estimation is excluded.

[3] The original method used data from 30 years (1980-2009) and use the 2009 Compustat file in SPSS, so it still has a large sample size after removing some missing values and outliers. But we only have 10-year sample. If we want to preserve all the Tobit regression variables of the original method, we would have a smaller sample size after deleting all missing values and lose some representative company samples. This is also the reason why we have not divided into 48 industries as the original. If the ten-year data is classified into 48 industries, when we calculate DEA by industry and by year, the samples will be greatly reduced, which is not conducive to compare and show the differences among firms' efficiency of DEA score)

In Equation (3), $\ln(\text{Total Assets})_i$ represents firm size; MarketShare_i is calculated as the ratio of firm sales to total sales of industry the firm belongs to; $\text{Free CashFlowIndicator}_i$ is coded to one if firm has a positive free cash flow (defined as earnings before depreciation and amortization less the change in working capital less capital expenditure at year t, zero otherwise; $\ln(\text{Age})_i$ is natural logarithm of firm age counted since first time price appears in CRSP database; and $Year_i$ control for the year fixed effects.

According to Demerjian et al. (2012), the residuals from the regression[4] is the proxy for managerial ability because the independent variables in the model control for the factors with firm-specific characteristics that expected to help or hinder managers' ability. In other words, they take on the efficiency attributed to firm-specific characteristics and thus what remains in the error term of this model is the efficiency attributed to manager-specific characteristics. Therefore, a higher residual represents higher managerial ability.

Besides the already mentioned advantages of DEA approach and superior ability in isolating managerial ability from other noise that managers cannot control, we choose to learn from Demerjian et al. (2012) method also because of its suitability: First, it is directly linked to our main research question investigating whether managers get (grant) in more (less) trade credits after using their comprehensive knowledgeabilities of business, skills to anticipate demand and changes and manage relationship. Second, it fits into large sample well and is not restricted to firms that change managers (Bertrand and Schoar, 2003). Third, unlike other measures derived from only CEOs' background and turnovers etc., it captures the overall ability of the whole management team.

According to Demerjian et al. (2012), although improvements over existing measures, there

[4] We think one concern of this measure may be endogenous effects resulting from a good firm will always have a good management and vice versa. Demerjian et al. (2012) note in their paper stating that the impact of unidentified features (e.g. unions or investor base) which will influence managers' ability to utilize firm resources may not be completely mitigated in Equation (3). Including firm fixed effects would be an alternative way to better catch these unidentified drivers of efficiency However, they choose to present residual.

are some weaknesses in this method mainly due to the assumption holding that the quality of financial reporting (where includes accounting values used to calculate firm efficiency) is constant. Problems occur when intentional manipulation—especially to revenues and incomparable recognition and measurement rules under U.S. GAAP used among different firms affect the financial reporting quality. Different ways of complying accounting rule cause data constraint and make them drop other important intangibles (e.g. purchased R&D). And problems can also come from imperfect industry classification because most firms have cross-industry operations. Since the managerial ability score is however the residual from a model, there are still a portion of the residual in step 2 including the factors that are not attributed to managerial ability.

3.3.2 Measuring Market Competition

We draw on the ongoing research practice and use the Herfindahl-Hirschman Index (HHI) to measure the competition of the product market. HHI is calculated as:

$$HHI = \sum((X_{i,t})/X)^2 \qquad (4)$$

In Equation (4), X_i represents the sales of certain firm in one certain year; $X = \sum X_t$ is the total sales in the same year of the whole industry, categorized into 9 industries according to GIC Sector (two-digit) in our study.

The Herfindahl-Hirschman Index can fairly measure the concentration ratio of various industries, that is, a higher HHI means a higher market's concentration. The higher the market's concentration, the closer a market is to a monopoly and thus indicating the lower its competition. Otherwise, the lower the value is, the greater the market competition is.

Following the study by Gonçalves and Schiozer et al. (2018), we also measure market competition by using market share of the top 4 firms within an industry (2-digit GIC):

$$CR_n = \sum_{i=1}^{n} S_i \qquad (5)$$

In Equation (5), S_i is the market share of the i-th company, and n represent the number of the largest companies within one industry. Since we calculate top 4 firms, so n=4.

The interpretation of CR4 is the same as Herfindahl-Hirschman Index, that is, a higher CR4 means a higher market's concentration. The higher the market's concentration, the closer a market is to a monopoly and thus indicating the lower its competition.

3.4 Dependent Variable: Trade Credit

A company can both act as a supplier to its customers and a customer to its suppliers, so the company can either grant or take up trade credit when there is a time difference between goods or service delivery and the payment, and thus creating the account payable and account receivables in one company's accounting records. We choose the accounts payable and accounts receivables normalized by total assets (i.e. the ratio of accounts payable to total assets and accounts receivables to total assets) as this thesis' proxies for trade credit. This measure is consistent with many previous researches, for examples, Dary and James (2019), Yazdanfar and Öhman (2016), Kim (2016), Hu and Liu (2015), Muscettola (2014), Kestens et al. (2012), Alarcón (2011), Zhu and Jiang (2009) and Deloof and Jegers (1999).

3.5 Control Variables

Learnt from Gonçalves and Schiozer et al. (2018) and Hu and Liu (2015), we select the following six control variables: Firm Size, ROA, Leverage, Cash/Assets, PPE/Assets and FreeCollateral. Firm Size is calculated as the natural logarithm of total assets. ROA takes earnings before interest, tax, depreciation and amortization (EBITDA) scaled by total assets. Leverage is the ratio of total liabilities to beginning-of-year total assets. These three variables control for influences coming from a firm's natural characteristics. And the rest control for liquidity, financial constraints and availability of collateral measures. Cash/Assets is the ratio of cash to total assets. PPE/Assets is the ratio of net property, plant & equipment to total

assets. FreeCollateral is calculated as the ratio of PPE after debt to total assets. And we also include both firm fixed effects and year fixed effects to reduce the endogeneity resulting from different individual and time effects that could affect dependent variable.

3.6 Regression Diagnostics

3.6.1 Multicollinearity

The multicollinearity is a concern when correlation between the independent variables in a multiple regression model is high. Higher variance can reduce the effectiveness of statistical test. One way to find out the most easily detected multicollinearity is to look at the matrix of correlation among independent variables. We present and simply discuss Pearson's correlations matrix in Section 4.1.2.

3.6.2 Heteroscedasticity

Heteroscedasticity occurs when non-constant variance in error terms show and thus leading to biased estimates of standard errors that invalidate conclusions on significance levels (Wooldridge, 2012). This problem can be detected by Breusch-Pagan / Cook-Weisberg test. The null hypothesis of this test is that all residuals have the same variance, i.e. they are of homoscedasticity. The alternative hypothesis is that the variance of the error terms differs among observations, i.e. they are of heteroscedasticity. The results of this test reported in **Table 6** in Appendix show a $\chi 2$-value of 47998.0200 and 47949.2100 and both a p-value of 0.0000, which lead us to reject the null hypothesis. So far, we examine that there is heteroscedasticity in our samples. The results from White test (**Table 7** in Appendix) also yield the same judgement of rejecting the null hypothesis.

To solve this problem, we need to adopt the method of clustering robust standard errors at firm level to adjust the standard deviation. So, we consistently use robust standard errors in our regressions and present them in the parentheses underneath each coefficient in our result tables.

3.6.3 Comparing Different Regression Models

There are only three forms of models that are available to choose for our static panel – pooled OLS model, fixed effects model and random effects model. We start with testing whether we should use pooled OLS model or the latter two models. Then if a fixed effects model is more suitable, we continue to test whether fixed effects or random effects model is better.

3.6.3.1 F Test

F test is used to decide whether a pooled OLS model is better than a fixed effects model for our case. This test set the null hypothesis that the pooled OLS model fits better for the panel data. As the results from F test reported in **Table 8** in Appendix, p-value is equal to 0.0000, so we need to reject the null hypothesis, suggesting that a fixed effects model is preferred for our panel data.

3.6.3.2 Hausman Test

Once we know from the F test that a fixed effects model is more suitable, we next want to know whether fixed effects model or random effects model is preferred in our case. So, we conducted the Hausman test. The null hypothesis of this test is the random effects model suits the panel data better. As the results from Hausman test reported in **Table 9** in Appendix, p-value is equal to 0.0000, so we need to reject the null hypothesis, indicating that a fixed effects model is more suitable.

3.7 Regression Models

In Section 3.6 we have decided on a fixed effects model and here we intend to include both firm fixed effects and year fixed effects to reduce the endogeneity resulting from different individual and time effects that could affect dependent variable. Two-dimensional fixed effects regressions on panel data are used in this thesis to examine Hypothesis 1 and 2 regarding association between managerial ability and trade credit and Hypothesis 3 about the moderating effect of market competition on the relationship between managerial ability and trade credit.

For Hypothesis 1 and 2:

$$\mathrm{TC}_{i,t} = \alpha_0 + \alpha_1 \mathrm{MA}_{i,t} + \alpha_2 \mathrm{Control}_{i,t} + \lambda_i + \mu_t + \varepsilon_{i,t} \qquad (1)$$

In Model (1), $\mathrm{TC}_{i,t}$ is the trade credit measured by accounts payable ($\mathrm{TC1}_{i,t}$) divided by total assets or accounts receivable ($\mathrm{TC2}_{i,t}$) divided by total assets. $\mathrm{MA}_{i,t}$ is the main independent variable measuring the managerial ability and is already described in detail in section 3.2. $\mathrm{Control}_{i,t}$ represents the six control variables described in section 3.4. λ_i represents firm fixed effects and μ_t represents time fixed effects.

For Hypothesis 3:

$$\mathrm{TC}_{i,t} = \delta_0 + \delta_1 \mathrm{MA}_{i,t} + \delta_2 \mathrm{HHI}_{i,t} + \delta_3 \mathrm{HHI} * \mathrm{MA}_{i,t} + \delta_4 \mathrm{Control}_{i,t} + \lambda_i + \mu_t + \varepsilon_{i,t} \qquad (2)$$

In Model (2), while the rest of variables keep the same as in the first model, we add $\mathrm{HHI}_{i,t}$ and an interaction term $\mathrm{HHI} * \mathrm{MA}_{i,t}$ into the second model. As discussed in section 3.3.1.2, a higher HHI means a higher market concentration, indicating a lower market competition. To make the coefficient display more intuitively and show a higher HHI for a higher market competition, we formulate $\mathrm{HHI}_{i,t}$ by taking the negative figure of the original HHI. The main independent variable in this model is the interaction term $\mathrm{HHI} * \mathrm{MA}_{i,t}$ representing the moderating effect that market competition may have on the relationship between managerial ability and trade credit.

4. Results

This section presents the results of our multivariate empirical tests designed in Section 3, starting with outlining descriptive statistics, and then showing our regression results. In the end of this section, the robustness tests are provided as well. Analysis based on the regression results with more interpretations and comments responding the hypotheses will be given in Section 5.

4.1 Descriptive Statistics

4.1.1 Variable Descriptive

Table 2 summarizes descriptive statistics for the variables used in the regression model. All the data are winsorized to the 1st and 99th percentile in order to limit the influence of extreme values and to decrease the impact of possible spurious outliers. TC1 is the trade credit measured by accounts payable/total assets while TC2 is the trade credit measured by account receivables/total assets. MA shows the characteristics of managerial ability. What the others represent are as their names in the table suggest. Size is the variable has the most variance compared with the variables.

Table 2 Descriptive statistic

Variable	Obs	Mean	Std.Dev.	Min	Max
TC1	24,081	0.1014	0.1433	0.0019	1.0656
TC2	24,081	0.1425	0.1067	0.0010	0.5396
MA	24,081	0.7304	0.1469	0.2552	1.0407
Size	24,081	19.8168	2.6157	13.2534	25.6305
ROA	24,081	-0.0462	0.5499	-3.8536	0.3981
Leverage	24,081	0.6650	0.8986	0.0634	7.4118
Cash/Assets	24,081	0.1794	0.1754	7.3551E-06	0.8123
PPE/Assets	24,081	0.1825	0.1803	0.0022	0.8461
FreeCollateral	24,081	-0.0331	0.3225	-1.7699	0.6367

Table 2 presents descriptive statistic for the variables we used in the models. TC1 is the trade credit measured by accounts payable/total assets while TC2 is the trade credit measured by accounts receivable/total assets. MA is the managerial ability measured after DEA and Tobit regression. Size is the firm size calculated as the natural logarithm of total assets. ROA takes EBITDA scaled by total assets. Leverage is the ratio of total liabilities to beginning-of-year total assets. Cash/Assets is the ratio of cash to total assets. PPE/Assets is the ratio of net property, plant & equipment to total assets. Free Collateral is calculated as the ratio of PPE after debt to total assets. All control variables are winsorized at the 99th and 1st percentile.

4.1.2 Pearson's Correlations

In **Table 10** of Appendix, Pearson's correlation coefficients for all independent variables are shown. It is done out of detecting multicollinearity. As in the **Table 10** of Appendix, the coefficients between our independent variables are relatively low. The highest correlation is the one (-0.6666) between the control variables Leverage and ROA. This is consistent with Doğan (2013), finding that control variables such as leverage reacts negatively with ROA.

And the only way to relieve multicollinearity is to extend sample size and our sample is big enough to avoid multicollinearity.

4.2 Regression Results

In the first two-dimensional fixed effects model, we test the relationship between managerial ability and trade credit. **Table 3** presents the results of six regressions we run. We start to run test the relationship without firm fixed effects as seen in regression (1) and (4), then we run the model with firm fixed effects but without winsorizing the data in regression (2) and (5) and finally controlling both year fixed effects and firm fixed effects, we run regression (3) and (6) after data being winsorized to the 1st and 99th percentile. All the results show a positive relationship at 1% significant level between TC1 (getting trade credit in term of accounts payable) and MA and a negative one at 1% significant level between TC2 (granting trade credit proxied by account receivables) and MA. This also means that the extreme values have little effect on our research results.

We interpret the ones with complete two-dimensional fixed effects model in detail. In the regression (3), the coefficient of MA is positive (0.0260) at a 1% level of significance, which means a very strong association between our independent variable and dependent variable that a percent unit increase of MA increases TC1 (getting trade credit in term of accounts payable) by 2.6% and ceteris paribus. A strong association can also be found in regression (6). The coefficient of MA in it is negative (-0.0314) at a 1% level of significance, suggesting that a percentage unit increase in MA reduces TC2 (granting trade credit proxied by account receivables) by 3.14%.

The results regarding control variables are all also at 1% level of significance and we go through some simple explanations for them based on the regression (3) and (6). The coefficients of Size to TC1 and TC2 are both significantly negative, which can be interpreted as big firms can access to other finance channel (e.g. bank loan) more easily than small firms and thus have fewer trade credit. This is consistent with one of the motivation theories behind

trade credit, substitute channels of funding (Meltzer, 1960; Schwartz, 1974) described in the Section 2.1.1. The coefficient between ROA and TC1 is negative while the one between ROA and TC2 is positive. One possible explanation for this can be a firm with better performance of ROA because it can purchase operating materials at lower price (therefore, lower level of accounts payable to its suppliers) and it can sell goods at higher price (therefore, higher level of account receivables from its customers). The coefficients of Leverage to TC1 and TC2 are both significantly positive, which can be interpreted as firms with higher leverage are those who are willing to take more risks to have more aggressive operating purchasing and selling policy and thus increasing both accounts payable and accounts receivable level. The coefficients of Cash/Assets to TC1 and TC2 are both negative at significance because firms with less cash may at financial constraint are more intended to ask for trade credit. The coefficients of PPE/Assets to TC1 and TC2 are also both significantly negative and one explanation can be when firms have more fixed assets that can be taken to make collaterals, they are more easily to take loan from other channels, which also agree with the theory of substitute channels of funding (Meltzer, 1960; Schwartz, 1974). And after deducted the debt resulting from other channels, the firm can react to trade credit more positively and therefore here comes positive coefficients of FreeCollateral to TC1 and TC2.

Table 3 Results from Model 1

Models	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	TC1	TC1	TC1	TC2	TC2	TC2
MA	0.0672***	0.1973***	0.0260***	-0.0495***	-0.0215***	-0.0314***
	(0.0064)	(0.0676)	(0.0073)	(0.0054)	(0.0068)	(0.0066)
Size	-0.0048***	0.0592	-0.0211***	-0.0088***	-0.0285***	-0.0292***
	(0.0004)	(0.0453)	(0.0022)	(0.0004)	(0.0020)	(0.0018)
ROA	-0.0630***	-0.2952***	-0.0571***	0.0556***	0.0045***	0.0304***
	(0.0049)	(0.0665)	(0.0071)	(0.0026)	(0.0011)	(0.0041)
Leverage	0.0949***	0.0686***	0.0749***	0.0300***	0.0006*	0.0119***
	(0.0039)	(0.0238)	(0.0058)	(0.0021)	(0.0003)	(0.0027)
Cash/Assets	-0.0925***	0.0752	-0.0523***	-0.1314***	-0.1226***	-0.1192***
	(0.0048)	(0.1070)	(0.0077)	(0.0040)	(0.0078)	(0.0068)
PPE/Assets	-0.0949***	0.1917	-0.0665***	-0.1790***	-0.0039**	-0.0477***
	(0.0070)	(0.2442)	(0.0139)	(0.0049)	(0.0016)	(0.0101)
FreeCollateral	0.0901***	-0.2671	0.0546***	0.0438***	0.0041**	0.0137***
	(0.0065)	(0.2991)	(0.0097)	(0.0040)	(0.0019)	(0.0052)
Constant	0.1185***	-1.3307	0.4639***	0.3972***	0.7388***	0.7615***
	(0.0080)	(0.9897)	(0.0437)	(0.0074)	(0.0383)	(0.0365)
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Firm Fixed Effects	NO	YES	YES	NO	YES	YES
N of Companies	4,259	4,259	4,259	4,259	4,259	4,259
Obs	24,081	24,081	24,081	24,081	24,081	24,081
Adj R-squared	0.5352	0.6328	0.4079	0.1441	0.1116	0.1253

Note: *, **, and *** represent significant at 10%, 5% and 1% levels respectively

Table 3 presents the 6 results from Model 1, regression (1) & (4) drop firm fixed effects, (2) & (5) without winsorization and (3) & (6) with winsorization and firm fixed effects; Standard errors in parentheses are clustered by firm.

In **Table 4**, we outline the regression results respectively without winsorizing (regression (1), (3), (5), (7) and with it (the rest of regressions) for the second model to test if there is a moderating effect of market competition on the relationship tested in our first model between managerial ability and trade credit. The extreme values have little effect on these research results either.

It is worth noting that the only main point of our interest in this model is the interaction term $\mathrm{HHI} * \mathrm{MA}_{i,t}$. The reason why there is no need to explain the coefficient (δ_2) of stand-alone $\mathrm{HHI}_{i,t}$ is that δ_2 will become 0 after calculating the partial derivative of TC to MA, and so

its significance is meaningless. The regression (2) of **Table 4**, contrary to the coefficient of MA to TC1 in regression (3) of **Table 3**, the coefficient of this interaction term to TC1 is negative, which means market competition weakens the original positive relationship between managerial ability and getting trade credit. (Note, we formulate $\mathrm{HHI}_{i,t}$ by taking the negative figure of the original HHI to make the coefficient display more directly to see a higher HHI represent a higher market competition). In the regression (4) of **Table 4**, the coefficient of interaction term $\mathrm{HHI} * \mathrm{MA}_{i,t}$ to TC2 is positive which is also opposite to the coefficient of MA to TC2 in regression (6) of **Table 3**, implying that market competition also weakens the original negative relationship between managerial ability and trade credit. But the coefficients of interaction term in regression (2) and (4) are not statistically significant.

Additionally, we replace Herfindahl-Hirschman Index (HHI) with market share of the top 4 firms within an industry (CR4) to test again. Out of the same reason, making the coefficient display more intuitively and directly to see a higher CR4 represent a higher market competition, we formulate CR4 by taking the negative figure of the originals. In **Table 4**, we get the same signs in coefficients of interaction term CR4*MA in regression (6) and (8) as the ones in coefficients of interaction term $\mathrm{HHI} * \mathrm{MA}_{i,t}$ in regression (2) and (4). But still, they are not at a significance level either.

Table 4 Results from Model 2

Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	TC1	TC1	TC2	TC2	TC1	TC1	TC2	TC2
MA	0.0582	0.0170	0.0003	-0.0299	0.0991	0.0100	0.0061	-0.0220
	(0.2131)	(0.0204)	(0.0189)	(0.0205)	(0.2727)	(0.0317)	(0.0253)	(0.0277)
HHI	4.1847	0.0889	-0.7954	-0.3582				
	(7.5985)	(0.6452)	(0.6052)	(0.6154)				
HHI*MA	-4.7577	-0.3214	0.7384	0.0357				
	(8.5505)	(0.6999)	(0.6078)	(0.7050)				
CR4					0.2943	0.0307	-0.0882	-0.0451
					(1.0051)	(0.1068)	(0.0865)	(0.0915)
CR4*MA					-0.3785	-0.0656	0.1055	0.0340
					(1.1831)	(0.1251)	(0.0957)	(0.1071)
Size	0.0599	-0.0212***	-0.0286***	-0.0293***	0.0595	-0.0212***	-0.0286***	-0.0293***
	(0.0461)	(0.0022)	(0.0020)	(0.0018)	(0.0459)	(0.0022)	(0.0020)	(0.0018)
ROA	-0.2952***	-0.0571***	0.0045***	0.0304***	-0.2952***	-0.0571***	0.0045***	0.0303***
	(0.0665)	(0.0071)	(0.0011)	(0.0041)	(0.0665)	(0.0071)	(0.0011)	(0.0041)
Leverage	0.0686***	0.0749***	0.0006*	0.0119***	0.0686***	0.0749***	0.0006*	0.0119***
	(0.0238)	(0.0058)	(0.0003)	(0.0027)	(0.0238)	(0.0058)	(0.0003)	(0.0027)
Cash/Assets	0.0751	-0.0523***	-0.1225***	-0.1192***	0.0752	-0.0523***	-0.1226***	-0.1192***
	(0.1069)	(0.0077)	(0.0078)	(0.0068)	(0.1071)	(0.0077)	(0.0078)	(0.0068)
PPE/Assets	0.1916	-0.0665***	-0.0039**	-0.0476***	0.1917	-0.0665***	-0.0039**	-0.0477***
	(0.2441)	(0.0140)	(0.0016)	(0.0101)	(0.2441)	(0.0140)	(0.0016)	(0.0101)
FreeCollateral	-0.2672	0.0546***	0.0042**	0.0136***	-0.2671	0.0546***	0.0042**	0.0137***
	(0.2992)	(0.0097)	(0.0019)	(0.0052)	(0.2992)	(0.0097)	(0.0019)	(0.0052)
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Firm Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Constant	-1.2287	0.4678***	0.7206***	0.7556***	-1.2621	0.4724***	0.7187***	0.7525***
	(0.8662)	(0.0460)	(0.0400)	(0.0378)	(0.8617)	(0.0486)	(0.0419)	(0.0398)
Observations	24,081	24,081	24,081	24,081	24,081	24,081	24,081	24,081
N of Companies	4,259	4,259	4,259	4,259	4,259	4,259	4,259	4,259
Ad R-squared	0.6328	0.4079	0.1117	0.1253	0.6328	0.4079	0.1116	0.1252

Note: *, **, and *** represent significant at 10%, 5% and 1% levels respectively;

Table 4 presents the 8 results for Model 2, regression (2) & (4) test the moderating effect of market competition measured by Herfindahl-Hirschman Index, regression (6) & (8) test the moderating effect of market competition measured by market share of the top 4 firms within an industry and regression (1), (3), (5) & (7) are the version without winsorizing to their right side respectively ; Standard errors in parentheses are clustered by firm.

4.3 Robustness Test

4.3.1 Alternative Measurement for Trade Credit

The first robustness test we conduct is to change the measurement of dependent variable. We choose the ratio of accounts payable to sales (TC3) and accounts receivable to sales (TC4) as the alternative proxies for TC1 and TC2 respectively. Many previous studies, for instance, Aktas et al. (2012) and Ferrando and Mulier (2013) use this measurement as well.

In the regression (1) of **Table 5**, the estimated coefficient of MA to TC3 is still significantly positive, suggesting managerial ability is still have a very positive impact on our alternative proxy for trade credit in term of accounts payable. As for the regression (2) of **Table 5**, the same association between managerial ability and the alternative proxy for trade credit in term of accounts receivable remains as regression (6) in **Table 3**. Therefore, our results of first model pass this robustness test.

4.3.2 Alternative measurements for control variables

In the second robustness test, we take Short-term debt/Assets as replacement for Leverage shown as Leverage2 and replace Size in the original first model with the number of employees (Size2). As in the regression (3) and (4) of **Table 5**, all the results yield the same outcome at 1% level of significance as in **Table 3**. Therefore, our results of first model also pass this robustness test.

Table 5 Robustness Test

Models	(1)	(2)	(3)	(4)
Dependent variable	TC3	TC4	TC1	TC2
MA	0.0682**	-0.0335***	0.0367***	-0.0313***
	(0.0309)	(0.0115)	(0.0082)	(0.0069)
Size	0.0029	0.0126***		
	(0.0070)	(0.0027)		
Size2			-0.0003*	-0.0001**
			(0.0001)	(0.0001)
Leverage	0.0823***	-0.0147***		
	(0.0205)	(0.0039)		
Leverage2			0.0814***	0.0263**
			(0.0193)	(0.0112)
ROA	-0.1554***	-0.0079	-0.1130***	0.0058
	(0.0266)	(0.0059)	(0.0089)	(0.0042)
Cash/Assets	0.0572*	-0.0829***	-0.0621***	-0.1042***
	(0.0313)	(0.0121)	(0.0091)	(0.0071)
PPE/Assets	-0.2152***	-0.1005***	0.0424***	-0.0007
	(0.0665)	(0.0172)	(0.0151)	(0.0099)
FreeCollateral	0.0807***	-0.0026	-0.0140	0.0049
	(0.0305)	(0.0072)	(0.0088)	(0.0049)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Constant	0.0189	-0.0060	0.0683***	0.1843***
	(0.1464)	(0.0542)	(0.0071)	(0.0057)
Observations	24,081	24,081	23,220	23,220
N of Companies	4,259	4,259	4,084	4,084
Adj R-squared	0.0655	0.0323	0.2148	0.0497

Note: *, **, and *** represent significant at 10%, 5% and 1% levels respectively;

Table 5 presents the robustness test for Model 1, regression (1) & (2) test the relationship between managerial ability (MA) and trade credit again while TC3 is the ratio of accounts payable to sales and TC4 is the ratio of accounts receivable to sales; regression (3) & (4) take Short-term debt/Assets as replacement for Leverage as Leverage2 and change Size in original Model 1 with the number of employees as Size2; Standard errors in parentheses are clustered by firm.

5. Analysis and Discussion

The following section set to provide interpretations and comments on the empirical results to response our three hypotheses developed in Section 2.2 and discuss the findings of this thesis in the theoretical and empirical background.

In order to answer our research questions:

> *What is the relationship between managerial ability and trade credit? And is there a moderating effect of market competition on the relationship between managerial ability and trade credit? If so, how does this moderating effect look like?*

We put up the following three hypotheses after analyzing previous literature:

Hypothesis 1: There is a positive relationship between managerial ability and getting trade credit.

Hypothesis 2: There is a negative relationship between managerial ability and granting trade credit.

Hypothesis 3: Market competition will have moderating effect on both the original positive relationship between managerial ability and getting trade credit and the original negative relationship between managerial ability and granting trade credit.

Then we test them in two two-dimensional fixed effects models. Regarding Hypothesis 1 and 2, the results from **Table 3** and plus the results from robustness test in Section 4.3 are statistically significant enough for us to validate our predicating that there is a positive relationship between managerial ability and getting trade credit measured by accounts payable and there is a negative relationship between managerial ability and granting trade credit proxied by accounts receivables. These findings mean that trade credit can be affected and explained from the management heterogeneity perspective – management team with higher managerial ability will increase and is able to increase the chances to use accounts payable while decrease the use of accounts receivable. This is consistent with agency theory that it is managers that take main responsibilities in corporate decisions and managers are different inputs to corporate with their own discretion. We think management team with higher managerial ability can get more trade credit may because they are good at mitigating information asymmetry by crafting trust culture, an image of worthy being trusted and a strong market position. Moreover, high managerial ability helps decrease information

asymmetry by providing high quality accounting information (Baik et al., 2011; Demerjian et al., 2013; Hasan 2020) and the mechanism of social connection to prompt bargaining power of the whole management team. This is consistent with Hu and Liu (2015) who identify CEOs' social connection from diverse experience can contribute to more accesses to outside funds including trade credits. Management team with higher managerial ability can also manage product quality and product reputation better out of their superior knowledge of predicting the product demand and sensitivity to business, industrial and technology trend to make wiser R&D and advertising investment, resulting in higher bargaining power and less needs to grant trade credit which contains operating and financial risk to work as a signal for goods quality.

Regarding Hypothesis 3, although the coefficient signs of the interaction term $\mathrm{HHI} * \mathrm{MA}_{i,t}$ in model 2 are exactly opposite to the coefficients of MA to TC1 and TC2 in model 1 respectively, which may imply market competition could weaken the original positive association between managerial ability and accounts payable and also weaken the original negative association between managerial ability and accounts receivable, neither of them are significant enough for us to conclude that there is a moderating effect of market competition on the relationship between managerial ability and trade credit, even when we conduct regressions by altering the measurement of market competition. This indicates that there is no such a strong moderating effect of market competition on the relationship between managerial ability and trade credit as we expect. One possible explanations for this insignificant moderating effect could be although the mechanism of building up market position and bargaining power are restricted by intensive market competition, other mechanism such as trust, information quality, social connection and product quality management brought by high managerial ability can still act actively and may offset certain degree of pressure from market competition. For example, on the one hand, market competition can ease the information asymmetry by prompting information flow, improving information comparability across firms and thus creating a more transparent information environment (Dhaliwal et al., 2014); on the other hand, management team with high managerial ability is equipped with unique insights and ways to interpret the future and thus

can still provide over-average better information in intensive competition environment. Since there are no previous studies investigating the moderating effect of market competition on the relationship between managerial ability and trade credit, we call for future research on this to explain why there is no such a moderating effect of market competition.

In summary, the first and second hypothesis developed in Section 2.2 are confirmed after robustness tests are conducted in methods of altering measurement of dependent variable and control variables. These significant results from our tests support the view that management heterogeneity matters in corporate decision and behavior in the area of trade credit. But the third hypothesis cannot get confirmation from our empirics that is lack of support at a significant level. Management team of higher managerial ability can better take advantages of market position and the mechanism such as trust, information quality, social connection and product quality management and thus will increase and is able to increase the use accounts payable while decrease the use of account receivables. And this impact from internal management level on trade credit cannot be either amplified or reduced by external environment proxied by market competition in our study.

6. Conclusion & Implication

6.1 Conclusion

In this thesis, we have investigated what influence the trade credit both from the perspective of internal management ability and external environment. Specifically, we try to answer the questions about whether there is a relationship between managerial ability and trade credit and, if so, how it would be and whether market competition has moderating effect on this relationship. We test our hypotheses on a sample of 24,081 firm-year observations within 4,259 US firms during the time period of 2009-2018. Using two-dimensional fixed effects regression analyses, we find that there is a statistically significant relationship between managerial ability and trade credit, a positive one with getting trade credit measured by accounts payable and a negative one with granting trade credit measured by accounts receivable. However, we find that there is no significant moderating effect of market

competition on this relationship. Our findings are also robust when we implement alternative proxies for dependent variable and control variables.

We argue that there is a positive relationship between managerial ability and getting trade credit and a negative relationship between managerial ability and granting trade credit, and market competition will have moderating effect on the relationship between managerial ability and trade credit. Our results show that managerial ability does matter in corporate decision and behavior in the area of trade credit, although market competition as an external factor cannot have a significant moderating effect on the relationship between managerial ability and trade credit. Our study also echoes the agency theory, information asymmetry and signal theory.

6.2 Contribution and Future Research

Our thesis contributes to current studies by examining what influence trade credit in a way that combines both internal management and external environment perspective. The internal perspective is a new perspective of management heterogeneity. To best of our knowledge, no previous researches have studied the relationship between managerial ability measured by method derived from Demerjian et al. (2012) and trade credit. Many researchers directly use the managerial ability score calculated by Demerjian et al. in 2009 or the newest version in 2016, which restricts the time scale and company observations of many studies. By calculating on our own, we extend the time period to year 2018 to provide more new observations and possible insights. Besides these, we also try to study the unclear relationship between market competition and trade credit again in term of the moderating effect of market competition to provide more empirical evidence on inconsistent conclusions.

Regarding future studies, we think some potentially interesting research questions could be to investigate what the most influential factors in managerial ability on trade credit are and why. Another question could be regarding our insignificant results of second topic, when it comes to the area of trade credit, how a firm's internal managerial trait and heterogeneity "resist" the

external market competition influence. Additional broader array of questions could be to what extent the influence of a firm's internal managerial trait and heterogeneity would reverse the market competition theory or is there any settings that managerial ability matters much more and make the firm stand out in external environment or even in adversity.

6.3 Limitation

One of the limitations in this study is that we are unable to know whether the management team measured in the managerial ability score is actually involved in the process deciding the utilization and investment of trade credit in each real firm case. Another limitation might be, according to our availability of data, in order to retain as many representative samples as possible and ensure that the observation objects in each industry are as varied as possible to make DEA calculation more realistically show the ranks and gaps among the efficiency of each firm, we take out the last two control variables in Tobit regression of the original method. This may cause slight noise when isolating firm efficiency attributed to managerial ability from the total firm efficiency.

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8. Appendix

Table 6 Breusch-Pagan Test

	chi-square	Prob>chi-square
Model 1	47998.0200	0.0000***
Model 2	47949.2100	0.0000***

Note: *, **, *** represent significance at the 10%, 5% and 1% respectively

Table 6 presents the results of the Breusch-Pagan test. The test is used to detect any form of heteroscedasticity. The null hypothesis is that the error variances are all equal, against the alternative that the error variances are a function of one or more variables.

Table 7 White Test

	White's general test statistic	P-value
Model 1	6608.7800	0.0000***
Model 2	6714.3420	0.0000***

Note: *, **, *** represent significance at the 10%, 5% and 1% respectively

Table 7 present the results of White Test to investigate heteroscedasticity and the main principle is the same as Breusch-Pagan test

Table 8 F Test

	F statistics	Prob > F
Model 1	16.9300	0.0000***
Model 2	16.9000	0.0000***

Note: *, **, *** represent significance at the 10%, 5% and 1% respectively

Table 8 presents the results from the F test. The test is used to identify whether a pooled model or a fixed effects model is preferred. The null hypothesis is that the preferred model is pooled regression. The results reject the null hypothesis. Therefore, a fixed effects regression model is preferred.

Table 9 Hausman test

	Chi-square	Prob > Chi-square
Model 1	234.2800	0.0000***
Model 2	263.1600	0.0000***

Note: *, **, *** represent significance at the 10%, 5% and 1% respectively

Table 9 presents the results of the Hausman test. The test is used to investigate whether fixed effects or random effects are more appropriate to control for unobserved effects on the panel of data. The null hypothesis is that the preferred model is random effects. The results reject the null hypothesis, therefore supporting the use of fixed effects model.

Table 10 Pearson's Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) MA	1.0000						
(2) Size	0.4572***	1.0000					
(3) ROA	0.2617***	0.5082***	1.0000				
(4) Leverage	-0.0258***	-0.2993***	-0.6666***	1.0000			
(5) Cash/Assets	-0.3012***	-0.3205***	-0.1806***	-0.0653***	1.0000		
(6) PPE/Assets	0.2954***	0.1365***	0.0410***	0.0712***	-0.3021***	1.0000	
(7) FreeCollateral	0.0647***	0.0614***	0.2461***	-0.5019***	0.0066	0.3862***	1.0000

Note: *, **, *** represent significance at the 10%, 5% and 1% respectively

Table 10 presents Pearson's correlation matrix

Table 11 Variable Description

Variable Name	Variable Description
Dependent Variables	
MA	Managerial ability measured with following factors
Sales	Sales is the total revenue
COGS	COGS is cost of goods sold
SG&A	SG&A is selling, general and administrative expenses
PPE	PPE is net property, plant, and equipment at the beginning of period balance
R&D	R&D is research and development expenses
Goodwill	Goodwill is purchased goodwill at the beginning of period balance
OtherIntangible	OtherIntangible is other intangible assets. It is measured by intangible asset minus goodwill at the beginning of period balance
Ln (Total Asset)	Firm size measured by natural logarithm of total assets
Market Share	Market Share is the ratio of firm sales to total sales of the firm's industry
Ln (Age)	Ln (Age) is natural logarithm of firm age counted since first time price appears in CRSP database
FreeCashFlowIndicator	Free CashFlowIndicator is coded to one if firm has a positive free cash flow, which is defined as earnings before depreciation and amortization less the change in working capital less capital expenditure at year t, zero otherwise
HHI	Herfindahl-Hirschman Index to measure the competition of the product market. HHI is calculated as: $HHI = \sum((X_{i,t})/X)^2$
CR4	Market competition measured by using market share of the top 4 firms within an industry: $CR_n = \sum_{i=1}^{n} S_i$
Independent Variables	
TC1	Trade credit measured by the ratio of accounts payable to total assets
TC2	Trade credit measured by the ratio of accounts receivable to total assets
TC3	Trade credit measured by the ratio of accounts payable to total revenue
TC4	Trade credit measured by the ratio of accounts receivable to total revenue
Control Variables	
Size	Firm size measured by natural logarithm of total assets
Size2	Firm size measured by the number of employees
Leverage	The ratio of total liabilities to beginning-of-year total assets.
Leverage2	The ratio of short-term debt to beginning-of-year total assets
ROA	ROA takes EBITDA scaled by total assets
Cash/Assets	The ratio of cash to total assets
PPE/Assets	The ratio of net property, plant & equipment to total assets
FreeCollateral	Free Collateral is calculated as the ratio of PPE after debt to total assets.

Table 11 presents variables involved in all regression model