Debt Maturity and Trade Credit in Public and Private Firms

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This thesis contains 56,728 words including title page, tables, and footnotes.

Abstract

The University of Manchester
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This thesis examines debt maturity and trade credit in public and private firms. It consists of three essays that try to answer the following questions: Does the IPO decision affect the debt maturity structure of a firm? Do private firms use more or less trade credit than public firms? Does the supplier's listing status affect its trade credit provision?

The first essay investigates the effect of an initial public offering (IPO) on the evolution of debt maturity structure using a sample of U.S. firms that went public during the period 1998–2011. I find that firms decrease their short-term debt by 19% in the first two years after the IPO and decrease it post-IPO, by about 7% relative to the pre-IPO level. These results continue to hold in a sample of new debt issues, in a difference-in-difference regression of IPO and non-IPO firms, in a treatment regression to account for endogeneity of the IPO decision, and in an instrumental variable regression to control for the joint determination of leverage and debt maturity. Further results show that the decline in short-term debt post-IPO is consistent with the asymmetric information and agency costs of equity theories and inconsistent with the agency costs of debt theory. I also find that the IPO effect on debt maturity was magnified during the recent financial crisis.

The second essay explores the use of trade credit by public and private firms using a sample of U.S. firms during the period 1995-2012. Evidence shows that private firms use more trade credit by about 40.4% than public firms. This result is robust to models accounting for sample selection and for the endogeneity associated with a firm's decision to go public. In line with the asymmetric information and credit constraints theories, private firms that are young, have more growth opportunities, and fewer tangible assets rely more on trade credit than their public counterparts. Compared to private firms, public firms are faster in adjusting toward their target trade credit due to their lower adjustment costs. I also find that during the recent financial crisis, public firms increased their reliance on trade credit, while, suppliers granted private firms less trade credit.

The third essay examines the supply side of trade credit; more specifically, the impact of a supplier's listing status on its trade credit provision using a sample of U.S. firms during the period 1994-2012. The findings show that public firms provide nearly a quarter more trade credit than their private counterparts. I propose that this is because public firms have higher financial capability, better ability in handling the trade credit process, and in enforcing payments and contract terms, than private firms. I rule out that the endogeneity of the listing decision and the observable differences between public and private firms have driven my earlier results. Additional tests show that firm characteristics, industries types, and level of competition, have a significant impact on the level of trade credit provided by public and private firms. The results also indicate that both types of firms provided less trade credit during the recent financial crisis.

Declaration

I, Yomna Ahmed Yousif Ali Ahmed Abdulla, declare that no portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

Copyright Statement

Dedication

I dedicate this thesis to my parents, Prof. Ahmed Yousif and Prof. Eman Farid

Acknowledgements

I have been waiting since the past three years for the day to write the acknowledgments of my thesis. It was not possible to reach the end of this journey without the love, help, and support of many people, undoubtedly after the grace, guidance, and blessing of Allah.

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I would like thank University of Bahrain for the financial support, I am now ready to be back to convey what I have learnt in the last three years. I also want to thank Manchester Business School with all its academics and administrators. I have benefited a lot from the comments in reviews panels, the division seminars, the first-year courses, the conferences funding, and from the PhD program as a whole.

Preface

A version of Chapter 2 has been accepted for publication in the Review of Quantitative Finance and Accounting Journal.

It was also presented in the following conferences:

1. Vietnam International Conference in Finance 2014*
2. Financial Management Association (FMA) Europe Conference 2014
3. French Financial Management Association (AFFI) Conference 2014
4. Manchester Business School Doctoral Conference 2013

A version of Chapter 3 has been nominated as one of the finalists for an award in Financial Management Association (FMA) Europe Conference 2015 and European Financial Management Association (EFMA) Conference 2015.

It was also presented/accepted in the following conferences:

1. Financial Management Association (FMA) Annual Conference 2015*
2. European Financial Management Association (EFMA) Conference 2015
3. Financial Management Association (FMA) Europe Conference 2015
4. Vietnam International Conference in Finance 2015*
5. Bradford Management School Seminar 2015*
6. British Accounting and Finance Association (BAFA) Conference 2015
7. Paris Financial Management Conference (PFMC) Conference 2014
8. Lancaster Management School Doctoral Workshop 2014

* Presented by supervisor.

Chapter 1
Introduction

1.1. Overview of Empirical Studies

Debt maturity and trade credit are two important corporate financial policies. The debt maturity structure is another facet of the capital structure decision. Choosing between short-term debt and long-term debt involves a trade-off between their costs and benefits and has implications for other financial policies (Harford, Klasa, and Maxwell, 2013). Firms also consider their assets life, agency costs, asymmetric information, and taxes levels that they face in determining debt maturity policies.[1]

The importance of the trade credit policy stems from the significant use of trade credit by firms as both borrowers and suppliers. In 2014, according to the U.S. flow of funds, accounts payable (accounts receivable) of non-financial firms was worth US$ 2,037.1 billion (US $2,542.7 billion). For the borrowing firm, trade credit is also a useful substitute for bank credit under adverse macroeconomic conditions (e.g., Nilsen, 2002; Love, Preve, and Sarria-Allende, 2007). On the other hand, firms provide trade credit because they have a lending advantage over conventional lenders, for instance, through their frequent interactions with customers, controlling of supplies, and their ability to re-sell the goods in case of customer default (e.g., Schwartz, 1974).[2] Additionally, the use and provision of trade credit has an economically significant effect on shareholders' wealth (Hill, Kelly, and Lockhart, 2012, 2013).

This thesis presents three essays on debt maturity and trade credit policies in publicly listed and privately held firms. Specifically, my papers investigate three interrelated questions, namely (i) the effect of an IPO on a company's debt maturity structure, (ii) the use of trade credit in public and private firms, and (iii) the impact of the supplier's listing status on its trade credit provision.

[1] See (Myers, 1977; Brick and Ravid, 1985; Flannery, 1986; Diamond, 1991).
[2] There are other reasons for providing trade credit, which are discussed in details in Chapter 4, p.138

Most U.S.-based studies on debt maturity and trade credit have been devoted to public firms due to the limited availability of data on privately held firms, although the latter firms comprise a substantial proportion of firms in the U.S. economy. Based on Forbes magazine (2013), nearly all of the 27 million firms in the U.S. are privately held, more specifically, out of the 5.7 million firms with employees, only 0.06% of firms are publicly listed, with the rest being privately held.[3] Though the vast majority of U.S. firms are private, we know little about their debt maturity and their use of trade credit. The thesis addresses this important gap in the literature by examining a large sample of private firms. My work is motivated by the availability of a relatively new database, S&P Capital IQ, which provides data on both public and private firms and thus allows researchers to overcome the data limitations regarding the latter firms.

The three papers in this thesis are also motivated by a growing literature documenting significant differences in various corporate financial policies between public and private firms, including leverage (Brav, 2009; Huynh, Paligorova, and Petrunia, 2012), payout ratios (Michaely and Roberts, 2012), cash holdings (Gao, Harford, and Li, 2013), investments (Mortal and Reisel, 2013; Asker, Farre-Mensa, and Ljungqvist, 2015), and innovations (Ferreira, Manso, and Silva, 2014; Gao, Hsu, and Li, 2014; Acharya and Xu, 2015). What this literature shows is that the documented differences in the financial policies between the two types of firms are driven by their differences in the following dimensions: asymmetric information, access to external markets, financial constraints, bargaining power with lenders, credit quality, and agency costs (Pagano, Panetta, and Zingales, 1998; Scherr and Hulburt, 2001; Brav, 2009; Schenone, 2010; Saunders and Steffen, 2011; Michaely and Roberts, 2012; Gao, Harford, and Li, 2013). Since, these dimensions are known to affect debt maturity and trade credit (e.g. Myers, 1977; Flannery,

[3] In 2010, U.S. private firms accounted for 52.8% of aggregate non-residential fixed investment, 68.7% of private-sector employment, 58.7% of sales, and 48.9% of aggregate pre-tax profits (Asker, Farre-Mensa, and Ljungqvist, 2015).

1986; Diamond, 1991; Petersen and Rajan, 1997; Hill, Kelly, and Lockhart, 2012), a potential difference is expected in the policies of the two firm types.

1.2. The Effect of an IPO on a Company's Debt Maturity Structure

The first essay examines the effect of the listing decision on the evolution of debt maturity over the life cycle of a company. Previous studies document that immediately after an IPO, firms use less debt because they can rely on more equity raised in the stock markets (Pagano, Panetta, and Zingales, 1998; Aslan and Kumar, 2011). However, there is a lack of research on whether the debt maturity structure also changes post-IPO, although it is an equally important capital structure decision (e.g., Johnson, 2003; Brockman, Martin, and Unlu, 2010). In addition, firms' debt maturity structures have significant impacts on their investments and cash holdings (Aivazian, Ge, and Qiu, 2005a, b; Harford, Klasa, and Maxwell, 2013). Moreover, despite the large number of U.S.-based studies on debt maturity, the literature has focused on public firms (e.g., Barclay and Smith, 1995; Barclay, Marx, and Smith, 2003; Johnson, 2003; Datta, Iskandar-Datta, and Raman, 2005; Brockman, Martin, and Unlu, 2010). The debt maturity of private firms has been given little attention due to the scarcity of data on U.S. private firms. Scherr and Hulburt (2001) is the only study that investigates the determinants of the debt maturity structures of small (private) firms but it uses a small sample based on survey data and does not provide a comparative analysis of public and private firms.

My essay aims to fill these gaps by investigating the effect of an IPO on the debt maturity structures of U.S. firms that went public over the period 1998-2011. Based on agency theories and asymmetric information models, I hypothesize that firms will use less short-term debt post-IPO. First, according to the agency theories (Myers, 1977), firms' growth opportunities will be utilized following an IPO, thus reducing their need to hold short-term debt to mitigate the under-investment problem. Firms may seek to invest in long-term innovative projects post-IPO, according to the matching principle between maturity of assets and liabilities, these projects should be financed using long-term debt

(Myers, 1977; Ortiz-Molina and Penas, 2008). In addition, post-IPO, managerial ownership decreases, leading to weaker interest alignment between shareholders and managers. Hence, managers will have an incentive to rely more on long-term debt to avoid the monitoring associated with short-maturity debt (Datta, Iskandar-Datta, and Raman, 2005). Second, based on the asymmetric information models, the level of information asymmetry faced by a firm decreases following an IPO, thus reducing the need for using short-term debt as a signaling device (Flannery, 1986). A better informational environment post-IPO also leads to stronger bargaining power and reduced financial constraints (Schenone, 2010; Saunders and Steffen, 2011), hence greater access to long-term debt. According to Diamond's (1991) model, firms with low and high credit quality rely on short-term debt while those with medium credit ratings use long-term debt. Following an IPO, a firm's default risk is likely to decrease and its credit quality improves, allowing it to use more long-term debt.

Consistent with the above hypothesis, my findings show that in the IPO and IPO+1 years, firms reduce their short-term debt ratio by about 7%, which represents nearly a fifth of the short-term debt ratio pre-IPO. On average, post-IPO the short-term debt ratio drops by 2.5% (or 7% relative to the pre-IPO level). These results continue to hold when I consider a sample of new debt issues and further perform a difference-in-differences analysis. Next, I investigate the drivers of the decline of short-term debt post-IPO and find that the IPO effect on debt maturity is only evident in small and high-growth firms, which is consistent with the argument based on asymmetric information theory. My findings further show that only high-leveraged firms and firms with a high dilution ratio reduce their short-term debt post-IPO, which is inconsistent with the argument based on the agency costs of debt but is in line with the argument based on the agency costs of equity. Additional tests rule out the concern that the potential endogeneity associated with the listing decision and the simultaneity bias due to the joint determination of leverage and debt maturity may have an impact on the baseline results. Lastly, I document that the IPO

effect on debt maturity was most pronounced during the financial crisis of 2007–2008 because firms preferred to hold less short-term debt to avoid refinancing risks, especially during a period of credit shocks.

The contributions of this essay are three-fold. Firstly, to the best of my knowledge, my paper is the first to examine the effect of the IPO on debt maturity. My results complement prior non-U.S. research on the effect of the IPO on leverage (Pagano, Panetta, and Zingales, 1998; Alti, 2006; Lemmon, Roberts, and Zender, 2008; Aslan and Kumar, 2011), as well as a few studies that briefly observe the link between IPOs and cash holdings (Von Eije, 2012; Bouwman and Lowry, 2012; Gao, Harford, and Li, 2013). Secondly, this essay contributes to the limited literature on the debt maturity of U.S. private firms (Scherr and Hulburt, 2001), by investigating the debt maturity of a large sample of IPO firms from when they were private to when they became public. The findings on the effect of the IPO on the evolution of debt maturity over the life cycle of a company complement the finding of Custódio, Ferreira, and Laureano (2013) on the evolution of debt maturity of the average public firm. Thirdly, my study extends the recent body of literature documenting differences in several corporate financial policies between public and private firms; here I provide novel evidence regarding a new corporate financial policy, namely debt maturity.

1.3. The Use of Trade Credit in Public and Private Firms

The second essay aims to study another source of short-term finance that is considered to be a substitute for short-term debt, i.e., trade credit. Specifically, it first investigates whether private firms rely more on trade credit than public firms. Second, it explores whether firms have a target level of trade credit, and if so, whether public and private firms have different adjustment behaviors. Finally, it examines whether the macro-economic conditions, proxied by the recent financial crisis, have differential effects on the use of trade credit by public and private firms.

A comparison of different aspects in the use of trade credit by public and private firms allows me address several important omissions in the literature on trade credit. First, I examine the argument that trade credit is an important form of financing for firms with limited access to external capital markets, put forward by Petersen and Rajan (1997), Bias and Gollier (1997), Berger and Udell (1998), and Fisman and Love (2003), but has not yet been tested using data on private firms. There is a limited number of non-U.S. papers that have examined the dynamics of trade credit (García-Teruel and Martínez-Solano, 2010a, b), although in studies of capital structure and cash holdings Brav (2009) and Gao, Harford, and Li (2013) document different adjustment mechanisms of public and private firms. Prior research shows the effect of crises on the use of trade credit by public firms (e.g., Love, Preve, and Sarria-Allende, 2007; Garcia-Appendini and Montriol-Garriga, 2013). My essay examines the effect of the financial crisis on trade credit policies not only in public firms but also in private firms: I explore if the crisis had differential effects on the levels of trade credit used in the two firm types.

My main hypothesis is that private firms demand more trade credit than public firms, because they have higher degrees of asymmetric information, and financial constraints, more limited access to external markets, and lower credit quality (Pagano, Panetta, and Zingales, 1998; Scherr and Hulburt, 2001; Brav, 2009; Michaely and Roberts, 2012; Gao, Harford, and Li, 2013). Using data on U.S. public and private firms for the period 1995−2012, my findings show that the level of accounts payable in private firms is 40.4% higher than that in their public counterparts. I confirm the robustness of my results by using a transition sample of IPO firms, which helps to control for the potential sample selection issue. I also run a treatment regression to account for the endogeneity of the listing decision and further employ propensity score matching techniques to account for the observable differences between public and private firms. The results survive these tests and, in addition, are robust to using further control variables, as well as using an extended sample and alternative measures of trade credit.

My additional results show that private firms that are younger, larger, have more growth opportunities, and fewer tangible assets use more trade credit than similar public firms. These results are consistent with the argument that young, high-growth, and low-tangibility firms demand more trade credit because they face high degrees of asymmetric information and credit constraints. Next, in line with my prior expectation, public firms move faster toward target trade credit than their private counterparts as they seem to face lower adjustment costs. Interestingly, my results document that private firms were granted significantly less trade credit, while public used more trade credit during the recent financial crisis. These results are more in line with a supply-side story, according to which suppliers were financially affected by the financial crisis (Love, Preve, Sarria-Allende, 2007) and became less willing to extend trade credit to private firms.

Similar to the first essay, this essay also adds to the literature documenting important differences in corporate financial policies between public and private firms. Here, I provide novel evidence on the difference in the use of trade credit by public and private firms. The findings complement earlier survey studies of trade credit in small and medium-size firms (Petersen and Rajan, 1997; Berger and Udell, 1998; Giannetti, Burkart, and Ellingsen, 2011). To the best of my knowledge, this paper provides the first evidence of the different speed of adjustment to the target level of trade credit of public and private firms, thereby adding to a very small number of non-U.S. papers (García-Teruel and Martínez-Solano, 2010a, b; Baños-Caballero, Garcia-Teruel, and Martinez-Solano, 2014) and contributing to studies documenting different target leverage and cash adjustment behaviors of public and private firms (Brav 2009; Gao, Harford, and Li, 2013). My evidence of the differential effects of the financial crisis on the use of trade credit by public and private firms adds to existing findings regarding public firms in Love, Preve, Sarria-Allende (2007) and Garcia-Appendini and Montriol-Garriga (2013).

1.4. The Impact of the Supplier's Listing Status on its Trade Credit Provision

Having documented the difference in the use of trade credit by public and private firms in the second essay, I now turn to explore the supply-side of trade credit. More specifically, my third essay examines whether the supplier's listing status has an impact on its trade credit provision. The existing U.S.-based studies are mainly focused on the determinants of trade credit and the contract terms (Mian and Smith, 1992; Long, Malitz, and Ravid, 1993; Petersen and Rajan, 1997; Ng, Smith, and Smith, 1999; Cuñat, 2007; Molina and Preve, 2009; Giannetti, Burkart, and Ellingsen, 2011; Klapper, Laeven, and Rajan, 2012; Murfin and Njoroge, 2015). However, there is a limited understanding of whether the supplier's access to stock markets affects its trade credit provision. Compared to private firms, public firms have greater access to external markets, lower asymmetric information, lower financial constraints, and higher bargaining power (Brav 2009; Schenone 2010; Hill, Kelly and Lockhart, 2012; Gao, Harford, Li 2013; Fabbri and Klapper, 2013; Acharya and Xu, 2015), suggesting a potential difference in their provision of trade credit. The literature on the effect of the macroeconomic conditions on the supply of trade credit (Choi and Kim, 2005; Love, Preve, and Sarria-Allende, 2007; Garcia-Appendini and Montriol-Garriga, 2013) has been dominated by studies of public firms. Nevertheless, there could an asymmetric crisis effect on the level of trade credit provided by private firms. For the reasons discussed above, this essay examines the supply of trade credit in both public and private firms and how it was affected by the recent financial crisis.

My main hypothesis is that public firms provide a higher level of trade credit because they have greater financial capability, better ability in handling the trade credit process, and in enforcing payments and contract terms, than private firms. Using a sample of U.S. public and private firms over the period 1994−2012, I find that public firms indeed provide a significantly higher level of trade credit than their private counterparts. Next, I carry out a number of robustness tests in which I include alternative control variables to address the omitted variable bias and conduct a propensity score matching analysis to

control for the observable differences between public and private firms. To deal with the concerns about the potential endogeneity of the going public decision, I also estimate a treatment regression. The results continue in those robustness checks.

Next, the findings indicate that, consistent with my prior expectations, public firms that are large, have low tangibility, high sales volatility, high bargaining power, and are high growth options provide more trade credit than their private counterparts. Large and low-tangibility firms should grant more trade credit because of their higher financial capability. Firms with high sales volatility provide more trade credit to smooth the demand for their goods. Firms with high bargaining power and high growth opportunities offer more trade credit because they have better ability to force payments and more incentives to attract customers respectively. Further results show that public firms provide more trade credit than private firms in differentiated and service industries, but less trade credit in retail and wholesale, standardized, and concentrated industries. These results highlight the importance of the product market dynamics in determining the supply of trade credit. I further find that both firm types provided less trade credit during the financial crisis.

The findings of this essay contribute to the literature on trade credit by providing, as far as I am aware, the first systematic evidence on the impact of suppliers' listing status on their trade credit provision. The results are also related to studies examining the supply of trade credit by U.S. small suppliers (Petersen and Rajan, 1997; Giannetti, Burkart, and Ellingsen, 2011; Murfin and Njoroge, 2015). Here, my study provides novel large-sample evidence on the trade credit offered by private U.S. firms. The evidence on the effects of the financial crisis on the level of trade credit granted by public and private firms addresses the existing gap in the literature regarding the question whether the financial crisis had differential impacts on trade credit provision by public and private firms. Additionally, it extends previous works that focus only on public firms; see Choi and Kim (2005), Love, Preve, and Sarria-Allende (2007), and Garcia-Appendini and Montriol-Garriga (2013). My findings on the effects of the market dynamics on the level of trade credit offered by public

and private firms contribute to existing evidence of the effects of product market characteristics on the supply of trade credit using non-U.S. data (McMillan and Woodruff, 1999; Johnson, McMillan, and Woodruff, 2002; Fisman and Raturi, 2004; Fabbri and Klapper, 2013) and U.S. SMEs survey data (Giannetti, Burkart, and Ellingsen, 2011).

1.5. Thesis Structure

The thesis structure follows the format accepted by the Manchester Accounting and Finance Group, Manchester Business School. It allows chapters to be incorporated into a format suitable for submission and publication in peer-reviewed academic journals. Therefore, this thesis is structured around three essays containing original research in Chapters 2, 3, and 4. The chapters are self-contained, i.e., each chapter has a separate literature review, answers unique and original questions, and employs a distinct analysis with different datasets. The equations, footnotes, tables, and figures are independent and are numbered from the beginning of each chapter. Page numbers, titles, and subtitles have a sequential order throughout the thesis.

The rest of the thesis continues as follows. Chapter 2 investigates the effect of an IPO on debt maturity structure. Chapter 3 examines the use of trade credit in public and private firms. Chapter 4 provides new evidence on the impact of a supplier's listing status on the level of trade credit it offers. Chapter 5 concludes.

In Chapters 2, 3, and 4, I use the third person (we, our) rather than the first person (I, my), as these chapters are in the form of submitted, accepted, or working papers co-authored with my supervisors.

Chapter 2
Debt Maturity and Initial Public Offerings

Abstract

We investigate the effect of an initial public offering (IPO) on the evolution of debt maturity by tracking a sample of U.S. firms that went public over the period 1998–2011. Our findings reveal a significant and increase in debt maturity post-IPO. The short-term debt ratio drops by nearly a fifth in the first two years after the IPO. These findings are economically significant and robust to controlling for the endogeneity in the listing decision. However, the lengthening of debt maturity post-IPO is only evident in small and high-growth firms, and primarily shown in highly levered firms. This finding lends more support to asymmetric information models than theories based on the agency costs of debt. There is some support for the argument based on the agency costs of equity as the IPO effect on debt maturity is only significant for firms with a high dilution ratio. Finally, the IPO effect varies with macroeconomic conditions as the increase in debt maturity post-IPO was most pronounced during the recent financial crisis.

2.1. Introduction

This paper investigates the effect of an IPO on the debt maturity structure of U.S. firms, tracking these firms from when they were private to when they went public. Understanding debt maturity choice and its evolution over the life cycle of a company is of importance to financial management because any change in debt maturity will affect real corporate behavior, including the level of investment (Aivazian, Ge, and Qiu, 2005a,b), especially in periods of credit and liquidity shocks (Almeida, Campello, Laranjeira, and Weisbenner, 2011; Custódio, Ferreira, and Laureano, 2013). Moreover, debt maturity structure is related to other financial policies, such as leverage and cash holdings. Harford, Klasa, and Maxwell (2013) show that firms with a large proportion of short-maturity debt tend to have large cash reserves in order to mitigate the refinancing risk associated with short-term debt. Studying the evolution of debt maturity in the periods pre- and post-IPO is also of great interest as it involves the IPO, one of the most important events in the life cycle of a company often associated with significant changes in corporate behavior.

An IPO can be viewed as an information-releasing event that changes the information structure of a company, especially with regards to its relationship with lenders (Schenone, 2010). One of the most important motives for firms to go public is to gain access to external financial markets. As a result, research has examined the impact of a firm's listing decision on its financial policies post-IPO. For example, it is well-documented that immediately after going public firms rely less on debt financing because they can raise capital in the equity markets (Pagano, Panetta, and Zingales, 1998; Aslan and Kumar, 2011). However, little attention has been devoted to the question of how a firm's debt maturity evolves after the IPO. This is a significant omission because debt maturity is also an important capital structure decision jointly determined with leverage (see Barclay and Smith, 1995; Stohs and Mauer, 1996; Johnson, 2003; Datta, Iskandar-Datta, and Raman, 2005; Antoniou, Guney, and Paudyal, 2006; Brockman, Martin, and Unlu, 2010).

It is important for the shareholders of an IPO firm to know whether there will be a change in the debt maturity structure post-IPO for there are costs and benefits of switching between debts of different maturities. For instance, while short-term debt typically has lower interest rates, is relatively easier to negotiate, and requires less collateral than long-term debt, it exposes the firm to the refinancing and liquidity risks. The refinancing risk associated with short-term debt arises when market conditions change, causing the firm to borrow at a higher interest rate (Froot, Scharfstein, and Stein, 1993). The liquidity risk, as highlighted by Diamond (1991), is the risk of the borrowing firm losing the control rent when lenders are reluctant to renew the debt after a downgrade to the firm. Further, firms relying heavily on short-term debt may be forced to sell important assets at fire-sale prices when they are unable to roll over their short-term debt contracts (Brunnermeier and Yogo, 2009; Choi, Hackbarth, and Zechner, 2014). According to the matching principle (Myers, 1977), a firm that maintains a high proportion of short-term debt in its capital structure will tend to invest mainly in short-term projects (Ortiz-Molina and Penas, 2008), which are less innovative and may affect the firm's long-term performance.

We hypothesize that the proportion of short-term debt in a firm's capital structure will decline after the firm goes public. Our hypothesis is motivated by two lines of argument based on agency theories and asymmetric information models. First, once a company goes public, its growth opportunities will be utilized, which alleviates the concern about underinvestment incentives and reduces the need for holding short-term debt as a solution to this agency problem (Myers, 1977). The maturity of assets might increase post-IPO if firms seek to invest in long-term innovative projects. This change in asset maturity structure leads to a similar shift in debt maturity toward greater reliance on long-term debt, as predicted by the matching principle (Myers, 1977; Ortiz-Molina and Penas, 2008). Following an IPO, managerial ownership decreases due to the dilution effect, resulting in weaker interest alignment with shareholders. This, in turn, will create an incentive for managers to entrench themselves by eschewing short-term debt and avoiding

the external monitoring that it provides especially in poorly governed firms (Datta, Iskandar-Datta, and Raman, 2005).

Our second argument is based on theoretical models of debt maturity in the presence of asymmetric information. According to Flannery's (1986) signaling model, a private firm that processes favorable (private) information about its prospects should use short-term debt to signal its quality to creditors. To the extent that informational asymmetries are reduced post-IPO, the newly listed firm will have less incentive to use short-term debt as a signaling device. Reduced asymmetric information post-IPO also means that public firms become less constrained and have stronger bargaining power (Schenone, 2010; Saunders and Steffen, 2011), implying greater access to debt of longer maturities. In Diamond's (1991) model, firms with private information choose debt of different maturities, i.e., those with high and low risk ratings borrow short term while those with medium risk ratings borrow long term. As a private firm goes public, its default risk is likely to decrease while its credit quality improves (Pagano, Panetta, and Zingales, 1998; Saunders and Steffen, 2011). This implies that after an IPO, the average firm is likely to use less short-term debt.

Using data from the S&P Capital IQ database for a sample of U.S. firms that went public over the period 1998–2011, we document a significant shift toward longer debt maturity post-IPO, which is consistent with our central hypothesis. The mean short-term debt ratio drops significantly from the pre-IPO level of 36% to the post-IPO level of 27.5%. Controlling for changes in firm characteristics, our regression analysis shows a 2.5% decrease in the short-term debt ratio post-IPO. The IPO effect on debt maturity is strongest in the first few years after the IPO. Firms reduce their short-term debt ratio by nearly 7% in the IPO and IPO+1 years, which represents a significant decrease of nearly a fifth (19%) compared to the pre-IPO level. Our results are robust to tests (1) adopting the incremental financing approach that uses a sample of new debt issues and (2) employing the difference-in-differences estimator that accounts for omitted time trends in debt

maturity, and unobserved differences in the characteristics of IPO and non-IPO firms. Overall, these findings provide strong support for our prediction that upon becoming public, firms will lengthen the maturity of their debt.

We next find that the decline in the short-term debt ratio is only observed in small and high growth firms, which is consistent with the argument based on asymmetric information. Small and high-growth firms, those that typically face greater asymmetric information, promptly switch to more long-term debt as a result of reduced informational asymmetries following the IPO. However, there is little evidence to support the argument based on the agency costs of debt as the lengthening of debt maturity post-IPO is only seen in high-growth firms, and is primarily observed in those with high leverage. High-growth firms and highly levered firms face high agency costs of debt, which they should mitigate by maintaining a high proportion of short-term debt. Our evidence does not support this prediction as we find thatthese firms use significantly less short-term debt after the IPO.

Our additional tests controlling for IPO-related characteristics show that the effect of the IPO on debt maturity is only relevant for firms with a higher dilution ratio, i.e., those with a more severe conflict of interests between managers and shareholders. This finding is consistent with the argument based on the agency costs of equity because managers with weaker interest alignment with shareholders would prefer to reduce external monitoring associated with short-term debt. We also find that the effect of the IPO on debt maturity remains significant, regardless of the intended use of the IPO proceeds. This finding suggests that our results are not restricted to a group of firms that simply use the proceeds from equity capital to retire debts. This is also in line with our earlier evidence obtained using the incremental financing approach.

We subject our results to a number of robustness tests and model specifications. First, one major concern about our analysis is that the IPO decision is endogenous and can be affected by unobserved firm factors that are related to debt maturity. We deal with this endogeneity concern using a treatment regression. Our main results are robust to this

model specification as we document a significant decline (7.6%) in the short-term debt ratio post-IPO. Second, we address the possibility that debt maturity and leverage, two interrelated capital structure decisions, are simultaneously determined. Using two-stage least squares regressions (2SLS) and alternative instruments for leverage, we obtain results consistent with our baseline findings. Finally, we examine whether the IPO effect on debt maturity varies with macroeconomic conditions. We find that this effect was magnified by the credit shocks associated with the recent financial crisis of 2007–2008. Since the financial crisis was a credit crunch, during which the refinancing and liquidity risks associated with short-term debt were amplified, IPO firms had even greater incentives to reduce their short-term debt usage.

Our study provides novel evidence of the impact of an IPO on debt maturity and contributes to three bodies of literature. In the IPO literature, we highlight an important impact of the listing decision on corporate financial policies. A few recent studies have started to document a potential association between an IPO and leverage (Pagano, Panetta, and Zingales, 1998; Alti, 2006; Lemmon, Roberts, and Zender, 2008; Aslan and Kumar, 2011). However, only two non-U.S. studies by Pagano, Panetta, and Zingales (1998) and Aslan and Kumar (2011) have formally tested the effect of an IPO on leverage. In the cash holdings literature, the association between IPO and cash has also been observed but has not been formally examined (Von Eije, 2012; Bouwman and Lowry, 2012; Gao, Harford, and Li, 2013). To the best of our knowledge, we are the first to study the impact of the listing decision on debt maturity structures.

In the debt maturity literature, most U.S.-based research has focused on public firms (Barclay and Smith, 1995; Barclay, Marx, and Smith, 2003; Johnson, 2003; Datta, Iskandar-Datta, and Raman, 2005; Brockman, Martin, and Unlu, 2010). Due to the scarcity of data, Scherr and Hulburt (2001) is the only study examining the determinants of the debt maturity structures of small (private) firms. However, the authors use a small sample of private firms collected from the National Survey of Small Business Finances (NSSBF) in

only two years 1987 and 1993. Using newly available data provided by S&P Capital IQ, we analyze a much larger sample of IPO firms over the period 1994–2012, tracking them from when they were private to when they became public. Importantly, the objective of our analysis is to examine the effect of the IPO decision on the evolution of debt maturity over the life cycle of a company. Hence, our study complements the recent finding regarding the secular decrease in the debt maturity of the average public firm documented by Custódio, Ferreira, and Laureano (2013).

Finally, our findings add to the recent surge of papers studying differences in the corporate financial policies of public and private firms, including leverage (Brav, 2009; Huynh, Paligorova, and Petrunia, 2012), payout ratios (Michaely and Roberts, 2012), cash holdings (Gao, Harford, and Li, 2013), investments (Mortal and Reisel, 2013; Asker, Farre-Mensa, and Ljungqvist, 2015), and innovations (Gao, Hsu, and Li, 2014; Acharya and Xu, 2015). More recently, Brav (2009) and Huynh, Paligorova, and Petrunia (2012) compare the capital structures of private and public firms in the UK and Canada, respectively. Although both studies document a difference in the debt maturity structures of private and public firms, the focus of their analyses is the leverage decision.[1] Our paper takes a different approach as we examine the impact of the IPO decision on debt maturity using a transition sample of U.S. firms that were private but subsequently went public. Our study contributes to this growing research agenda by documenting the first systematic US evidence of the impact of the listing status on debt maturity structure.

The remainder of the chapter proceeds as follows. We review the literature and develop our main hypothesis in the next section. We then describe our data in Section 2.3 and discuss the methodology in Section 2.4. We provide univariate and multivariate results in Section 2.5. We investigate what is responsible for the change in debt maturity post-IPO in Section 2.6. We deal with sample selection and endogeneity concerns in Section 2.7. In

[1] For example, Brav (2009) only performs a univariate analysis in which he compares the debt maturity structures of public and private firms in the UK.

Section 2.8, we examine the IPO effect on debt maturity under different credit conditions. We conclude in Section 2.9.

2.2. Literature Review and Hypothesis Development

2.2.1. Literature on Debt Maturity

Most studies in the literature investigate the debt maturity choice of either private or public firms with only a few examining both types of firms. Nevertheless, there is growing international evidence that private firms tend to use more short-term debt than public firms. Using a sample of predominantly unlisted firms in Europe, Giannetti (2003) shows that listed firms have longer debt maturity than their unlisted counterparts. In a univariate analysis of the debt maturity of UK firms, Brav (2009) finds that private firms use more short-term debt and leverage than public firms. This result is consistent with Huynh, Paligorova, and Petrunia's (2012) recent findings for Canadian firms. Analyzing a sample of small (private) U.S. firms, Scherr and Hulburt (2001) show that small (private) firms have shorter debt maturity than the public firms examined by earlier studies. Similar evidence is also documented for Italian unlisted firms (Magri, 2010).

The findings that private firms use more short-term debt than public firms can be explained in two ways. The first explanation is based on agency theories and concerns differences in the growth opportunities and asset maturity structures of public and private firms. The second regards differences in asymmetric information, financial constraints, bargaining power, and credit quality. First, private firms tend to have higher growth opportunities and thus face higher agency costs of debt due to the underinvestment problem (Garcia-Teruel and Martinez-Solano, 2007; Heyman, Deloof, and Ooghe, 2008; Magri, 2010). This underinvestment incentive arises because managers in high-growth firms acting in the interest of shareholders are likely to pass up positive-NPV projects as the payoffs from these projects would partially accrue to debt-holders (Myers, 1977). To mitigate this problem, private firms should use short-term debt that expires prior to the timing of investment and thus enables shareholders to gain the full payoff from the

investment. Next, private and small firms tend to operate with shorter-lived assets than public and large firms (Scherr and Hulburt, 2001). Based on the matching principle, assets with short lives should be financed with debt of similar maturities (Myers, 1977), suggesting that private firms should have shorter debt maturity than their public counterparts. From a different agency perspective, private firms are less likely to be known by lenders, who would prefer the discipline of external monitoring and renegotiation associated with short-term debt (Magri, 2010).

Second, due to a lack of transparency and disclosure requirements, private firms have higher degrees of asymmetric information than their public counterparts. Hence, those with favorable private information about their prospects have incentives to use short-term debt as a costly and credible signaling device that cannot be mimicked by firms with unfavorable information (Flannery, 1986). Additionally, as a consequence of asymmetric information, private firms tend to be financially constrained and suffer from weak bargaining power (Saunders and Steffen, 2011), which force them to rely heavily on short-term borrowings. Further, private firms are generally riskier than their public counterparts. According to Diamond's (1991) model, firms with high risk ratings may be refused the option of long-term borrowings because of the resulting adverse selection problem that would see these firms choose very high-risk projects (see Scherr and Hulburt, 2001; Garcia-Teruel and Martinez-Solano, 2007). Peel (2000) also observes that private firms, which have low liquidity and more volatile cash flows, are susceptible to financial distress and thus rely heavily on short-term borrowings.

While prior research has focused on either listed or unlisted firms as reviewed above, it has not studied the evolution of debt maturity over the life cycle of firms. Custódio, Ferreira, and Laureano (2013) are the first to investigate the evolving debt maturity structure over time. Using a sample of U.S. public firms, they document an increase in the short-term debt ratio of the average firm over time, and find the new listings phenomenon to be responsible for this increase. The objective of our study is different

from that of Custódio, Ferreira, and Laureano (2013) as we examine the evolution of debt maturity over the life cycle of IPO firms, with a focus on studying the short-term and long-term effects of the IPO event on the debt maturity choice. Put differently, we are interested in examining the (time-series) change in the debt maturity of the average transition firm pre- and post-IPO, while Custódio, Ferreira, and Laureano (2013) document the trend in the average debt maturity of public firms by calendar year.

2.2.2. Literature on IPO and Corporate Financial Policies

Using a sample of private firms in Italy, Pagano, Panetta, and Zingales (1998) examine the reasons for firms to go public. They document three main motives related to capital structure: greater access to financial markets, an increase in bargaining power with banks, and a decrease in the cost of borrowing. The authors further study the effects of the listing decision on financial and operating variables ex post, showing that the IPO effects are significant up to three years after the IPO. Their findings indicate that firms go public to rebalance their capital structure after a period of high investment and growth. Aslan and Kumar (2011) apply a similar methodology to a sample of UK private firms, providing further support to Pagano, Panetta, and Zingales's (1998) earlier finding that leverage drops instantly after the IPO. Neither of the two studies examines the choice of debt maturity, although it is an equally important capital structure policy (Barclay and Smith, 1995; Stohs and Mauer, 1996; Johnson, 2003).

A few recent studies have investigated the association between an IPO and two financial policies, leverage, and cash holdings. Alti (2006) examines the effect of market timing on capital structure through analyzing the changes in the leverage ratios of market timers.[2] The results indicate that the effect of market timing on capital structure lasts for two years post-IPO.[3] Lemmon, Roberts, and Zender (2008) study the evolution of capital structure from the year of the IPO up to 20 years after the IPO. They find that leverage is

[2] Market timers are firms that go public in "hot" markets, i.e., in months with above the median distribution of the (detrended) monthly moving average IPO volume.
[3] It should be noted that Alti (2006) only uses data for one-year preceding the IPO.

persistent over time and is significantly determined by its initial values. Lemmon, Roberts, and Zender (2008), however, do not consider the evolution of capital structure, and, in particular, debt maturity pre-IPO.

Some recent research has also started to realize a possible association between an IPO and cash management policies (Von Eije, 2012; Gao, Harford, and Li, 2013). Gao, Harford, and Li (2013) focus on the cash holdings in private and public firms, although they also briefly study the cash policies of a sample of transition firms pre- and post-secondary IPOs.[4] According to their graphical evidence, the level of cash increases dramatically around the IPO year (i.e., from IPO−1 to IPO and from IPO to IPO+1). Using a sample of international private firms, Von Eije (2012) documents that cash holdings decline after the IPO, although they remain even higher than the cash holdings of firms that are never listed publicly. Bouwman and Lowry (2012) also examine differences in the cash holdings of new IPO and mature firms, and among IPO firms with various financing types preceding the IPO. Their findings show extreme persistence in the level of cash in the period between IPO+3 and IPO+5, even though the growth rate, an important reason for holding a high level of cash, slows down post-IPO.

To conclude, although both theoretical and empirical studies suggest that a firm's choice of short-term versus long-term debt may evolve over its life cycle, no study has investigated the potential effect of the IPO on debt maturity structure. With a few exceptions, existing research on the evolution of corporate finance policies in general and debt maturity in particular has mainly looked at public firms. We extend the literature by examining the choice of debt maturity in the periods pre- and post-IPO, which enables us to provide a comprehensive picture of the evolution of debt maturity over the life cycle of firms.

[4] A secondary IPO is one in which the issuer does not receive any cash proceeds.

2.2.3. Hypothesis Development

Our main hypothesis is that after going public, firms lengthen the maturity structure of their debt. This prediction is based on two main lines of argument drawn from existing agency theories and asymmetric information models. The first considers changes in IPO firms' growth opportunities, asset maturity, and managerial ownership. The second argument entails changes in these firms' levels of asymmetric information, financial constraints, bargaining power, and credit quality.

First, Myers' (1977) agency model suggests that firms with high growth and risky debt should shorten the maturity of their debt in order to mitigate underinvestment incentives. Since private firms have high growth options and great concerns about this incentive problem, they tend to rely heavily on short-term debt. However, when these firms go public, their growth opportunities will be utilized, reducing the need for using short-term debt as a solution for the underinvestment problem. Next, newly listed firms might invest in more long-term innovative projects, which should be financed with debt of longer maturities according to the matching principle (Myers, 1977). From another agency perspective, when a firm goes public the managerial ownership decreases due to the dilution effect. Consequently, the conflict of interests between managers and shareholders intensifies especially in poorly governed firms, creating an incentive for managers to entrench themselves by avoiding short-term debt and the frequent monitoring that it provides (Rajan and Winton, 1995; Stulz, 2004; Datta, Iskandar-Datta, and Raman, 2005).

Second, under the asymmetric information framework, Flannery (1986) demonstrates how firms with favorable private information may credibly signal their prospects through short-term debt. Since going public helps firms improve transparency and disclosure while reducing the levels of asymmetric information (Schenone, 2010), it is expected that listed firms will have less incentive to use short-term debt for signaling purposes. In a related argument, private firms often face financial constraints and have limited access to long-term borrowings due to their high levels of informational

asymmetries. This occurs because these firms may be unknown to lenders, who would prefer to supply short-term debt that allows for frequent monitoring and negotiation (Magri, 2010). However, as asymmetric information is reduced post-IPO, newly listed firms become less constrained and have stronger bargaining power (Saunders and Steffen, 2011), enabling them to use long-term borrowings. In another asymmetric information model, Diamond (1991) examines the relationship between a firm's credit quality and its choice of debt maturity in the presence of the liquidity risk associated with short-term debt. He finds that this relationship is non-monotonic, i.e., low-risk firms choose to use short-term debt while high-risk firms are forced to use it and only medium-risk firms use long-term debt. Since liquidity and default risk decrease while credit quality improves following an IPO (Pagano, Panetta, and Zingales, 1998; Saunders and Steffen, 2011), it is expected that the average listed firm will use more long-term debt post-IPO, especially if its credit rating is upgraded from a high-risk category to a medium one.

The above arguments suggest that subsequent to the IPO, a firm's growth opportunities, asset maturity, managerial ownership, asymmetric information, financial constraints, bargaining power, and credit quality experience material changes, thus affecting the agency costs of debt and equity, or the level of the asymmetric information facing the firm. This will in turn either reduce the firm's incentive to hold short-term debt or improve its access to long-term borrowings, both contributing to a shift toward debt of longer maturities.

In addition to these theoretical arguments, there are also several other motives for newly listed firms to switch to long-term debt and alleviate the disadvantages of short-term borrowings. Ortiz-Molina and Penas (2008) show that information-opaque and risky firms are biased toward selecting short-term debt. This bias will, in turn, affect these firms' choice of investment, driving them toward short-term projects with a quick payoff and away from long-term innovative projects. Caprio and Demirgu-Kunt (1998) conclude that long-term finance is associated with higher productivity and firms can grow more rapidly

using long-term finance contracts than internal sources and short-term credit. Custódio, Ferreira, and Laureano (2013) find that due to frequent renewal, a high level of short-term debt significantly exposes firms to external credit and liquidity shocks. In sum, all our arguments point to the prediction that after going public, firms should use less short-term debt and more long-term debt.

2.3. Data

We collect data on IPO firms from the S&P Capital IQ database.[5] In addition to data on public firms, this database also provides data on private firms that file Forms 10-K (annual reports), 10-Q (quarterly reports), or S-1 (securities registration) with the Securities Exchange Commission (SEC), as well as other private firms from third-party sources. According to the SEC regulations, firms with total assets of $10 million or above, and with 500 or more shareholders are required to file 10-K and 10-Q reports while firms with public debt are required to file S-1 Form (Gao, Harford, and Li, 2013). Further, U.S. IPO firms are required to provide two years of financial statements in their IPO prospectuses (Latham and Watkins, 2013).

S&P Capital IQ has been used by many recent empirical studies (Colla, Ippolito, and Li, 2013; Gao, Harford, and Li, 2013; Garcia-Appendini and Montoriol-Garriga, 2013) and, importantly, its quality of data has been verified by such studies. For instance, the quality of S&P Capital IQ data on public firms is comparable to that of Compustat data (Colla, Ippolito, and Li, 2013).

Our sample covers U.S. firms that did an IPO over the period 1998–2011 because S&P Capital IQ starts recording the IPO transactions from 1998. Since our analysis needs pre-IPO data, we included the pre-IPO data for those firms from 1994 (the year that Capital IQ started recording firms' financial data). Similarly, to have post-IPO data we had to include firms that did an IPO only up to 2011 to have their post-IPO data. Therefore, our sample period covers the period 1994-2012. As standard in the literature, we exclude

[5] All our data are from S&P Capital IQ, with the exception of the term structure of interest rates, which is retrieved from the Federal Reserve Bank of St. Louis website.

financial and utilities firms. Note that S&P Capital IQ does not remove dead companies so we rule out the concern about survivorship bias. Consistent with the IPO literature (e.g., Lowry, 2003), we exclude firm-year observations with an offer price of less than $5, REITs, and unit offerings. We further drop firm-year observations with negative equity values. Our final sample consists of 1,712 firms and 9,562 firm-year observations.

2.4. Methodology

2.4.1. Empirical Models

The main objective of our study is to examine the effect of the IPO on the choice of debt maturity. Prior literature typically investigates the IPO effects on corporate financial policies for a number of years subsequent to the IPO. Pagano, Panetta, and Zingales (1998), for example, argue that the impacts of an IPO on financial and operating variables may remain significant for up to three years post-IPO. Gao, Harford, and Li (2013) graphically show that the effect of the listing decision on cash holdings is significant for three years after the IPO. Thus, to examine the (short-term) effect of the IPO decision on the evolution of debt maturity in the years immediately after the IPO, we estimate the following model:

$$ST_{it} = \beta_0 + \beta_1 D_{IPO} + \beta_2 D_{IPO+1} + \beta_3 D_{IPO+2} + \beta_4 D_{IPO+3} + \boldsymbol{\theta}' \boldsymbol{X}_{it} + \varepsilon_{it}. \quad (1)$$

In this model, the dependent variable, ST_{it}, is the short-term debt ratio, measured as debt maturing within one year (i.e., short-term borrowings plus the current portion of long-term debt) divided by total debt.[6] D_{IPO} takes the value of 1 in the IPO year, and 0 otherwise. D_{IPO+i} with i=1..3 takes the value of 1 in the IPO+i year, and 0 otherwise. $\boldsymbol{X}_{it}$ is a vector of the control variables, which we will discuss in detail in Section 2.4.2. Note that model (1), which includes four IPO dummies, considers a test window between the pre-IPO years and the IPO+3 year. Pagano, Panetta, and Zingales (1998) employ a comparable model

[6] Our measure of debt maturity is consistent with previous studies of private firms that typically define short-term debt as debt maturing within one year (Scherr and Hulbert, 2001; Giannetti, 2003; García-Teruel and Martínez-Solano, 2007; Brav, 2009; Magri, 2010). Note that studies of public firms often consider several measures of short-term debt, such as debt maturing within one, three, and five years (e.g., Harford, Klasa, and Maxwell, 2013). However, the private firms in our sample have the majority of their debt maturing within five years. Thus, considering debt maturing within three and five years as short-term debt is inappropriate for our analysis, as it would overestimate the short-term debt ratio.

although they do not include any control variables. The exclusion of the control variables may give rise to an omitted variables bias. We alleviate this potential bias by including the commonly known determinants of debt maturity. According to our main hypothesis, we expect the coefficients on the IPO dummies to be negative and significant.

Next, we estimate the following model to examine the long-term effect of the IPO on debt maturity:

$$ST_{it} = \beta_0 + \beta_1 D_{Post\_IPO} + \boldsymbol{\theta}' \boldsymbol{X}_{it} + \varepsilon_{it}. \quad (2)$$

where D_{Post_IPO} is a dummy variable that takes the value of 1 in the IPO year and the years post-IPO, and 0 otherwise. Schenone (2010) uses a comparable model to test the effect of an IPO on the cost of borrowing measured by the loan spread. Since we predict a decline in the short-term debt ratio post-IPO, we expect the coefficient on D_{Post_IPO} to be negative.

2.4.2. Control Variables

Consistent with the debt maturity literature, we consider the following control variables: asset maturity, earnings volatility, growth opportunities, leverage, firm size, firm size-squared, and the term structure of interest rates.[7] Myers (1977) claims that matching the maturities of assets and liabilities can help to reduce the underinvestment problem. Consistent with the results in Johnson (2003), a negative relationship is expected between asset maturity and the short-term debt ratio. Following Giannetti (2003), we proxy for asset maturity using the proportion of long-term assets in total assets.

Kane, Marcus, and McDonald (1985) argue that firms with high earnings volatility prefer long-term debt so as to avoid the refinancing and liquidity risks that arise from the frequent renewal of short-term debt. We thus predict a negative relation between volatility and short-term debt. We follow Antoniou, Guney, and Paudyal (2006) and measure earnings volatility as the difference between the absolute value of the annual change in earnings (EBITD) and the average change.

[7] We are unable to include governance variables because they are unavailable pre-IPO. In a robustness check, we also include firm age as an additional control variable and obtain qualitatively similar results.

High-growth firms should use more short-term debt to mitigate the underinvestment problem (Myers, 1977). Thus, a positive relationship between short-term debt and growth opportunities is anticipated. Following previous studies of private firms (Scherr and Hulburt, 2001; Giannetti, 2003; Brav, 2009), we measure growth opportunities as sales growth.[8]

Consistent with Scherr and Hulburt (2001) and Johnson (2003), we expect leverage to be negatively related to short-term debt as firms with high leverage tend to use more long-term debt to reduce the probability of bankruptcy (Morris, 1992). We measure leverage as long-term debt plus short-term debt, divided by total assets.

Firm size is often used as a proxy for asymmetric information (Scherr and Hulburt, 2001) as well as credit quality (Johnson, 2003). Large firms have less asymmetric information and higher credit quality, suggesting a negative relationship between short-term debt and size. Following Scherr and Hulburt (2001), we measure size as the natural logarithm of total sales.

Diamond (1991) predicts a non-monotonic relationship between credit quality and debt maturity. Similar to previous research (Johnson, 2003; Custódio, Ferreira, and Laureano, 2013), we use firm size to proxy for credit quality and use both size and size-squared to capture the potential non-monotonic relation between risk ratings and short-term debt. We expect short-term debt to be negatively related to firm size and positively related to size-squared.

Brick and Ravid (1985) argue that if the term structure of interest rates is upward sloping, firms should use long-term debt because the tax benefits are potentially greater. We thus predict a negative relation between term structure and short-term debt. Consistent with Harford, Klasa, and Maxwell (2013), we measure the term structure of interest rates as the difference between the month-end yields on ten-year government bonds and six-month treasury bills.

[8] We are unable to use the market-to-book ratio, a common measure of growth options for public firms, as market values are not available pre-IPO.

We winsorize the control variables at 1% and further require that the leverage and short-term debt ratios be in the unit interval. We provide variable definitions in the appendix.

2.5. Results

2.5.1. Summary Statistics

Table 1 presents summary statistics of the variables. We report the results for the full sample in Panel A and the results for two sub-periods pre- and post-IPO in Panel B. While the short-term debt ratio has a mean of 30.2% (median of 11.7%) for the full sample period, it has a higher mean of 36% (median of 22.8%) pre-IPO, which drops to 27.5% (median of 8%) post-IPO. This provides the first evidence of the decline in short-term debt (of 8.5% relative to the mean) after the IPO. After going public, firms change their leverage by a smaller magnitude compared to debt maturity: the mean leverage ratio is 45.7% (median of 40%) pre-IPO and increases to 48.1% (median of 44.5%) post-IPO. The t-tests in Panel B show that the differences in debt maturity and leverage pre- and post-IPO are statistically significant. Overall, firms have significantly longer debt maturity and higher leverage after the IPO.[9]

[Insert Table 1 here]

2.5.2. IPO and the Evolution of Financial Policies

In Figure 1, we further examine graphically the evolution of leverage and short-maturity debt from IPO–4 to IPO+5. Our window of analysis begins in the IPO–4 year, as this is the starting point at which we have a reasonable number of observations prior to the IPO. The test window carries on up to IPO+5, as in Bouwan and Lowry (2012).

Debt Maturity

Figure 1(a) illustrates the evolution of the debt maturity structures of IPO firms. The short-term debt ratio exhibits a moderate upward trend pre-IPO: it reaches a peak of

[9] In comparison to Scherr and Hulburts's (2001) sample of small (private) firms, the private firms in our sample are larger, have more growth opportunities, longer debt maturity, and less leverage.

37.8% (median of 26.1%) in the IPO−2 year and remains at the same level in the IPO−1 year (median of 27.1%). The effect of the IPO on the short-term debt ratio becomes negative post-IPO. From IPO−1 to IPO there is a decline of 4.5% in the mean short-term debt ratio while there is an even higher drop of 7.2% in the median ratio. After the IPO year, there is a gradual downward trend in the mean and the median values of short-term debt up to IPO+5. Overall, our graphical evidence clearly shows a decrease in short-term debt usage post-IPO, which is consistent with our main hypothesis.

Leverage

Figure 1(b) shows the evolution of leverage in the periods pre- and post-IPO. Similar to short-term debt, there is a relative accumulation of leverage in the pre-IPO years, starting from IPO−4 and reaching its peak in the IPO−1 year (mean of 47.7% and median of 41.3%). A sharp drop in mean leverage of 10.5% (median of 14.8%) is observed from IPO−1 to IPO, which is consistent with the evidence in Pagano, Panetta, and Zingales (1998), Alti (2006), and Aslan and Kumar (2011). This decline is next followed by an upward trend in the mean and median of leverage up to IPO+5. Overall, we first observe a sharp decline in leverage between IPO−1 and IPO, as firms are likely to use their IPO proceeds to repay their debt. However, this impact appears to be temporary, as firms tend to lever up in the subsequent years (see also Alti, 2006). This finding seems to be consistent with the argument based on asymmetric information, i.e., listed firms become less constrained and use more leverage due to lower asymmetric information, and liquidity and default risks. Our results are different from the evidence of a decrease in leverage post-IPO for Italian and UK firms documented by Pagano, Panetta, and Zingales (1998) and Aslan and Kumar (2011).[10]

[Insert Figure 1 here]

[10] Such a difference in our results and those reported by Pagano, Panetta, and Zingales (1998) and Aslan and Kumar (2011) may be caused by the varying bankruptcy codes. The bankruptcy law in the U.S. is less creditor-friendly than those in the UK and Italy, suggesting that post-IPO U.S. firms can rely more on debt finance than their UK and Italian counterparts. See Rajan and Zingales (1995) and Acharya, Sundaram, and John (2011) for detailed discussions.

2.5.3. Univariate Analysis

In Panel A of Table 2, we compare pre and post-IPO short-term debt over different windows. First, we find a significant decline of 8.5% in the mean short-term debt post-IPO, compared to the pre-IPO level.[11] Both the mean and the median tests provide consistent and significant results. Next, we consider a narrower window in order to compare the use of short-term debt pre-IPO with that in first three years after the IPO; this test is in line with model (1) in our multivariate analysis. The results show that the decline in short-term debt is significant for all windows, with the largest decline observed in the window between pre-IPO and IPO+2 (5.2%), followed by [pre-IPO, IPO+3] (4.4%), [pre-IPO, IPO+1] (3.9%), and [pre-IPO, IPO] (2.7%). Overall, consistent with the trend observed in Figure 1 (a), there is a significant increase in debt maturity post-IPO.

In Panel B, we test whether the lengthening of debt maturity post-IPO is driven by the decline in short-term debt (measured by short-term debt over total assets), the increase in long-term debt (measured by long-term over total assets), or a combination of both. The results indicate that the change in debt maturity post-IPO is due to firms simultaneously retiring short-term debt and issuing debt of long maturities. However, the decline in short-term debt usage appears to be the main driver of the increase in debt maturity post-IPO.

[Insert Table 2 here]

2.5.4. Multivariate Analysis

Table 3 reports the regression results for our baseline models (1) and (2).[12] The results in Column (1) show that, controlling for changes in firm characteristics, there is a significant decline (3.7%) in short-term debt in the IPO year. Note that the financial statement in the year of the IPO is typically prepared after the IPO, meaning that any immediate effect of the IPO should be observed from the IPO year. Our results thus imply that firms reduce their reliance on short-term debt immediately after going public. The

[11] In unreported tests, we have considered various windows excluding the year of the IPO and found qualitatively similar results.

[12] Due to data availability and different model specifications, the number of observations varies across models.

impact of the IPO on debt maturity is also significant in the IPO+1 year, although the magnitude of this impact is smaller (3%). This latter observation suggests that the IPO effect on debt maturity diminishes over time. In sum, the cumulative effect of the IPO decision on short-term debt in the first two years amounts to 6.7%. This represents an economically significant drop of nearly 20% relative to the mean short-term debt ratio pre-IPO (36%).

The results in Column (2) show that the dummy variable D_{Post_IPO} is significantly negative, suggesting that the IPO effect on debt maturity is not a short-term but a long-term one. Specifically, we find that after going public firms reduce their short-term debt ratio by 2.5%, which represents about 7% of the pre-IPO level. This evidence of a statistically and economically significant, lasting impact of the IPO event on debt maturity provides strong support for our main hypothesis. Taken together with the results in Column (1), this finding suggests that a firm's IPO decision has both short-term and long-term effects on its choice of debt maturity.

In Columns (3)–(6), we consider alternative model specifications. First, in Columns (3) and (4), we do not control for industry and year effects. We obtain results that are similar to those reported in Columns (1) and (2), although the IPO effects appear to be more significant, both statistically and economically. In Column (3), the IPO effect on short-term debt is statistically significant from IPO to IPO+2. The magnitude of the decline in the short-term ratio in the first three years after the IPO is 10.9%, representing nearly a third (30.5%) of the pre-IPO level. The results in Column (4) also show that the short-term debt ratio post-IPO declines by 3.7%, which represents more than 10% of the pre-IPO level. Second, in Columns (5) and (6), we include individual firm fixed effects to control for unobserved firm factors affecting debt maturity. We document qualitatively similar results, although the IPO effect appears to be less significant than in the baseline results in Columns (1) and (2).

Regarding the control variables, we obtain results generally consistent with our

prior expectations and previous empirical findings. First, asset maturity is significantly negative, except in Columns (5) and (6), suggesting that firms do attempt to match the maturities of their assets and liabilities. This finding is consistent with our prediction and is in line with Johnson (2003) and Custódio, Ferreira, and Laureano (2013). However, firm-level earnings volatility and growth opportunities are both insignificant, although the former variable is marginally significant with an unexpected (positive) sign in Column (2), while the latter variable is significant with an unexpected (negative) sign in Column (6). The insignificance of growth opportunities is not uncommon in previous studies of private firms (e.g., Scherr and Hulburt, 2001). As expected, leverage is negatively related to short-term debt, similar to the findings of Johnson (2003) and Custódio, Ferreira, and Laureano (2013). Highly levered firms use less short-term debt to mitigate the liquidity and refinancing risks associated with short-term debt. Size and size-squared are both negative and significant (except in Column (6) for size and (4) for size-squared). The former finding supports the argument that large firms should use less short-term debt for signaling purposes, consistent with asymmetric information models (Flannery, 1986). The latter finding regarding size-squared is, however, not in line with Diamond's (1991) model implication that this variable should be positively related to short-term debt due to a non-monotonic relationship between credit quality and debt maturity. Next, we observe a positive relationship between short-term debt and the term structure of interest rates (except in Column (2)), which is consistent with Johnson (2003) but does not support the taxation hypothesis. Note that the prediction of a negative relationship between short-term debt and term structure is based on the assumption that the term structure is upward sloping, which is not always met in our sample period. In short, we find that the short-term debt ratio is negatively related to asset maturity, leverage, size, and size-squared, but is positively associated with the term structure of interest rates.

In summary, our results show that going public allows firms to reduce their reliance on short-term debt. The IPO effect on debt maturity is most pronounced in the IPO and

IPO+1 years and then weakens over time. Although firms adjust their debt maturity structure most significantly in the first few years after the IPO, the switch to more long-term debt appears to be a long-term one. We note that our results are not in conflict with the recently documented evidence of a secular decrease in debt maturity (Custódio, Ferreira, and Laureano, 2013). Specifically, Custódio, Ferreira, and Laureano's (2013) conclusions that the composition and nature of publicly listed firms are responsible for the decline in debt maturity over time do not contradict our results because while these firms may use relatively more short-term debt than those that went public and entered the Compustat database earlier, our results show that they rely relatively less on short-term debt compared to the pre-IPO period.[13]

[Insert Table 3 here]

2.5.5. Robustness Checks

In this section, we perform two robustness checks using the incremental financing approach and the difference-in-differences estimator. First, we investigate the effect of the listing status on debt maturity using a sample of new debt issues. The advantage of this approach is that we can test whether firms prefer long-term or short-term debt in incremental financing activities (Brockman, Martin, and Unlu, 2010; Custódio, Ferreira, and Laureano, 2013). Using this incremental approach allows us to take the perspective of a prospective creditor who determines his/her preferred maturity structures of new debt issues upon evaluating the borrowing firm characteristics (Brockman, Martin, and Unlu, 2010), including its listing status. We collect data on new debt issues from S&P Capital IQ to perform this additional regression. In Table 4, we re-estimate our model of debt maturity for the constructed sample of new debt issues. The results in Column (1) of Table 4 confirm our earlier results that firms prefer to issue less (more) short-term (long-term) debt

[13] In (unreported) analysis, we examine the relation between the IPO and debt maturity over time. Although we have already controlled for the evolution of debt maturity by including year effects, we further investigate whether the IPO effects on short-term debt change over two (pre-crisis) periods 1998–2002 and 2003–2006. The results show that there is no significant difference in the strength of the IPO – debt maturity relation over time.

post-IPO. Specifically, after going public, firms reduce the proportion of short-term debt in new debt issues by 3.5%.

Second, to address the concern that our results are driven by omitted time trends or unobserved differences between IPO and non-IPO (private) firms that may affect the debt maturity choice, we conduct a difference-in-differences regression analysis. Unlike Column (1), we now adopt the balance sheet approach and use our original sample and a new sample of non-IPO firms collected from the same database S&P Capital IQ. We perform one-to-*n* matching with replacement to identify matching firm-year observations because this approach has lower data requirements, as well as provides better matches and less bias (Roberts and Whited, 2012). For a firm-year observation in the treatment group (IPO firms), we find matching firm-year observations in the control group (non-IPO firms) that are in the same industry and the IPO–1 year, and are similar in size and growth opportunities (allowing for a deviation of 30%). Our sample includes 3,248 firm-year observations in total, with 2,767 observations in the treatment group and 481 observations in the control group.[14]

We next estimate the following model:

$$ST_{it} = \beta_0 + \beta_1 D_{Post\_IPO*} + \beta_2 IPO_{firms} + \beta_3 D_{Post\_IPO*} \times IPO_{firms} + \boldsymbol{\theta}' \boldsymbol{X}_{it} + \varepsilon_{it}. \quad (3)$$

For the treatment group (IPO firms), D_{Post_IPO*} is defined the same way as D_{Post_IPO} used in Model (2), that is, D_{Post_IPO*} is a dummy variable that takes the value of 1 from the IPO year onward, and 0 pre-IPO. However, for the control group (non-IPO firms), D_{Post_IPO*} takes the value of 1 from the (counterfactual) *hypothetical* IPO year onward, and 0 in the years before the *hypothetical* IPO event. Essentially, this dummy variable controls for omitted time trends common to both IPO and non-IPO firms. Next, IPO_{firms} is a dummy that takes the value of 1 for the (treatment) IPO firms, and 0 for the (control) non-IPO firms. Our main variable of interest, $D_{Post\_IPO*} \times IPO_{firms}$, is the interaction term between

[14] We have fewer matched firm-year observations because there are quite a few missing values of total debt in non-IPO (private) firms.

D_{Post_IPO*} and IPO_{firms}. According to our prediction, we expect this interaction term to be significantly negative.

In Column (2), the coefficient on D_{Post_IPO*} is significantly positive, suggesting that a common, secular increase in short-term debt for both IPO and non-IPO firms exists. This finding is consistent with Custódio, Ferreira, and Laureano's (2013) evidence of the evolution of debt maturity. Next, the coefficient on IPO_{firms} is significantly positive, indicating that the treatment IPO firms overall use more short-term debt than the control non-IPO firms. Most importantly, our variable of interest, $D_{Post\_IPO*} \times IPO_{firms}$ is significantly negative (-9.1%), suggesting that IPO firms reduce their short-term debt ratio by more than 9% after becoming public, consistent with our baseline results.

Overall, we show that our main findings are robust to tests using the incremental approach and the difference-in-differences estimator. The latter analysis, in particular, controls for omitted time trends and unobserved differences between IPO and non-IPO firms, thus alleviating the concern that our findings are driven by confounding effects.

[Insert Table 4 here]

2.6. What Drives the Increase in Debt Maturity Post-IPO?

In this section, we investigate which types of firms reduce their short-term debt ratio post-IPO. In particular, we examine the IPO effects on debt maturity conditional on firm factors and IPO-related characteristics that proxy for the degrees of asymmetric information, and the agency costs of debt and equity.

2.6.1. Firm Characteristics

We first examine whether the increase in debt maturity post-IPO is consistent with the arguments based on asymmetric information and/or agency costs of debt. Firms with private information tend to hold higher levels of short-term debt for signaling purposes or simply because they are refused the option of long-term debt as lenders prefer frequent monitoring via short-term debt. Once private firms go public, their levels of asymmetric information decrease, thus reducing the need for using short-term debt and improving

access to long-term debt. We expect the impact of the IPO on debt maturity to be more pronounced for firms with higher levels of asymmetric information. To test this prediction, we follow prior research (Bharath, Pasquariello, and Wu, 2009; Leary and Michaely, 2011; Custódio, Ferreira, and Laureano, 2013) and employ two commonly-used measures of asymmetric information, namely size and growth opportunities; small and high-growth firms are expected to have more asymmetric information.[15]

In Columns (1)–(4) of Table 5, we split our sample into two sub-samples of small and large firms. The results in Column (1) show that small firms reduce the short-term debt ratio significantly, by 6%, 4.2%, and 4%, respectively from IPO to IPO+2. In Column (2), however, there is no evidence of a statistically significant change in short-term debt post-IPO for large firms. The results in Columns (3) and (4) show that, post-IPO, small firms significantly reduce their short-term debt ratio by 3.6%, while large firms see no significant change in their debt maturity structure. Combining the results in Columns (1)–(4) suggests that the decline in short-term debt post-IPO is only evident in small firms and that the IPO effect on debt maturity is driven by the results for this subsample of firms.

In Columns (5)–(8), we examine whether the IPO effect on debt maturity varies with growth opportunities. The results in Column (5) show that all IPO dummies are insignificant, suggesting that low-growth firms do not reduce their short-term ratio after the IPO. However, in Column (6), there is strong evidence of a negative effect of the IPO on debt maturity: high-growth firms significantly reduce their short-term debt by 4.9% and 5.2% in the IPO and IPO+1 years, respectively. The results in Columns (7)–(8) show that while low-growth firms experience no long-term change in the short-term debt ratio post-IPO, high-growth firms see a 3.8% increase in their debt maturity post-IPO. Overall, the effect of the IPO on debt maturity is only seen in high-growth firms. Considering that high-

[15] In unreported results, we use age as alternative measure of asymmetric information and find qualitatively similar results. Although asymmetric information can be proxied by other variables such as analysts forecast coverage and dispersion, stock return volatility, R&D etc., we are unable to use these proxies due to the unavailability of data for pre-IPO period.

growth firms tend to have more asymmetric information (see Bharath, Pasquariello, and Wu, 2009; Leary and Michaely, 2011, among others), this finding is consistent with our prediction based on asymmetric information.

As reviewed in the previous section, agency theory suggests that high-growth firms have higher agency costs of debt and should maintain a substantial amount of short-term debt in order to mitigate the underinvestment problem. This implies that firms facing higher agency costs of debt should experience a less pronounced decline in short-term debt post-IPO (Myers, 1977). To the extent that growth opportunities can also be used as a proxy for the agency costs of debt (i.e., firms with more growth face higher agency costs of debt), our results in Columns (5)–(8), which show that only high-growth firms reduce short-term debt ratio, are inconsistent with the agency theory's prediction. In Columns (9)–(12), we re-examine this prediction through another measure of the agency costs of debt. Following Custódio, Ferreira, and Laureano (2013), we consider leverage as a proxy for the agency costs of debt, i.e., firms with high (low) leverage have higher (low) agency costs of debt. The results in Columns (9) and (10) show that the IPO effect is only relevant for highly levered firms, which reduce the short-term debt ratio by 6.3%, 5%, and 4.4% between IPO and IPO+2; these magnitudes are stronger than in the baseline results in Table 3. The results in Columns (11) and (12) are qualitatively similar. While there is a significantly negative effect of the IPO on short-term debt for firms with high leverage, there is little evidence of this effect for firms with low leverage (i.e., the IPO dummy is only marginally significant in Column (11)). Taken together, the results in Columns (9)–(12) do not support the argument based on the agency costs of debt. Although highly levered firms have higher agency costs of debt, they use significantly less short-term debt post-IPO.

In sum, the IPO effect on debt maturity is only significant in small, high-growth, and highly-levered firms, which is consistent with the arguments based on asymmetric

information and is inconsistent with theories based on the agency cost of debt.[16]

[Insert Table 5 here]

2.6.2. Dilution Ratio and the Use of the IPO Proceeds

We now study the impact of managerial ownership and the intended use of IPO proceeds on a firm's decision on its debt maturity post-IPO. In Columns (1)–(4) of Table 6, we sub-divide our sample according to the median of the dilution ratio, which is defined as the proportion of primary shares offered to the total number outstanding pre-IPO (Habib and Ljungqvist, 2001). We use the dilution ratio as a proxy for the agency costs of equity because the higher the proportion of the primary shares issued during the IPO, the higher the dilution ratio, and the more severe the agency conflict between managers and shareholders post-IPO.[17] The results in Columns (1) and (2) show that only firms with a high dilution ratio reduce their short-term debt in the IPO and IPO+1 years. Columns (3) and (4) also reveal that the IPO effect on debt maturity is only evident for firms with a high dilution ratio. Taken together, these results are consistent with our prediction that firms with weak interest alignment between managers and shareholders and high agency costs of equity should experience the most pronounced decline in short-term debt usage post-IPO.

We further examine the IPO effect on debt maturity conditional on the intended use of the IPO proceeds. A large proportion of firms (54%) in our sample (926 firms) declared in their IPO prospectuses that they would use the proceeds from new equity capital to repay their outstanding debt. To the extent that these newly listed firms use the IPO proceeds to retire their existing short-term debts, we are likely to observe a more pronounced negative relation between the IPO and short-maturity debt. To examine this conjecture, we examine two sub-samples of IPO firms according to their intended use of the IPO proceeds.

[16] In unreported results, we also examine the results conditional on other firm characteristics. For example, using the modified Altman z-score as a proxy for financial distress, we also rule out the possibility that the decrease in short-term debt post-IPO is due to bankruptcy reasons.

[17] Our approach does not control for the quality of the corporate governance setup of our sample firm. However, as the agency conflicts between managers and shareholders are magnified in poorly governed firms, we would expect to find a larger decline in the short-term debt post-IPO in those firms.

Columns (5)–(8) report the regression results for two groups: (1) firms that use the IPO proceeds to repay their debts, and (2) those that do not use the IPO proceeds to repay their debts. The results in Column (5) show that firms in the first group reduce their short-term debt by 4.3% and 2.8% between the IPO and IPO+1 years, which is comparable to the baseline results in Table 3. In Column (6), we find that firms in the second group only reduce their short-term debt in the IPO+1 year, though by a larger magnitude (4.1%). Next, in Columns (3) and (4), we find evidence of a long-term change in debt maturity post-IPO for both groups of firms.[18] Overall, we find that regardless of the use of the IPO proceeds, both groups of firms use less short-term debt post-IPO. Put simply, the effect of the IPO on debt maturity is significant, irrespective of the intended use of the IPO proceeds. This finding rules out a possibility that the main findings of our paper are restricted to the group of firms that retire debt using the proceeds from equity capital. Consistent with the results for a sample of new debt issues reported earlier, we argue that there is another channel through which the IPO affects debt maturity. After going public, firms making new debt issues prefer debt of longer maturities, thus ending up with a smaller proportion of short-term debt over time.

[Insert Table 6 here]

2.7. Sample Selection, Endogeneity, and Simultaneity

2.7.1. Sample Selection and the Endogeneity of the IPO Decision

Our use of a transition sample consisting of IPO firms largely mitigates the concern of sample selection. Gao, Harford, and Li (2013) argue that using a transition sample controls for the time-invariant unobservable firm characteristics pre- and post-IPO, thus helping to reduce the selection bias. However, we further address the sample selection concern by running a treatment regression. This approach can deal with sample selection and, more importantly, the endogeneity of the IPO decision as treatment regression

[18] The Chow test (unreported) indicates no significant difference in the magnitudes of the D_{Post_IPO} coefficient for the two groups of firms.

accounts for the endogeneity of a binary variable. Going public is not an exogenous event as it can be influenced by (unobserved) firm characteristics that may also affect the choice of debt maturity. In the treatment regression, the D_{Post_IPO} dummy variable is treated as endogenous.[19] Formally, the approach involves estimating the following equations:

$$D^*_{Post\_IPO} = \boldsymbol{\gamma'Z}_{it} + \omega_{it.}\,; \qquad \textit{First-stage regression} \tag{4}$$

$$D_{Post\_IPO} = 1\ if\ D^*_{Post\_IPO} > 0; = 0\ otherwise$$

$$ST_{it} = \beta_1 D_{Post\_IPO} + \boldsymbol{\theta'X_{it}} + \varepsilon_{it}. \qquad \textit{Second-stage regression} \tag{5}$$

In the first stage, we estimate a probit model with D_{Post_IPO} being the binary dependent variable. The vector Z includes the instrumental variable (IV) that determines the listing decision and other control variables for identification purposes. We use profitability as an instrument for D_{Post_IPO}. Note that profitability satisfies all the conditions about the instrument for debt maturity as it affects the IPO decision but does not influence the choice of debt maturity (Johnson, 2003; Brockman, Martin, and Unlu, 2010).[20] However, there is no consensus in the prior literature on the direction of the effect of profitability on the propensity of firms going public. Pagano, Panetta, and Zingales (1998) argue that this effect can be positive, as high profits are needed for the listing requirements. On the other hand, Aslan and Kumar (2011) contend that highly profitable firms will not need external equity, thus implying a negative relationship. To perform the treatment regression, we consider a larger sample consisting of both IPO and non-IPO firms that never became public. This sample has 10,731 firm-year observations, out of which 9,562 belong to 1,712 IPO firms and the remaining 1,169 observations belong to 761 private firms. As in the difference-in-differences analysis, data on private firms are retrieved from S&P Capital IQ.

Table 7 reports the results from the treatment regression estimated using the maximum likelihood estimator. The first-stage regression results show a significantly

[19] Unlike the Heckman two-stage approach, the treatment regression should be employed when the data on both treated and control groups are available, which is the case in our analysis. The treated group data is the post-IPO data, while the control group data is the pre-IPO data.

[20] In unreported results, we use lagged profitability and find qualitatively similar results.

negative relation between the D_{Post_IPO} dummy variable and profitability. This suggests that profitable firms are less likely go public, which is consistent with Aslan and Kumar (2011). More importantly, in the second-stage regression, we find the coefficient on the D_{Post_IPO} dummy variable to be significantly negative with an even larger magnitude (7.6%) than in our baseline regressions. Our main qualitative conclusions thus remain unchanged after controlling for sample selection and endogeneity. Note that the endogeneity test is significant, thus rejecting the hypothesis that the D_{Post_IPO} dummy variable is exogenous and confirming the validity and relevance of our treatment regression. Furthermore, the estimated coefficient of rho is negative suggesting that the unobservable characteristics that affect the IPO decision are negatively related to debt maturity.[21] However, a potential limitation of our approach here is that the instrument, profitability, can affect leverage (Johnson, 2003; Brockman, Martin, and Unlu, 2010).[22] We address this issue in the next subsection.

[Insert Table 7 here]

2.7.2. Joint Determination of Leverage and Debt Maturity

It is well-established in the literature that debt maturity and leverage are simultaneously determined (Barclay, Marx, and Smith, 2003; Johnson, 2003; Datta, Iskandar-Datta, and Raman, 2005; Brockman, Martin, and Unlu, 2010). To deal with the simultaneity bias, previous research typically runs a two-stage least squares (2SLS) regression using an instrument for leverage that does not affect debt maturity. We adopt this approach and use either tangibility or the effective tax rate as an instrument for leverage. Tangibility is the most commonly used instrument in literature (Johnson, 2003; Datta, Iskandar-Datta, and Raman, 2005; Brockman, Martin, and Unlu, 2010) because it is one of the most important determinants of leverage (Frank and Goyal, 2009) and is not

[21] For further details on the interpretation of rho and treatment models, see Campa and Kedia (2002).

[22] Following Gao, Harford, and Li (2013), we have also considered the industry-level underwriter concentration as an alternative instrument, and obtained qualitatively similar results, however, the diagnostic test shows that IPO is not endogeneous. Furthermore, our model is over-identified if we include both profitability and the industry-level underwriter concentration as instruments.

considered to be related to debt maturity in prior debt maturity studies. Recent research by Hall (2012), however, argues that tangibility may also affect debt maturity. To address this concern, we consider an alternative instrument, namely the effective tax rate. Prior research has used the effective tax rate as an instrument for leverage in the debt maturity equation because it positively affects leverage but does not affect debt maturity (Barclay, Marx, and Smith, 2003).

Table 8 presents the results for the 2SLS regression using either tangibility or the effective tax rate as an instrument for leverage. In the first-stage regression reported in Columns (1) and (3), tangibility is, as expected, significantly and positively related to leverage. Firms with more tangible assets tend to use more leverage, which is in line with the argument that tangible assets can be used as collateral, thus facilitating borrowing. In Column (2), we find that the IPO effect on short-term debt persists up to the IPO+3 year. Firms reduce the short-term debt ratio by 12.1%, 9.6%, 7.7%, and 6.5% between IPO and IPO+3. In Column (4), the second-stage results confirm the long-term decline of short-term debt post-IPO: firms reduce their short-term debt by 7.2%. Further, the effect of the IPO seems stronger than what is reported earlier for the full- and sub-sample results. In Columns (5)–(8), using the effective tax rate an alternative instrument for leverage, we find it to be positively related to leverage, as expected. More importantly, our main conclusions still hold with the coefficients on the variables of interest having even greater magnitudes. We thus conclude that our results are robust, and if anything, become economically stronger after accounting for the joint determination of debt maturity and leverage.[23]

[Insert Table 8 here]

2.8. Credit Conditions and the Effect of an IPO on Debt Maturity

In this section, we examine whether the effect of an IPO on debt maturity is dependent on macroeconomic and credit conditions. The financial crisis of 2007–2008

[23] This finding also helps address the concern that, due to the negative relation between leverage and short-maturity debt, our results simply reflect a leverage effect. Our analysis rules out this interpretation because we find evidence of a robust positive impact of the listing status on debt maturity after controlling for leverage in both our baseline and 2SLS regressions.

serves as a useful event for this test as it was a "credit crunch" that significantly contracted the supply of bank loans (Ivashina and Scharfstein, 2010; Santos, 2011). The association of the crisis and debt maturity structure has been shown in Almeida, Campello, Laranjeira, and Weisbenner (2011) who find that firms with debt maturing right after the third quarter of 2007 cut their quarterly investment rates by 2.5%. It can be argued that the refinancing and liquidity risks associated with short-term debt were most severe during the crisis period, having drastic effects on real corporate behavior. Accordingly, we hypothesize that IPO firms had greater incentives to reduce their short-term debt and exposure to those risks during the crisis. To test this hypothesis, we examine two subsamples of firms that went public over two different periods, namely the crisis period of 2007–2008 and the non-crisis period.[24]

Table 9 summarizes the regression results. In Column (1), the effect of the IPO on debt maturity during the crisis was significant until IPO+3 as firms reduced the short-term debt ratio by 20.2%–32% each year between the IPO and IPO+3 years.[25] However, the results for the non-crisis period in Column (2) show that the IPO effect is only significant up to IPO+2, with significantly smaller magnitudes, as confirmed by the Chow test. In Columns (3) and (4), we find that after going public, firms reduced their short-term debt ratio drastically by 20.6% over the crisis period, but only by 2.9% in the non-crisis period. The difference of 17.7% in the D_{Post_IPO} dummy variable between the two periods is also statistically significant according to the Chow test. In sum, our results provide evidence of a more pronounced IPO effect on debt maturity during the crisis. This is consistent with the prediction that IPO firms sought to lengthen their debt maturity more significantly as they were more concerned about the severe refinancing and liquidity risks during the crisis.

[Insert Table 9 here]

[24] The choice of the financial crisis period is consistent with previous papers on debt maturity and financial crisis such as Almeida, Campello, Laranjeira, and Weisbenner (2011) and Custódio, Ferreira, and Laureano (2013). However, we are aware that one could argue that the financial crisis is assumed to be until 2009, therefore, we re-estimated the models defining the crisis period as 2007-2009 and the results remain qualitatively the same.

[25] In (unreported) results, we find that the short-term debt to total assets ratio decreased by 1.7%, while the long-term debt to total assets ratio increased by 2.4% during the crisis period.

2.9. Conclusion

We investigate the effect of an IPO on debt maturity structure for a sample of U.S. firms that went public between 1998 and 2011. Based on agency theories and asymmetric information models, we hypothesize that after going public, firms have a longer debt maturity as they have less incentive to use short-term debt and greater access to long-term borrowings. Our results provide strong support for this hypothesis as we document a long-term drop of 2.5% (or 7% relative to the pre-IPO level) in the short-term debt ratio post-IPO. The IPO effect on debt maturity seems to be most pronounced in the first few years after the IPO. In the IPO and IPO+1 years, firms reduce their short-term debt ratio by about 7%, which represents nearly a fifth of the short-term debt ratio pre-IPO. These results are robust to using the incremental financing approach, and the difference-in-differences estimator controlling for omitted time trends and unobserved differences between IPO and non-IPO firms.

We also find that the IPO effect on debt maturity is only evident in small and high-growth firms, which is consistent with the argument based on asymmetric information. Further, the negative relation between the IPO and short-term debt is only seen in firms with high leverage and those with a high dilution ratio (i.e., a measure of agency costs of equity). The former finding is inconsistent with the argument based on the agency costs of debt, while the latter is in line with the argument based on the agency costs of equity.

Our empirical findings continue to hold in additional tests in which we control for the endogeneity associated with the listing decision and the simultaneity bias due to the joint determination of leverage and debt maturity. Finally, we show that the negative IPO effect on debt maturity varies with macroeconomic conditions: it was magnified by credit shocks during the financial crisis of 2007–2008.

Overall, our study provides new evidence on the evolution of debt maturity over the life cycle of a company. It highlights a significant impact, both in the short and long run, of the decision to go public on the choice of debt maturity structure post-IPO. Hence, our

paper also contributes to a broader discussion following Jensen's (1989) critique of public corporations.[26] Our results complement recent studies in documenting the benefits of going public, including the greater ability to take advantage of growth opportunities (Mortal and Reisel, 2013), especially conventional investment projects (Ferreira, Manso, and Silva, 2014), and the ability to innovate in industries with greater need for external finance (Acharya and Xu, 2015). Our evidence of the positive IPO effect on debt maturity suggests that another benefit of listing is to gain access to long-term borrowings, which is useful for firms wishing to pursue long-term investment projects but having limited access and exposure to financial markets. To the extent that long-term investment projects are important to high-growth firms operating in R&D intensive industries such as computers, electronics, biotechnology, and pharmaceuticals (Jensen, 1989), our study thus shows that listing can be particularly beneficial for such firms. We also expect that firms post-IPO will experience a lower cost of debt due to the lower asymmetric information and higher credit quality, similar to the findings of Pagano, Panetta, and Zingales (1998) and Schenone (2010) as well as complementing the strand of literature on corporate transparency and cost of debt (see Andrade, Bernille, and Hood, 2014; Funchal and Gottlieb, 2015).

[26] See the Economist "The endangered public company" and "The big engine that couldn't". 19 May 2012. Available at: http://www.economist.com/node/21555552 and http://www.economist.com/node/21555552 (Accessed: 27 March 2015).

References

Acharya, V., Sundaram, R., and John, K., 2011. Cross-country variations in capital structures: The role of bankruptcy codes. *Journal of Financial Intermediation*, 20(1), pp. 25–54.

Acharya, V., and Xu, Z., 2015. Financial dependence and innovation: The case of public versus private firms. *Journal of Financial Economics* Forthcoming.

Aivazian, V., Ge, Y., and Qiu, J., 2005a. The impact of leverage on firm investment: Canadian evidence. *Journal of Corporate Finance*, 11(1-2), pp. 277–291.

Aivazian, V., Ge, Y., and Qiu, J., 2005b. Debt maturity structure and firm investment. *Financial Management*, 34(4), pp. 107–119.

Almeida, H., Campello, M., Laranjeira, B., and Weisbenner, S., 2011. Corporate debt maturity and the real effects of the 2007 credit crisis. *Critical Finance Review*, 1(1), pp. 3–58.

Alti, A., 2006. How persistent is the impact of market timing on capital structure ? *Journal of Finance*, 61(4), pp. 1681–1710.

Andrade, S., Bernile, G., and Hood, F., 2014. SOX, corporate transparency, and the cost of debt. *Journal of Banking and Finance*, 38, pp. 145–165.

Antoniou, A., Guney, Y., and Paudyal, K., 2006. The determinants of debt maturity structure: Evidence from France, Germany and the UK. *European Financial Management*, 12(2), pp. 161–194.

Asker, J., Farre-Mensa, J., and Ljungqvist, A., 2015. Corporate investment and stock market listing: A puzzle? *Review of Financial Studies*, 28(2), pp. 342–390.

Aslan, H., and Kumar, P., 2011. Lemons or cherries? Growth opportunities and market temptations in going public and private. *Journal of Financial and Quantitative Analysis*, 46(2), pp. 489–526.

Barclay, M., Marx, L., and Smith, C., 2003. The joint determination of leverage and maturity. *Journal of Corporate Finance*, 9(2), pp. 149–167.

Barclay, M., and Smith, C., 1995. The Maturity Structure of corporate debt. *Journal of Finance*, 50(2), pp. 609–631.

Bharath, S., Pasquariello, P., and Wu, G., 2009. Does asymmetric information drive capital structure decisions? *Review of Financial Studies*, 22 (8), pp. 3211–3243.

Bouwman, C., and Lowry, M., 2012. Cash holdings and the effects of pre-IPO financing in newly public firms. Working Paper. Case Western Reserve University.

Brav, O., 2009. Access to capital, capital structure and the funding of the firm. *Journal of Finance*, 64(1), pp. 263–308.

Brick, I., and Ravid, S., 1985. On the relevance of debt maturity structure. *Journal of Finance*, 40(5), pp. 1423–1437.

Brockman, P., Martin, X., and Unlu, E., 2010. Executive compensation and the maturity structure of corporate debt. *Journal of Finance*, 65(3), pp. 1123–1161.

Brunnermeier, M., and Yogo, M., 2009. A note on liquidity risk management. *American Economic Review*, 99(2), pp. 578–583.

Campa, J., and Kedia, S., 2002. Explaining the diversification discount. *Journal of Finance*, 57(4), pp. 1731–1762.

Caprio, G., and Demirgu-Kunt, A., 1998. The role of long-term finance: Theory and evidence. *The World Bank Research Observer*, 13(2), pp. 171–189.

Choi, J., Hackbarth, D., and Zechner, J., 2014. Granularity of corporate debt. Working Paper. University of Illinois.

Colla, P., Ippolito, F., and Li, K., 2013. Debt specialization. *Journal of Finance*, 68(5), pp. 2117–2141.

Custódio, C., Ferreira, M., and Laureano, L., 2013. Why are US firms using more short-term debt? *Journal of Financial Economics*, 108(1), pp. 182–212.

Datta, S., Iskandar-Datta, M., and Raman, K., 2005. Managerial stock ownership and the maturity structure of corporate debt. *Journal of Finance*, 60(5), pp. 2333–2350.

Diamond, D., 1991. Debt maturity structure and liquidity risk. *Quateraly Journal of Economics*, 106(3), pp. 709–737.

Ferreira, D., Manso, G., and Silva, A., 2014. Incentives to innovate and the decision to go public or private. *Review of Financial Studies*, 27(1), pp. 256–300.

Flannery, M., 1986. Asymmetric information and risky debt maturity choice. *Journal of Finance*, 41(1), pp. 19–37.

Frank, M., and Goyal, V., 2009. Capital structure decisions: Which factors are reliably important? *Financial Management*, 38(1), pp. 1–37.

Froot, K., Scharfstein, D., and Stein, J., 1993. Risk management: Coordinating corporate investment and financing policies. *Journal of Finance*, 48(5), pp. 1629–1658.

Funchal, B., and Gottlieb, D., 2015. Corporate governance and credit access in Brazil : The Sarbanes-Oxley Act as a natural experiment. *Corporate Governance: An International Review* Forthcoming.

Gao, H., Harford, J., and Li, K., 2013. Determinants of corporate cash policy : Insights from private firms. *Journal of Financial Economics*, 109(3), pp. 623–639.

Gao, H., Hsu, P., and Li, K., 2014. Managerial short-termism and corporate innovation strategies. Working Paper. University of British Columbia.

Garcia-Appendini, E., and Montoriol-Garriga, J., 2013. Firms as liquidity providers: Evidence from the 2007-2008 financial crisis. *Journal of Financial Economics*, 109(1), pp. 272–291.

Garcia-Teruel, P., and Martinez-Solano, P., 2007. Short-term debt in Spanish SMEs. *International Small Business Journal*, 25(6), pp. 579–602.

Giannetti, M., 2003. Do better institutions mitigate agency problems? Evidence from corporate finance choices. *Journal of Financial and Quantitative Analysis*, 38(1), pp. 185–212.

Habib, M., and Ljungqvist, A., 2001. Underpricing and entrepreneurial wealth losses in IPOs: Theory and evidence. *Review of Financial Studies*, 14(2), pp. 433–458.

Hall, T., 2012. The collateral channel: Evidence on leverage and asset tangibility. *Journal of Corporate Finance*, 18(3), pp. 570–583.

Harford, J., Klasa, S., and Maxwell, W., 2013. Refinancing risk and cash holdings. *Journal of Finance*, 69(3), pp. 975–1012.

Heyman, D., Deloof, M., and Ooghe, H., 2008. The financial structure of private-held Belgian firms. *Small Business Economics*, 30(3), pp. 301–313.

Huynh, K., Paligorova, T., and Petrunia, R., 2012. Capital structure decisions : Lessons from private Firms. Working Paper. Lakehead University.

Ivashina, V., and Scharfstein, D., 2010. Bank lending during the financial crisis of 2008. *Journal of Financial Economics*, 97(3), pp. 319–338.

Jensen, M., 1989. Eclipse of the public corporation. *Harvard Business Review*, Sept.-Oct., pp. 61–74.

Johnson, S., 2003. Debt Maturity and the effects of growth opportunities and liquidity risk on leverage. *Review of Financial Studies*, 16(1), pp. 209–236.

Kane, A., Marcus, A., and McDonald, R., 1985. Debt policy and the rate of return premium to leverage. *Journal of Financial and Quantitative Analysis*, 20(4), pp. 479–499.

Lathman and Watkins, 2013. Financial statement requirements in US securities offerings: What you need to know. KPMG. http://www.lw.com/thoughtLeadership/us-financial-statements-guide-2013. Accessed 16 July 2014.

Leary, M., and Michaely, R., 2011. Determinants of dividend smoothing: Empirical evidence. *Review of Financial Studies*, 24(10), pp. 3197–3249.

Lemmon, L., Roberts, M., and Zender, J., 2008. Back to the beginning : Persistence and the cross-section of corporate capital structure . *Journal of Finance*, 63(4), pp.1575–1608.

Lowry, M., 2003. Why does IPO volume fluctuate so much? *Journal of Financial Economics*, 67(1), pp. 3–40.

Magri, S., 2010. Debt maturity choice of nonpublic Italian firms. *Journal of Money, Credit and Banking*, 42(2-3), pp. 443–463.

Michaely, R., and Roberts, M., 2012. Corporate dividend policies: Lessons from private firms. *Review of Financial Studies*, 25(3),pp. 711–746.

Morris, J., 1992. Factors affecting the maturity structure of corporate debt. Working Paper. University of Colorado at Denver.

Mortal, S., and Reisel, N., 2013. Capital allocation by public and private firms. *Journal of Financial and Quantitative Analysis*, 48(1), pp. 77–103.

Myers, C., 1977. Determinants of corporate borrowings. *Journal of Financial Economics*, 5(2), pp. 147–175.

Ortiz-Molina, H., and Penas, M., 2008. Lending to small businesses: The role of loan maturity in addressing information problems. *Small Business Economics*, 30(4), pp. 361–383.

Pagano, P., Panetta, F., and Zingales, L., 1998. Why do companies do public ? An empirical analysis. *Journal of Finance*, 53(1), pp. 27–64.

Peel, M., 2000. Late payment and credit management in the small firm sector: Some empirical evidence. *International Small Business Journal*, 18(2), pp.17–37.

Rajan, R., and Winton, A., 1995. Covenants and collateral as incentives to monitor. *Journal of Finance*, 50(4), pp. 1113–1146.

Rajan, R., and Zingales, L., 1995. What do we know about capital structure? Some evidence from international data. *Journal of Finance*, 50(5), pp. 1421–1460.

Roberts, M., and Whited, T., 2012. Endogeneity in empirical corporate finance. Working Paper. University of Rochester.

Santos, J., 2011. Bank corporate loan pricing following the subprime crisis. *Review of Financial Studies*, 24(6), pp. 1916–1943.

Saunders, A., and Steffen, S., 2011. The costs of being private: Evidence from the loan market. *Review of Financial Studies*, 24(12), pp. 4091–4122.

Schenone, C., 2010. Lending relationships and information rents: Do banks exploit their information advantages? *Review of Financial Studies*, 23(3), pp. 1149–1199.

Scherr, F., and Hulburt, H., 2001. The debt maturity structure of small firms. *Financial Management*, 30(1), pp. 85–111.

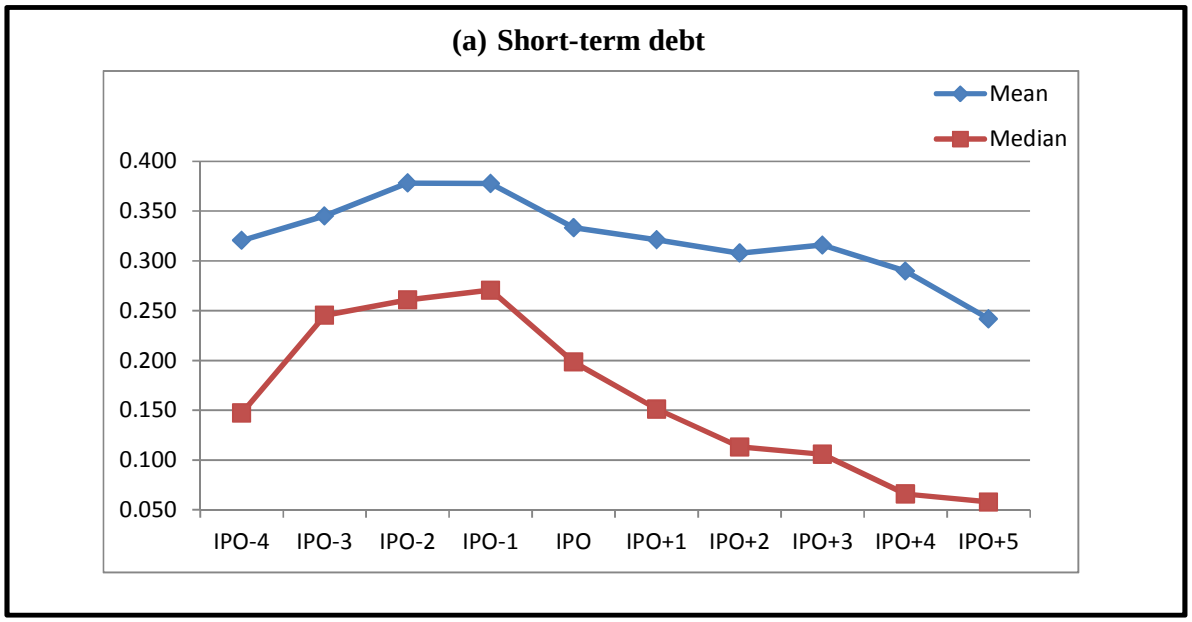
Stohs, M., and Mauer, D., 1996. The determinants of corporate debt maturity structure. *Journal of Business*, 69(3), pp. 279–312.

Stulz, R., 2004. Does financial structure matter for economic growth? A corporate finance perspective. In: financial structure and economic growth: a cross-country comparison of banks, markets, and development, MIT Press, pp. 143–188.

Von Eije, H., 2012. What causes differences in cash holdings between listed and unlisted firms around the world ? Working Paper. University of Groningen.

Figure 1: Evolution of Short-term Debt and Leverage

This figure illustrates the evolution of the short-term debt and leverage ratios of our sample of U.S. firms that did an IPO during the period 1998–2011.



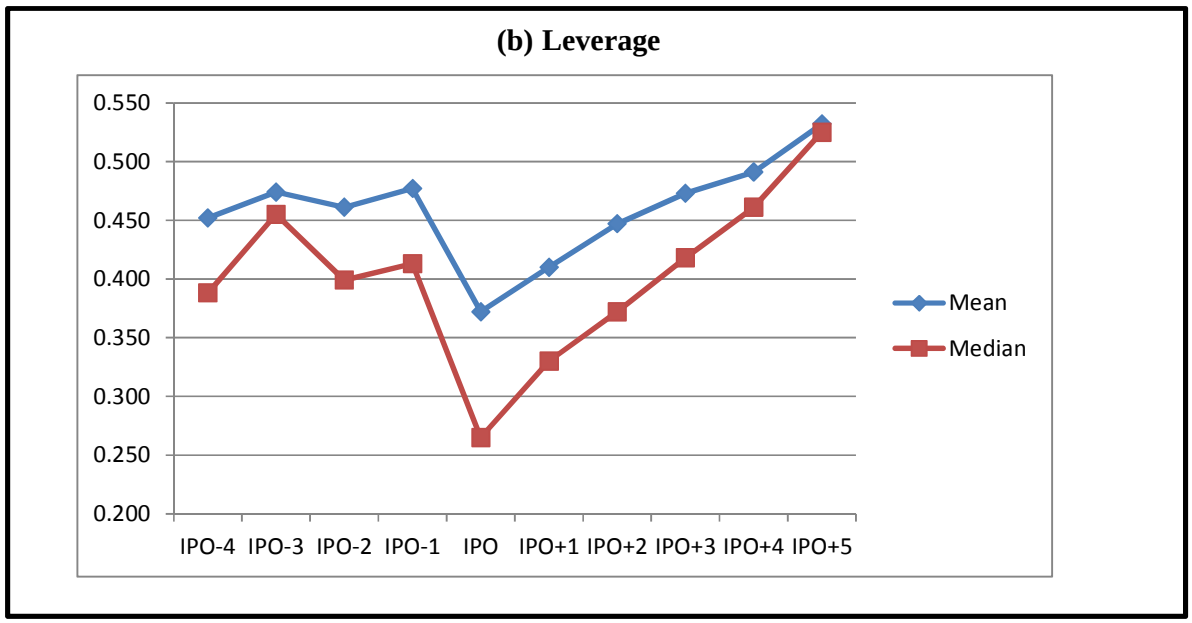


Table 1: Summary Statistics

The table reports the summary statistics, including the mean, median, standard deviation (std dev.), minimum (min), and maximum (max) of the variables. Our sample consists of 9,562 firm-year observations covering the period 1994–2012. Short-term debt is measured by short-term borrowings plus the current portion of long-term debt divided by total debt. Asset maturity is long term assets divided by total assets. Firm-level volatility is the difference between the absolute value of the annual change in earnings (EBITD) and the average earnings change. Growth opportunities is measured by sales growth. Leverage is short-term debt plus long term debt divided by total assets. Size is the natural logarithm of total sales. Term structure is the difference between the (month-end) yields on ten-year government bonds and six-month treasury bills. Panel A presents the summary statistics for the full sample. Panel B reports the summary statistics for the periods pre- and post-IPO. Here we also report the p-values of the t-test for differences in means.

Panel A: Full Sample

Variable	Mean	Median	Std dev.	Min	Max
Short-term debt (%)	0.302	0.117	0.358	0.000	1.000
Asset maturity	0.340	0.201	0.328	0.000	1.000
Firm-level volatility	21.685	5.761	58.301	-68.612	325.046
Growth opportunities (%)	0.795	0.185	2.516	-0.900	19.486
Leverage (%)	0.473	0.433	0.354	0.000	1.000
Size	4.995	5.158	2.156	-4.106	9.251
Size squared	29.603	26.601	20.570	0.020	85.701
Term structure	1.465	1.650	1.364	-0.580	3.650

Panel B: Sub-sample Periods

	Pre-IPO					Post-IPO					
Variable	Mean	Median	Std dev.	Min	Max	Mean	Median	Std dev.	Min	Max	Mean test (p-value)
Short-term debt (%)	0.360	0.228	0.364	0.000	1.000	0.275	0.080	0.352	0.000	1.000	0.000
Leverage (%)	0.457	0.400	0.347	0.000	1.000	0.481	0.445	0.358	0.000	1.000	0.000

Table 2: Univariate Analysis

This table reports the results for our univariate tests. Panel A examines the evolution of the short-term debt ratio reporting the p-values of the t-test for differences in means and those of the Wilcoxon-Mann-Whitney test for differences in medians. Panel B reports the summary statistics of short-term and long-term debt, scaled by total assets and the p-values of the tests for differences in means.

Panel A: Evolution of Short-term Debt

	Time period		Mean/Median test (p-value)
[Pre, Post]	Pre -IPO	Post-IPO	
Mean	0.360	0.275	0.000
Median	0.228	0.080	0.000
[Pre, IPO]	Pre-IPO	IPO	
Mean	0.360	0.333	0.016
Median	0.228	0.199	0.001
[Pre, IPO+1]	Pre-IPO	IPO+1	
Mean	0.360	0.321	0.001
Median	0.228	0.151	0.000
[Pre, IPO+2]	Pre-IPO	IPO+2	
Mean	0.360	0.308	0.000
Median	0.228	0.113	0.000
[Pre, IPO+3]	Pre-IPO	IPO+3	
Mean	0.360	0.316	0.001
Median	0.228	0.106	0.000

Panel B: Short-term Debt and Long-term Debt Pre- and Post-IPO

	Pre-IPO	Post-IPO	Mean test (p-value)
Short-term debt/total assets	0.063	0.037	0.000
Long-term debt/total assets	0.204	0.216	0.009

Table 3: Baseline Regression Results

The table reports the baseline regression results regarding the effect of an IPO on debt maturity structure. The dependent variable is the short-term debt ratio, measured by short-term borrowings plus the current portion of long-term debt divided by total debt. D_{IPO} is a dummy variable that takes the value of 1 in the IPO year, and 0 otherwise. D_{IPO+i} with i=1..3 is a dummy variable that takes the value of 1 in the IPO+i year, and 0 otherwise. D_{Post_IPO} is a dummy variable that takes the value of 1 from the IPO year onward, and 0 in the years pre-IPO. The control variables are defined as follows. Asset maturity is long term assets divided by total assets. Firm-level volatility is the difference between the absolute value of the annual change in earnings (EBITD) and the average earnings change. Growth opportunities is measured by sales growth. Leverage is short-term debt plus long term debt divided by total assets. Size is the natural logarithm of total sales. Term structure is the difference between the (month-end) yields on ten-year government bonds and six-month treasury bills. Industry effects are proxied by 48 Fama-French industry dummy variables. T-statistics are reported in parentheses. Standard errors are heteroskedasticity-consistent. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
D_{IPO}	-0.0371***		-0.0459***		-0.0227**	
	(-3.02)		(-3.86)		(-1.97)	
D_{IPO+1}	-0.0300**		-0.0379***		-0.0198*	
	(-2.36)		(-3.22)		(-1.65)	
D_{IPO+2}	-0.0194		-0.0261**		-0.0044	
	(-1.41)		(-2.06)		(-0.32)	
D_{IPO+3}	-0.0022		-0.0136		0.0018	
	(-0.15)		(-0.98)		(0.11)	
D_{Post_IPO}		-0.0247***		-0.0368***		-0.0157*
		(-2.95)		(-5.14)		(-1.77)
Asset maturity	-0.1020***	-0.0813***	-0.1030***	-0.0850***	-0.0044	0.0102
	(-12.14)	(-13.64)	(-13.03)	(-14.86)	(-0.15)	(0.52)
Firm-level volatility	9.30×10^{-5}	$8.90\times10^{-5*}$	6.10×10^{-5}	6.30×10^{-5}	7.83×10^{-6}	3.50×10^{-5}
	(1.26)	(1.86)	(0.84)	(1.35)	(0.08)	(0.64)
Growth opportunities	-0.0018	-0.0013	-0.0014	-0.0009	-0.0017	-0.0035**
	(-1.17)	(-0.88)	(-0.89)	(-0.63)	(-1.18)	(-2.43)
Leverage	-0.3550***	-0.3430***	-0.3630***	-0.3510***	-0.2510***	-0.2830***
	(-27.33)	(-33.96)	(-29.44)	(-36.44)	(-12.40)	(-18.62)
Size	-0.0221***	-0.0320***	-0.0225***	-0.0312***	0.0187**	0.0072
	(-3.67)	(-6.07)	(-3.80)	(-6.02)	(2.13)	(0.94)
Size-squared	-0.0019***	-0.0009*	-0.0018***	-0.0008	-0.0049***	-0.0039***
	(-3.15)	(-1.82)	(-2.95)	(-1.64)	(-4.21)	(-4.54)
Term structure	0.0099*	0.0005	0.0079***	0.0080***	0.0124***	0.0091***
	(1.65)	(0.11)	(2.67)	(3.40)	(4.63)	(4.31)
Intercept	0.6740***	0.6940***	0.7020***	0.7030***	0.4820***	0.5110***
	(18.96)	(24.17)	(45.86)	(50.65)	(15.91)	(21.00)
Industry effects	Yes	Yes	No	No	No	No
Year effects	Yes	Yes	No	No	No	No
Firm effects	No	No	No	No	Yes	Yes
N	6,092	9,562	6,092	9,562	6,092	9,562
Adj. R-squared	0.301	0.298	0.281	0.282	0.251	0.256

Table 4: Robustness Checks using the Incremental Approach and Difference-in-Differences Estimator

This table reports two main robustness checks. In Column (1), we examine the effect of an IPO on the maturity structures of new debt issued by the IPO firms. In Columns (2), we use the balance sheet approach as in Table 3 but now perform a difference-in-differences analysis for a sample of treatment (IPO) and matched control (non-IPO) firms. We use one-to-*n* matching with replacement to identify matching firm-year observations. For a firm-year observation in the treatment group, we find matching firm-year observations that are in the same industry and year (i.e., the IPO–1 year), and are similar in size and growth opportunities (allowing for a deviation of 30%). For the treatment IPO firms, $D_{Post\_IPO^*}$ is a dummy variable that takes the value of 1 from the IPO year onward, and 0 pre-IPO. For the control non-IPO firms, $D_{Post\_IPO^*}$ is a dummy variable that takes the value of 1 from the (counterfactual) *hypothetical* IPO year onward, and 0 in the years before the *hypothetical* IPO event. The IPO_{firms} is a dummy takes the value of 1 for IPO firms (treatment group), and 0 for non-IPO firms (control group). Other variable definitions are provided in the appendix and the notes to Table 3. Standard errors are heteroskedasticity-consistent. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)
D_{Post_IPO}	-0.0352***	
	(-2.92)	
$D_{Post\_IPO^*}$		0.0700**
		(2.25)
IPO_{firms}		0.1284***
		(5.92)
$D_{Post\_IPO^*} \times IPO_{firms}$		-0.0914***
		(-2.76)
Asset maturity	-0.0584***	-0.0848***
	(-7.23)	(-7.36)
Firm-level volatility	-0.0002***	0.0001
	(-2.84)	(1.18)
Growth opportunities	-0.0029*	-0.0040
	(-1.75)	(-0.69)
Leverage	-0.2058***	-0.3607***
	(-14.45)	(-20.24)
Size	0.0058	-0.0412***
	(0.85)	(-2.66)
Size-squared	5.04×10^{-5}	4.50×10^{-5}
	(0.07)	(0.03)
Term structure	0.0057	0.0184***
	(0.97)	(2.65)
Intercept	0.3780***	0.5515***
	(6.44)	(9.76)
Industry effects	Yes	Yes
Year effects	Yes	Yes
N	7,302	3,248
Adj. R-squared	0.089	0.283

Table 5: Firm Characteristics and the Effect of an IPO on Debt Maturity

The table presents the effect of an IPO on debt maturity conditional on firm size, growth opportunities, and leverage. Columns (1)–(4) present the models for the two sub-samples of firms with above and below the median of size. Columns (5)–(8) present the models for the two sub-samples of firms with above and below the median of growth opportunities. Columns (9)–(12) present the models for the two sub-samples of firms with above and below the median of leverage. Variable definitions are provided in the appendix and the notes to Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity-consistent. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	Firm size				Growth opportunities				Leverage			
	Small	Large	Small	Large	Low	High	Low	High	Low	High	Low	High
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
D_{IPO}	-0.0600***	-0.0095			-0.0239	-0.0492***			-0.0243	-0.0626***		
	(-3.31)	(-0.58)			(-1.29)	(-2.96)			(-1.33)	(-4.22)		
D_{IPO+1}	-0.0422**	-0.0183			-0.0085	-0.0516***			-0.0186	-0.0503***		
	(-2.03)	(-1.19)			(-0.46)	(-2.89)			(-0.94)	(-3.30)		
D_{IPO+2}	-0.0398*	0.0008			-0.0034	-0.0369			-0.0031	-0.0439***		
	(-1.67)	(0.05)			(-0.19)	(-1.58)			(-0.13)	(-2.89)		
D_{IPO+3}	0.0132	-0.0090			0.0123	-0.0128			0.0216	-0.0248		
	(0.49)	(-0.54)			(0.67)	(-0.51)			(0.86)	(-1.50)		
D_{Post_IPO}			-0.0362***	-0.0072			-0.0052	-0.0376***			-0.0228*	-0.0367***
			(-2.91)	(-0.67)			(-0.41)	(-3.31)			(-1.78)	(-3.56)
Asset maturity	-0.1493***	-0.0733***	-0.1365***	-0.0429***	-0.0819***	-0.1293***	-0.0549***	-0.1094***	-0.1642***	-0.0645***	-0.1500***	-0.0496***
	(-9.16)	(-7.72)	(-10.56)	(-5.54)	(-7.09)	(-9.98)	(-5.65)	(-10.30)	(-8.51)	(-7.37)	(-10.38)	(-8.64)
Firm-level volatility	-4.58×10^{-5}	-4.35×10^{-5}	-0.0004*	-1.11×10^{-5}	0.0001	3.19×10^{-5}	6.07×10^{-5}	8.67×10^{-5}	0.0002	6.01×10^{-5}	0.0003**	8.76×10^{-6}
	(-0.15)	(-0.58)	(-1.78)	(-0.20)	(1.08)	(0.27)	(0.76)	(0.92)	(1.34)	(0.91)	(2.36)	(0.22)
Growth opportunities	-0.0024	0.0009	-0.0021	0.0028	-0.0059	-0.0019	-0.0392	-0.0016	-0.0025	-0.0014	-0.0021	-0.0024
	(-1.40)	(0.27)	(-1.34)	(0.82)	(-0.18)	(-1.13)	(-1.48)	(-1.13)	(-1.30)	(-0.59)	(-1.14)	(-1.09)
Leverage	-0.3228***	-0.3532***	-0.3665***	-0.2926***	-0.3555***	-0.3473***	-0.3305***	-0.3488***	-0.6357***	-0.2126***	-0.5815***	-0.1802***
	(-14.25)	(-21.43)	(-22.49)	(-24.95)	(-19.83)	(-17.76)	(-24.57)	(-23.52)	(-10.33)	(-8.45)	(-14.12)	(-8.84)
Size	-0.0069	-0.1633***	-0.0012	-0.1140***	-0.0247***	-0.0189*	-0.0296***	-0.0323***	-0.0021	-0.0591***	-0.0049	-0.0731***
	(-0.81)	(-3.46)	(-0.18)	(-2.68)	(-2.94)	(-1.89)	(-4.74)	(-4.47)	(-0.26)	(-5.71)	(-0.74)	(-6.94)
Size-squared	-0.0029	0.0099***	-0.0058***	0.0069**	-0.0018**	-0.0017	-0.0014**	-0.0002	-0.0042***	0.0019**	-0.0043***	0.0034***
	(-1.49)	(2.92)	(-4.18)	(2.32)	(-2.28)	(-1.60)	(-2.35)	(-0.28)	(-4.33)	(1.99)	(-5.53)	(3.72)
Term structure	0.0439**	-0.0222	0.0394*	-0.0369**	-0.0081	0.0224	0.0408**	0.0013	0.0257**	-0.0020	0.0137*	0.0011
	(2.08)	(-1.40)	(1.93)	(-2.53)	(-0.48)	(1.09)	(2.02)	(0.07)	(2.33)	(-0.33)	(1.91)	(0.23)
Intercept	0.6079***	1.1230***	0.6121***	0.9070***	0.7160***	0.6611***	0.6246***	0.7209***	0.8155***	0.6100***	0.8320***	0.6059***

	(3.19)	(6.80)	(3.81)	(5.70)	(11.24)	(5.78)	(7.74)	(6.79)	(3.52)	(13.89)	(3.65)	(15.31)
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3,046	3,046	4,781	4,781	3,046	3,046	4,781	4,781	3,046	3,046	4,781	4,781
Adj. R-squared	0.178	0.261	0.217	0.195	0.315	0.287	0.298	0.297	0.157	0.238	0.178	0.195

Table 6: IPO Characteristics and the Effect of an IPO on Debt Maturity

The table reports the effect of an IPO on debt maturity conditional on two IPO-related characteristics, namely the dilution ratio and the intended use of the IPO proceeds. In Columns (1)–(4), we sub-divide the sample into two sub-samples of firms with above and below the median of the dilution ratio, which is defined as proportion of primary shares to the total outstanding shares pre-IPO. In Columns (5)–(8), we sub-divide the sample according to the use of the IPO proceeds. 926 out of 1,712 firms declared that they would use the IPO proceeds to repay their debt. Variable definitions are provided in the appendix and the notes to Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity-consistent. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	Dilution ratio				Use of IPO proceeds			
	Low dilution (1)	High dilution (2)	Low dilution (3)	High dilution (4)	Repay debts (5)	Do not repay debts (6)	Repay debts (7)	Do not repay debts (8)
D_{IPO}	-0.0071	-0.0527**			-0.0429***	-0.0328		
	(-0.32)	(-2.37)			(-2.89)	(-1.55)		
D_{IPO+1}	-0.0219	-0.0475**			-0.0283*	-0.0411*		
	(-0.93)	(-2.17)			(-1.90)	(-1.76)		
D_{IPO+2}	0.0011	-0.0287			-0.0141	-0.0359		
	(0.05)	(-1.21)			(-0.89)	(-1.35)		
D_{IPO+3}	0.0163	-0.0088			-0.0097	-0.0058		
	(0.62)	(-0.34)			(-0.57)	(-0.21)		
D_{Post_IPO}			-0.0075	-0.0378**			-0.0241**	-0.0335**
			(-0.51)	(-2.53)			(-2.45)	(-2.13)
Asset maturity	-0.0875***	-0.1164***	-0.0629***	-0.0909***	-0.1050***	-0.0839***	-0.0815***	-0.0524***
	(-5.31)	(-8.07)	(-5.47)	(-8.89)	(-11.70)	(-3.69)	(-13.09)	(-2.94)
Firm-level volatility	-0.0002*	0.0004**	-9.20×10^{-5}	0.0002**	0.0001*	-0.0004***	$9.20\times10^{-5*}$	-0.0003**
	(-1.83)	(2.44)	(-1.06)	(2.57)	(1.82)	(-2.79)	(1.83)	(-2.04)
Growth opportunities	0.0049*	-0.0047*	0.0044*	-0.0035	-0.0035	-0.0004	-0.0024	-0.0004
	(1.88)	(-1.66)	(1.73)	(-1.41)	(-1.49)	(-0.21)	(-1.15)	(-0.18)
Leverage	-0.3819***	-0.3553***	-0.3442***	-0.3530***	-0.3660***	-0.3110***	-0.3370***	-0.3330***
	(-16.53)	(-15.13)	(-19.59)	(-19.35)	(-23.70)	(-11.88)	(-28.49)	(-15.95)
Size	-0.0236**	-0.0028	-0.0305***	-0.0179**	-0.0489***	-0.0019	-0.0497***	-0.0061
	(-2.08)	(-0.32)	(-3.02)	(-2.39)	(-4.58)	(-0.23)	(-5.67)	(-0.79)

Size-squared	-0.0013	-0.0045***	-0.0009	-0.0027***	0.0008	-0.0036***	0.0012	-0.0042***
	(-1.13)	(-4.75)	(-0.92)	(-3.52)	(0.78)	(-3.42)	(1.50)	(-4.60)
Term structure	0.0129	-0.0017	0.0035	-0.0014	0.0031	0.0299**	5.02×10^{-5}	0.0116
	(1.40)	(-0.15)	(0.47)	(-0.18)	(0.47)	(2.24)	(0.01)	(1.27)
Intercept	0.7060***	0.6775***	0.7293***	0.6881***	0.7110***	0.6470***	0.6760***	0.7080***
	(3.95)	(14.28)	(4.08)	(19.52)	(17.97)	(8.02)	(21.39)	(9.15)
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,923	1,935	3,023	3,036	3,745	2,347	6,235	3,327
Adj. R-squared	0.303	0.345	0.293	0.334	0.320	0.203	0.297	0.216

Table 7: Dealing with Sample Selection and Endogeneity

The table reports the results from the treatment regression in which D_{Post_IPO} is considered to be endogenous; D_{Post_IPO} is a dummy variable that takes value of 1 from the IPO year onward, and 0 otherwise. The sample includes both IPO firms and private firms that never went public. It consists of 9,562 IPO firm-year observations (1,712 firms) and 1,169 non-IPO (private) firm-year observations (761 firms). Column (1) presents the first-stage (probit) regression results in which probability, measured as return on assets, is used as an instrument for D_{Post_IPO}. Column (2) presents the second-stage regression results obtained using the maximum likelihood estimator. Here the dependent variable is short-term debt, measured by short-term borrowings plus the current portion of long-term debt divided by total debt. All other variables are defined in the appendix and the notes to Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity-consistent. χ-test is the statistics from the Rho (Chi-squared) test of endogeneity under the null of exogeneity. p-values are reported in square brackets. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)
D_{Post_IPO}		-0.0764^{***}
		(-3.64)
Asset maturity	0.0585^{**}	-0.0881^{***}
	(2.02)	(-14.47)
Firm-level volatility	-0.0002^{***}	$5.42\times10^{-5***}$
	(-3.09)	(3.44)
Growth opportunities	-0.0034	-0.0034^{**}
	(-0.60)	(-2.33)
Leverage	0.1095^{***}	-0.3958^{***}
	(2.63)	(-40.54)
Size	0.1977^{***}	-0.0384^{***}
	(7.75)	(-7.20)
Size-squared	0.0019	-0.0019^{***}
	(0.75)	(-3.69)
Term structure	0.1212^{***}	0.0206^{***}
	(12.51)	(5.21)
Profitability	-0.2258^{***}	
	(-8.10)	
Intercept	-0.9690^{***}	0.8452^{***}
	(-15.12)	(29.35)
Industry effects	Yes	Yes
Year effects	Yes	Yes
N	10,731	10,731
Rho (χ-test)		-0.1292^{***}
		[0.000]

Table 8: Joint Determination of Debt Maturity and Leverage

This table reports the results from the two-stage least square regression that deals with the joint determination of debt maturity and leverage. Columns (1), (3), (5), and (7) report the first-stage regression results, in which we use either tangibility, measured as property, plant and equipment, divided by total assets (Columns (1) and (3)), or the effective tax rate, measured as income tax expense over earning before tax (EBT) (Columns (5) and (7)) as an instrument for leverage. Columns (2), (4), (6), and (8) report the results from the second-stage regression, in which the dependent variable is short-term debt, measured by short-term borrowings plus the current portion of long-term debt divided by total debt. In the second stage, the fitted values of leverage estimated from the first stage are used. All other variables are defined in the appendix and the notes to Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity-consistent. χ-test statistics is the statistics from the Chi-squared test of endogeneity under the null of exogeneity. *F*-test is the statistics from the *F*-test of instrument validity under the null that the instruments are insignificant in the first-stage regression. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	Model 1		Model 2		Model 1		Model 2	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Leverage		-1.1490***		-0.8610***		-1.3248***		-1.2213***
		(-8.03)		(-11.61)		(-3.27)		(-2.66)
D_{IPO}	-0.1002***	-0.1210***			-0.0843***	-0.1214***		
	(-4.62)	(-4.12)			(-5.82)	(-3.09)		
D_{IPO+1}	-0.0728***	-0.0964***			-0.0698***	-0.1035***		
	(-3.35)	(-3.55)			(-4.67)	(-2.92)		
D_{IPO+2}	-0.0537**	-0.0765***			-0.0551***	-0.0774**		
	(-2.36)	(-2.94)			(-3.38)	(-2.40)		
D_{IPO+3}	-0.0650**	-0.0650**			-0.0369**	-0.0625**		
	(-2.30)	(-2.34)			(-2.11)	(-2.16)		
D_{Post_IPO}			-0.0715***	-0.0715***			-0.0624***	-0.0889***
			(-5.05)	(-4.66)			(-6.22)	(-2.80)
Asset maturity	0.0004***	-2.00×10^{-5}	0.0005***	-0.0001	0.1649***	0.0585	0.1692***	0.0724
	(2.98)	(-0.17)	(3.80)	(-1.35)	(15.52)	(0.86)	(20.79)	(0.93)
Firm-level volatility	-0.0005***	-0.0005***	-0.0004***	-0.0002**	-0.0005***	-0.0003	-0.0004***	-0.0003
	(-3.94)	(-3.37)	(-4.40)	(-2.44)	(-4.69)	(-1.41)	(-5.69)	(-1.32)
Growth opportunities	-0.0013	-0.0067*	-0.0016	-0.0051*	-0.0008	-0.0013	-0.0018	-0.0019
	(-0.47)	(-1.85)	(-0.65)	(-1.82)	(-0.49)	(-0.52)	(-1.18)	(-0.78)
Size	0.0651***	-0.0174	0.0678***	-0.0499***	0.0167***	-0.0087	0.0209***	-0.0176
	(5.66)	(-0.91)	(7.12)	(-3.42)	(2.90)	(-0.80)	(4.11)	(-1.45)

Size-squared	-0.0016	0.0021	-0.0019**	0.0038***	0.0020***	0.0004	0.0015***	0.0012
	(-1.34)	(1.36)	(-2.13)	(3.20)	(3.09)	(0.36)	(2.74)	(1.17)
Term structure	0.0062	0.0142	0.0210***	0.0152**	0.0084	0.0153	0.0345***	0.0284
	(0.60)	(1.20)	(3.04)	(2.10)	(1.08)	(1.29)	(6.58)	(1.63)
Tangibility	0.1069***		0.1216***					
	(8.10)		(12.74)					
Effective tax					8.00×10^{-5}***		3.00×10^{-5}**	
					(2.73)		(2.23)	
Intercept	0.4482***	1.0210***	0.4395***	0.9410***	0.5593***	1.2257***	0.4791***	1.0977***
	(3.43)	(9.01)	(3.55)	(13.57)	(8.95)	(5.21)	(8.83)	(4.87)
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2,320	2,320	3,827	3,827	4,460	4,460	6,881	6,881
χ-test	55.58***		60.16***		6.30***		12.31***	
F-test	61.82***		158.29***		7.47***		4.99***	

Table 9: Credit Conditions and the Effect of an IPO on Debt Maturity

This table reports the regression results of the effect of an IPO on debt maturity conditional on whether the IPO took place during the recent financial crisis of 2007–2008. All other variables are defined in the appendix and the notes to Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity-consistent. P-values of the F-statistics obtained using the Chow test for differences in the coefficient estimates are reported in square brackets. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	Crisis period	Non-crisis period	Crisis period	Non-crisis period	F-stat of Chow test	F-stat of Chow test
	(1)	(2)	(3)	(4)	(1-2)	(3-4)
D_{IPO}	-0.2024**	-0.0352**			3.44	
	(-2.49)	(-2.57)			[0.064]	
D_{IPO+1}	-0.3017**	-0.0322**			4.47	
	(-2.49)	(-2.28)			[0.035]	
D_{IPO+2}	-0.3068**	-0.0268*			3.41	
	(-2.08)	(-1.77)			[0.065]	
D_{IPO+3}	-0.3195*	-0.0078			3.12	
	(-1.85)	(-0.49)			[0.078]	
D_{Post_IPO}			-0.2059**	-0.0285***		3.88
			(-2.55)	(-3.12)		[0.049]
Asset maturity	-0.1317***	-0.0998***	-0.1161***	-0.0799***		
	(-6.09)	(-9.18)	(-6.03)	(-10.35)		
Firm-level volatility	3.34×10^{-5}	8.74×10^{-5}	3.72×10^{-5}	8.47×10^{-5}		
	(0.16)	(0.94)	(0.22)	(1.34)		
Growth opportunities	-0.0021	-0.0016	-0.0006	-0.0012		
	(-0.44)	(-1.05)	(-0.14)	(-0.87)		
Leverage	-0.3031***	-0.3552***	-0.2970***	-0.3436***		
	(-8.73)	(-25.62)	(-9.45)	(-32.85)		
Size	-0.0395***	-0.0186***	-0.0440***	-0.0291***		
	(-3.10)	(-3.19)	(-3.66)	(-6.06)		
Size-squared	-0.0012	-0.0021***	-0.0009	-0.0010**		
	(-0.85)	(-3.21)	(-0.65)	(-2.05)		
Term structure	0.0068	0.0070	0.0636***	0.0051		
	(0.35)	(0.87)	(2.68)	(1.11)		
Intercept	0.8427***	0.6322***	0.8779***	0.6370***		
	(7.06)	(10.36)	(7.39)	(12.27)		
Industry effects	Yes	Yes	Yes	Yes		
Year effects	Yes	Yes	Yes	Yes		
N	726	5,366	851	8,711		
Adj. R-squared	0.419	0.293	0.407	0.296		

Appendix

Variable Definitions

This table provides a description of our variables. Data on all variables are from the S&P Capital IQ database, with the exception of term structure, which is retrieved from the Federal Reserve Bank of St. Louis website.

Variable	Definition
Short-term debt	Short-term borrowings plus the current portion of long-term debt divided by total debt
D_{IPO}	Dummy variable that takes the value of 1 in the IPO year, and 0 otherwise
D_{IPO+1}	Dummy variable that takes the value of 1 in the IPO+1 year, and 0 otherwise
D_{IPO+2}	Dummy variable that takes the value of 1 in the IPO+2 year, and 0 otherwise
D_{IPO+3}	Dummy variable that takes the value of 1 in the IPO+3 year, and 0 otherwise
D_{Post_IPO}	Dummy variable that takes the value of 1 from the IPO year, onward, and 0 otherwise
Asset maturity	Long term assets divided by total assets
Firm level volatility	The difference between the absolute value of the annual change in earnings (EBITD) and the average change
Growth opportunities	Change in total sales divided by lagged sales
Leverage	Short-term debt plus long term debt divided by total assets
Size	Log of total sales
Term structure	The difference between the month-ends yields on ten-year government bonds and six-month treasury bills
Dilution ratio	Proportion of primary shares to the total outstanding shares pre-IPO
Profitability	Net income divided by total assets
Tangibility	Property, plant, and equipment divided by total assets
Effective tax rate	Income tax expense over earning before tax (EBT)

Chapter 3
The Use of Trade Credit by Public and Private Firms: An Empirical Investigation

Abstract

We investigate the use of trade credit by public and private firms and show that the level of trade credit in private firms is 40.4% higher than that in public firms. This result is statistically and economically significant, and is robust to controlling for sample selection and the endogeneity associated with a firm's decision to go public. The impact of being private on trade credit is robust, and is more pronounced in young, high-growth, and low-tangibility firms, consistent with the argument that firms with greater asymmetric information and credit constraints rely more on supplier financing. Both public and private firms seek to adjust toward optimal trade credit levels, although private firms experience slower adjustment. We further find that during the financial crisis of 2007–2009, public firms used slightly more trade credit as an alternative source of financing, while private firms were granted significantly less trade credit.

3.1. Introduction

Trade credit or accounts payable is a major component of working capital as nearly 40% of inventories and accounts receivable in U.S. firms are financed with trade credit (Aktas, Croci, and Petmezas, 2015). Just before the onset of the recent financial crisis, trade credit funded almost 90% of global merchandise trade, worth US$25 trillion (Klapper, Laeven, and Rajan, 2012). Further, trade credit is the most important source of short-term financing for U.S. firms (Petersen and Rajan, 1997; Demirguc-Kunt and Maksimovic, 2001): the aggregate volume of trade credit is three times as large as that of bank credit and fifteen times as large as that of commercial papers (Barrot, 2014).[1] Trade credit also carries significant economic importance, acting as a substitute for bank credit during periods of monetary contractions or financial crises (e.g., Nilsen, 2002; Love, Preve, and Sarria-Allende, 2007; Garcia-Appendini and Montriol-Garriga, 2013).

Theory provides several motives for using trade credit (e.g., financing, transaction, and price discrimination), and explains why it is an important source of short-term financing. First, the supplier of trade credit has a cost advantage over specialized financial intermediaries because it knows more about, or has more control over, the buyer (Schwartz, 1974; Emery, 1984; Mian and Smith, 1992; Petersen and Rajan, 1997). According to this financing motive, financially unconstrained suppliers have a comparative advantage in extending trade credit to constrained buyers (Schwartz, 1974), especially to those that face liquidity shocks that could endanger their survival (Cuñat, 2007). Trade credit is also used as a screening and signaling tool, Biais and Gollier (1997) and Burkart and Ellingsen (2004) show that banks are encouraged to provide loans to firms using trade credit. In a similar vein, trade credit is

[1] In a sample of non-financial US public firms for period 1987–1991, Rajan and Zingales (1995) find that accounts payable represent 15% of total assets, whereas short-term debt (debt in current liabilities) is 7.4% of total assets. Using a sub-sample (non-zero short-term debt) of our public and private firms, we document that the ratio of accounts payable to total assets for public (private) firms is 9.5% (16.1%), while the ratio of short-term debt to total assets is 6.4% (12.9%).

beneficial for customers in distress because they are likely to be granted renegotiation concessions (Wilner, 2000). The second, non-financial, motive for using trade credit is that it reduces transaction costs by separating the payment cycle from the delivery schedule, thus reducing the need for holding inventories of both money and goods (Ferris, 1981; Emery, 1987; Bougheas, Mateut, and Mizen, 2009). By allowing buyers to use a product before payment, trade credit also helps to reduce the costs associated with the verification of product quality (Smith, 1987; Lee and Stowe, 1993; Long, Maltiz, and Ravid, 1993). Finally, trade credit can be used as a means for high-quality buyers to exercise their bargaining power (Giannetti, Burkart, and Ellingsen, 2011), or for risky customers to obtain favorable price discrimination from suppliers (Brennan, Maksimovics, and Zechner, 1988).

This paper investigates the use of trade credit by public and private firms. As reviewed above, previous studies argue that trade credit is an important form of financing for firms with limited access to external capital markets (Petersen and Rajan, 1997; Bias and Gollier, 1997; Berger and Udell, 1998; Fisman and Love, 2003). However, none of these studies has explored the impact of the listing status and, in particular, the importance of access to public equity markets on trade credit policy. This is a significant omission because a growing body of research has documented important differences in public and private firms' financial decisions, such as capital structure (Brav, 2009), dividends (Michaely and Roberts, 2012), cash holdings (Gao, Harford, and Li, 2013), investments (Mortal and Reisel, 2013; Asker, Farre-Mensa, and Ljungqvist, 2015), and innovations (Gao, Hsu, and Li, 2014; Ferreira, Manso, and Silva, 2014; Acharya and Xu, 2015). This literature also shows that public and private firms have fundamental differences in the degrees of asymmetric information, financial constraints, and creditworthiness, which are known factors affecting trade credit demands. This leads us to the following questions: Do private firms rely more or less on supplier financing than their public counterparts? Do firms have a target level of trade credit, and if so,

does the listing status affect the speed with which they adjust toward this target? Did the credit shock associated with the recent financial crisis of 2007–2009 have differential effects on trade credit in public and private firms? In the empirical work that follows, we seek to provide answers to these research questions.

We hypothesize that private firms will have a higher level of trade credit than their public counterparts. Compared to publicly listed companies, privately held firms have higher degrees of asymmetric information and financial constraints, and hence more limited access to alternative sources of financing (e.g., Brav, 2009; Michaely and Roberts, 2012; Gao, Harford, and Li, 2013). Accordingly, private buyers will have a higher demand for trade credit than their public counterparts. Using a sample of US public and private firms collected from the S&P Capital IQ database for the period 1995–2012, we begin our analysis by documenting that the level of accounts payable in private firms is 40.4% higher than that in their public counterparts. This result is both statistically and economically significant, and continues to hold for a matched sample of public and private firms.

We subject our finding to a battery of robustness checks. To address the potential sample selection and endogeneity concerns associated with the listing status of a company, we first analyze a transition sample of firms that were private and subsequently went public over the sample period. We observe a significant decline in these firms' reliance on trade credit post-listing, which is most pronounced in the first three years after the IPO. This finding is broadly in line with our baseline regression results. Next, we run a treatment regression that accounts for the endogeneity of the listing decision. Controlling for this endogeneity concern, our results continue to show a significantly higher level of trade credit in private firms than in their public counterparts. We then confirm our baseline regression results using one-to-one propensity score matching. We also find that our findings are insensitive to including

additional control variables, as well as using an extended sample and alternative measures of trade credit.

We next examine the impact of the listing status on the use of trade credit for subsamples of firms with different characteristics. We find that compared to publicly listed companies, privately held firms maintain a significantly higher level of trade credit, especially when they are younger, larger, have more growth opportunities, and fewer tangible assets. Young, high-growth, and low-tangibility firms often face high degrees of asymmetric information and credit constraints, which may explain their greater demand for trade credit. These findings are again consistent with our main argument based on information problems and financial constraints.

In the second part of our analysis, we address the question about the optimum and dynamics of trade credit policy. We examine whether public and private firms attempt to adjust toward target levels of trade credit, and if so, whether the speed with which these firms adjust their trade credit varies according to the listing status. We find evidence to support the prediction that public firms move faster to target trade credit than their private counterparts, which is consistent with the notion that the former firms face lower adjustment costs than the latter. This result suggests that, although private firms rely more on trade credit than public firms, they may find it more difficult to adjust their trade credit and operate close to the optimal level.

In the final part of our empirical work, we investigate the impact of macroeconomic conditions on the use of trade credit by public and private firms. Our results show that private (public) firms were granted significantly less (slightly more) trade credit during the crisis. A possible explanation for these results is that the crisis affected not only financial lenders but also non-financial suppliers (Love, Preve, Sarria-Allende, 2007), making it more difficult for private firms to obtain supplier credit than their public counterparts. This finding shows how

vulnerable private firms are during a credit crunch when the supply of trade credit, a potential substitute for bank credit, also dries up.

The main findings of our study contribute to the growing literature documenting differences in several important corporate financial policies between public and private firms (e.g., Brav, 2009; Michaely and Roberts, 2012; Gao, Harford, and Li, 2013; Mortal and Reisel, 2013; Gao, Hsu, and Li, 2014; Ferreira, Manso, and Silva, 2014; Acharya and Xu, 2015; Asker, Farre-Mensa, and Ljungqvist, 2015). To the best of our knowledge, we are the first to examine the use of trade credit by public and private U.S. firms. Further, our research complements earlier studies of trade credit in small and medium-size firms (Petersen and Rajan, 1997; Berger and Udell, 1998; Giannetti, Burkart, and Ellingsen, 2011). We note that those studies analyze data collected from the National Survey of Small Business Finance (NSSBF) in a single year (e.g., 1987, 1993 or 1998), and do not examine the impact of the listing status on trade credit policy.

Our finding regarding the difference in the speed of adjustment between public and private firms contributes to the limited (non-US) literature studying the optimum and dynamics of various components of working capital, such as accounts receivable, accounts payable, and net trade cycle (García-Teruel and Martínez-Solano, 2010a; García-Teruel and Martínez-Solano, 2010b; Baños-Caballero, Garcia-Teruel, and Martinez-Solano, 2014). It further adds to the recent evidence of differences in target adjustment behavior of public and private firms documented by research on other areas of corporate finance, such as capital structure (Brav, 2009) and cash holdings (Gao, Harford, and Li, 2013).

Finally, our analysis of the effects of the recent financial crisis on trade credit in public and private firms extends recent evidence for the former firm type documented by Love, Preve, and Sarria-Allende (2007) and Garcia-Appendini and Montriol-Garriga (2013). We provide the first systematic evidence of the differential effects of the crisis on the use of trade

credit by public and private firms, as well as relevant policy implications regarding the latter group.

The remainder of the chapter is organized as follows. We review the literature in Section 3.2 and develop our hypotheses in Section 3.3. We discuss our data and the methodology in Section 3.4. We present our empirical results in Section 3.5 and conclude the paper in Section 3.6.

3.2. Related Literature

3.2.1. Trade Credit: Theory and Evidence

One of the most important explanations for the use of trade credit is the financing motive (e.g., Schwartz, 1974). In the presence of asymmetric information, the supplier of trade credit has a comparative advantage over traditional financial institutions in evaluating the buyer's creditworthiness and enforcing credit contracts (Cuñat, 2007). Petersen and Rajan (1997) summarize this cost advantage in three dimensions: advantage in information acquisition, advantage in controlling the buyer, and advantage in salvaging value from the goods. First, compared to traditional lenders, the supplier of trade credit is able to obtain information about the buyer more quickly and at a lower cost thanks to the course of business between the two parties (Smith, 1987; Biais and Gollier, 1997; Burkart and Ellingsen, 2004). Second, suppliers may control buyers by threatening them with cutting off their supplies; this threat is credible if there are limited sources of such supplies. Finally, trade creditors have a comparative advantage over traditional lenders in re-selling the goods in case of customer default thanks to their established network for selling within the industry (Mian and Smith, 1992; Fabbri and Menichini, 2010).

Among several theories of trade credit mentioned in the Introduction, the financing motive reviewed above is most relevant for research examining public and private firms because it is based on the assumption of asymmetric information between the supplier and the

buyer, and is able to explain why trade credit is important for firms with credit constraints. To the extent that public and private buyers have varying degrees of informational asymmetries and financial constraints (e.g., Brav, 2009; Schenone, 2010; Michaely and Roberts, 2012; Gao, Harford, and Li, 2013), the incentives for suppliers to extend credit to these firms also vary.

There is an extensive body of empirical research examining various aspects related to the use of trade credit (e.g., Mian and Smith, 1992; Long, Maltiz, and Ravid, 1993; Ng, Smith, and Smith, 1999; Danielson and Scott, 2004; Choi and Kim, 2005; Molina and Preve, 2009; Klapper, Laeven, and Rajan, 2012; Hill, Kelly, and Lockhart, 2013).[2] However, this literature focuses on either large, public firms or small and medium-size firms (hereafter SMEs). Using data collected from the NSSBF database, several recent studies have examined trade credit contracts among US SMEs (e.g., Petersen and Rajan, 1997; Berger and Udell, 1998; Giannetti, Burkart, and Ellingsen, 2011). They generally find that supplier financing is important for firms that are financially constrained and have difficulty accessing other sources of external financing. While these studies provide useful insights about factors affecting not only the amount of trade credit but also details about credit contract terms, they have not examined the impact of the listing status of the borrowing firm on its demand for trade credit. This is an important gap in the trade credit literature because recent research examining public and private firms has revealed significant differences in the characteristics of these firm types, which have been shown by this literature to be important determinants of trade credit demands.[3]

[2] There is a vast literature examining the use of trade credit in non-US SMEs. See, for example, Wilson and Summers (2002), Huyghebaert (2006), Niskanen and Niskanen (2006), Rodriguez-Rodriguez (2006), Cuñat (2007), García-Teruel and Martínez-Solano (2010c), and Baños-Caballero, Garcia-Teruel, and Martinez-Solano (2014). However, none of these studies examines the effect of the listing status.

[3] Atanasova (2007) examines the impact of credit constraints on the use trade credit for a small sample of UK public and private firms. Her analysis, however, uses a regime-switching approach to categorize firms into constrained vs. unconstrained, and thus does not focus on examining the effect of the listing status on trade credit. Using a sample of European public and private firms, Anagnostopoulou (2012) shows that public firms have a higher cash conversion cycle than their private counterparts. However, the author uses a broad measure of working capital and does not examine its components including trade credit.

3.2.2. Optimal Trade Credit and Speed of Adjustment to Target Trade Credit

Emery (1984) shows how a firm derives its target trade credit by balancing the marginal benefits of trade credit against its marginal costs. From a buyer's perspective, trade credit brings about several benefits because it acts as an alternative source of financing for firms facing credit constraints (Schwartz, 1974), liquidity shocks (Cuñat, 2007), or financial distress (Wilner, 2000), reduces transaction costs and provides a guarantee about product quality (Smith, 1987), and allows certain buyers to obtain favorable price discrimination (Brennan, Maksimovics, and Zechner, 1988). On the other hand, relying on supplier financing also has disadvantages because trade credit is generally a more expensive form of credit (Petersen and Rajan, 1997) and it can expose firms to refinancing risk, since suppliers can stop providing credit at any time. Furthermore, there are opportunity costs associated with using trade credit due to a loss of discount for early payment (Ng, Smith, and Smith, 1999), or an increase in future cost of credit or deterioration in credit reputation, or less favorable delivery dates, due to late payments or a customer default (Nadiri, 1969; Danielson and Scott, 2004; Wu, Rui, and Wu, 2012). Nadiri (1969) develops a theoretical model to study optimal trade credit policy by taking into account certain benefits and costs of trade credit. He argues that the observed level of trade credit may deviate from the optimum due to firms' inaccurate estimates of sales, purchases, and the opportunity costs of trade credit, as well as disequilibrium in other assets such as inventories. However, firms should attempt to close out any deviation from the optimum by making adjustment in their trade credit over time.

Based on Nadiri's (1969) adjustment framework, a few papers have examined the dynamics of trade credit and related components of working capital, such as accounts receivable (García-Teruel and Martínez-Solano, 2010a), or net trade cycle (Baños-Caballero, Garcia-Teruel, and Martinez-Solano, 2014). Particularly, García-Teruel and Martínez-Solano (2010b) investigate the speed of adjustment toward optimal accounts payable using a sample

of UK SMEs; they find that these firms adjust quickly to their target trade credit with a speed of 77%. However, all these studies use non-U.S. data, and none of them has examined potential different adjustment behavior of public and private firms. This is an important omission because recent research on public and private firms has investigated target adjustment behavior of other financial policies. In the capital structure literature, Brav (2009) shows that public firms adjust toward target leverage more quickly than their private counterparts. However, in recent research on cash holdings, Gao, Harford, and Li (2013) find that public firms are slower than private firms in moving toward their target cash balances.

3.2.3. The Effect of Macroeconomic Conditions on Trade Credit

The use of trade credit is affected by macroeconomic conditions (Schwartz, 1974; Smith, 1987), and this effect varies according to the creditworthiness of the firm; see extensive reviews by Mishkin (1995) and Mateut (2005). According to prior research, trade credit can act as a substitute for other sources of external financing such as bank loans, especially during periods of monetary contractions (Bias and Gollier, 1997; Petersen and Rajan, 1997; Nilsen, 2002; Choi and Kim, 2005). This finding is based on Meltzer's (1960) and Schwartz's (1974) redistribution view that large, liquid firms with better access to capital markets will have incentives to redistribute the credit received to financially less secure firms via trade credit. In Cuñat's (2007) theoretical model, suppliers are willing to extend trade credit to buyers faced with a liquidity shock, even if traditional lenders refuse to do so. Empirically, Nilsen (2002) finds that small firms and even large firms without a credit standing resort to trade credit at times of tight monetary policy.

Recent research has examined the effects of crises on the use of trade credit. Love, Preve, and Sarria-Allende (2007) examine trade credit during the Asian and Mexican currency crises. They find that the amount of trade credit provided and received increased at the peak of those crises, although it contracted post-crisis due to the shrinking of both bank and supplier

credit. Most recently, Garcia-Appendini and Montriol-Garriga (2013) show that during the 2007–2008 financial crisis, liquid suppliers extended more trade credit to support their customers and consequently experienced better performance. On the demand side, trade credit taken, especially by constrained firms, also increased during the credit crunch.[4]

3.3. Hypotheses

In this section, we develop three hypotheses corresponding to the research questions set out in our Introduction. To begin with, we expect to find a significant difference in the level of trade credit between public and private firms because there are well-documented differences between these two firm types. First, due to information disclosure requirements, publicly listed firms are more transparent and have lower degrees of asymmetric information than their privately held counterparts (Brav, 2009; Schenone, 2010). Since suppliers can acquire information about opaque firms more quickly and control them with supplier financing more effectively than formal lenders (Smith, 1987; Petersen and Rajan, 1997; Biais and Gollier, 1997; Burkart and Ellingsen, 2004), they have a financing motive to extend trade credit to private firms.

Second, private firms are more financially constrained than public firms because they have or choose to have limited access to public equity markets. They also face a higher cost of debt (Brav, 2009; Gao, Harford, Li, 2013), and have weaker bargaining power with banks (Saunders and Steffen, 2011). Hence, private firms have greater incentives to use trade credit as a substitute for other forms of external financing. On the supply side, the demand for trade credit by private firms is likely to be accommodated by unconstrained suppliers, at least during normal times, because trade creditors have incentives to exploit a cost advantage over specialized financial institutions by redistributing their credit (Petersen and Rajan, 1997).

[4] See also Bastos and Pindado (2013) and Casey and O'Toole (2014) for recent international evidence on the effect of a financial crisis on trade credit policy.

Third, prior evidence suggests that private firms have a lower credit quality and are riskier than public firms (Pagano, Panetta, and Zingales, 1998; Scherr and Hulburt, 2001). While independent lenders are reluctant to provide credit to firms with a high failure rate, suppliers may be willing to do so (Cuñat, 2007; Boissay and Gropp, 2013). As a result, private firms have strong incentives to rely on trade credit. Also note that trade credit is more flexible than bank loans because it is easier to renegotiate due to its revolving nature, and is less costly to delay repayments (Wilner, 2000; Cuñat, 2007). In the event of a customer default, trade creditors often provide more concessions to maintain their product market relationship (Wilner, 2000). Petersen and Rajan (1997) argue that the implicit equity stake of suppliers in buyers consists of the present value of current and future sales. Hence, unlike banks, suppliers are concerned about the continuation of their customers and tend to be lenient toward cases of financial distress (Huyghebaert, Van De Gucht, and Van Hulle, 2007). These benefits are valuable for private firms with a lower credit quality and a higher risk than their public counterparts. Based on the above arguments, we develop the following hypothesis:

H1: Private firms have a higher level of trade credit than public firms.

According to pioneering research by Nadiri (1969) and Emery (1984), we predict that a firm will have an optimal level of trade credit that balances the benefits and costs of trade credit and maximizes the firm's value. Further, we argue that the speed with which firms adjust toward this optimum depends on the costs of adjusting their accounts payable. We expect public firms to have lower adjustment costs than private firms because the former firms may have greater bargaining power, allowing them to renegotiate with suppliers, adjust the amount of trade credit taken, and amend credit contract terms more easily (Klapper, Laeven, and Rajan, 2012). Public firms also face a lower cost of capital (Campello, Giambona, Graham, and Harvey, 2011; Saunders and Steffen, 2011), as a result of having greater transparency (Schenone, 2010), greater liquidity (Pagano, Panetta, and Zingales, 1998), and

greater access to external sources of liquidity (Faulkender and Petersen, 2006; Lins, Servaes, and Tufano, 2010). Having a lower cost of capital allows these firms to adjust their trade credit more quickly by switching to other forms of credit. In sum, this argument suggests that private firms should have a lower speed of adjustment than public firms.

However, one could argue that public firms have less incentive to operate at target trade credit than private firms, especially when the costs of deviating from such target are not material to them. For instance, in theory, firms maintaining more trade credit than the optimal level face the expected costs of default and higher costs of future credit due to the deterioration in their credit reputation. However, to the extent that public firms are less prone to bankruptcy and have better bargaining power than private firms, they may be less concerned about facing the possibility of default as well as the associated costs. As a result, the incentive for public firms to revert toward the optimal trade credit may be weaker than that for private firms. Overall, given the conflicting arguments, we develop the following alternative hypotheses:

H2a: Private firms adjust toward target trade credit more slowly than public firms.

H2b: Private firms adjust toward target trade credit more quickly than public firms.

According to prior research examining the impact of monetary contractions and financial crises on the use of trade credit, we argue that both public and private firms will have incentives to substitute bank financing for supplier financing during a credit crunch, when the supply of bank credit dries up. Our argument is based on the redistribution view of trade credit provision (Meltzer, 1960; Schwartz, 1974; Petersen and Rajan, 1997) and empirical evidence showing public firms increased their trade credit at the peak of the Asian and Mexican currency crises (e.g., Love, Preve, and Sarria-Allende, 2007), as well as the recent financial crisis (Garcia-Appendini and Montriol-Garriga, 2013). Moreover, we also predict that between public and private firms, the latter firms will have a greater demand for trade credit during a

credit shock. This is because private firms are more constrained than public firms, and have even more limited access to alternative sources of financing. Our prediction is also motivated by prior evidence on the differential impacts of macroeconomic uncertainty on firms with varying degrees of constraints (Korajczyk and Levy, 2003), and, in particular, results regarding the effect of monetary tightening on the use of trade credit by constrained firms (Nilsen, 2002; Atanasova, 2007; Garcia-Appendini and Montriol-Garriga, 2013).

On the other hand, from a supply-side perspective, suppliers may prefer to grant more trade credit to public firms than private firms during economic downturns. Suppliers may prefer to grant more trade credit to public firms than private firms during economic downturns because public firms tend to have a lower default risk than private firms. Suppliers expect the former firms to be less prone to bankruptcy, which may affect their decision to provide trade credit, especially during periods of credit crunch. Hence, one could argue that although private firms may demand more trade credit during crisis periods, suppliers may be less willing to grant it to them due to their low credit quality. Suppliers may prefer to provide trade credit to public firms, given that during the recent financial crisis suppliers may have had financial problems themselves and may have been cautious in their trade credit provision.

In sum, the arguments above enable us to develop our final hypothesis:

H3(a): Private firms experience a greater increase in the level of trade credit than public firms during a financial crisis.

H3 (b): Private firms experience a greater decrease in the level of trade credit than public firms during a financial crisis.

3.4. Data and Methodology

3.4.1. Sample Description

We collect our data from the S&P Capital IQ database for the period 1995–2012. S&P Capital IQ provides data on both US public and private firms;[5] however, its coverage of trade credit includes more private than public firms. Colla, Ippolito, and Li (2013) compare the quality of data for public firms provided by Compustat and that provided by S&P Capital IQ. Examining several corporate variables such as leverage, size, profitability, cash holdings, tangibility, and asset maturity, they conclude that the quality of S&P Capital IQ data is comparable to that of Compustat data. In Table A.1 of the Appendix, we show that Colla, Ippolito, and Li's (2013) finding can be extended to data on trade credit, our variable of interest. Specifically, we find that the summary statistics of the trade credit variable for public firms collected from S&P Capital IQ and from Compustat are comparable. This suggests that our sample of public firms from S&P Capital IQ is a representative sample of all public firms in Compustat.

Following Gao, Harford, and Li (2013), we exclude financials and utilities, IPO firms, firms that went private during our sample period, and firms with a cash flow to total assets ratio of less than -50%. Next, we remove observations with missing variables, negative equity, and negative total assets. Finally, we winsorize the variables at the 1st and 99th percentiles to alleviate the impact of outliers. Our sample consists of 27,300 private firms with 70,011 firm-year observations and 3,340 public firms with 33,766 firm-year observations.[6]

[5] S&P Capital IQ provides data on private firms that file Forms 10-K (annual reports), 10-Q (quarterly reports), or S-1 (securities registration) with the Securities Exchange Commission (SEC). According to the SEC regulations, firms with total assets of $10 million or above, and with 500 or more shareholders are required to file 10-K and 10-Q reports, while firms with public debt are required to file S-1 Form. S&P Capital IQ confirms that they also cover other private firms from the third-party Private Company Financials provider, which receives data by directly contacting the company, from CPAs, from courts and recording offices regarding suits, liens, judgments and bankruptcy filings, and from top news providers. The use of various sources for data on private firms provides more coverage and alleviates the sample selection concern.

[6] Consistent with Asker, Farre-Mensa, and Ljungqvist (2015) and Gao, Lemmon, and Li (2012), our sample includes more firm-year observations for private firms than for public firms.

3.4.2. Empirical Models

To examine differences in the trade credit ratios of public and private firms (*Hypothesis 1*), we estimate the following model:

$$TC_{it} = \beta_0 + \beta_1 Public_{it} + \boldsymbol{\theta}' \boldsymbol{X}_{it} + \varepsilon_{it}. \quad (1)$$

where the dependent variable, trade credit (TC_{it}), is measured as the ratio of accounts payable to total assets (Petersen and Rajan, 1997; Fisman and Love, 2003; Giannetti, Burkart, and Ellingsen, 2011). $Public_{it}$ is a dummy variable that takes the value of 1 for public firms, and 0 for private firms. Following prior research (Petersen and Rajan, 1997; Love, Preve, and Sarria-Allende, 2007; Garcia-Appendini and Montoriol-Garriga, 2013), our control variables ($\boldsymbol{X}_{it}$) include ln(1+age), ln(1+age)^2, cash flow, cash holdings, current assets, negative growth, positive growth, short-term debt, and firm size. We provide a detailed discussion of these variables in Section 3.4.3. We note that our model is similar that used by Gao, Harford, and Li (2013) to investigate differences in the cash holdings of public and private firms. Since we hypothesize that private firms rely more on trade credit than their public counterparts, we expect β_1 to be negative.

Next, to test *Hypotheses 2a* and *2b*, we compare how quickly public and private firms adjust toward their target trade credit levels. We do so by estimating the following partial adjustment model for public and private firms separately:

$$\Delta TC_{it} = \beta_0 + \delta(TC_{it}^{*} - TC_{it-1}) + \varepsilon_{it}\,. \quad (2)$$

The dependent variable, ΔTC_{it}, is the change in trade credit from year $t-1$ to t. TC_{it-1} is the lagged value of trade credit. TC_{it}^{*} is the target trade credit ratio, which is estimated from a regression of trade credit on the control variables listed above, separately for public and private firms, as follows:

$$TC_{it} = \beta_0 + \boldsymbol{\gamma}' \boldsymbol{X}_{it} + \varepsilon_{it}. \quad (3)$$

Our approach allows for the possibility that public and private firms may maintain heterogeneous trade credit targets, which is in line with our argument that these firms have different trade credit demands. The coefficient of interest δ measures the speed of adjustment toward the target level of trade credit; it takes a value from zero to one. If the firm adjusts its trade credit immediately, the speed of adjustment will be equal to one. However, the speed of adjustment will be equal to zero if the adjustment costs are so high that the firm is unable to adjust to its target trade credit. We compare the speed of adjustment between public and private firms by testing whether the difference in the estimates of δ is statistically significant using the Chow test.

Finally, to examine the differential effects of credit conditions on public and private firms' use of trade credit (*Hypothesis 3*), we estimate following model:

$$TC_{it} = \beta_0 + \beta_1 Crisis_{it} + \beta_2 Public_{it} + \beta_3 Crisis_{it} \times Public_{it} + \boldsymbol{\theta}' \boldsymbol{X}_{it} + \varepsilon_{it}. \quad (4)$$

Model (4) extends model (1) in that it includes dummy variables to account for the effects of a supply credit shock, proxied by the recent financial crisis of 2007–2009.[7] $Crisis_{it}$ is a dummy variable that takes the value of 1 in the years 2007–2009, and 0 otherwise. Our chosen period consists of the first-stage of the crisis from July 2007 to June 2008 and the second-stage following the bankruptcy of Lehman Brothers in September 2008 until the fourth quarter of 2009. To avoid confounding effects due to other periods of macroeconomic fluctuations before 2003, we estimate the model for the period 2004–2009. $Crisis_{it} \times Public_{it}$ is an interaction term between the $Crisis_{it}$ and $Public_{it}$ dummy variables. The effects of the crisis on private firms and public firms are captured by β_1 and $\beta_1 + \beta_3$, respectively. We expect both public and private firms to rely more on trade credit during the crisis with private firms' use of trade credit increasing the most, i.e., $\beta_1 > 0$ and $\beta_3 > 0$.

[7] Table A.4 in the Appendix reports the regression results when we restrict the crisis period to 2007–2008.

3.4.3. Control Variables

Consistent with the literature, the control variables in models (1), (3), and (4) include ln(1+age), $\ln(1+age)^2$, cash flow, cash holdings, current assets, negative growth, positive growth, short-term debt, and size. A firm's demand for trade credit is affected by its creditworthiness, which can be proxied by firm size and age (Petersen and Rajan, 1997). Large and old firms may use less trade credit because they have access other sources of financing. However, from a supplier's perspective, these firms are more likely to be granted trade credit with favorable terms due to their better credit quality (Klapper, Laeven, and Rajan, 2012). These conflicting arguments suggest that the direction of the relationship between trade credit and size (age) should be resolved empirically. Consistent with Scherr and Hulburt (2001), we measure size as the natural logarithm of total sales in 2012 dollar price. Following Petersen and Rajan (1997), age is the number of years from incorporation, and is calculated as ln(1+age). We include $\ln(1+age)^2$ to account for the conjecture that early years are more important for building a firm's reputation than later years; we expect it to be negatively related to trade credit (Cuñat, 2007).

The pecking order theory shows that, in the presence of asymmetric information, firms prefer to use internal funds to external financing (Myers and Majluf, 1984). Since trade credit is an external source of financing, this theory predicts that firms will resort to trade credit after having exhausted internal resources. We thus expect trade credit to have a negative relationship with internal funds. As in Petersen and Rajan (1997), we measure the internal sources of financing using cash flow, calculated as the ratio of net profits plus depreciation to total assets.

Morris (1976) argues that firms should match the maturities of their assets and liabilities in order to ensure that cash inflows generated from the assets can always cover the cash outflows to service the liabilities. Myers (1977) further shows how firms can reduce

underinvestment incentives and the agency costs of debt by matching the maturity structure of their debt to the life of their assets. Based on these arguments, we expect trade credit and current assets to have a positive relationship; we calculate currents assets as current assets minus cash, divided by total assets (Petersen and Rajan, 1997). In addition, we follow Love, Preve, and Sarria-Allende (2007), and Garcia-Appendini and Montriol-Garriga (2013) and include cash holdings as an additional control variable. We expect cash holdings to have a positive effect on trade credit; we measure cash holdings as the ratio of cash and cash equivalents to total assets.

High-growth firms tend to be more constrained and, as a result, rely more on trade credit (Cuñat, 2007). Alternatively, firms with high growth, especially in sales, have a greater demand for trade credit to finance the new investments in current assets. Following previous studies of private firms (Scherr and Hulburt, 2001; Brav, 2009), we measure growth using sales growth. Consistent with Petersen and Rajan (1997), we differentiate between positive and negative growth; positive (negative) growth is defined as sales growth multiplied by a positive growth dummy variable that takes the value of 1 if sales growth is positive (negative), and 0 otherwise. We expect trade credit to be positively (negatively) related to positive (negative) growth.

Prior research shows how trade credit acts as a substitute for other sources of short-term financing (Petersen and Rajan, 1997; Nilsen, 2002). Hence, to model the demand for trade credit, we include short-term debt to control for alternative forms of credit. We expect short-term debt to have a negative relation with trade credit to reflect the substitution effect. Following previous research on private firms (Scherr and Hulburt, 2001), we measure short-term debt as the ratio of short-term borrowings plus the current portion of long-term debt to total assets.

3.5. Empirical Results

In this section, we first report the univariate and multivariate results regarding the difference in trade credit policies between public and private firms. Next, we present regression results conditional on firm characteristics. We then examine whether and how quickly public and private firms adjust toward their target trade credit. Finally, we provide evidence on the effects of macroeconomic conditions on the use of trade credit by public and private firms.

3.5.1. Difference in Trade Credit between Public and Private Firms

3.5.1.1. Sample Overview and Univariate Analysis

Panel A of Table 1 reports the summary statistics for the full sample of public and private firms. The mean trade credit ratio is 13.6% (median of 8.9%), which is much higher than the figure for short-term debt (mean of 3%). Current assets represent more than a half of total assets (50.7%), while cash holdings is 13.4% of total assets. The average age of the sample firms is about 40 years (median of 31 years).

Panel B of Table 1 presents the results from our univariate analysis. Public firms have a mean trade credit of 8.9% (median of 6.6%), which is about half of the figure for private firms (mean of 15.8% and median of 11.1%).[8] The difference in the trade credit ratios of the two groups is 6.9% (median of 4.5%), and is significant as confirmed by our statistical tests. This provides the first evidence to support *Hypothesis 1* that private firms rely more on trade credit than their public counterparts. In unreported analysis, we also observe significant differences in other characteristics of public and private firms, consistent with the literature. For example, public firms are larger and more mature, as well as have less short-term debt, less cash flow, and more cash holdings than their private counterparts (see Brav, 2009; Gao, Harford, and Li, 2013; Gao, Hsu, and Li, 2014; Asker, Farre-Mensa, and Ljungqvist, 2015).

[8] The ratio of account payables to total liabilities is 21.7% (33.8%) in public (private) firms.

[Insert Table 1 here]

Table 2 shows how trade credit varies across the 12–Fama French industries. Several studies argue that the use of trade credit is uniform within an industry but varies across industries (Smith, 1987; Ng, Smith, and Smith, 1999; Fisman and Love, 2003). Panel A shows that firms relying most on trade credit operate in the retail and wholesale industry, with a mean trade credit ratio of 18.8% (median of 14.7%). This finding is similar to García-Teruel and Martínez-Solano's (2010c) earlier evidence for European firms. Firms with the lowest level of trade credit (mean of 6.5% and median of 4.1%) are in the health sector (including healthcare, medical equipment, and drugs). This finding is consistent with Fisman and Love (2003), who argue that trade credit is unpopular for drugs companies because it is difficult for suppliers to resell these specific products in the event of a customer default.

Panel B of Table 2 presents the summary statistics of trade credit across industries. The health sector still exhibits the lowest level of trade credit, and also the smallest difference in the level of trade credit between public and private firms. The largest difference in public and private firms' trade credit ratios is observed in the energy industry (difference in mean of 8% and in median of 3.6%). The difference in the trade credit ratio between public and private firms in other industries ranges from 3.2% to 7.5%. More importantly, the test statistics for differences in mean and median are all statistically significant. Overall, we find that public and private firms maintain significantly different levels of trade credit and that this finding holds across industries.

[Insert Table 2 here]

3.5.1.2. Multivariate Analysis – Baseline Regression Results

Table 3 reports the regression results for model (1), in which we investigate the difference in the use of trade credit by public and private firms. In the first two columns, we

simply regress trade credit on the *Public* dummy without controlling for firm-specific characteristics. The results in Column (1) show that the difference in trade credit between public and private firms (6.9%) is significantly negative, consistent with the univariate analysis.[9] In Column (2), we include industry and year effects to account for unobserved industry-level heterogeneity and common time trends.[10] We find that the difference in public and private firms' trade credit decreases to 4.4%, but remains statistically significant. In Column (3), we include the control variables. In Column (4) we further control for industry and year effects.[11] The results show that, even after controlling for firm-specific variables, the *Public* dummy is still significantly negative. The difference in the level of trade credit in public and private firms varies between 5.5% and 3.6%, and is economically significant. Using the *Public* dummy coefficient estimate in the baseline model in Column (4), the difference in public and private firms' trade credit is 40.4% relative to the mean trade credit ratio of public firms (8.9%). This finding strongly supports *Hypothesis 1* that privately held firms have a higher level of trade credit than their publicly listed counterparts. In Column (5), we estimate the baseline model again using a matched sample of public and private firms. In particular, we employ a *one*-to-*n* matching technique, where we match, with replacement, each public firm-year observation to any private firm-year observation in the same industry and year, and of similar size (allowing for a deviation of 30%). The results show that the difference in the trade credit ratios of the public and matched private firms (6.6%) remains statistically significant, and even becomes economically stronger.

[Insert Table 3 here]

[9] In our regressions, we report heteroskedasticity-consistent (robust) standard errors. However, the results remain qualitatively the same if we estimate robust standard errors clustered at the firm level.

[10] In unreported analysis, we also examine the evolution of trade credit for both public and private firms (in Figure 1 we present different graphical evidence of how trade credit evolves around the IPO). However, unlike recent evidence of the secular increase in cash holdings (Bates, Kahle, and Stulz, 2009) and in short-maturity debt (Custódio, Ferreira, and Laureano, 2013), we observe no clear pattern in trade credit over time.

[11] Since the firms in our sample remain public or private throughout the sample period, we do not include firm fixed effects because they are highly correlated with the *Public* dummy variable. Our approach is consistent with Gao, Lemmon, and Li (2012), Gao, Harford, and Li (2013), and Asker, Farre-Mensa, and Ljungqvist (2015).

The results regarding the control variables are broadly consistent with the literature. ln(1+age) has a significantly negative coefficient, indicating that young firms use more trade credit. However, we find that $\ln(1+age)^2$ is insignificant. As expected, firms with high cash flow rely less on trade credit, consistent with the evidence in Petersen and Rajan (1997). The results also show that current assets and trade credit are positively related. Similarly, cash holdings have a positive impact on trade credit, in line with Garcia-Appendini and Montriol-Garriga (2013). Both of these results support the principle of matching the maturities of assets and liabilities. Positive growth has a positive effect on trade credit, consistent with our prediction and Petersen and Rajan (1997). However, negative growth is also significantly positive, suggesting that firms with negative growth options are provided with more trade credit. A possible explanation for this finding is that firms that have few growth opportunities but are large and less constrained can borrow more (Petersen and Rajan, 1997). Firms with high short-term debt have less trade credit, which is in line with the substitution effect. Finally, large firms are granted more trade credit, supporting the notion that suppliers are willing to provide more trade payables with more favorable and longer credit terms to large firms because these firms have greater market power (Klapper, Laeven, and Rajan, 2012).

3.5.1.3. Dealing with Sample Selection and Endogeneity

Transition Sample

To deal with the sample selection concern about firms self-selecting themselves to go public, we use a transition sample of the same IPO firms that went public during the sample period. Using this transition sample mitigates the sample selection bias by controlling for the selection on the time-invariant unobservable firm characteristics; see also Gao, Harford, and Li (2013) and Acharya and Xu (2015) for a similar approach.

Figure 1 demonstrates graphically the evolution of the trade credit policy of IPO firms around the IPO event, specifically from the IPO–4 year to the IPO+5 year. The peak mean

trade credit is in the IPO–2 and IPO–1 years, both at 9.1% (median of 5.1% and 5.8%, respectively). In the IPO year, there is a 1.4% decline in the mean trade credit, which remains stable at this relatively low level, compared to the pre-IPO level, of about 7% post-IPO, until IPO+5. Overall, this graphical evidence is in line with the multivariate analysis above.

[Insert Figure 1 here]

Next, we perform a regression analysis to investigate the change in trade credit post-IPO using this transition sample. We estimate the long-term effect of the listing decision on trade credit post-IPO as well as the temporary effects in the first few years following the IPO. Our estimated models are specified as follows:

$$TC_{it} = \beta_0 + \beta_1 D_{Post\_IPO} + \boldsymbol{\theta}' \boldsymbol{X}_{it} + \varepsilon_{it}. \quad (5)$$

$$TC_{it} = \beta_0 + \beta_1 D_{IPO} + \beta_2 D_{IPO+1} + \beta_3 D_{IPO+2} + \beta_4 D_{IPO+3} + \boldsymbol{\theta}' \boldsymbol{X}_{it} + \varepsilon_{it}. \quad (6)$$

In both models, the dependent variable is trade credit. In model (5), D_{Post_IPO} is a dummy variable that takes the value 1 in the IPO year and the years after the IPO, and 0 otherwise. In model (6), D_{IPO} is a dummy variable that takes the value 1 in the IPO year, and 0 otherwise; D_{IPO+i} with i=1..3 is a dummy variable that takes the value 1 in the IPO+i year, and 0 otherwise. $\boldsymbol{X}_{it}$ is a vector of the control variables as discussed above.

Table 4 presents the regression results for the transition sample of 1,282 IPO firms that did an IPO during our sample period. Columns (1)–(3) report the results for model (5), without and with industry, year, and firm effects, respectively.[12] The D_{Post_IPO} dummy is significantly negative, which lends support to the notion that as the firm goes public its reliance on trade credit decreases. The magnitude of the decline in trade credit is between 2.2% and 1.1%, which remains economically significant. In Columns (4)–(6), we report the results regarding the temporary effects of the IPO decision on trade credit, without and with

[12] Using year dummies also accounts for time trends in the market conditions that may affect the IPO timing.

industry, year, and firm effects, respectively. The results suggest that IPO firms rely significantly less on trade credit in the first few years post-IPO. Specifically, compared to the pre-IPO level, firms reduce their trade credit level by 1%–2.1% between IPO and IPO+3. Overall, the results for the transition sample suggest that IPO firms maintain a significantly lower level of trade credit after going public, which lends further support for Hypothesis 1.

[Insert Table 4 here]

Treatment Regression

Going public can be an endogenous decision because it may be affected by unobserved firm characteristics that are also related to trade credit. To deal with this potential endogeneity problem, we run a treatment regression that involves estimating the following models in two stages (Gao, Harford, and Li, 2013):

$$Public_{it}^{*} = \gamma_0 + \boldsymbol{\gamma}'\boldsymbol{Z}_{it} + \omega_{it}; \qquad First-stage\ regression \tag{7}$$

$$Public_{it} = 1\ if\ Public_{it}^{*} > 0; = 0\ otherwise$$

$$TC_{it} = \beta_0 + \beta_1 Public_{it} + \boldsymbol{\theta}'\boldsymbol{X}_{it} + \varepsilon_{it}\ . \quad Second-stage\ regression \tag{8}$$

In the first stage, we estimate a probit model (7), which captures the decision to go public. The second stage involves estimating model (8), in which trade credit is regressed on the fitted values of the *Public* dummy variable, estimated from the first stage, and the control variables. Following Gao, Harford, and Li (2013), we use industry-level underwriter concentration as an instrument for the *Public* dummy. This instrumental variable affects the costs of doing an IPO and subsequently the listing decision (Liu and Ritter, 2011), but is not related to other corporate decisions such as trade credit.[13] Furthermore, this instrumental variable is less likely to be related to trade credit because it is an industry-level rather than a

[13] Industry-level underwriter concentration is defined as the number of IPOs underwritten by the top five underwriters divided by the number of IPOs in that industry. The top five underwriters are determined by the number of IPOs underwritten in the last five years (Liu and Ritter, 2011).

firm-level variable. For identification purposes, we include all the exogenous regressors in the first-stage regression along with this instrument.

We tabulate the treatment regression results obtained using the maximum likelihood estimator in Table 5, with the first-stage regression results in Column (1) and the second-stage regression results in Column (2). In Column (1), the underwriter concentration variable is statistically significant and has the expected negative sign. This suggests that the higher the underwriter concentration, the higher the costs of doing an IPO, and the less likely firms are listed. We also note that the diagnostic test statistic is significant, supporting the notion that the going public decision should be treated as endogenous and validating our treatment regression approach. Additionally, the estimated coefficient of rho is positive suggesting that the unobservable characteristics that affect the decision of going public are positively related to trade credit. In Column (2), the results regarding the *Public* dummy suggest that public firms maintain a significantly lower level of trade credit than private firms. The difference (7%) in public and private firms' trade credit is economically stronger than the baseline result. This suggests that, failing to control for the endogeneity concern may underestimate the impact of the listing status on the use of trade credit. Overall, our finding that private firms use a higher level of trade credit than public firms is robust to accounting for endogeneity.

[Insert Table 5 here]

Propensity score matching

Table 6 presents the results of the propensity score matching analysis, which controls for selection based on observable differences between public and private firms. Since we have more observations for private firms, we consider public firms as the treated group and private firms as the control group. Using the propensity score matching technique, we implement *one*-to-*one* matching to the nearest neighborhood, without replacement (Gao, Harford, and Li,

2013).[14] Specifically, we match each public firm-year observation to a private firm-year observation using the propensity score of being public from a probit regression based on certain firm characteristics. In the probit model, we use two matching specifications to capture the status of being a privately or publicly held firm. In Specification 1, the matching is based on firm size, industry, and year effects. In Specification 2, the matching is based on all the control variables used in our baseline regression, including ln(1+age), $\ln(1+\text{age})^2$, cash holdings, cash flow, current assets, negative growth, positive growth, short-term debt, size, and industry and year effects. Panel A presents the pairwise differences in the mean trade credit in the propensity score-matched sample together with the bootstrapped standard errors based on 50 replications. We find that in Specification 1(2), there is a statistical and economic difference in the trade credit of the propensity score-matched public and private firms, i.e., the level of trade credit in private firms is 7.9% (6.1%) higher than that in public firms. In Panel B, we re-estimate the baseline regression model using the propensity score-matched sample. The results confirm our earlier baseline results that private firms have a higher level of trade credit (by 3.6%–3.7%).

[Insert Table 6 here]

3.5.1.4. Additional Robustness Checks

Table 7 reports the results from several additional robustness checks. In the first two columns, we include two additional control variables, namely the cost of external finance and the annual rate of GDP growth.[15] Specifically, we control for the cost of external finance in Column (1), consistent with previous studies examining small firms (e.g., Rodriguez-Rodriguez, 2006; García-Teruel and Martínez-Solano, 2010b). The higher the cost of external finance, the higher is the demand for trade credit. We measure the cost of external finance

[14] We obtain qualitatively similar results when we use propensity score matching without replacement, and a caliper of 30% standard deviation of the propensity score.
[15] Table A.3 in the Appendix presents the regression results after including further control variables.

(Fcost) as interest expense divided by total debt minus trade credit. The results show that this variable is positively related with trade credit as expected.

In Column (2), we include the annual rate of GDP growth to proxy for macroeconomic conditions (e.g., Niskanen and Niskanen, 2006; García-Teruel and Martínez-Solano, 2010b). During adverse conditions, trade credit is an alternative source of funds and, thus, its demand is expected to increase. Alternatively, during favorable macroeconomic conditions, there are more investment opportunities, which require more funding including trade credit.[16] Consistent with the later argument, we find a positive relation between the GDP growth rate and trade credit.

In Column (3), we follow prior research (e.g., Petersen and Rajan, 1997) and analyze a larger sample of firms that includes utilities. In Column (4), we follow Love, Preve, and Sarria-Allende (2007) and Garcia-Appendini and Montriol-Garriga (2013) and use an alternative measure of trade credit in which we normalize accounts payable by the cost of goods sold, instead of total assets as in our main analysis.

Overall, the above robustness checks show that our main findings continue to hold. Indeed, there is strong and robust evidence that private firms rely more on trade credit than their public counterparts. The difference in their trade credit varies between 2.2% and 3.8%, which is similar in magnitude to the results for the baseline model (3.6%).

[Insert Table 7 here]

3.5.2. Results Conditional on Firm-specific Characteristics

In this section, we examine whether the difference in public and private firms' trade credit varies according to certain firm-specific characteristics that proxy for the degrees of asymmetric information and credit constraints, and are related to the financing motive of using supplier financing. We consider subsamples of firms according to their age, growth

[16] GDP data comes from the Federal Reserve Bank of St Louis website.

opportunities, tangibility, and size, respectively. Table 8 presents the results for models using dummy variables and their interaction terms with the *Public* dummy. The *Mature* dummy variable takes the value of 1 for firm-year observations with above the median age, and 0 otherwise. The *High growth* dummy variable takes the value of 1 for observations with above the median growth, and 0 otherwise. The *High tangibility* dummy variable takes the value of 1 for observations with above the median tangibility, and 0 otherwise. The *Large* dummy variable takes the value of 1 for observations with above the median size, and 0 otherwise. We expect young, high-growth, low-tangibility, and small firms to have greater information problems and less access to external capital markets, and thus to rely more on supplier financing (Cuñat, 2007).

The results in Column (1) show that the *Public* dummy variable remains statistically negative, in line with our earlier findings. While *Mature* is significantly negative, its interaction term with *Public* dummy is significantly positive. Consistent with our conjecture, this finding suggests that young firms maintain a higher level of trade credit than their mature counterparts. Further, within the group of young firms, those that are private rely more on trade credit than those that are public. The results in Columns (2)–(3) show that firms with high growth and low tangibility use more trade credit than those with the opposite characteristics. Further, within these groups of firms, those that are private have a higher level of trade credit. Private firms that are young, and have high growth options, or limited tangible assets face higher degrees of asymmetric information and financial constraints, which may explain why these firms have greater demands for trade credit. This finding is consistent with previous evidence documenting the impact of asymmetric information and credit constraints on the use of trade credit (Nilsen, 2002; Fisman and Love, 2003; Cuñat, 2007). In Column (4), we find that large firms use more trade credit than small firms, which is consistent with some evidence in the literature (Petersen and Rajan, 1997; Klapper, Laeven, and Rajan, 2012). This

finding also supports a supply-side explanation that large firms are granted more trade credit due to their better credit quality and greater bargaining power. However, within the group of public firms, those that are larger rely less on trade credit. Considering that large firms are less concerned about information problems than small firms, this latter finding is in line with the argument based on asymmetric information, and the results in Columns (1)–(3). Overall, our results suggest the difference in public and private firms' use of trade credit varies with the levels of informational asymmetries and credit constraints facing these firms.

[Insert Table 8 here]

3.5.3. Speed of Adjustment to Target Trade Credit

In this section, we examine whether public and private firms adjust toward target trade credit levels and whether they do so with different adjustment speeds. We first estimate the target level of trade credit separately for public and private firms, given by model (3), and tabulate the results in Table A.2 of the Appendix. Our approach accounts for a difference in the target trade credit level between public and private firms; indeed, we find evidence of significantly different coefficients on the determinants of those target levels.[17]

Panel A of Table 9 presents the regression results for the partial adjustment model of trade credit, given by model (2). The results indicate that both public and private firms adjust toward their target levels of trade credit at moderate rates. This result is consistent with the argument that firms have optimal trade credit (Nadiri, 1969) and that they seek to adjust toward this target. Empirically, our estimated speeds of adjustment are statistically significant, but much lower in magnitude than the speed of adjustment estimated using a sample of UK SMEs in previous research (García-Teruel and Martínez-Solano, 2010b). More importantly,

[17] In unreported results, we also follow Gao, Harford, and Li's (2013) approach and assume that public and private firms have the same target trade credit. That is we estimate the target level using a pooled sample of public and private firms. Using this approach, we obtain qualitatively similar results regarding the adjustment speeds.

we find that private firms adjust at a slower rate (23%) than public firms (29%); the Chow test also confirms that the difference in these adjustment speed estimates is statistically significant. This finding supports *Hypothesis 2a* that private firms have a slower adjustment speed due to facing higher adjustment costs. The finding that private firms adjust their trade credit more slowly than their public counterparts is in line with the earlier evidence on leverage adjustment (Brav, 2009).

In Panels B and C, we investigate whether the difference in the speed of adjustment between public and private firms is dependent on the deviation from target trade credit. Conditional on being above the target trade credit level, public firms have a speed of adjustment of 39%, which is higher than the speed of 26% for private firms. In contrast, conditional on being below the target trade credit level, private firms have a higher speed of adjustment than public firms (20% vs. 11%). The former finding suggests that, due to having lower adjustment costs, public firms are able to adjust quickly toward their target trade credit when they are above the target, thus allowing them to mitigate the costs of bankruptcy and the loss of reputation in the event of a default. On the other hand, private firms adjust their trade credit more quickly when they are below the target, possibly because of the importance of trade credit as a major source of financing for these firms and hence the need for them to operate closer to the optimal level.

[Insert Table 9 here]

3.5.4. The Use of Trade Credit during a Crisis

We next examine the differential impacts of credit conditions on public and private firms' trade credit polices (*Hypothesis 3*). As mentioned, we use the recent financial crisis of 2007–2009 as a proxy for a credit crunch. Column (1) of Table 10 reports the regression results for model (4). The results show that the crisis has a significantly negative effect on the average level of trade credit for both public and private firms. Additionally, we note that, as in

our baseline regression model, the coefficient on the *Public* dummy variable (-0.046) has the expected negative sign, and is statistically and economically significant.

In Column (2), we examine the crisis effects on private and public firms separately. The effect on public firms is captured by the interaction term between *Public* and *Crisis*, plus the stand-alone *Crisis* dummy, which yield a combined effect of 0.2%, or 2% relative to the mean trade credit (9%) of public firms. This effect is statistically significant, but is quite small in magnitude. One possible explanation for this finding is that it captures the combined effects on both constrained and unconstrained public firms. For example, Garcia-Appendini and Montriol-Garriga (2013) find evidence of an increase in the amount of trade credit taken by public firms, but mainly for the constrained group. Another potential explanation is that while Garcia-Appendini and Montriol-Garriga (2013) use quarterly data and focus on the first stage of the crisis before the collapse of Lehman Brothers, from July 2007 to June 2008, we analyze annual data and cover a longer crisis period. This suggests our results could capture the combined effects of the first-stage of the crisis and the post-Lehman Brothers phase of the crisis associated with a full-blown financial crisis and economic recession.

The impact of the crisis on private firms is captured by the coefficient on *Crisis* (-0.011), which is significantly negative. The coefficient on this dummy variable suggests that during the crisis private firms experienced a one-percent decrease in their trade credit ratio, or a six-percent decrease relative to the mean trade credit of these firms. This finding is consistent with Hypothesis (3b) that private firms use less trade credit during the crisis. It suggests that although private firms may have demanded more trade credit during the crisis, their demand was probably not matched by the suppliers' willingness to lend. The finding that supply-side factors may have played an important role in reducing the trade credit of private firms during the crisis is in line with previous research in the literature. Love, Preve, and Sarria-Allende (2007) highlight the importance of the supply of credit during crises. They

argue that the increase in trade credit provision in the crisis year, followed by its decline in the post-crisis years, is consistent with a supply-side explanation, as firms vulnerable to the crisis extended less trade credit due to the shortage of funds. Our evidence of a decline in the trade credit of private firms during the crisis is a new and important empirical result, and adds to prior U.S. evidence of the crisis effect on the trade credit of public firms.

In Columns (3)–(4), we further investigate the differential effects of the crisis on the trade credit levels of public and private firms conditional on two measures of financial vulnerability, namely short-term debt and cash flow. Love, Preve, and Sarria-Allende (2007) argue that pre-crisis, firms with a high level of short-term debt (cash flow) are more (less) vulnerable to credit shocks. We consider 2006 as the pre-crisis year and use the 2006 values of those variables as proxies for financial vulnerability. The results in Column (3) show that conditional on the pre-crisis level of short-term debt ($ST\ debt_{pre\text{-}crisis}$), the impact of the crisis on public firms, measured by the sum of the coefficients on *Crisis* (-0.010), *Crisis*×*Public* (0.012), $ST\ debt_{pre\text{-}crisis}$×*Crisis* (-0.085), $ST\ debt_{pre\text{-}crisis}$.×*Public* (0.129), and $ST\ debt_{pre\text{-}crisis}$×*Crisis*×*Public* (0.068), is significantly positive, and is increasing in $ST\ debt_{pre\text{-}crisis}$. This is consistent with Love, Preve, and Sarria-Allende (2007), and suggests that public firms with more short-term debt faced an increased refinancing risk during the crisis, forcing them to rely more on trade credit as a substitute. However, for private firms, the impact of the crisis conditional on the pre-crisis level of short-term debt, measured by the sum of the coefficients on *Crisis* (-0.010) and $ST\ debt_{pre\text{-}crisis}$×*Crisis* (-0.085), is significantly negative. This finding is in line with the earlier results in Column (2), and suggests that the more vulnerable private firms were pre-crisis, the more difficult it was for them to obtain trade credit.

Column (4) reports the crisis impact conditional on the pre-crisis level of cash flow. The results in Column (4) show that the impact on public firms, equal to the sum of the coefficients on *Crisis* (-0.0072), *Crisis*×*Public* (0.0088), $Cash\ flow_{pre\text{-}crisis}$×*Crisis* (-0.0341),

Cash flow$_{pre\text{-}crisis}$×*Public* (0.0002), and *Cash flow*$_{pre\text{-}crisis}$×*Crisis*×*Public* (0.0331), is significantly positive but has a negligible magnitude at the mean cash flow of 0.0861. This finding does not support the argument that internally generated cash flow could be used as a substitute for supplier financing during the crisis. Empirically, our result is consistent with Love, Preve, and Sarria-Allende (2007), who also find that firms with high pre-crisis cash flow do not use less trade credit during the Asian and Mexican currency crises. High cash flow signals better creditworthiness, allowing firms to maintain their access to supplier financing. Finally, the impact of the crisis on the trade credit ratio of private firms, equal to the sum of the coefficients on *Crisis* (-0.007) and *Cash flow*$_{pre\text{-}crisis}$×*Crisis* (-0.034), is significantly negative, and increases with the pre-crisis level of cash flow. This suggests that private firms with more cash flow pre-crisis needed less trade credit during the crisis, which is consistent with the substitution effect.

[Insert Table 10 here]

Overall, we document differential effects of the financial crisis on the trade credit ratios of public and private firms. While public firms used slightly more trade credit during the crisis period, private firms were granted significantly less trade credit. The former finding is consistent with our conjecture that firms substitute short-term borrowings for trade credit during a crisis. However, the latter finding is more in line with a supply-side story whereby firms with a high default risk are likely to be refused trade credit, especially during bad times when the supply of such credit also dries up.

3.6. Conclusion

In this paper, we compare the use of trade credit by public and private firms. We hypothesize that private firms have a higher level of trade credit because they have higher degrees of asymmetric information, financial constraints, and a higher default risk. Using data from the S&P Capital IQ database for the period 1995–2012, we find strong evidence to

support this hypothesis. The level of trade credit in private firms is 40.4% higher than that in public firms. This finding is robust to controlling for sample selection and endogeneity concerns. We also find that the impact of being private on trade credit is most pronounced in young, high-growth, low-tangibility, and large firms. Our results thus show that the difference in public and private firms' use of trade credit varies with the degrees of asymmetric information and constraints facing these firms.

We further examine optimal trade credit policies for both public and private firms. Our findings show that both firm types adjust quite actively toward their target trade credit. However, public firms are able to move faster to their target, which is consistent with the argument that public firms have lower adjustment costs due to their greater bargaining power with suppliers as well as greater access to other forms of credit. While our findings show how reliant private firms are on trade credit, they also indicate how relatively difficult it is for these firms to adjust their trade credit and maintain its level close to, or at, the optimum.

Finally, we document differential effects of credit conditions on the use of trade credit by public and private firms. During the recent financial crisis, public firms were able to use slightly more trade credit as a substitute for other sources of financing, while private firms were granted significantly less trade credit and were forced to rely on internally generated funds. The latter finding suggests that a supply-side story may be at work as the demand for more trade credit by private firms may not be accommodated by suppliers during a credit crunch when both bank and trade credit become less accessible. Overall, while our results demonstrate the importance of trade credit to private firms, they also highlight the limitations of this form of credit in absorbing credit shocks. Our study, thus, provides implications for policies aimed at enhancing the flow of lending to private firms during times of extreme financial stress.

References

Acharya, V., and Xu, Z., 2015. Financial dependence and innovation: The case of public versus private firms. *Journal of Financial Economics* Forthcoming.

Aktas, N., Croci, E., and Petmezas, D., 2015. Is working capital management value-enhancing? Evidence from firm performance and investments. *Journal of Corporate Finance*, 30, pp. 98–113.

Anagnostopoulou, S., 2012. Working capital management and firm listing status. *Multinational Finance Journal*, 16(3-4), pp. 261–301.

Asker, J., Farre-Mensa, J., and Ljungqvist, A., 2015. Corporate investment and stock market listing: A puzzle? *Review of Financial Studies*, 28(2), pp. 342–390.

Atanasova, C., 2007. Access to institutional finance and the use of trade credit. *Financial Management*, 36(1), pp. 49–67.

Baños-Caballero, S., García-Teruel, P., and Martínez-Solano, P., 2014. Working capital management, corporate performance, and financial constraints. *Journal of Business Research*, 67(3), pp. 332–338.

Barrot, J., 2014. Trade credit and industry dynamics: Evidence from trucking firms. Working Paper. Massachusetts Institute of Technology.

Bastos, R., and Pindado, J., 2013. Trade credit during a financial crisis: A panel data analysis. *Journal of Business Research*, 66(5), pp. 614–620.

Bates, T., Kahle, K., and Stulz, R., 2009. Why do U.S. firms hold so much more cash than they used to? *Journal of Finance*, 64(5), pp. 1985–2021.

Berger, A., and Udell, G., 1998. The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle. *Journal of Banking and Finance*, 22(6), pp. 613–673.

Biais, B., and Gollier, C., 1997. Trade credit and credit rationing. *Review of Financial Studies*, 10(4), pp. 903–937.

Boissay, F., and Gropp, R., 2013. Payment defaults and interfirm liquidity provision. *Review of Finance*, 17(6), pp. 1853–1894.

Bougheas, S., Mateut, S., and Mizen, P., 2009. Corporate trade credit and inventories: New evidence of a trade-off from accounts payable and receivable. *Journal of Banking and Finance*, 33(2), pp. 300–307.

Brav, O., 2009. Access to capital, capital structure and the funding of the firm. *Journal of Finance*, 64(1), pp. 263–308.

Brennan, M., Maksimovics, V., and Zechner, J., 1988. Vendor financing. *Journal of Finance*, 43(5), pp. 1127–1141.

Burkart, M., and Ellingsen, T., 2004. In-kind finance: A theory of trade credit. *American Economic Review*, 94(3), pp. 569–90.

Campello, M., Giambona, E., Graham, J., and Harvey, C., 2011. Liquidity management and corporate investment during a financial crisis. *Review of Financial Studies*, 24(6), pp. 1944–1979.

Casey, E., and O'Toole, C., 2014. Bank lending constraints, trade credit and alternative financing during the financial crisis: Evidence from European SMEs. *Journal of Corporate Finance*, 27, pp. 173–193.

Choi, W., and Kim, Y., 2005. Trade credit and the effect of macro-financial shocks: Evidence from US panel data. *Journal of Financial and Quantitative Analysis*, 40(4), pp. 897–925.

Colla, P., Ippolito, F., and Li, K., 2013. Debt specialization. *Journal of Finance*, 68(5), pp. 2117–2141.

Cuñat, V., 2007. Trade credit: Suppliers as debt collectors and insurance providers. *Review of Financial Studies*, 20(2), pp. 491–527.

Custódio, C., Ferreira, M., and Laureano, L., 2013. Why are US firms using more short-term debt? *Journal of Financial Economics*, 108(1), pp. 182–212.

Danielson, M., and Scott, J., 2004. Bank loan availability and trade credit demand. *Financial Review*, 39(4), pp. 579–600.

Demirgüç-Kunt, A., and Maksimovic, V., 2001. Firms as financial intermediaries: Evidence from trade credit data. Working Paper. World Bank Development Research Group.

Emery, G., 1984. A pure financial explanation for trade credit. *Journal of Financial and Quantitative Analysis*, 19(3), pp. 271–285.

Emery, G., 1987. An optimal financial response to variable demand. *Journal of Financial and Quantitative Analysis*, 22(2), pp. 209–225.

Fabbri, D., and Menichini, A., 2010. Trade credit, collateral liquidation, and borrowing constraints. *Journal of Financial Economics*, 96(3), pp. 413–32.

Faulkender, M., and Petersen, M., 2006. Does the source of capital affect capital structure? *Review of Financial Studies*, 19(1), pp. 45–79.

Ferreira, D., Manso, G., and Silva, A., 2014. Incentives to innovate and the decision to go public or private. *Review of Financial Studies*, 27(1), pp. 256–300.

Ferris, J., 1981. A transactions theory of trade credit use. *Quarterly Journal of Economics*, 96(2), pp. 243–270.

Fisman, R., and Love, I., 2003. Trade Credit, financial Intermediary development, and industry growth. *Journal of Finance*, 58(1), pp. 353–74.

Gao, H., Harford, J., and Li, K., 2013. Determinants of corporate cash policy : Insights from private firms. *Journal of Financial Economics*, 109(3), pp. 623–639.

Gao, H., Hsu, P., and Li, K., 2014. Managerial short-termism and corporate innovation strategies. Working Paper. University of British Columbia.

Gao, H., Lemmon, M., and Li, K., 2012. Are CEOs in US public firms overpaid? New evidence from private firms. Working Paper. Nanyang Technological University.

Garcia-Appendini, E., and Montoriol-Garriga, J., 2013. Firms as liquidity providers: Evidence from the 2007-2008 financial crisis. *Journal of Financial Economics*, 109(1), pp. 272–291.

García-Teruel, P., and Martínez-Solano, P., 2010(a). A dynamic approach to accounts receivable: A study of Spanish SMEs. *European Financial Management*, 16(3), pp. 400–421.

García-Teruel, P., and Martínez-Solano, P., 2010(b). A dynamic perspective on the determinants of accounts payable. *Review of Quantitative Finance and Accounting*, 34(4), pp. 439–457.

García-Teruel, P., and Martínez-Solano, P., 2010(c). Determinants of trade credit: A comparative study of European SMEs. *International Small Business Journal*, 28(3), pp. 215–233.

Giannetti, M., Burkart, M., and Ellingsen, T., 2011. What you sell is what you lend? Explaining trade credit contracts. *Review of Financial Studies*, 24(4), pp. 1261–1298.

Hill, M., Kelly, G., and Lockhart, G., 2013. Downstream value of upstream finance. *Financial Review*, 48(4), pp. 697–723.

Huyghebaert, N., 2006. On the determinants and dynamics of trade credit use: Empirical evidence from business start-ups. *Journal of Business Finance and Accounting*, 33(1-2), pp. 305–328.

Huyghebaert, N., Van De Gucht, L., and Van Hulle, C., 2007. The choice between bank debt and trade credit in business start-ups. *Small Business Economics*, 29(4), pp. 435–452.

Klapper, L., Laeven, L., and Rajan, R., 2012. Trade credit contracts. *Review of Financial Studies*, 25(3), pp. 838–867.

Korajczyk, R., and Levy, A., 2003. Capital structure choice: Macroeconomic conditions and financial constraints. *Journal of Financial Economics*, 68(1), pp. 75–109.

Lee, Y., and Stowe, J., 1993. Product risk, asymmetric information, and trade credit. *Journal of Financial and Quantitative Analysis*, 28(2), pp. 285–300.

Lins, K., Servaes, H., and Tufano, P., 2010. What drives corporate liquidity? An international survey of cash holdings and lines of credit. *Journal of Financial Economics*, 98(1), pp. 160–176.

Liu, X., and Ritter, J., 2011. Local underwriter oligopolies and IPO underpricing. *Journal of Financial Economics*, 102 (3), pp. 579–601.

Long, M., Malitz, I., and Ravid, S., 1993. Trade credit, quality guarantees and product marketability. *Financial Management*, 22(4), pp. 117–127.

Love, I., Preve, L., and Sarria-Allende, V., 2007. Trade credit and bank credit: Evidence from recent financial crises. *Journal of Financial Economics*, 83(2), pp. 453–469.

Mateut, S., 2005. Trade credit and monetary policy transmission. *Journal of Economic Surveys*, 19(4), pp. 655–670.

Meltzer, A., 1960. Mercantile credit, monetary policy, and size of firms. *Review of Economics and Statistics*, 42(4), pp. 429–437.

Mian, S., and Smith, C., 1992. Accounts receivable management policy: Theory and evidence. *Journal of Finance*, 47(1), pp. 169–200.

Michaely, R., and Roberts, M., 2012. Corporate dividend policies: Lessons from private firms. *Review of Financial Studies*, 25(3), pp. 711–746.

Mishkin, F., 1995. Symposium on the monetary transmission mechanism. *Journal of Economic Perspectives*, 9(4), pp. 3–10.

Molina, C., and Preve, L., 2009. Trade receivables policy of distressed firms and its effect on the costs of financial distress. *Financial Management*, 38(3), pp. 663–686.

Morris, R., 1976. On the corporate debt maturity strategies. *Journal of Finance*, 31(1), pp. 29–37.

Mortal, S., and Reisel, N., 2013. Capital allocation by public and private firms. *Journal of Financial and Quantitative Analysis*, 48(1), pp. 77–103.

Myers, C., 1977. Determinants of corporate borrowings. *Journal of Financial Economics*, 5(2), pp. 147–175.

Myers, S., and Majluf, N., 1984. Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, 20(2), pp. 293–315.

Nadiri, M., 1969. The determinants of trade credit in the US total manufacturing sector. *Econometrica*, 37(3), pp. 408–423.

Ng, C., Smith, J., and Smith, R., 1999. Evidence on the determinants of credit terms used in inter-firm trade. *Journal of Finance*, 54(3), pp. 1109–1129.

Nilsen, J., 2002. Trade credit and the bank lending channel. *Journal of Money, Credit, and Banking*, 34(1), pp. 226–253.

Niskanen, J., and Niskanen, M., 2006. The determinants of corporate trade credit policies in a bank-dominated financial environment: The case of Finnish small firms. *European Financial Management*, 12(1), pp. 81–102.

Pagano, P., Panetta, F., and Zingales, L., 1998. Why do companies do public ? An empirical analysis. *Journal of Finance*, 53(1), pp. 27–64.

Petersen, M., and Rajan, R., 1997. Trade credit: Theories and evidence. *Review of Financial Studies*, 10(3), pp. 661–691.

Rajan, R., and Zingales, L., 1995. What do we know about capital structure? Some evidence from international data. *Journal of Finance*, 50(5), pp. 1421–1460.

Rodriguez-Rodriguez, O., 2006. Trade credit in small and medium size firms: An application of the system estimator with panel data. *Small Business Economics*, 27(2-3), pp. 103–26.

Saunders, A., and Steffen, S., 2011. The costs of being private: Evidence from the loan market. *Review of Financial Studies*, 24(12), pp. 4091–4122.

Schenone, C., 2010. Lending relationships and information rents: Do banks exploit their information advantages? *Review of Financial Studies*, 23(3), pp. 1149–1199.

Scherr, F., and Hulburt, H., 2001. The debt maturity structure of small firms. *Financial Management*, 30(1), pp. 85–111.

Schwartz, R., 1974. An economic model of trade credit. *Journal of Financial and Quantitative Analysis*, 9(4), pp. 643–657.

Smith, J., 1987. Trade credit and informational asymmetry. *Journal of Finance*, 42(4), pp. 863–872.

Wilner, B., 2000. The exploitation of relationship in financial distress: The case of trade credit. *Journal of Finance*, 55(1), pp. 153–178.

Wilson, N., and Summers, B., 2002. Trade credit terms offered by small firms: Survey evidence and empirical analysis. *Journal of Business and Finance Accounting*, 29(3-4), pp. 317–335.

Wu, W., Rui, O., and Wu, C., 2012. Trade credit, cash holdings, and financial deepening: Evidence from a transitional economy. *Journal of Banking and Finance*, 36(11), pp. 2868–2883.

Figure 1: Evolution of Trade Credit and the Listing Status

This figure illustrates the evolution of trade credit around the IPO year for a transition sample of 1,282 IPO firms that went public during the sample period. Trade credit is defined as the ratio of accounts payable to total assets.

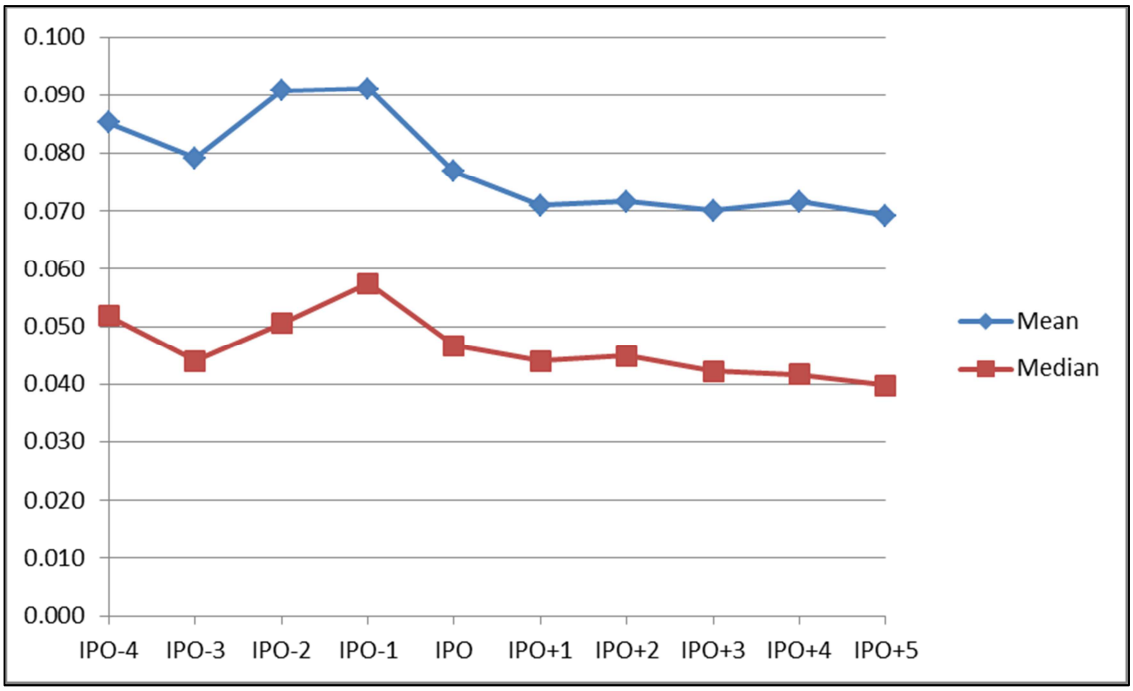


Table 1: Summary Statistics and Univariate Analysis

Panel A of this table reports the summary statistics of the variables under consideration. Trade credit is defined as the ratio of accounts payable to total assets. Firm age is the number of years from incorporation. Cash flow is measured by net profits plus depreciation, scaled by total assets. Cash holdings is cash and cash equivalents, scaled by total assets. Current assets is current assets minus cash, scaled by total assets. Negative growth is sales growth times the negative growth dummy variable, which takes the value of 1 if sales growth is negative, and 0 otherwise. Positive growth is sales growth times the positive growth dummy variable, which takes the value of 1 if sales growth is positive, and 0 otherwise. Short-term debt is short-term borrowings plus the current portion of long-term debt, scaled by total assets. Size is the natural logarithm of total sales, measured in 2012 dollar price. The total number of observations in our sample is 103,777. Panel B presents the univariate analysis of the trade credit of the public and private firms in the full sample using the t-test for differences in mean and the Wilcoxon-Mann-Whitney test for differences in median.

Panel A: Summary Statistics

Variable	Mean	Median	Std dev	Min	Max
Trade credit (%)	0.1359	0.0898	0.1324	0.0077	0.5612
Age (years)	39.97	31.000	29.49	0.0000	135.00
Cash flow (%)	0.0861	0.0540	0.2001	-0.5000	1.5003
Cash holdings (%)	0.1344	0.7742	0.1553	0.0000	1.0000
Current assets (%)	0.5071	0.5098	0.2561	0.0000	0.9819
Negative growth	-0.0523	0.0000	0.1262	-1.0000	0.0000
Positive growth	0.2068	0.0650	0.7545	0.0000	15.7500
Short-term debt (%)	0.0301	0.0000	0.0843	0.0000	1.0000
Size (Ln)	2.7121	2.1207	2.0889	-3.6498	8.2483

Panel B: Univariate Analysis

Trade credit	Public	Private	Mean test (p-value)	Median test (p-value)
Mean	0.0896	0.1582	0.000	
Median	0.0663	0.1108		0.000
Number of obs	33,766	70,011		

Table 2: The Use of Trade Credit by Public and Private Firms across Industries

This table shows the level of trade credit according to the 12-Fama French industry classification. Trade credit is defined as the ratio of accounts payable to total assets. Panel A provides the summary statistics (i.e., the mean, median, standard deviation (std. dev.), minimum, and maximum), of the trade credit ratio across industries. Panel B shows how the trade credit of public and private firms varies across industries. It reports the p-values of the t-test of differences in mean (i.e., mean test) and the p-value of the Wilcoxon-Mann-Whitney test of differences in median (median test).

Panel A: Full Sample

Industry	Industry description	Mean	Median	Std. dev.	Min	Max	N. obs.
1	Consumer non-durables	0.1064	0.0787	0.0941	0.0109	0.4732	4,794
2	Consumer durables	0.1257	0.0998	0.0979	0.0147	0.5621	1,866
3	Manufacturing	0.1080	0.0863	0.0797	0.0171	0.3829	11,762
4	Energy	0.0819	0.0548	0.0936	0.0019	0.9086	2,536
5	Chemicals	0.1049	0.0880	0.0779	0.0159	0.6777	1,891
6	Business equipment	0.1018	0.0637	0.1140	0.0069	0.7944	9,787
7	Telecommunications	0.0690	0.0337	0.1083	0.0029	0.7876	1,610
9	Retail and wholesale	0.1882	0.1474	0.1473	0.0168	0.5751	26,823
10	Health	0.0654	0.0409	0.0758	0.0077	0.5261	9,098
12	Others	0.1467	0.0938	0.1451	0.0054	0.5507	33,610

Panel B: Public Firms versus Private Firms

Industry	Industry description	Firm type	Mean	Median	Std. dev.	N. obs.	Mean test	Median test
1	Consumer non-durables	Private	0.1295	0.0915	0.1149	2,383		
		Public	0.0836	0.0715	0.0591	2,411	0.000	0.000
2	Consumer durables	Private	0.1480	0.1182	0.1217	710		
		Public	0.1120	0.0940	0.0767	1,156	0.000	0.000
3	Manufacturing	Private	0.1226	0.0969	0.0933	6,460		
		Public	0.0904	0.0788	0.0539	5,302	0.000	0.000
4	Energy	Private	0.1517	0.0887	0.1717	340		
		Public	0.0711	0.0524	0.0685	2,196	0.000	0.000
5	Chemicals	Private	0.1330	0.1035	0.1132	523		
		Public	0.0942	0.0836	0.0554	1,368	0.000	0.000
6	Business equipment	Private	0.1547	0.0982	0.1604	2,846		
		Public	0.0800	0.0564	0.0784	6,941	0.000	0.000
7	Telecommunications	Private	0.0776	0.0305	0.1282	708		
		Public	0.0622	0.0365	0.0892	902	0.005	0.048
9	Retail and wholesale	Private	0.1949	0.1535	0.1516	22,440		
		Public	0.1541	0.1238	0.1178	4,383	0.000	0.000
10	Health	Private	0.0695	0.0394	0.0861	5,058		
		Public	0.0603	0.0426	0.0602	4,040	0.000	0.370
12	Others	Private	0.1587	0.1076	0.1495	28,543		
		Public	0.0793	0.0479	0.0922	5,067	0.000	0.000

Table 3: Difference in Trade Credit between Public and Private Firms

This table reports the regression results for model (1), which captures the difference in the trade credit of public and private firms. Columns (1)–(4) provide the results for the full sample. Column (5) provides the results for a matched sample, in which we match, with replacement, each public firm to any private firm in the same industry and year, and of closest size (allowing for a deviation of 30%). The dependent variable is trade credit, defined as the ratio of accounts payable to total assets. *Public* is a dummy variable that takes the value of 1 for public firms, and 0 otherwise. Firm age is the number of years from incorporation. Cash flow is net profits plus depreciation, scaled by total assets. Cash holdings is cash and cash equivalents, scaled by total assets. Current assets is current assets minus cash, scaled by total assets. Negative (positive) growth is sales growth times the negative (positive) growth dummy, which takes the value of 1 if sales growth is negative (positive), and 0 otherwise. Short-term debt is short-term borrowings plus the current portion of long-term debt, scaled by total assets. Size is the natural logarithm of total sales, measured in 2012 dollar price. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Public	-0.0686***	-0.0435***	-0.0554***	-0.0362***	-0.0659***
	(-96.26)	(-45.56)	(-60.04)	(-31.66)	(-53.97)
ln(1+age)			-0.0221***	-0.0198***	-0.0046
			(-8.93)	(-8.07)	(-1.16)
$\ln(1+age)^2$			0.0004	-0.0002	-0.0019***
			(1.13)	(-0.50)	(-3.38)
Cash flow			-0.0471***	-0.0474***	-0.0644***
			(-21.86)	(-22.15)	(-27.59)
Cash holdings			0.0770***	0.0761***	0.1043***
			(29.03)	(27.75)	(32.06)
Current assets			0.2228***	0.1961***	0.1912***
			(146.43)	(103.32)	(90.72)
Negative growth			0.0099***	0.0224***	0.0133***
			(3.18)	(7.08)	(3.84)
Positive growth			0.0048***	0.0039***	0.0059***
			(8.98)	(8.04)	(4.59)
Short-term debt			-0.0646***	-0.0707***	-0.0619***
			(-14.65)	(-16.14)	(-12.20)
Size			0.0090***	0.0079***	0.0094***
			(40.79)	(36.44)	(25.19)
Intercept	0.1582***	0.1291***	0.0825***	0.0817***	0.0405***
	(-96.26)	(30.26)	(19.14)	(14.12)	(3.42)
Industry effects	No	Yes	No	Yes	Yes
Year effects	No	Yes	No	Yes	Yes
Number of obs.	103,777	103,777	103,777	103,777	84,243
Adjusted R^2	0.059	0.176	0.236	0.283	0.268

Table 4: Regression Results for the Transition Sample

This table presents the regression results for the transition sample of 1,282 IPO firms. The dependent variable is trade credit, defined as the ratio of accounts payable to total assets. D_{Post_IPO} is a dummy variable that takes the value of 1 from the IPO year onwards, and 0 in the years pre-IPO. D_{IPO+i} with i=1..3 is a dummy variable that takes the value of 1 in the IPO+i year, and 0 otherwise. The other independent variables are defined in Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
D_{Post_IPO}	-0.0223***	-0.0148***	-0.0113***			
	(-9.48)	(-6.55)	(-4.21)			
D_{IPO}				-0.0087**	-0.0104***	-0.0111***
				(-2.35)	(-3.06)	(-3.35)
D_{IPO+1}				-0.0169***	-0.0150***	-0.0148***
				(-4.85)	(-4.38)	(-3.57)
D_{IPO+2}				-0.0176***	-0.0133***	-0.0129**
				(-4.93)	(-3.85)	(-2.45)
D_{IPO+3}				-0.0207***	-0.0144***	-0.0174***
				(-5.54)	(-4.02)	(-2.66)
ln(1+age)	-0.0199***	-0.0055	-0.0099	-0.0150***	-0.0039	0.0049
	(-5.20)	(-1.50)	(-1.18)	(-3.03)	(-0.86)	(0.51)
$\ln(1+age)^2$	0.0041***	0.0014**	0.0019	0.0032***	0.0009	-0.0009
	(6.14)	(2.23)	(0.53)	(3.45)	(1.02)	(-0.14)
Cash flow	-0.0064	-0.0265***	-0.0069	0.0007	-0.0277***	-0.0023
	(-1.08)	(-4.48)	(-1.22)	(0.07)	(-2.97)	(-0.24)
Cash holdings	0.0169***	0.0408***	0.0215**	0.0103	0.0309***	-0.0185
	(3.56)	(8.23)	(2.42)	(1.63)	(4.57)	(-1.64)
Current assets	0.1394***	0.1357***	0.0844***	0.1405***	0.1310***	0.0493***
	(30.34)	(26.86)	(7.09)	(20.62)	(17.54)	(3.74)
Negative growth	0.0036	0.0049	0.0166**	-0.0001	0.0015	0.0244***
	(0.45)	(0.61)	(2.40)	(-0.01)	(0.12)	(2.64)
Positive growth	-0.0002	-0.0002	8.34×10^{-05}	0.0001	-1.18×10^{-05}	0.0003
	(-0.33)	(-0.35)	(0.20)	(0.17)	(-0.02)	(0.70)
Short-term debt	0.0896***	0.0086	0.0525***	0.0826***	0.0067	0.0620***
	(6.73)	(0.66)	(3.55)	(3.76)	(0.30)	(2.72)
Size	0.0061***	0.0028***	-9.84×10^{-05}	0.0076***	0.0042***	-0.0024
	(9.35)	(4.46)	(-0.06)	(7.59)	(4.10)	(-1.00)
Intercept	0.0334***	0.0319*	0.0894***	0.0182**	0.0209	0.0786*
	(5.59)	(1.84)	(5.81)	(2.36)	(1.17)	(1.67)
Industry effects	No	Yes	Yes	No	Yes	Yes
Year effects	No	Yes	Yes	No	Yes	Yes
Firm effects	No	No	Yes	No	No	Yes
Number of obs.	9,976	9,976	9,976	4,444	4,444	4,444
Adjusted R^2	0.170	0.302	0.086	0.181	0.332	0.127

Table 5: Treatment Regression Results

This table reports the results of the treatment regression models (7) and (8), in which the *Public* dummy variable, which takes the value of 1 for public firms, and 0 otherwise, is assumed to be endogenous. Columns (1)–(2) report the first and second-stage regression results, respectively. The first-stage regression is a probit regression with the *Public* dummy being the dependent variable. We instrument for this variable using the industry underwriter concentration variable, defined as the number of IPOs underwritten by the Top 5 underwriters divided by the number of IPOs in that industry. Here, the Top 5 underwriters are determined by the number of IPOs that they have underwritten over the last five years. The other independent variables are defined in Table 3. T-statistics are reported in parentheses. p-values are reported in square brackets. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)
Public		-0.0702***
		(-10.94)
ln(1+age)	-0.0450	-0.0228***
	(-1.14)	(-8.54)
$\ln(1+age)^2$	-0.0372***	0.0004
	(-6.25)	(1.10)
Cash flow	-2.5536***	-0.0506***
	(-47.80)	(-15.25)
Cash holdings	0.2808***	0.0766***
	(7.18)	(27.18)
Current assets	-1.4988***	0.2167***
	(-63.96)	(79.56)
Negative growth	-1.1543***	0.0065*
	(-23.09)	(1.68)
Positive growth	0.5485***	0.0055***
	(28.02)	(7.96)
Short-term debt	1.8264***	-0.0603***
	(28.88)	(-10.78)
Size	0.4584***	0.0109***
	(119.46)	(12.88)
Underwriter concentration	-0.3796***	
	(-22.29)	
Intercept	-0.4114***	0.0873***
	(-6.04)	(16.83)
Endogeneity test		0.0817**
		[0.013]
Number of obs.		92,495

Table 6: Propensity Score Matching

This table reports the propensity score matching results. We match each public firm to a private firm using one-to-one propensity score matching to the nearest neighborhood, without replacement. In Specification (1), the matching is based on size, industry, and year. In Specification (2), the matching is based on all the control variables, namely ln(1+age), $\ln(1+age)^2$, cash holdings, cash flow, current assets, negative growth, positive growth, short-term debt, size, industry, and year effects. Panel A presents the pairwise differences in the mean trade credit in the matched samples. Bootstrapped standard errors (Std. error) based on 50 replications are reported in the square brackets. Panel B reports the baseline regression results for the matched samples. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: Pairwise Differences in the Mean Trade Credit

	Specification (1)	Specification (2)
Difference	-0.0793***	-0.0607***
Std. error	[0.09%]	[0.11%]

Panel B: Regression Results for the Propensity-score Matched Sample

	Specification (1)	Specification (2)
Public	-0.0369***	-0.0359***
	(-28.94)	(-30.04)
ln(1+age)	-0.0159***	-0.0162***
	(-6.36)	(-6.78)
$\ln(1+age)^2$	-1.40×10^{-05}	0.0003
	(-0.04)	(0.74)
Cash flow	-0.0429***	-0.0703***
	(-18.92)	(-21.24)
Cash holdings	0.0704***	0.0736***
	(22.08)	(26.38)
Current assets	0.1896***	0.2049***
	(86.93)	(97.57)
Negative growth	0.0219***	0.0381***
	(5.85)	(11.96)
Positive growth	0.0026***	0.0024***
	(5.52)	(5.38)
Short-term debt	-0.0520***	-0.0826***
	(-10.42)	(-19.04)
Size	0.0054***	0.0054***
	(22.25)	(22.33)
Intercept	0.0748***	0.0729***
	(11.34)	(11.41)
Industry effects	Yes	Yes
Year effects	Yes	Yes
Number of obs.	67,532	67,532
Adjusted R^2	0.322	0.325

Table 7: Additional Robustness Checks

This table presents the regression results from four robustness checks. Columns (1)-(2) report the results after including additional control variables. Specifically, Column (1) includes Fcost, which is interest expense divided by the sum of total debt minus accounts payable, while Column (2) includes the annual rate of GDP growth. Column (3) presents the regression results for an extended sample including utilities firms. Column (4) reports the regression results in which an alternative definition of the dependent variable (accounts payable over cost of goods sold) is used. The other independent variables are defined in Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)
Public	-0.0383***	-0.0362***	-0.0346***	-0.0219**
	(-29.61)	(-31.66)	(-31.68)	(-2.04)
ln(1+age)	-0.0197***	-0.0198***	-0.0202***	-0.0646***
	(-8.03)	(-8.07)	(-8.44)	(-5.86)
$\ln(1+age)^2$	-0.0002	-0.0002	3.21×10^{-05}	0.0083***
	(-0.48)	(-0.50)	(0.09)	(5.26)
Cash flow	-0.0469***	-0.0474***	-0.0461***	-0.1139***
	(-21.92)	(-22.15)	(-21.75)	(-6.94)
Cash holdings	0.0769***	0.0761***	0.0758***	-0.0902***
	(27.83)	(27.75)	(27.96)	(-5.13)
Current assets	0.1967***	0.1961***	0.1966***	-0.1558***
	(103.20)	(103.32)	(104.80)	(-14.89)
Negative growth	0.0224***	0.0224***	0.0176***	-0.3150***
	(7.08)	(7.08)	(8.08)	(-11.19)
Positive growth	0.0039***	0.0039***	0.0042***	0.0249***
	(7.74)	(8.04)	(8.62)	(8.49)
Short-term debt	-0.0724***	-0.0707***	-0.0687***	0.0178
	(-16.46)	(-16.14)	(-15.79)	(0.76)
Size	0.0081***	0.0079***	0.0078***	-0.0209***
	(36.68)	(36.44)	(37.57)	(-19.30)
Fcost	0.0564***			
	(3.26)			
ΔGDP		0.0005*		
		(1.72)		
Intercept	0.0805***	0.0739***	0.0759***	0.3617***
	(13.88)	(13.23)	(13.63)	(13.52)
Industry effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Number of obs.	103,777	103,777	107,338	33,922
Adjusted R^2	0.283	0.283	0.295	0.238

Table 8: The Use of Trade Credit by Public and Private Firms Conditional on Firm Characteristics

This table presents the effect of four firm-specific characteristics, namely firm age, growth opportunities, tangibility, and firm size, on the difference in the level of trade credit used by public and private firms. The dependent variable is trade credit, defined as the ratio of accounts payable to total assets. *Mature* is a dummy variable that takes the value of 1 for observations with above the median age, and 0 otherwise. *High growth* is a dummy variable that takes the value of 1 for observations with above the median growth opportunities, and 0 otherwise. *High tangibility* is a dummy variable that takes the value of 1 for observations with above the median tangibility, and 0 otherwise. *Large* is a dummy variable that takes the value of 1 for observations with above the median size, and 0 otherwise. *Public* is a dummy variable that takes the value of 1 for public firms, and 0 otherwise. The other independent variables are defined in Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

Age (1)		Growth opportunities (2)		Tangibility (3)		Size (4)	
Mature	-0.0199***	High growth	0.0178***	High tangibility	-0.0164***	Large	0.0127***
	(-15.35)		(17.43)		(-15.15)		(10.90)
Public	-0.0492***	Public	-0.0274***	Public	-0.0532***	Public	-0.0133***
	(-35.91)		(-21.41)		(-35.21)		(-8.24)
Mature×Public	0.0272***	High growth×Public	-0.0178***	High tangibility×Public	0.0311***	Large×Public	-0.0349***
	(20.15)		(-13.90)		(21.98)		(-19.52)
ln(1+age)	-0.0195***	ln(1+age)	-0.0191***	ln(1+age)	-0.0188***	ln(1+age)	-0.0189***
	(-8.10)		(-7.84)		(-7.73)		(-7.73)
$\ln(1+age)^2$	0.0006*	$\ln(1+age)^2$	-0.0002	$\ln(1+age)^2$	-0.0003	$\ln(1+age)^2$	-0.0003
	(1.72)		(-0.49)		(-0.87)		(-0.74)
Cash flow	-0.0507***	Cash flow	-0.0498***	Cash flow	-0.0491***	Cash flow	-0.0443***
	(-23.44)		(-23.03)		(-22.81)		(-20.73)
Cash holdings	0.0763***	Cash holdings	0.0765***	Cash holdings	0.0656***	Cash holdings	0.0743***
	(27.85)		(27.94)		(23.46)		(27.22)

Current assets	0.1940***	Current assets	0.1955***	Current assets	0.1829***	Current assets	0.1959***
	(102.01)		(103.17)		(91.10)		(103.30)
Negative growth	0.0239***	Negative growth	0.0054	Negative growth	0.0239***	Negative growth	0.0231***
	(7.54)		(1.62)		(7.61)		(7.34)
Positive growth	0.0044***	Positive growth	0.0028***	Positive growth	0.0041***	Positive growth	0.0031***
	(8.86)		(5.90)		(8.39)		(6.41)
Short-term debt	-0.0689***	Short-term debt	-0.0716***	Short-term debt	-0.0709***	Short-term debt	-0.0748***
	(-15.73)		(-16.36)		(-16.14)		(-17.11)
Size	0.0072***	Size	0.0079***	Size	0.0075***	Size	0.0083***
	(32.48)		(35.97)		(34.37)		(29.44)
Intercept	0.0852***	Intercept	0.0714***	Intercept	0.0979***	Intercept	0.0757***
	(14.67)		(12.32)		(16.63)		(13.08)
Industry effects	Yes	Industry effects	Yes	Industry effects	Yes	Industry effects	Yes
Year effects	Yes	Year effects	Yes	Year effects	Yes	Year effects	Yes
Number of obs.	103,777	Number of obs.	103,777	Number of obs.	103,777	Number of obs.	103,777
Adjusted R^2	0.286	Adjusted R^2	0.285	Adjusted R^2	0.286	Adjusted R^2	0.285

Table 9: Speed of Adjustment to Target Trade Credit

This table presents the regression results for the partial adjustment model of trade credit (2). It reports the estimated speed of adjustment, showing how fast public and private firms adjust toward their respective target level of trade credit. Panel A presents the results for the full sample of public and private firms. Panel B provides the results for the subsample of public and private firms with above-target trade credit. Panel C reports the results for the subsample of public and private firms with below-target trade credit. The dependent variable, ΔTC_{it}, is the change in trade credit. The independent variable, $TC_{it}^{*} - TC_{it-1}$, is the deviation from target trade credit, where TC_{it}^{*} is the estimated target trade credit (see also Table A.2 in the Appendix for more details). P-values of the Chow test of differences in the adjustment speed estimates are reported in square brackets. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

Panel A: Full Sample

	Public Firms ΔTC_{it}	Private Firms ΔTC_{it}	F-stat of Chow test [p-value]
$TC_{it}^{*} - TC_{it-1}$	0.2919***	0.2316***	38.32
	(97.85)	(101.74)	[0.000]
Intercept	-0.0029***	-0.0018***	
	(-11.95)	(-6.11)	
Number of obs.	33,766	70,011	
Adjusted R^2	0.221	0.129	

Panel B: Firms with Above-target Trade Credit

	Public Firms ΔTC_{it}	Private Firms ΔTC_{it}	F-stat of Chow test [p-value]
$TC_{it}^{*} - TC_{it-1}$	0.3956***	0.2638***	66.53
	(68.88)	(53.13)	[0.000]
Intercept	0.0088***	0.0032***	
	(14.16)	(4.10)	
Number of obs.	13,929	29,459	
Adjusted R^2	0.254	0.087	

Panel C: Firms with Below-target Trade Credit

	Public Firms ΔTC_{it}	Private Firms ΔTC_{it}	F-stat of Chow test [p-value]
$TC_{it}^{*} - TC_{it-1}$	0.1088***	0.2046***	68.65
	(17.36)	(36.24)	[0.000]
Intercept	0.0011***	-0.0005	
	(3.54)	(-0.82)	
Number of obs.	19,837	40,552	
Adjusted R^2	0.015	0.031	

Table 10: The Effects of the Financial Crisis on the Use of Trade Credit by Public and Private Firms

This table presents the regression results for model (4), which captures the effects of the recent financial crisis on the trade credit ratios of public and private firms. The model is estimated for the period 2004–2009. The crisis period is defined as from 2007 to 2009. The dependent variable is trade credit, defined as the ratio of accounts payable to total assets. *Crisis* is a dummy variable that takes the value of 1 for the years 2007–2009, and 0 otherwise. *Public* is a dummy variable that takes the value of 1 for public firms, and 0 otherwise. *ST debt*$_{pre\text{-}crisis}$ is the pre-crisis (2006) level of short-term debt. *Cash flow*$_{pre\text{-}crisis}$ is the pre-crisis (2006) level of cash flow. The model includes all the control variables, listed and defined as in Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)
Crisis	-0.0082***	-0.0106***	-0.0099***	-0.0072***
	(-4.68)	(-5.71)	(-5.35)	(-3.81)
Public	-0.0402***	-0.0464***	-0.0524***	-0.0461***
	(-24.53)	(-24.44)	(-26.36)	(-24.29)
Crisis×Public		0.0127***	0.0122***	0.0088***
		(6.56)	(5.91)	(4.41)
ST debt$_{pre\text{-}crisis}$×Crisis			-0.0849***	
			(-6.13)	
ST debt$_{pre\text{-}crisis}$×Public			0.1288***	
			(7.19)	
ST debt$_{pre\text{-}crisis}$×Crisis×Public			0.0681**	
			(2.50)	
Cash flow$_{pre\text{-}crisis}$×Crisis				-0.0341***
				(-8.92)
Cash flow$_{pre\text{-}crisis}$×Public				0.0002
				(0.39)
Cash flow$_{pre\text{-}crisis}$×Crisis×Public				0.0331***
				(8.26)
Controls	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Number of obs.	56,283	56,283	56,283	56,283
Adjusted R^2	0.273	0.273	0.274	0.274

Appendix

Table A.1. Comparison between data on trade credit provided by S&P Capital IQ and Compustat

This table provides a comparison of the summary statistics (i.e., the mean, median, and standard deviation) of the trade credit of the public firms in our sample and the public firms in the Compustat database. Trade credit is defined as the ratio of accounts payable to total assets.

Trade Credit	Our Sample	Compustat
Mean	0.0895	0.0894
Median	0.0663	0.0642
Std dev.	0.0836	0.0882
Number of obs.	33,766	114,845

Table A.2. Estimation of the Target Trade Credit Levels of Public and Private Firms

This table reports the regression results for the estimation of the target level trade credit as given by model (3). Trade credit is defined as the ratio of accounts payable to total assets. The other independent variables are defined in Table 3. P-values of the Chow test for differences in the coefficient estimates are reported in square brackets. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	Public firms	Private firms	F-stat of Chow test [p-value]
ln(1+age)	-0.0176***	-0.0063*	5.93
	(-6.88)	(-1.65)	[0.015]
$\ln(1+age)^2$	0.0019***	-0.0030***	52.59
	(5.11)	(-5.32)	[0.000]
Cash flow	-0.0514***	-0.0540***	0.33
	(-13.11)	(-21.52)	[0.564]
Cash holdings	0.0019	0.1133***	562.55
	(0.63)	(31.69)	[0.000]
Current assets	0.1362***	0.2197***	478.70
	(45.00)	(94.01)	[0.000]
Negative growth	0.0177***	0.0146***	0.29
	(4.49)	(3.44)	[0.592]
Positive growth	0.0007	0.0315***	193.96
	(1.62)	(14.53)	[0.000]
Short-term debt	0.0596***	-0.1397***	565.98
	(9.04)	(-26.96)	[0.000]
Size	0.0019***	0.0143***	641.06
	(8.18)	(32.74)	[0.000]
Intercept	0.0413***	0.0250	
	(6.50)	(1.56)	
Industry effects	Yes	Yes	
Year effects	Yes	Yes	
Number of obs.	103,777	103,777	
Adjusted R^2	0.262	0.260	

Table A.3. Additional Control Variables

This table presents the regression results for model (1) after including additional control variables. Specifically, Column (1) includes inventory defined as inventory divided by total assets, Column (2) includes the accounts receivable defined as accounts receivable over total sales. The other independent variables are defined in Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)
Public	-0.0305***	-0.0360***
	(-24.14)	(-31.33)
ln(1+age)	-0.0190***	-0.0198***
	(-6.72)	(-8.08)
$\ln(1+age)^2$	-0.0003	-0.0002
	(-0.81)	(-0.48)
Cash flow	-0.0395***	-0.0475***
	(-15.49)	(-22.16)
Cash holdings	0.0401***	0.0759***
	(12.37)	(27.59)
Current assets	0.1789***	0.1965***
	(82.63)	(101.59)
Negative growth	0.0328***	0.0220***
	(8.79)	(6.88)
Positive growth	0.0039***	0.0039***
	(6.04)	(8.06)
Short-term debt	-0.0801***	-0.0708***
	(-17.09)	(-16.16)
Size	0.0060***	0.0079***
	(19.22)	(36.27)
Inventory	7.81×10^{-06}**	
	(2.28)	
Accounts Receivable		-0.0032
		(-0.70)
Intercept	0.0986***	0.0821***
	(14.98)	(14.13)
Industry effects	Yes	Yes
Year effects	Yes	Yes
Number of obs.	77,864	103,777
Adjusted R^2	0.280	0.283

Table A.4. The Effects of the Financial Crisis on the Use of Trade Credit by Public and Private Firms- An Alternative Window for the Financial Crisis

This table presents the regression results for model (4), which captures the effects of the recent financial crisis on the trade credit ratios of public and private firms. The model is estimated for the period 2004–2008. The crisis period is defined as 2007- 2008. The dependent variable is trade credit, defined as the ratio of accounts payable to total assets. *Crisis* is a dummy variable that takes the value of 1 for the years 2007–2008, and 0 otherwise. *Public* is a dummy variable that takes the value of 1 for public firms, and 0 otherwise. ST $debt_{pre\text{-}crisis}$ is the pre-crisis (2006) level of short-term debt. *Cash* $flow_{pre\text{-}crisis}$ is the pre-crisis (2006) level of cash flow. The model includes all the control variables, listed and defined as in Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)
Crisis	-0.0073***	-0.0091***	-0.0083***	-0.0048**
	(-4.40)	(-5.01)	(-4.51)	(-2.49)
Public	-0.0402***	-0.0446***	-0.0527***	-0.0445***
	(-20.81)	(-20.43)	(-22.77)	(-20.36)
Crisis×Public		0.0096***	0.0109***	0.0058**
		(4.20)	(4.43)	(2.47)
ST $debt_{pre\text{-}crisis}$ ×Crisis			-0.0649***	
			(-3.91)	
ST $debt_{pre\text{-}crisis}$ ×Public			0.1813***	
			(7.24)	
ST $debt_{pre\text{-}crisis}$ ×Crisis×Public			0.0071	
			(0.20)	
Cash $flow_{pre\text{-}crisis}$×Crisis				-0.0308***
				(-6.64)
Cash $flow_{pre\text{-}crisis}$×Public				-0.0032
				(-0.92)
Cash $flow_{pre\text{-}crisis}$×Crisis×Public				0.0153**
				(2.05)
Controls	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Number of obs.	42,193	42,193	42,193	42,193
Adjusted R^2	0.275	0.276	0.278	0.277

Chapter 4
Listing Status, Financial Crisis and the Provision of Trade Credit

Abstract

We examine the impact of a supplier's listing status on its provision of trade credit. We find that the amount of trade credit provided by public firms is nearly a quarter higher than that provided by private firms. This finding is statistically and economically significant, and is robust to controlling for endogeneity and sample selection. We also find that public firms that are large, have low tangibility, high sales volatility, high bargaining power, and are high growth provide more trade credit than their private counterparts. Further, public firms supply more trade credit in differentiated and service industries, but less trade credit in retail and wholesale, standardized, and concentrated industries. The financial crisis of 2007-09 had no differential effect on the level of trade credit provided by public and private firms though both types of firms did cut back on their provision of trade credit during the crisis.

4.1. Introduction

Provision of trade credit is a common practice around the world (Demirgüc-Kunt and Maksimovic, 2001). In the U.S. alone, according to the Flow of Funds Accounts, accounts receivable of non-financial corporate businesses amounted to nearly $2,432 billion in 2013.[1] Trade credit arises when there is a gap between the time of delivery of goods and the time of payment. During this period, the supplier is seen as providing finance to the customer. Supplying trade credit not only links firms financially but is also beneficial in gluing them together and strengthening their relationship in the supply chain (Kim and Shin, 2012). Prior literature documents the reasons for trade credit provision and its importance, however, little attention has been devoted to whether the trade credit provision is uniform across public and private firms. We also know little if public and private firms behave differently in their provision of trade credit during periods of economic downturns such as the recent financial crisis of 2007.

Public firms have greater access to external markets, lower asymmetric information, lower financial constraints, and higher bargaining power than private firms (Brav, 2009; Schenone, 2010; Hill, Kelly and Lockhart, 2012; Gao, Harford, Li, 2013; Fabbri and Klapper, 2013; Acharya and Xu, 2015). Given these differences between public and private firms, the motives for these firms for providing trade credit can be different, both during normal periods and periods of economic crises. In this paper we investigate whether the supplier's listing status affects its trade credit provision. The second objective of our study is to examine whether the recent financial crisis, had any effect (or a differential effect) on the provision of trade credit by public and private firms. Though there are several studies that find that the macro-economic conditions affect the provision of trade credit by public firms (Choi and Kim, 2005; Love, Preve, and Sarria-Allende, 2007; Garcia-Appendini and Montriol-Garriga, 2013),

[1] In this paper we use accounts receivable and trade credit interchangeably.

none of them include an examination of the U.S. private firms nor they investigate whether the macro-economic conditions have a similar impact on the trade credit provided by public and private firms.[2]

Using data from the S&P Capital database for the period 1994-2012, we find that for every Dollar of trade credit provided by private firms, public firms provide $1.23 in trade credit. We argue that this result can be explained by public firms' higher financial capability, better ability in handling the trade credit process and in enforcing payments and contract terms, than private firms. These arguments are motivated by public firms' greater access to external markets, lower asymmetric information, lower financial constraints, and higher bargaining power. We confirm the robustness of our results using three robustness tests; first, we include alternative control variables. Second, we conduct a one-to-one propensity score matching and one-to-n matching to control for the observable differences between public and private firms. Third, we estimate a treatment regression to address the endogeneity of going public decision in the trade credit model.

Additional results show that certain firm characteristics govern the impact of the supplier's listing status on its trade credit provision. In particular, we find that public firms that are large, have low tangibility, high sales volatility, high bargaining power and are high-growth, provide more trade credit than comparative private firms. This result is broadly consistent with the predictions of the motives for providing trade credit. Based on the financial motive, large firms and low tangibility firms should grant more trade credit because of their higher financial capability.[3] The operational motive predicts that firms with high sales volatility provide more trade credit to smooth the demand of their goods, while, the

[2] Less than 1% of the 27 million (5.7 million with employees) businesses in the US are publicly traded on the major stock exchanges (see Forbes Magazine, "Four things you don't know about private companies", 26 May 2013, Available at: http://www.forbes.com/sites/sageworks/2013/05/26/4-things-you-dont-know-about-private-companies, Accessed: 5 July 2015.

[3] We discuss the different motives of granting trade credit in the next section.

commercial motive suggests that firms with high bargaining power and high-growth firms offer more trade credit because they have better ability to force payments and they are more concern to attract customers respectively.

Next, we investigate the effect of the product market dynamics on the difference between the offered level of trade credit by public and private firms. Our findings show that public firms provide more trade credit in differentiated and service industries, but less trade credit in retail, wholesale and standardized industries than private firms. Unlike differentiated and service industries, retail, wholesale and standardized industries have weak supplier-customer relationship, low customer loyalty, and a higher level of customer fraud.[4] These features discourage public firms to provide trade credit especially in the presence of additional risk such as customer fraud risk. Further, our findings also show that in concentrated industries, public firms supply a lower level of trade credit than that provided by private firms. This result suggests that in concentrated industries, public firms are less inclined to attract new customers and prevent current customers from switching to another supplier. Possibly, this is because in concentrated industries, there are few suppliers, so public firms are less in need to grant trade credit to attract customers. Overall, these results suggest that public firms can pick and choose when and to whom to provide trade credit.

Our analysis of the impact of the financial crisis on the provision of trade credit shows that, though the level of trade credit provided by both public and private firms decreased during the financial crisis, the crisis itself did not have a differential effect on the supply of trade credit by public and private firms. This finding confirms the argument that during the financial crisis, suppliers were not able to accommodate trade credit requests because of the shortage in global liquidity.

[4] Customer fraud occurs when the customer re-sell the products that he bought on credit to get cash. Therefore, there are high chances of customer fraud in industries where products can be easily diverted into cash (Burkrat and Ellingsen, 2004).

The results of this study contribute to various strands of literature. In the trade credit literature, we are the first to examine the impact of the supplier's listing status on its trade credit provision. Our findings complement the studies on the provision of trade credit by U.S. SMEs (Petersen and Rajan, 1997; Giannetti, Burkart, and Ellingsen, 2011; Murfin and Njoroge, 2015), as we provide first large-sample evidence on the trade credit offered by U.S. private firms, whereas these papers use survey cross-section data or a small sample. We add to the studies on the effect of macro-economic conditions on trade credit provision (Choi and Kim, 2005; Love, Preve, and Sarria-Allende, 2007; Garcia-Appendini and Montriol-Garriga, 2013), as these studies only examine the effect of crises on public firms' trade credit provision. Our paper also adds to a recent strand of literature that has been investigating the effect of market dynamics on a firm's provision of trade credit (McMillan and Woodruff, 1999; Johnson, McMillan, and Woodruff, 2002; Fisman and Raturi, 2004; Giannetti, Burkart, and Ellingsen, 2011; Fabbri and Klapper, 2013), by providing evidence on the differential effect of the industry type and industry's level of competition on the level of trade credit provided by public and private firms. With the exception of Giannetti, Burkart, and Ellingsen (2011), all the other three studies use non-U.S. survey data, while, Giannetti, Burkart, and Ellingsen (2011) use U.S. SMEs data. Our novel evidence that public firms provide more trade credit than private firms, contribute to the extensive body of literature on the difference between the corporate financial policies of public and private firms. This growing literature includes capital structure (Brav, 2009), dividends (Michaely and Roberts, 2012), cash holdings (Gao, Harford, and Li, 2013), investments (Mortal and Reisel, 2013; Asker, Farre-Mensa, and Ljungqvist, 2015), and innovation (Gao, Hsu, and Li, 2014; Ferreira, Manso, and Silva, 2014; Acharya and Xu, 2015).

The rest of the chapter proceeds as follows. We discuss the theoretical models of trade credit and related literature in section 4.2. We develop our hypotheses in section 4.3. We

discuss our data and methodology in section 4.4 and present our results in section 4.5. Section 4.6 concludes.

4.2. Why do Firms Provide Trade Credit?

According to the theoretical models of trade credit, suppliers grant trade credit for three main motives: financial, operational, and commercial. First, based on the financial motive, suppliers have a lending advantage over other conventional creditors (see Schwartz, 1974; Petersen and Rajan, 1997). This advantage arises from their information advantage due to the frequent interactions with customers (Biais and Gollier, 1997; Burkart and Ellingsen, 2004; Fabbri and Menichini, 2010), their monitoring advantage due to their knowledge about the goods and the industry as well as their ability to enforce payment through the cutting of supplies (Burkrat and Ellingsen, 2004; Boissoy and Gropp, 2013), and their liquidity advantage due to the ease in reselling the product in case of customer's default (Mian and Smith, 1992; Fabbri and Menichini, 2010). Therefore, according to this motive, suppliers should grant trade credit to their customers. In addition, Emery (1984) argues that firms should provide trade credit because it is a short-term investment, which has a significant return higher than marketable securities. For instance, the most common trade credit term of 2% net 10, 30, has an annual return of 40%.

Second, according to the operational motive, suppliers offer trade credit to smooth the demand of their goods (Emery, 1987), for instance, through deferring the payment in periods of low demand. Suppliers face seasonality in demand, which cause them to be vulnerable to variation in either prices or production, and both alternatives are expensive. The variation in the production is costly to suppliers, for instance, it might involve installing extra capacity, while, the variation in prices might decrease the demand. Therefore, firms with unstable demand are expected to offer more trade credit to smooth the demand of their goods (Long, Malitz, and Ravid, 1993). Additionally, Ferris's (1981) theoretical model shows that trade

credit reduces transaction costs, such as warehousing costs through overcoming the problem of holding inventories of goods, as it separates the payment and delivery cycles (Petersen and Rajan, 1997; Bougheas, Mateut, and Mizen, 2009).

Third, the commercial motive suggests that trade credit can be utilized as a guarantee for the product quality and as a marketing tool to attract and stimulate demand (Smith, 1987; Lee and Stowe, 1993; Long, Malitz, and Ravid, 1993). Instead of immediate cash payments, customers will be granted a credit period as a guarantee of quality of the goods before payment. Long, Malitz, and Ravid (1993) find that trade credit is offered for product quality purposes, more in low reputation or small firms, and in industries with quality-based products, such as technology, machinery, etc. Trade credit can also be utilized as a marketing tool to attract new customers. Fabbri and Klapper (2013) claim that it is a less aggressive and more flexible marketing instrument than, for instance, price reduction, which can cause price wars and reactions from other firms in the industry. Blazenko and Vandezande (2003) show that trade credit plays a similar role to advertising to differentiate the products and attract customers. Biais and Gollier (1997) indicate that managers often claim that if firms did not grant trade credit they would not have been able to sell their goods. The commercial motive is of more relevance to firms which are concerned about attracting customers such as high-growth and low bargaining power firms (Fabbri and Klapper, 2013), and therefore are expected to provide more trade credit. On the other hand, firms with higher bargaining power are better able to enforce payment and contract terms and hence can also provide a higher level of trade credit (Wilner, 2000).

A number of U.S. empirical papers examine the determinants of supplying trade credit and the contract terms (Mian and Smith, 1992; Long, Malitz, and Ravid, 1993; Ng, Smith, and Smith, 1999; Cuñat, 2007; Klapper, Laeven, and Rajan, 2012). More recently, a few papers focus on trade credit provision in a specific group of firms such as U.S. SMEs (Petersen and

Rajan, 1997; Giannetti, Burkart, and Ellingsen, 2011; Murfin and Njoroge, 2015) and U.S. distressed firms (Molina and Preve, 2009).[5] However, there has been no study examining the effect of the supplier's listing status on its provision of trade credit; despite of the well-documented differences between public and private firms that can result in a potential difference in their level of trade credit.[6] A related recent strand of literature investigates the effects of market dynamics, for instance, the effect of product market industry (Johnson, McMillan, and Woodruff, 2002; Giannetti, Burkart, and Ellingsen, 2011), the effect of industry's level of competition (McMillan and Woodruff, 1999; Fisman and Raturi, 2004), and the effect of macro-economic conditions (Choi and Kim, 2005; Love, Preve, and Sarria-Allende, 2007; Garcia-Appendini and Montriol-Garriga, 2013) on a firm's trade credit provision. However, we still know very little on whether those market dynamics have a similar effect on the provision of trade credit by public and private firms.

4.3. Development of Hypotheses

We develop two hypotheses for our two research questions. The first relates to the impact of the supplier's listing status on its trade credit provision and the second is on the effect of the macro-economic conditions on the trade credit provided by public and private firms. We hypothesize that the supplier's listing status influences its trade credit provision based on the differences between public and private firms in their access to external markets, the level of asymmetric information, financial constraints, and bargaining power. These differences in turn affect the motives for providing trade credit and the supplied level of trade credit. However, these differences can have contradictory implications, so we consider the two

[5] For non-U.S. studies on the supply of trade credit (see Deloof, 1996; Wilson and Summers, 2002; Pike, Cheng, Cravens, and Lamminmaki, 2005; using SMEs data, see Niskanen and Niskanen, 2006; García-Teruel and Martínez-Solano, 2010).

[6] Anagnostopoulou (2012) is the only study that compares the working capital (cash conversion cycle) of public and private firms using European data. However, the author does not examine potential differences in the components of working capital such as trade credit in public and private firms.

alternatives hypotheses, i.e. public firms provide a higher or lower level of trade credit than private firms.

We predict that public firms provide a higher level of trade credit than private firms because of their greater access to financial markets, lower level of asymmetric information and financial constraints, and higher bargaining power (Brav, 2009; Schenone, 2010; Hill, Kelly and Lockhart, 2012; Gao, Harford, Li, 2013; Fabbri and Klapper, 2013; Acharya and Xu, 2015). These differences affect the amount of trade credit through the following three channels. First, based on the differences in access to financial markets, asymmetric information, and financial constraints, public firms are predicted to be more financially capable of providing trade credit. Their higher financially capability is due to their various alternative sources of finance, lower cost of debt (Brav 2009; Gao, Harford, Li, 2013), and stronger bargaining power with banks (Saunders and Steffen, 2011). Meltzer (1960) and Schwartz (1974) suggest that large, firms with better access to capital markets, financially unconstrained firms should grant more trade credit; this is known as the redistribution view. The redistribution view explains the financial channel of trade credit, where funds should flow from large, liquid, unconstrained, better credit quality to small, constrained and lower credit quality firms. Petersen and Rajan (1997) argue that there is a positive relationship between the access of finance and the supply of trade credit. Hill, Kelly and Lockhart (2012) indicate that financially constrained firms may preserve their limited funding to finance projects or R&D projects rather than financing trade credit.

Second, based on the difference in financial constraints between public and private firms, public firms are expected to have better ability in handling the trade credit process. The financial motive of providing trade credit, which we discussed earlier, has three dimensions: information advantage, monitoring advantage, and liquidity advantage. Public firms are predicted to have better ability in utilizing these dimensions because they are expected to have

economies of scale and sophisticated credit management techniques, which facilitate the handling of trade credit. In addition, offering trade credit has costs such as discounts granted, late payments, bad debts losses, customer defaults, and administrative and monitoring costs, and more generally, the opportunity cost of tying up cash in trade credit (see Emery, 1984; Kim and Atkins, 1978; Sartoris and Hill, 1981, Hill, Kelly and Lockhart, 2012). Hill, Kelly, and Lockhart (2012) argue that, given the costs of granting trade credit, constrained firms may find it difficult to grant it. The administrative process of offering trade credit involves five stages: credit-risk assessment, credit granting, trade credit financing, credit collection, and credit-risk bearing (Mian and Smith, 1992). Public firms are less financially constrained than private firms, therefore, can deal with the credit administration process and the costs of trade credit more effectively and at the same time utilize the three dimensions of the financial motive.

Third, according to the commercial motive of trade credit provision, firms with higher bargaining power, can more easily enforce payments and contract terms and evaluate a customer's credit risk because customers depend on them mainly for their purchases (Wilner, 2000). Public firms are expected to have higher bargaining power because bargaining power is usually measured by firm's market share in industry sales (Hill, Kelly and Lockhart, 2012; Fabbri and Klapper, 2013), public firms are anticipated to be larger with higher sales than private firms (Brav, 2009; Gao, Harford, and Li, 2013; Asker, Farre-Mensa, and Ljungqvist, 2015; Acharya and Xu, 2015).[7] Taken together, these arguments support that public firms provide a higher level of trade credit than their private counterparts.

However, one could argue that, since public firms have greater access to external markets, lower asymmetric information, are less financially constrained, and have higher bargaining power than private firms, they may be less willing to grant trade credit because of

[7] Consistent with this argument, Martínez-Sola, García-Teruel, and Martínez-Solano (2014) predict that SMEs have low bargaining power.

the following alternative arguments. First, public firms are less financially constrained than private firms, therefore, they may be less inclined to grant trade credit to utilize its financial advantage. Trade credit can be factored if funds are needed before collection (Mian and Smith, 1992). It can also be collateralized and used to secure asset-backed funding (Hill, Kelly, and Lockhart, 2012). However, public firms can use several alternative sources to meet their financial needs and are less in need to provide trade credit to use its financial privileges.

Second, trade credit is used as a tool to guarantee product quality before payment and ultimately to signal the supplier's quality. One of the predictions of the product quality model is that firms with established reputations are less in need of extending trade credit as a quality signal. Public firms have a higher level of transparency (Saunders and Steffen, 2011) to outsiders and it is relatively easier to signal their quality and their products' quality; according to the product quality model, they are expected to provide a lower level of trade credit.

Third, trade credit is granted to attract and stimulate demand of their goods. Small, growing firms, firms with low bargaining power, and new entrant firms must grant trade credit and offer competitive terms to market their products and attract customers (Wilson and Summers, 2002). As discussed earlier, private firms are predicted to have lower bargaining power than public firms. In a similar context, Fabbri and Klapper (2013) find that Chinese firms with lower bargaining power grant more trade credit, because they are more in need to provide a guarantee for the quality of their products, attract new customers, and when dealing with high bargaining power customers they are forced offer longer and better payment terms.

Given the arguments and counter-arguments discussed above, our prediction of the relationship between listing status of a firm and its provision of trade credit is ambiguous. We, therefore, have the following alternative hypotheses:

H1(a): Public firms provide a higher level of trade credit than private firms.

H1(b): Public firms provide a lower level of trade credit than private firms.

We hypothesize that the recent financial crisis had differential effects on the trade credit provided by private and public firms. Private firms are expected to provide less trade credit during adverse periods, because they are financially constrained and cannot accommodate further financial pressure from trade credit provision during crisis periods. Specifically, suppliers do not receive compensation in case of a customer deferment of payments or default. Trade credit often has no late payments penalty and usually there are concessions in case of a customer default (Wilner, 2000). Furthermore, based on the redistribution view, trade credit should flow from large, liquid, unconstrained, and better credit quality firms to small, constrained and lower credit quality firms especially during tight macroeconomic conditions (Meltzer, 1960; Schwartz, 1974). Compared to public (private) firms, private (public) firms are financially constrained (unconstrained), with limited (alternative) sources of finance, and thus are expected to grant less (more) trade credit during the crisis periods. Consistent with these predictions, Love, Preve, and Sarria-Allende (2007) and Garcia-Appendini and Montriol-Garriga (2013) find that firms which are more (less) vulnerable to crisis decrease (increase) their trade credit provision dramatically during crisis periods. We expect public (private) firms to be less (more) vulnerable to crisis and so public (private) firms should increase (decrease) their trade credit provision during the recent financial crisis. Collectively, the arguments discussed above lead to the following hypothesis:

H2: During economic downturns, private firms decrease their provision of trade credit, while, public firms increase theirs.

4.4. Data Description and Empirical Models

The data source is the S&P Capital IQ database for the period 1994-2012. Our data allows us to investigate the trade credit over a period and to address the concern of Petersen and Rajan (1997) that the most important challenge for future research is to examine the determinants of trade credit over time. In the same context, Huyghebaert (2006) indicates that

trade credit has a dynamic nature and hence it is better investigated using panel data. S&P Capital IQ database specialize in providing U.S. private firm's data, therefore, its coverage of trade credit data includes more private than public firms. Our final sample consists of 30,108 private firms with 76,632 firm-year observations and 3,385 public firms with 34,821 firm-year observations.[8] We arrive at the final sample after excluding financials and utilities, IPO firms, firms that went private during our sample period, and firms with cash flow over total assets of less than -50%.[9] We also remove observations with missing variables, negative equity, and negative total assets.[10] Finally, we winsorize the variables at the 1% and 99% levels. Survivorship bias does not affect our analysis because S&P Capital IQ does not remove dead companies.

We use the following model to capture the impact of supplier's listing status on its trade credit provision:

$$AR_{it} = \beta_0 + \beta_1 Public_{it} + \boldsymbol{\theta}' \boldsymbol{X_{it}} + \varepsilon_{it}. \quad (1)$$

The dependent variable is accounts receivable ratio (AR_{it}) measured as accounts receivable to total sales (Pertersen and Rajan, 1997; Love, Preve, and Sarria-Allende, 2007; Giannetti, Burkart, and Ellingsen, 2011; Garcia-Appendini and Montriol-Garriga, 2013). $Public_{it}$ is a dummy that takes a value of 1 for public firms and 0 otherwise. The impact of the supplier's listing status on its trade credit provision is captured by β_1. Based on prior studies (Pertersen and Rajan, 1997; Choi and Kim, 2005; Giannetti, Burkart, and Ellingsen, 2011; Garcia-Appendini and Montriol-Garriga, 2013), we include a vector of control variables (X_{it}) which includes age, age-squared, fixed assets, negative growth, positive growth, profitability, short-term debt, and size. ε_{it} is the error term.

[8] Consistent with Gao, Lemmon, and Li (2012), and Asker, Farre-Mensa, and Ljungqvist (2015) and our sample includes more observations for private than for public firms.

[9] We find qualitatively similar results if we include utilities firms in our sample. The regression results are tabulated in Table A.1 in the Appendix.

[10] Our filtration strategy is consistent with Gao, Harford, and Li (2013).

Age and size are proxies for the creditworthiness of the firm (Petersen and Rajan, 1997). We measure age as ln(1+age) and size as the natural logarithm of total sales (Scherr and Hulburt, 2001), measured in the 2012 Dollar price. Large and old firms, due to their better financial ability, should grant more trade credit. At the same time, large firms are less in need of boosting the demand of their goods by providing trade credit, in addition, small and young firms should provide more trade credit as a guarantee for the quality of their products, (Long, Malitz, and Ravid, 1993). We also include age-squared to account for the importance of the first few years in developing firm's reputation. Fixed assets has a substitute effect on accounts receivable because of the trade-off between investing in it and providing trade credit. We measure fixed assets as property, plant and equipment over total assets and expect to find a negative relationship between fixed assets and accounts receivable, consistent with the findings of Giannetti, Burkart, and Ellingsen (2011) and Garcia-Appendini and Montriol-Garriga (2013).

We measure negative growth as sales growth times the negative growth dummy variable, which takes the value of 1 if sales growth is negative, and 0 otherwise. Positive growth is sales growth times the positive growth dummy variable, which takes the value of 1 if sales growth is positive, and 0 otherwise, consistent with Petersen and Rajan (1997). Profitability is a proxy for the internal funds of the firm, used to finance trade credit. We measure it as net income over total sales (Petersen and Rajan, 1997). Firms with high profitability are expected to provide more trade credit. Short-term debt is another source (external) to finance trade credit. We measure short-term debt as short-term borrowings plus current portion of long-term debt over total assets (Scherr and Hulburt, 2001). We expect to find a positive relationship between short-term debt and the supply of trade credit, consistent with Choi and Kim (2005).

Our second model examines the effects of the recent financial crisis (2007-2009) on the level of trade credit provided by public and private firms:

$$AR_{it} = \beta_0 + \beta_1 Public_{it} + \beta_2\ Crisis_{it} + \beta_3\ Crisis_{it}\times Public_{it} + \boldsymbol{\theta}'\boldsymbol{X_{it}} + \varepsilon_{it}. \quad (2)$$

The dependent variable is similar to the first model, accounts receivable ratio (AR_{it}) is defined as accounts receivable to total sales. $Public_{it}$ is a dummy that takes a value of 1 for public firms and 0 otherwise. $Crisis_{it}$ is a dummy that takes the value of 1 for crisis years 2007-2009.[11] $Crisis_{it}\times Public_{it}$ is the interaction term between $Crisis_{it}$ and $Public_{it}$. ε_{it} is the error term. Following Love, Preve, and Sarria-Allende (2007), we include three years pre-crisis and the crisis period, thus, the model is estimated during the period 2004-2009, to avoid capturing effects from other macro-economic events. The effect of the financial crisis on private firms' trade credit provision is captured by the coefficient of $Crisis$, while on public firms' by the sum of coefficients of $Crisis$ and $Crisis\times Public$. If Hypothesis 2 is to be supported, we expect β_2 to be negative to indicate that private firms decrease their trade credit provision during the crisis period.

4.5. Empirical Results

This section is divided into six sub-sections: In the first sub-section, we discuss the descriptive statistics and the univariate analysis, followed by the regression results of the impact of suppliers' listing status on its trade credit provision in the second sub-section. We present a series of robustness checks in the third sub-section. Next, we examine the effects of firm characteristics on the level of trade credit provided by public and private firms in the fourth sub-section. We then report the results of the effects of the product market dynamics on the level of trade credit provided by public and private firms in the fifth sub-section and finally

[11] We find qualitatively similar results if we define the crisis period as 2007-2008. The regression results are tabulated in Table A.2 of the Appendix.

we present the results of the effects of the macro-economic conditions on the level of trade credit provided by public and private firms in the sixth sub-section.

4.5.1. Sample Description

Table 1 presents the descriptive statistics of our sample (Panel A) and of accounts receivable ratio across industries (Panel B). The mean (median) of accounts receivable ratio of our firms is 13.4% (11.9 %). The average age is 39.6 years. Our firms have 23.4% of their assets as fixed assets.

Panel (B) of Table 1 reports the accounts receivable ratio across the 12-Fama French Industry classification. We find that the highest levels of accounts receivable ratio are in the energy and business equipment industries, with mean (median) of 18.7% (15.5%) and 18.4% (16.2%) respectively. Accounts receivable ratio is expected to be high in the energy industry because customer fraud is low as the products are difficult to be diverted into cash (Giannetti, Burkart, and Ellingsen, 2011). In addition, business equipment industry has products that require a guarantee of quality; therefore, suppliers provide more trade credit in this industry. Similar to the findings of Giannetti, Burkart, and Ellingsen (2011), we find that the retail and wholesale industry has the lowest accounts receivable ratio. This finding suggests that this is because of high customer fraud and low customer loyalty. Suppliers in the retail and wholesale industry, suppliers find it difficult to induce loyalty without undue credit risk, therefore choose to offer less trade credit (Blazenko and Vandezande, 2003).

[Insert Table 1 here]

Table 2 presents the accounts receivable ratio of public and private firms for the full sample as well as across different industries. Panel (A) of Table 2 reports the univariate analysis of accounts receivable ratio of public and private firms. The mean (median) accounts receivable ratio of public firms is 15.7% (14%), while private firms have a mean of accounts receivable ratio of 12.4% (10.9%). The difference between the means (medians) of accounts

receivable ratio of the two types of firms is 3.3% (3.1%). The t-test of the differences in mean and the Wilcoxon-Mann-Whitney test of differences in median, confirm that the differences are statistically significant; and suggest that public firms provide a higher level of trade credit than private firms, supporting Hypothesis (1a).

In Panel (B) of Table 2, we report the summary statistics of accounts receivable ratio of public and private firms across industries. In all industries, there is a statistical significant difference between the mean (median) of accounts receivable ratio of public and private firms. Public firms provide more trade credit than private firms in all industries, with the exception of retail and wholesale industry, where private firms offer a higher level of trade credit by about 1.2%, we will return to discuss this result at length in section 4.5.5.1. Overall, the results indicate a variation in the difference in trade credit provided by public and private firms across industries; therefore, we examine later the impact of the industry type on the supply of trade credit by public and private firms.

[Insert Table 2 here]

4.5.2. The Supplier's Listing Status and Trade Credit Provision

Table (3) presents the regression results of our first model of the impact of the supplier's listing status on its trade credit provision. In Columns (1-2), we examine the relationship between the *Public* dummy and accounts receivable ratio without and with year and industry dummies respectively. The *Public* dummy is positive and statistically significant with a coefficient of 3.3% (1.9%) in Column 1(2) respectively, confirming that public firms provide more trade credit than private firms. The results in Columns (3-4) show that the inclusion of the control variables does not significantly alter our earlier results, the *Public* dummy is still positive, and statistically significant with a higher coefficient of 4.9% and 2.9%

respectively.[12] According to the coefficient of *Public* dummy in Column (4) (2.9%), public firms supply more trade credit than private firms by 23.4% relative to the mean of accounts receivable ratio of private firms (12.4%). This result supports that Hypothesis (1a) denominates the alternative hypothesis and confirms that public firms provide more trade credit than private firms. The prediction of Hypothesis (1a) leaned on the arguments that public firms have higher financial capability, better ability in handling the trade credit process and in enforcing payments and contract terms, than private firms.

With respect to the control variables, their results are consistent with prior studies. Age and size are negatively related to accounts receivable, consistent with the findings of Giannetti, Burkart, and Ellingsen (2011) and Garcia-Appendini and Montriol-Garriga (2013). This supports the argument that large and old firms are less in need in providing trade credit to attract customers and to signal their products' quality. As predicted, and consistent with the findings of Giannetti, Burkart, and Ellingsen (2011) and Garcia-Appendini and Montriol-Garriga (2013), firms with high tangibility provide less trade credit due to the substitution effect between investing in fixed assets and trade credit. In line with Petersen and Rajan (1997), positive growth has a positive coefficient and negative growth has a negative coefficient. We find that firms with high profitability provide less trade credit, similar to the findings of Petersen and Rajan (1997) and Garcia-Appendini and Montriol-Garriga (2013). Petersen and Rajan (1997) argue that this could be driven by firms with negative profits; in the next sub-section, we distinguish between positive and negative profits. Finally, we document as expected a positive relationship between short-term debt and trade credit in Column (4), in line with the findings of Choi and Kim (2005).

[Insert Table 3 here]

[12] All our empirical regressions results are using robust heteroskedasticity-consistent standard errors, however, our results remain qualitatively similar if we use robust standard errors clustered at the firm level.

4.5.3. Robustness Checks

We apply a battery of additional tests to check the robustness of our results reported above. First, we include alternative measures of control variables in model (1). Second, we utilize two matching techniques to control for the observable differences between public and private firms. Third, we run a treatment regression to account for the possibility of the endogeneity of the *Public* dummy in the accounts receivable model.

4.5.3.1. Alternative Measures of Control Variables

Table 4 reports the results of model (1) after including alternative measures of the determinants of trade credit provision.[13] In all Columns, we still find strong evidence that public firms provide a higher level of trade credit than private firms.

In Column (1), we distinguish between negative and positive profits. This disaggregation is used to investigate why profitability has a negative impact on the supply of trade credit. The justification is that the firms with negative profits drive this negative relationship, these firms grant more trade credit to stimulate the demand for their products (Petersen and Rajan, 1997). We find evidence for this argument and observe that negative profits have higher magnitude than positive profits. Here, public firms grant a higher level of trade credit than private firms by 2.3%.

In Column (2), we include letter of credit, being an alternative source of financing for trade credit other than short-term debt that we used in our baseline regression. It is measured as undrawn letter of credit over total assets, following Giannetti, Burkart and Ellingsen (2011). The finding shows that public firms provide a higher level of trade credit than private firms by

[13] Table A.1 of the appendix presents the regression results on an extended sample and after including further control variables.

1.5%, and that firms with a higher level of undrawn letters of credit provide more trade credit.[14]

In Column (3), we confirm the robustness of our results, after including turnover, being an alternative proxy for the product quality theory, other than size and age which we used in our baseline regression. Turnover is measured as total sales over total assets minus accounts receivable (Long, Malitz, and Ravid, 1993). Firms with lower turnover have a longer production cycle and are expected to grant more trade credit to signal their products'quality. Products with long production cycle are assumed to be of high quality. We find that public firms offer a higher level of trade credit than private firms by 2.9%; turnover is, as expected, negatively related to trade credit.

In Column (4), we account for the possible substitution effect between investing in inventory and accounts receivable. We measure inventory as inventory over total assets. Public firms provide a higher level of trade credit than private firms by 2.3% as shown in Columns (4). The results show that firms with lower inventory will provide more trade credit.

[Insert Table 4 here]

4.5.3.2. Matching Techniques

We employ two matching techniques, one-to-one propensity score matching, and one-to-n matching, similar to Gao, Harford, and Li (2013), to rule out that our results are being driven by the observable differences between public and private firms. In the propensity score matching, we match each public firm observation to a private firm observation using the one-to-one nearest neighborhood without replacement approach, which choose the matches that minimize the absolute value of the difference between the propensity scores of the public (treated) and private (control) firm. The propensity scores are from a probit regression of being public, using the matching criteria. In the first criterion, we match on industry, year and

[14] Due to missing data on letter of credit of private firms, we run this regression with limited number of observations.

size. In the second criterion, we match on all the control variables, namely, age, age-squared, fixed assets, negative growth, positive growth, profitability, short-term debt, and size. In the one-to-n matching, we match each public firm with a private firm in the same industry and year, and of closest size (allowing for a deviation of 30%). The one-to-n matching procedure (with replacement) allows us to have more matches, since each private (control) firm can be a match for more than one public (treated) firm. The results of the matched samples are presented in Table 5. In Panel (A) of Table 5, we report the pairwise differences in the accounts receivable ratio between public and private firms in the propensity score-matched sample, public firms provide a higher level of trade credit than private firms by 3.3% (2.8%) in criterion 1 (2).

In Panel (B) of Table 5, we present the multivariate analysis of the matched sample, the first (second) Column reports the regression results of the matched sample based on criterion 1 (2) of the propensity score matching. In both Columns, public firms provide a higher level of trade credit than private firms by 3.7% (3.8%). In the third Column, we present the regression results of the matched sample based on the one-to-n matching. Public firms continue to provide a higher level of trade credit by 3.6% than private firms.

[Insert Table 5 here]

4.5.3.3. Treatment Regression

A possible concern, given that the decision to go public can be affected by variables that also determine firm's trade credit provision, is that the *Public* dummy can be endogeneous in the accounts receivable model (1). To account for this concern, we estimate a treatment regression. Treatment regression accounts for the endogeneity of a binary variable (see Gao, Harford, and Li, 2013). It involves estimating two-stage regression as follows:

$$Public_{it} = \boldsymbol{\gamma}' \boldsymbol{Z_{it}} + \omega_{it};\ \text{First} - \text{stage regression} \quad (3)$$

$$Public_{it} = 1\ if\ Public_{it}^{*} > 0; = 0\ otherwise$$

$$AR_{it} = \beta_1 Public_{it} + \boldsymbol{\theta}' \boldsymbol{X_{it}} + \varepsilon_{it}. \text{ Second} - \text{stage regression} \quad (4)$$

The first stage regression (model 3) is a probit regression of *Public* dummy and the fitted value of *Public* dummy is included in the second-stage regression (model 4) of the accounts receivable regression. The independent variables are similar in both models except that we include an instrument for the *Public* dummy in model (3) for identification purposes. The instrument should directly affect the *Public* dummy, but does not affect the accounts receivable directly unless through *Public* dummy. The industry level of underwriter concentration satisfies these requirements as it affects the costs of doing an IPO and the decision to go public, but does not affect corporate financial policies (Gao, Harford, and Li, 2013). The industry level of underwriter concentration is defined as the number of IPOs underwritten by the top five underwriters divided by the number of IPOs in that industry (Liu and Ritter, 2011).

Table 6 presents the results of the treatment regression, with the first-stage of the treatment regression in Column (1) and the second-stage regression in Column (2). Consistent with the findings of Liu and Ritter (2011) and Gao, Harford, and Li (2013), we find that the higher the underwriter concentration, the less likely is a firm to go public. In Column (2), *Public* dummy has a positive significant coefficient of 3.8%, suggesting that public firms provide more trade credit than private firms. The test of endogeneity confirms the endogeneity of the *Public* dummy in accounts receivable regression and the estimated coefficient of rho is negative suggesting that the unobservable characteristics that affect the decision of going public are negatively related to accounts receivable. As here the *Public* dummy has a higher coefficient than our baseline results, this indicates that the endogeneity affected the strength of our baseline results.

[Insert Table 6 here]

4.5.4. The Effects of Firm Characteristics on Trade Credit Provision

In this section, we investigate whether the strength of our earlier results vary across different types of firms. In particular, we sub-divide our sample according to the firm characteristics related to the motives of providing trade credit, namely size, tangibility, sales volatility, bargaining power, and growth opportunities. We borrow the usage of these variables as proxies for the motives of trade credit provision from Long, Malitz, and Ravid (1993) and Hill, Kelly, and Lockhart, (2012). Hill, Kelly, and Lockhart (2012) perform similar sub-sampling to investigate the impact of supplying trade credit on shareholder returns.

Table 7 presents the regression results on the difference between the level of trade credit provided by public and private firms, conditioned on these firm characteristics. In the first Column, we consider size; large firms provide more trade credit by 0.6% because these are expected to have higher financial ability as suggested by Pertersen and Rajan (1997). The interaction term (*Large×Public*) shows that large public firms provide even more trade credit by 0.6%. This is consistent with the predictions of the redistribution view that large, unconstrained, better credit quality should grant more trade credit. Additionally, within public firms, the financial motive arguments are stronger in large firms, such as the lending advantage, handling the trade credit process, re-selling advantage in case of a customer default etc. In the second Column, *High Tang* dummy. is negatively related to trade credit. Generally, firms with high tangibility provide less trade credit by 0.5% because they are less in need to use trade credit as collateral, consistent with findings of Giannetti, Burkart, and Ellingsen (2011) and Garcia-Appendini and Montriol-Garriga (2013). We argued earlier that public firms are less in need to utilize trade credit to benefit from its collateral feature. Subsequently, public firms with high tangibility can use these tangible assets as collateral and therefore, provide even less trade credit, by 0.9% than similar private firms.

In Column (3), we consider the volatility of sales measured by the standard deviation of sales of three years over average sales of three years, following Long, Malitz, and Ravid (1993). Firms with high sales volatility provide more trade credit by 0.2%, consistent with the operational motive of trade credit to smooth the demand of their goods and the findings of Long, Malitz, and Ravid (1993). The interaction term (*High Vol.×Public*) is positive, supporting the arguments of the operational motive, public firms with high sales volatility offer more trade credit, by 0.5% than comparable private firms.

In Column (4), we consider the bargaining power measured by a firm's sales divided by aggregate industry sales in a given year, following Hill, Kelly, and Lockhart (2012). The *High Bargain.* dummy is significantly positive, supporting the argument that firms with high bargaining power provide more trade credit by 0.5%, because they have a greater ability to enforce payments and contract terms. These arguments remain consistent in public firms as shown by the positive significant interaction term (*High Bargain.×Public*). Within public firms, those with higher bargaining power provide more trade credit, by 1.3% than comparable private firms. This confirms that public firms with higher bargaining are better able to force payments and contract terms. Finally, in Column (5), *High Growth* dummy confirms that firms with high growth provide more trade credit by 0.8% to stimulate the demand of their products. The interaction term (*High Growth×Public*) shows that public firms with high growth grant more trade credit by 0.3% than similar private firms. This is consistent with the commercial motive predictions that high growth firms are more inclined to stimulate demand and attract customers, hence, supply more trade credit.

[Insert Table 7 here]

To sum up, we find that public firms that are large, have low tangibility, high sales volatility, high bargaining power, and are high growth provide more trade credit than respective private firms. These findings are broadly consistent with the expectation of the

motives for providing trade credit. The results of this sub-section are not fully supporting the theories (financial constraints, access to financial markets, and asymmetric information) that we rely on in explaining our main results (Table 3). Nevertheless, we find them to be consistent with an alternative views, i.e., to the motives of trade credit provision.

4.5.5. The Product Market Dynamics and Trade Credit Provision

Our earlier results document that the supplied level of trade credit varies across industries similar to prior studies. In this sub-section, we examine the effects of two product market dynamics on the level of trade credit provided by public and private firms, namely industry's type (including differentiated, service, retail and wholesale, and standardized industries) and industry's level of competition.

4.5.5.1. Industry's Type

The type of industry affects the supplied amount of trade credit (Johnson, McMillan, and Woodruff, 2002). Giannetti, Burkart, and Ellingsen (2011) find that firms in differentiated and service industries grant more trade credit. Their classification of industries is based on Rauch (1999) in which industries are categorized by the first two digits of the standard industrial classification (SIC) code.[15] The findings confirm their two main arguments: the difficulty of diverting, and high switching costs. In differentiated and service industries, the products and services sold are less liquid and so are difficult to be diverted into cash and (Burkart and Ellingsen, 2004), therefore, customers are less likely to commit fraud. In addition, these industries have high switching costs because there are limited number of suppliers, hence, the customers are more concern about preventing these costs (Hill, Kelly, and Lockhart, 2012) and are less tempted to default.[16] These two arguments highlight the strong supplier-

[15] Service industry include firms with the first two SIC digits 41, 42, 44, 45, 47-57, 59, 61, 64, 65, 73, 75, 78 and 79. Differentiated industry include firms with the first two SIC digits 25, 27, 30, 32, 34-39, and standardized industry is defined as firms with the first two SIC digits 12, 14, 20, 22-24, 26, 28, 29, 31, and 33.

[16] Switching costs are costs incurred by customers if they switch to another supplier. Examples of switching costs are learning and transaction costs (Klemperer, 1987; Chevalier and Scharfstein, 1996). Learning costs could be

customer relationship in these industries. Burkart and Ellingsen (2004) argue that from the supplier's perspective, the ideal scenario for providing trade credit is to have a good which is difficult to divert and has a high collateral value.

There are two other possible justifications for the high supply of trade credit in differentiated and service industries, compared to other industries (Giannetti, Burkart, and Ellingsen, 2011). First, the collateral argument, which is only valid in differentiated industry, as services have no liquidation value. Suppliers in differentiated industry are better at re-selling the product in the case of customer's default, because they know their customer base and are able to modify the product and re-sell it to other customers; this encourages suppliers to grant more trade credit. [17] Second, the product quality argument, goods and services offered in differentiated and service industries tend to be unique and quality-based, therefore, suppliers should offer more trade credit as a guarantee for the product quality.

In respect to public versus private firms, we expect that at least two of the above-mentioned arguments are more pronounced in one type of firms than the other, such as, the re-selling of products and the product quality argument. Our earlier discussion predicts that public firms have better ability in re-selling of products due to their sophisticated networks in the industry, while, private firms are more concerned to provide trade credit to signal their products' quality. Therefore, we investigate whether there is a difference in the trade credit provided by public and private firms in these industries. Table 8 reports the regression results of this analysis.

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software, learning how to use a new machine product line, transaction costs related to new suppliers, new equipment, etc.

[17] The advantage of re-selling the goods has been magnified after the Bankruptcy Abuse and Customer Protection Act in 2005. The act has changed the supplier's reclamation rights. In the case of the customer's insolvency, the reclamation period was extended from 10 to 45 days, and the grace period after the bankruptcy case from 10 to 20 days (Section 546 (c)). Trade creditors who provided goods to a distressed debtor within 20 days before the start of a bankruptcy case are entitled to administration priority equal to the value of the goods sold (Section 503 b (9)). These changes in regulations have granted suppliers substantial reclamation rights.

Column (1) of Table (8) confirms that in differentiated industries, there is a higher supply of trade credit by 1.1%, consistent with the findings of Giannetti, Burkart, and Ellingsen (2011). The interaction term (*Diff.×Public*) supports that public firms in differentiated industries provide more trade credit by 0.8% than private firms. This result confirms that public firms are better at re-selling the good in the event of customer default.[18]

We tabulate the service industry results in Column (2), where we find a lower level of trade credit by 4.3%. Possibly, this finding can be explained by two reasons; first, it appears that the feature of zero liquidation value of service industry denominates the other opposing arguments, and so we find that firms are reluctant to supply trade credit in this industry. Second, the employed definition of service industry includes retail and wholesale firms, which as documented in section 4.5.1., have a lower level of trade credit. The positive significant coefficient on the interaction term (*Service×Public*) shows that public firms in service industry provide a higher level of trade credit than their private counterparts. This result suggests that the characteristic of zero liquidation value of the service industry is of more concern to private firms because they are financial constrained and this feature provide more risks in case of a customer default because the service cannot be re-sold.

Retail and wholesale industry is included under the service industry according to Giannetti, Burkart, and Ellingsen's (2011) classification. However, they differ than service firms, because the products sold in these industries are very liquid and can be easily diverted into cash, resulting in high chances of customer fraud and therefore lower supply of trade credit (Johnson, McMillan, and Woodruff, 2002; Burkart and Ellingsen, 2004; Giannetti, Burkart, and Ellingsen, 2011). We identify firms in the retail and wholesale industry according to the 12-Fama French industry classification. In Column (3), we find that the supply of trade credit is lower in the retail and wholesale industry by 5.7%. Furthermore, public firms in retail

[18] We do not rule out the possibility that other reasons, such as high switching costs and difficulty to divert, can explain this result.

and wholesale industry provide even a lower level of trade credit, by 2.6% than private firms. In this industry, public firms tend to choose to grant less trade credit, possibly because of the high chances of customer fraud, especially, that this industry have weak supplier-customer relationship.

In Column (4), we report the regression results of the standardized industry. Standardized industry has similar high chances of customer fraud to the retail and wholesale industry, as well as has a weak supplier-customer relationship. In the standardized industry, first, products are homogeneous, hence, there is less need to offer trade credit to guarantee the product quality. Second, there are many suppliers providing similar products and switching costs are low, therefore there is a weak supplier-customer relationship and customers are not discouraged to default. These reasons suggest that firms provide a lower level of trade credit in the standardized industry, as argued by Johnson, McMillan, and Woodruff (2002) and Giannetti, Burkart, and Ellingsen (2011). Our findings show that the supply of trade credit in standardized industries is lower by 1% and public firms supplying standardized products provide even less trade credit than private counterparts, by 0.8%. We propose that this result is due to, the same arguments as in the retail and wholesale industry, the high chances of customer fraud and the weak supplier-customer relationship leads public firms to be less concern to provide trade credit.

In short, we find that there is a variation in the level of trade credit provided by public and private firms across industries. Specifically, public firms provide more trade credit in differentiated and service industries, but less trade credit in retail, wholesale and standardized industries than private firms.[19] These findings suggest that public firms do not grant more trade credit than private firms in all industries, however, they tend to carefully evaluate the costs and benefits of supplying trade credit.

[19] In unreported results, we investigate the high tech. industry, but we find no differential effect on the supply of trade credit by public and private firms.

4.5.5.2. Industry's Level of Competition

The industry's level of competition influences trade credit provision, however, the direction of its effect remains debatable. In competitive industries, a firm's market power and negotiating ability are lower, firms find it difficult to provide less trade credit without harming their market share, especially with the existence of alternative suppliers (Hill, Kelly, and Highfield, 2010). Fabbri and Klapper (2013) explain that since competitive markets have most likely homogeneous products, suppliers are willing to grant more trade credit to attract new customers as well as to prevent current customers from switching to another supplier. Fisman and Raturi (2004) and Fabbri and Klapper (2013) find that in competitive industries, suppliers are more likely to offer more trade credit with better contract terms.

However, McMillan and Woodruff (1999) find that in concentrated industries the supply of trade credit is higher because the suppliers have better ability to force payments from customers and contract terms, particularly, that there are few if any alternative suppliers. Molina and Preve (2009) argue that concentrated industries have strong supplier-customer relationship, due to the difficulty in finding alternative suppliers and the high switching costs. This feature forces customers to maintain their reputation as reliable customers and be less likely to default. As discussed earlier, public firms have better ability to enforce payments, whereas, private firms are more concern to attract customers. These differences suggest that the industry's level of competition can have a differential effect on the level of trade credit provided by public and private firms. Column (5) of Table 8, reports the regression results. Concentrated industries are industries with above the median Herfindahl-Hirschman index, following Molina and Preve (2009) and Hill, Kelly, and Lockhart (2012).

The results show that firms in concentrated industries offer an extra 3.6% trade credit as compared to other industries. This supports the argument that in concentrated industries, firms have better ability to force payments and contract terms as well as they have a strong

relationship with their customers, consistent with McMillan and Woodruff (1999). The statistically significant interaction term (*Concentrated×Public*) confirms that there is a differential effect between the supply of trade credit by public and private firms in concentrated industries. In concentrated industries, public firms supply less trade credit than private firms as indicated by the negative coefficient on the interaction term *Concentrated×Public* (-0.016). This result suggests that because there are few suppliers in concentrated industries, public firms are less inclined to attract new customers and prevent current customers from switching to another supplier.

[Insert Table 8 here]

4.5.6. The Effects of Macro-economic Conditions on Trade Credit Provision

We investigate the effect of the macro-economic conditions, proxied by the recent financial crisis, on the level of trade credit provided by public and private firms. During bad macro-economic conditions, previous studies predict that inter-firm finance should play an important role (Meltzer, 1960; Schwartz, 1974). However, Garcia-Appendini and Montriol-Garriga (2013) document an overall decline in the supply of trade credit provided by public firms during the recent financial crisis, if they do not take in to account the level of supplier's pre-crisis liquidity. Table 9 reports the regressions results of model (2).

We first examine the overall effect of the financial crisis on trade credit provision; next, we consider its effects on the level of trade credit provided by public and private firms. Consistent with aggregate results of Garcia-Appendini and Montriol-Garriga (2013), we find a negative effect of the financial crisis on amount of supplied trade credit by 1.2% (1.6%) in Column 1(2). This finding confirms that during the financial crisis, the shortage in global liquidity did not allow suppliers to provide as much trade credit as they would have planned for. However, in Columns (3-4), we do not find significant evidence for a differential effect of

the financial crisis on the level of trade credit provided by public and private firms as demonstrated by the insignificant interaction term between (*Crisis* × *Public).*

The pre-crisis level of liquidity affects the level of trade credit offered during the crisis period (Love, Preve, and Sarria-Allende, 2007; Garcia-Appendini and Montriol-Garriga, 2013). We define the pre-crisis liquidity by the level of cash holdings, measured as cash and cash equivalents to total assets of the year of 2006. We report the effects of the financial crisis on trade credit levels provided by public and private firms conditional on pre-crisis firm's cash holdings in Columns (5-6). According to Column (6), the effect of the financial crisis on the level of trade credit provided by private firms, given the pre-crisis cash holdings is measured by the sum of the coefficients of *Crisis* (-0.007) and $Cash_{pre\text{-}crisis} \times Crisis$ (-0.054). The sum of the coefficients is significantly negative, indicating that the level of private firms' pre-crisis cash holdings was not fully sufficient to clear the decline in their supply of trade credit during the financial crisis. Similarly, based on Column (6), the impact of the crisis on public firms' trade credit provision, conditioned on the pre-crisis cash holdings is captured by the sum of coefficients of *Crisis* (-0.007), *Crisis* × *Public* (-0.008), $Cash_{pre\text{-}crisis} \times Crisis(-0.085),Cash_{pre\text{-}crisis} \times Public$(-0.054*),* and $Cash_{pre\text{-}crisis} \times Crisis \times Public$ (0.070) is significantly negative. This negative impact is potentially driven by firms' choice to hold cash for precautionary reasons rather than using it to offer trade credit.

Overall, suppliers had financially suffered during the recent financial crisis, regardless of their listing status; both types of firms provided less trade credit. [20]

[Insert Table 9 here]

4.6. Conclusion

In this paper, we examine the impact of the supplier's listing status on its trade credit provision. The data on both public and private firms is collected from the S&P Capital IQ

[20] In unreported results (available upon request), we do not find a differential effect of the pre-crisis level of short-term debt on the level of trade credit provided by public and private firms during the recent financial crisis.

database for the period 1994-2012. We predict that public firms provide more trade credit than private firms, because public firms have higher financial capability, better ability in handling the trade credit process and in enforcing payments and contract terms, than private firms. This is because public firms have greater access to external markets, lower asymmetric information, lower financial constraints, and higher bargaining power. Consistent with our hypothesis, our findings show that the amount of trade credit provided by public firms is 23.4% higher than that provided by private firms. Our results are robust to including alternative control variables, re-estimating the analysis on a matched sample of public and private firms, and taking into account the endogeneity of the going public decision.

We find that public firms that are large, have low tangibility, high sales volatility, high bargaining power, and are high growth provide more trade credit than the private counterparts. The findings also show that public firms provide more trade credit in differentiated and service industries, but less trade credit in retail and wholesale, standardized, and concentrated industries than private firms. These results suggest that public firms do not always provide more trade credit than private firms; their decision depends on the product market dynamics and a weighing of the costs against the benefits of providing trade credit. The financial crisis had no differential effect on the level of trade credit provided by public and private firms. Both types of firms reduced their supply of trade credit.

Overall, our results show that the decision of supplying trade credit does not only depend on the supplier's financial ability, but it involves an evaluation of the costs and benefits of providing trade credit. In a similar context, Murfin and Njoroge (2015) investigate the implicit costs of small, constrained suppliers when they provide trade credit to their larger, financial unconstrained, and higher bargaining power customers. Future research should explore further, the costs and benefits of providing trade credit.

References

Acharya, V., and Xu, Z., 2015. Financial dependence and innovation: The case of public versus private firms. *Journal of Financial Economics* Forthcoming.

Anagnostopoulou, S., 2012. Working capital management and firm listing status. *Multinational Finance Journal*, 16(3–4), pp. 261–301.

Asker, J., Farre-Mensa, J., and Ljungqvist, A., 2015. Corporate investment and stock market listing: A puzzle? *Review of Financial Studies*, 28(2), pp. 342–390.

Biais, B., and Gollier, C., 1997. Trade credit and credit rationing. *Review of Financial Studies*, 10(4), pp. 903–937.

Blazenko, G., and Vandezande, K., 2003. The product differentiation hypothesis for corporate trade credit. *Managerial and Decision Economics*, 24(6–7), pp. 457–469.

Boissay, F., and Gropp, R., 2013. Payment defaults and interfirm liquidity provision. *Review of Finance*, 17(6), pp. 1853–1894.

Bougheas, S., Mateut, S., and Mizen, P., 2009. Corporate trade credit and inventories: New evidence of a trade-off from accounts payable and receivable. *Journal of Banking and Finance*, 33(2), pp. 300–307.

Brav, O., 2009. Access to capital, capital structure and the funding of the firm. *Journal of Finance*, 64(1), pp. 263–308.

Burkart, M., and Ellingsen, T., 2004. In-kind finance: A theory of trade credit. *American Economic Review*, 94(3), pp. 569–590.

Chevalier, J., and Scharfstein, D., 1996. Capital market imperfections and countercyclical markups: Theory and evidence. *American Economic Review*, 86(4), pp. 703–725.

Choi, W., and Kim, Y., 2005. Trade credit and the effect of macro-financial shocks: Evidence from US panel data. *Journal of Financial and Quantitative Analysis*, 40(4), pp. 897–925.

Cuñat, V., 2007. Trade credit: Suppliers as debt collectors and insurance providers. *Review of Financial Studies*, 20(2), pp. 491–527.

Deloof, M., and Jegers, M., 1996. Trade credit, product quality, and intragroup trade: Some European evidence. *Financial management*, 25(3), pp. 33–43.

Demirgüç-Kunt, A., and Maksimovic, V., 2001. Firms as financial intermediaries: Evidence from trade credit data. Working Paper. World Bank Development Research Group.

Emery, G., 1984. A pure financial explanation for trade credit. *Journal of Financial and Quantitative Analysis*, 19(3), pp. 271–285.

Emery, G., 1987. An optimal financial response to variable demand. *Journal of Financial and Quantitative Analysis*, 22(2), pp. 209–225.

Fabbri, D., and Klapper, L., 2013. Bargaining power and trade credit. Working Paper. City University London.

Fabbri, D., and Menichini, A., 2010. Trade credit, collateral liquidation, and borrowing constraints. *Journal of Financial Economics*, 96(3), pp. 413–432.

Ferreira, D., Manso, G., and Silva, A., 2014. Incentives to innovate and the decision to go public or private. *Review of Financial Studies*, 27(1), pp. 256–300.

Ferris, J., 1981. A transactions theory of trade credit use. *Quarterly Journal of Economics*, 96 (2) pp. 243–270.

Fisman, R., and Raturi, M., 2004. Does competition encourage credit provision? Evidence from African trade credit relationships. *Review of Economics and Statistics*, 86(1), pp. 345–352.

Gao, H., Harford, J., and Li, K., 2013. Determinants of corporate cash policy : Insights from private firms. *Journal of Financial Economics*, 109(3), pp. 623–639.

Gao, H., Hsu, P., and Li, K., 2014. Managerial short-termism and corporate innovation strategies. Working Paper. Nanyang Technological University.

Gao, H., Lemmon, M., and Li, K. 2012. Are CEOs in US public firms overpaid? New evidence from private firms. Working Paper. Nanyang Technological University.

García-Teruel, P., and Martínez-Solano, P., 2010. Determinants of trade credit: A comparative study of European SMEs. *International Small Business Journal*, 28(3), pp. 215–233.

Garcia-Appendini, E., and Montoriol-Garriga, J., 2013. Firms as liquidity providers: Evidence from the 2007-2008 financial crisis. *Journal of Financial Economics*, 109(1), pp. 272–291.

Giannetti, M., Burkart, M., and Ellingsen, T., 2011. What you sell is what you lend? Explaining trade credit contracts. *Review of Financial Studies,* 24(4), pp. 1261–1298.

Hill, M., Kelly, G., and Highfield, M., 2010. Net operating working capital behavior: A first look. *Financial Management*, 39(2), pp. 783–805.

Hill, M., Kelly, G., and Lockhart, G., 2012. Shareholder returns from supplying trade credit. *Financial Management*, 41(1), pp. 255–280.

Huyghebaert, N., 2006. On the determinants and dynamics of trade credit use: Empirical evidence from business start-ups. *Journal of Business Finance and Accounting*, 33(1–2), pp. 305–328.

Johnson, S., McMillan, J., and Woodruff, C., 2002. Courts and relational contracts. *Journal of Law, Economics, and Organization,* 18(1), pp. 221–277.

Kim, Y., and Atkins, J., 1978. Evaluating investments in trade credit: A wealth maximizing framework. *Journal of Finance*, 33(2), pp. 403–412.

Kim, S., and Shin, H., 2012. Sustaining production chains through financial linkages. *American Economic Review*, 102(3), pp. 402–406.

Klapper, L., Laeven, L., and Rajan, R., 2012. Trade credit contracts. *Review of Financial Studies*, 25(3), pp. 838–867.

Klemperer, P., 1987. Markets with consumer switching costs, *Quarterly Journal of Economics*, 102(2), pp. 375–394.

Lee, Y., and Stowe, J., 1993. Product risk, asymmetric information, and trade credit. *Journal of Financial and Quantitative Analysis*, 28(2), pp. 285–300.

Liu, X., and Ritter, J., 2011. Local underwriter oligopolies and IPO underpricing. *Journal of Financial Economics*, 102(3), pp. 579–601.

Long, M., Malitz, I., and Ravid, S., 1993. Trade credit, quality guarantees and product marketability. *Financial Management*, 22(4), pp. 117–127.

Love, I., Preve, L., and Sarria-Allende, V., 2007. Trade credit and bank credit: Evidence from recent financial crises. *Journal of Financial Economics*, 83(2), pp. 453–469.

Martínez-Sola, C., García-Teruel, P., and Martínez-Solano, P., 2014. Trade credit and SME profitability. *Small Business Economics*, 42(3), pp. 561–577.

McMillan, J., and Woodruff, C., 1999. Interfirm relationships and informal credit in Vietnam. *Quarterly Journal of Economics*, 114(4), pp. 1285–1320.

Meltzer, A., 1960. Mercantile credit, monetary policy, and size of firms. *Review of Economics and Statistics*, 42(4), pp. 429–437.

Mian, S., and Smith, C., 1992. Trade credit management policy: Theory and evidence. *Journal of Finance*, 47(1), pp. 169–200.

Michaely, R., and Roberts, M., 2012. Corporate dividend policies: Lessons from private firms. *Review of Financial Studies*, 25(3), pp. 711–746.

Molina, C., and Preve, L., 2009. Trade receivables policy of distressed firms and its effect on the costs of financial distress. *Financial Management*, 38(3), pp. 663–686.

Mortal, S., and Reisel, N., 2013. Capital allocation by public and private firms. *Journal of Financial and Quantitative Analysis*, 48(1), pp. 77–103.

Murfin, J., and Njoroge, K., 2015. The implicit costs of trade credit borrowing by large firms. *Review of Financial Studies*, 28(1), pp. 112–145.

Ng, C., Smith, J., and Smith, R., 1999. Evidence on the determinants of credit terms used in inter-firm trade. *Journal of Finance*, 54(3), pp. 1109–1129.

Niskanen, J., and Niskanen, M., 2006. The determinants of corporate trade credit policies in a bank-dominated financial environment: The case of Finnish small firms. *European Financial Management*, 12(1), pp. 81–102.

Petersen, M., and Rajan, R., 1997. Trade credit: Theories and evidence. *Review of Financial Studies*, 10(3), pp. 661–691.

Pike, R., Cheng, N., Cravens, K., and Lamminmaki, D., 2005. Trade credit terms: Asymmetric information and price discrimination evidence from three continents. *Journal of Business Finance and Accounting*, 32(5-6), pp. 1197–1236.

Rauch, J., 1999. Networks versus markets in international trade. *Journal of International Economics*, 48(1), pp. 7–35.

Sartoris, W., and Hill, N., 1981. Evaluating credit policy alternatives: A present value framework. *Journal of Financial Research*, 4(1), pp. 81–89.

Saunders, A., and Steffen, S., 2011. The costs of being private: Evidence from the loan market. *Review of Financial Studies*, 24(12), pp. 4091–4122.

Schenone, C., 2010. Lending relationships and information rents: Do banks exploit their information advantages? *Review of Financial Studies*, 23(3), pp. 1149–1199.

Scherr, F., and Hulburt, H., 2001. The debt maturity structure of small firms. *Financial Management*, 30(1), pp. 85–111.

Schwartz, R., 1974. An economic model of trade credit. *Journal of Financial and Quantitative Analysis*, 9(4), pp. 643–657.

Smith, J., 1987. Trade credit and informational asymmetry. *Journal of Finance*, 42(4), pp. 863–872.

Wilner, B., 2000. The exploitation of relationship in financial distress: The case of trade credit. *Journal of Finance*, 55(1), pp. 153–178.

Wilson, N., and Summers, B., 2002. Trade credit terms offered by small firms: Survey evidence and empirical analysis. *Journal of Business and Finance Accounting*, 29(3-4), pp. 317–335.

Table 1: Summary Statistics and Accounts Receivable Ratio across Industries

Panel A of this table reports the summary statistics. Accounts receivable ratio is defined as the ratio of accounts receivable to total sales. Firm age is the number of years from incorporation. Fixed assets is property, plant, and equipment scaled by total assets. Negative growth is sales growth times the negative growth dummy variable, which takes the value of 1 if sales growth is negative, and 0 otherwise. Positive growth is sales growth times the positive growth dummy variable, which takes the value of 1 if sales growth is positive, and 0 otherwise. Profitability is net income over total sales. Short-term debt is short-term borrowings plus the current portion of long-term debt, scaled by total assets. Size is the natural logarithm of total sales, measured in 2012 dollar price. The total number of observations in our sample is 111,453. Panel B provides the summary statistics of accounts receivable ratio across the 12-Fama French industries.

Panel A: Summary Statistics

Variable	Mean	Median	SD.	Min.	Max.
Accounts receivable (%)	0.1340	0.1185	0.1067	0.0000	1.0000
Age(years)	39.59	31.00	29.36	0.00	135.00
Fixed assets (%)	0.2340	0.1633	0.2161	0.0000	1.0000
Negative growth	-0.0531	0.0000	0.1275	-1.0000	0.0000
Positive growth	0.2129	0.0651	0.7770	0.0000	15.7500
Profitability	0.0659	0.0249	3.4586	-1.0017	609.0735
Short-term debt (%)	0.0301	0.0000	0.0854	0.0000	1.0000
Size(Ln)	2.6659	2.0901	2.0608	-3.6498	8.2483

Panel B: Accounts Receivable Ratio across Industries

Industry	Industry description	Mean	Median	Std. dev.	Min	Max	N
1	Consumer Non-Durables	0.1161	0.1003	0.0827	0.000	1.000	5,019
2	Consumer Durables	0.1391	0.1299	0.0951	0.000	1.000	1,945
3	Manufacturing	0.1469	0.1352	0.0836	0.000	1.000	12,164
4	Energy	0.1869	0.1545	0.1563	0.000	1.000	2,645
5	Chemicals	0.1474	0.1369	0.1029	0.000	1.000	1,942
6	Business Equipment	0.1837	0.1619	0.1148	0.000	1.000	10,224
7	Telecommunications	0.1407	0.1176	0.1309	0.000	1.000	1,719
9	Retail and Wholesale	0.0869	0.0738	0.0839	0.000	1.000	28,384
10	Health	0.1436	0.1298	0.1082	0.000	1.000	9,845
12	Others	0.1467	0.1292	0.1106	0.000	1.000	37,566

Table 2: Trade Credit Provision by Public and Private Firms

This table reports the accounts receivable ratio of public and private firms in the full sample and across the 12-Fama French industries. Accounts receivable ratio is defined as the ratio of accounts receivable to total sales. Panel A presents the univariate analysis of the accounts receivable ratio of public and private firms in the full sample using the t-test for differences in mean and the Wilcoxon-Mann-Whitney test for differences in median. Panel B reports the mean, median, standard deviation, of accounts receivable ratio of public and private firms across industries, the p-values of the t-test of differences in mean (mean test) and the Wilcoxon-Mann-Whitney test of differences in median (median test).

Panel A: Univariate Analysis

Accounts Receivable	Public	Private	Mean test (p-value)	Median test (p-value)
Mean	0.1568	0.1236	0.000	
Median	0.1400	0.1091		0.000
N	34,821	76,632		

Panel B: Accounts Receivable Ratio of Public Firms versus Private Firms, by Industries

Industry	Industry description	Firm type	Mean	Median	Std. dev.	N	Mean test	Median test
1	Consumer Non-Durables	Private	0.1098	0.0926	0.0859	2,520		
		Public	0.1226	0.1078	0.0789	2,499	0.000	0.000
2	Consumer Durables	Private	0.1194	0.1135	0.0717	757		
		Public	0.1517	0.1419	0.1056	1,188	0.000	0.000
3	Manufacturing	Private	0.1328	0.1224	0.0709	6,746		
		Public	0.1646	0.1509	0.0943	5,418	0.000	0.000
4	Energy	Private	0.1596	0.1369	0.1121	380		
		Public	0.1916	0.1584	0.1622	2,265	0.000	0.000
5	Chemicals	Private	0.1189	0.1087	0.0722	546		
		Public	0.1586	0.1466	0.1107	1,396	0.000	0.000
6	Business Equipment	Private	0.1579	0.1442	0.0862	3,070		
		Public	0.1948	0.1696	0.1235	7,154	0.000	0.000
7	Telecommunications	Private	0.1105	0.0892	0.0947	777		
		Public	0.1656	0.1399	0.1501	942	0.000	0.000
9	Retail and Wholesale	Private	0.0888	0.0771	0.0790	23,856		
		Public	0.0766	0.0426	0.1055	4,528	0.000	0.000
10	Health	Private	0.1219	0.1171	0.0701	5,658		
		Public	0.1728	0.1549	0.1394	4,187	0.000	0.000
12	Others	Private	0.1455	0.1304	0.0995	32,322		
		Public	0.1539	0.1191	0.1630	5,244	0.000	0.000

Table 3: The Supplier's Listing Status and Trade Credit Provision

This table provides the regression results for the impact of the supplier's listing status on its trade credit provision. The dependent variable is accounts receivable ratio is defined as the ratio of accounts receivable to total sales. *Public* is a dummy variable that takes the value of 1 for public firms, and 0 otherwise. Firm age is the number of years from incorporation. Fixed assets is property, plant, and equipment scaled by total assets. Negative growth is sales growth times the negative growth dummy variable, which takes the value of 1 if sales growth is negative, and 0 otherwise. Positive growth is sales growth times the positive growth dummy variable, which takes the value of 1 if sales growth is positive, and 0 otherwise. Profitability is net income over total sales. Short-term debt is short-term borrowings plus the current portion of long-term debt, scaled by total assets. Size is the natural logarithm of total sales, measured in 2012 dollar price. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)
Public	0.0332***	0.0196***	0.0486***	0.0286***
	(42.70)	(20.72)	(41.52)	(21.42)
ln(1+age)			-0.0088***	-0.0124***
			(-3.44)	(-5.03)
ln(1+age)2			0.0002	0.0019***
			(0.48)	(5.17)
Fixed assets			-0.0775***	-0.0798***
			(-51.63)	(-47.47)
Negative growth			-0.1081***	-0.1035***
			(-22.10)	(-20.28)
Positive growth			0.0059***	0.0045***
			(6.25)	(4.77)
Profitability			-0.0004***	-0.0003***
			(-3.14)	(-3.09)
Short-term debt			-0.0105**	0.0259***
			(-2.28)	(5.98)
Size			-0.0051***	-0.0035***
			(-18.23)	(-13.04)
Intercept	0.1236***	0.1507***	0.1718***	0.1970***
	(374.38)	(32.26)	(39.21)	(32.40)
Industry effects	No	Yes	No	Yes
Year effects	No	Yes	No	Yes
N	111,453	111,453	111,453	111,453
Adjusted R^2	0.021	0.157	0.088	0.200

Table 4: Alternative Measures of Control Variables

This table presents the regression results after including alternative measures of control variables. Positive profits is profitability times the positive profits dummy variable, which takes the value of 1 if profitability is positive, and 0 otherwise. Negative profits is profitability times the negative profits dummy variable, which takes the value of 1 if profitability is negative, and 0 otherwise. Letter of credit is undrawn letter of credit over total sales. Turnover is total sales over total assets minus accounts receivable. Inventory is inventory over total assets. The other independent variables are defined in Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)
Public	0.0229***	0.0150**	0.0285***	0.0230***
	(18.11)	(2.38)	(21.42)	(18.40)
ln(1+age)	-0.0106***	-0.0379***	-0.0096***	-0.0129***
	(-4.38)	(-2.60)	(-3.92)	(-4.86)
ln(1+age)2	0.0017***	0.0060***	0.0013***	0.0020***
	(4.63)	(2.94)	(3.64)	(5.20)
Fixed assets	-0.0802***	-0.0963***	-0.0781***	-0.1095***
	(-47.87)	(-9.07)	(-46.85)	(-58.22)
Negative growth	-0.0949***	-0.1630***	-0.1002***	-0.1185***
	(-18.77)	(-3.50)	(-19.76)	(-18.64)
Positive growth	0.0034***	0.0079***	0.0044***	0.0059***
	(3.66)	(2.69)	(4.72)	(4.56)
Profitability		0.0237*	-0.0004***	-0.0005**
		(1.95)	(-3.29)	(-2.30)
Short-term debt	0.0250***	0.0424	0.0251***	0.0565***
	(5.76)	(1.19)	(5.77)	(13.14)
Size	-0.0024***	-0.0015	-0.0056***	-0.0054***
	(-9.64)	(-1.35)	(-18.49)	(-20.85)
Positive profits	-0.0002*			
	(-1.69)			
Negative profits	-0.0489***			

	(-8.98)			
Letter of credit		0.2753***		
		(6.00)		
Turnover			-2.51 ×10^{-5}***	
			(-17.12)	
Inventory				-0.1304***
				(-66.74)
Intercept	0.1932***	0.2593***	0.1991***	0.2265***
	(32.01)	(4.99)	(32.88)	(35.54)
Industry effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
N	111,453	3,816	111,453	82,295
Adjusted R^2	0.203	0.267	0.205	0.283

Table 5: Results on the Matched Sample

This table presents the results of the one-to-one propensity score matching and the one-to-n matching. In the propensity score matching, we match each public firm observation to a private firm observation using the one-to-one nearest neighborhood without replacement. In Criterion (1), the matching is based on size, industry, and year. In Criterion (2), the matching is based on all the control variables, namely ln(1+age), $\ln(1+age)^2$, fixed assets, negative growth, positive growth, profitability, short-term debt, size, industry, and year effects. In the one-to-n matching, we match with replacement, each public firm to a private firm in the same industry and year, and of closest size (allowing for a deviation of 30%). Panel A presents the pairwise differences in the mean accounts receivable ratio in the propensity score matched samples and the bootstrapped standard errors (SE) based on 50 replications are reported in the square brackets. Panel B reports the baseline regression results for the matched samples, with the propensity score matching in Columns (1-2) and the one-to-n matching in Column (3).

Panel A: Propensity Score Matching: Pairwise Differences

	Criterion (1)	Criterion (2)
Difference	0.0313***	0.0282***
SE	[0.09%]	[0.08%]

Panel B: Multivariate Analysis

	Propensity Score Matching		One-to- n Matching
	Criterion (1)	Criterion (2)	(3)
Public	0.0374***	0.0376***	0.0359***
	(38.36)	(38.49)	(39.43)
ln(1+age)	-0.0079***	-0.0075***	-0.0178***
	(-3.42)	(-3.30)	(-6.31)
ln(1+age)2	0.0007**	0.0007*	0.0016***
	(1.98)	(1.89)	(3.82)
Fixed assets	-0.0875***	-0.0888***	-0.0919***
	(-46.39)	(-46.73)	(-50.25)
Negative growth	-0.1216***	-0.1156***	-0.0353***
	(-33.73)	(-37.09)	(-7.71)
Positive growth	0.0053***	0.0052***	0.0109***
	(12.10)	(11.74)	(10.15)
Profitability	-0.0004***	-0.0004***	-0.0015
	(-4.36)	(-4.23)	(-0.48)
Short-term debt	-0.0023	-0.0187***	0.0372***
	(-0.48)	(-4.41)	(9.97)
Size	-0.0050***	-0.0053***	-0.0014***
	(-22.06)	(-22.90)	(-5.41)
Intercept	3.4488***	3.7944***	0.2470***
	(17.18)	(18.75)	(19.79)
Industry effects	Yes	Yes	Yes
Year effects	Yes	Yes	Yes
N	69,642	69,642	84,300
Adjusted R^2	0.098	0.100	0.232

Table 6: Treatment Regression

This table presents the results of the treatment regression models (3) and (4) which accounts for the endogeneity of *Public* dummy in the accounts receivable model (1). Columns (1)-(2) report the first and second-stage regression results, respectively. The first-stage regression is a probit regression with the *Public* dummy being the dependent variable. We instrument for this variable using the industry underwriter concentration variable, defined as the number of IPOs underwritten by the Top 5 underwriters divided by the number of IPOs in that industry. The Top 5 underwriters are determined by the number of IPOs that they have underwritten over the last five years. The other independent variables are defined in Table 3. T-statistics are reported in parentheses. p-values are reported in square brackets. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)
Public		0.0378***
		(21.88)
ln(1+age)	-0.1972***	-0.0136***
	(-5.87)	(-5.17)
ln(1+age)2	-0.0090*	0.0022***
	(-1.76)	(5.61)
Fixed assets	0.4541***	-0.0807***
	(19.19)	(-45.70)
Negative growth	-1.6892***	-0.1035***
	(-37.78)	(-18.68)
Positive growth	0.5250***	0.0039***
	(37.12)	(4.04)
Profitability	0.0089**	-0.0004***
	(1.98)	(-3.12)
Short-term debt	1.5531***	0.0189***
	(27.69)	(4.16)
Size	0.4270***	-0.0048***
	(121.49)	(-17.20)
Underwriter concentration	-0.3315***	
	(-22.12)	
Intercept	-1.1586***	0.1708***
	(-20.13)	(24.13)
Endogeneity test-Rho		-0.0562***
		[0.000]
N		99,549

Table 7: The Effects of Firm Characteristics on Trade Credit Provision

This table presents the effects of five firm-specific characteristics, namely firm size, tangibility, volatility of sales, bargaining power, and growth opportunities, on the level of trade credit provided by public and private firms. The dependent variable is accounts receivable ratio is defined as accounts receivable to total sales. *Large* is a dummy variable that takes the value of 1 for observations with above the median size, and 0 otherwise. *High Tang.* is a dummy variable that takes the value of 1 for observations with above the median tangibility, and 0 otherwise. *High Vol.* is a dummy variable that takes the value of 1 for observations with above the median volatility of sales, and 0 otherwise. Volatility of sales measured by standard deviation of sales of 3 years over average sales of 3 years. *High Bargain.* is a dummy variable that takes the value of 1 for observations with above the median bargaining power, and 0 otherwise. Bargaining power measured by firm sales divided by aggregate industry sales in a given year. *High Growth* is a dummy variable that takes the value of 1 for observations with above the median growth opportunities, and 0 otherwise. *Public* is a dummy variable that takes the value of 1 for public firms, and 0 otherwise. The other independent variables are defined in Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)		(2)		(3)		(4)		(5)
Large	0.0063***	High Tang.	-0.0055***	High Vol.	0.0015**	High Bargain.	0.0051***	High Growth	0.0080***
	(7.28)		(-5.94)		(2.09)		(5.91)		(9.85)
Public	0.0249***	Public	0.0329***	Public	0.0252***	Public	0.0196***	Public	0.0271***
	(10.53)		(19.64)		(17.87)		(6.98)		(17.10)
Large×Public	0.0061***	High Tang.× Public	-0.0095***	High Vol.×Public	0.0052***	High Bargain. ×Public	0.0131***	High Growth ×Public	0.0029**
	(2.58)		(-6.12)		(3.80)		(4.53)		(2.05)
ln(1+age)	-0.0129***	ln(1+age)	-0.0126***	ln(1+age)	-0.0121***	ln(1+age)	-0.0134***	ln(1+age)	-0.0125***
	(-5.26)		(-5.13)		(-4.67)		(-5.43)		(-5.09)
ln(1+age)2	0.0020***	ln(1+age)2	0.0019***	ln(1+age)2	0.0019***	ln(1+age)2	0.0021***	ln(1+age)2	0.0020***
	(5.45)		(5.35)		(4.88)		(5.63)		(5.44)
Fixed assets	-0.0796***	Fixed assets	-0.0651***	Fixed assets	-0.0793***	Fixed assets	-0.0798***	Fixed assets	-0.0793***
	(-47.44)		(-28.16)		(-45.98)		(-47.60)		(-47.25)
Negative growth	-0.1033***	Negative growth	-0.1035***	Negative growth	-0.0984***	Negative growth	-0.1039***	Negative growth	-0.1166***
	(-20.29)		(-20.28)		(-18.19)		(-20.43)		(-21.13)
Positive growth	0.0045***	Positive growth	0.0043***	Positive growth	0.0043***	Positive growth	0.0046***	Positive growth	0.0033***

	(4.77)		(4.64)		(4.20)		(4.92)		(3.40)
Profitability	-0.0004***	Profitability	-0.0003***	Profitability	-0.0003***	Profitability	-0.0003***	Profitability	-0.0004***
	(-3.15)		(-3.11)		(-3.04)		(-3.02)		(-3.20)
Short-term debt	0.0257***	Short-term debt	0.0261***	Short-term debt	0.0268***	Short-term debt	0.0262***	Short-term debt	0.0261***
	(5.90)		(6.00)		(5.90)		(6.02)		(6.01)
Size	-0.0052***	Size	-0.0033***	Size	-0.0033***	Size	-0.0052***	Size	-0.0037***
	(-14.80)		(-12.14)		(-12.05)		(-16.45)		(-13.49)
Intercept	0.1980***	Intercept	0.1973***	Intercept	0.1943***	Intercept	0.1961***	Intercept	0.1911***
	(32.64)		(32.45)		(31.70)		(32.33)		(31.36)
Industry effects	Yes	Industry effects	Yes	Industry effects	Yes	Industry effects	Yes	Industry effects	Yes
Year effects	Yes	Year effects	Yes	Year effects	Yes	Year effects	Yes	Year effects	Yes
N	111,453	N	111,453	N	105,226	N	111,453	N	111,453
Adjusted R^2	0.200	Adjusted R^2	0.201	Adjusted R^2	0.199	Adjusted R^2	0.200	Adjusted R^2	0.201

Table 8: The Impacts of the Product Market Dynamics on Trade Credit Provision

This table presents the effects of the product market dynamics on the supply of trade credit by public and private firms. The dependent variable is accounts receivable ratio is defined as accounts receivable to total sales. *Public* is a dummy variable that takes the value of 1 for public firms, and 0 otherwise. Diff. is a dummy variable that takes a value of 1 for differentiated industry and 0 otherwise. Service is a dummy variable that takes a value of 1 one for service industry and 0 otherwise. Retail is a dummy variable that takes a value of 1 for retail and wholesale industry and 0 otherwise. Std. is a dummy variable that takes a value of 1 for standardized industry and 0 otherwise. Differentiated, Service and Standardized industries are determined according to Giannetti, Burkart, and Ellingsen (2011) classification. Retail and Wholesale industry is defined according to 12 Fama-French industry classification. Concentrated is a dummy variable that takes a value of 1 for concentrated industries and 0 otherwise. Concentrated industries are industries with above the median Herfindahl-Hirschman index. The other independent variables are defined in Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)		(2)		(3)		(4)		(5)
Diff.	0.0115^{***}	Service	-0.0433^{***}	Retail	-0.0568^{***}	Std.	-0.0102^{***}	Concentrated	0.0358^{***}
	(13.43)		(-67.63)		(-86.31)		(-8.37)		(55.13)
Public	0.0344^{***}	Public	0.0268^{***}	Public	0.0301^{***}	Public	0.0435^{***}	Public	0.0480^{***}
	(23.20)		(19.94)		(22.94)		(33.17)		(33.28)
Diff.×Public	0.0083^{***}	Service×Public	0.0240^{***}	Retail×Public	-0.0256^{***}	Std.×Public	-0.0079^{***}	Concentrated×Public	-0.0155^{***}
	(5.34)		(13.62)		(-14.81)		(-3.92)		(-10.30)
ln(1+age)	-0.0072^{***}	ln(1+age)	-0.0080^{***}	ln(1+age)	-0.0076^{***}	ln(1+age)	-0.0074^{***}	ln(1+age)	-0.0068^{***}
	(-2.80)		(-3.10)		(-3.00)		(-2.85)		(-2.67)
ln(1+age)2	3.15×10^{-5}	ln(1+age)2	0.0002	ln(1+age)2	0.0005	ln(1+age)2	0.0002	ln(1+age)2	0.0002
	(0.08)		(0.54)		(1.43)		(0.42)		(0.57)
Fixed assets	-0.0760^{***}	Fixed assets	-0.0876^{***}	Fixed assets	-0.0951^{***}	Fixed assets	-0.0784^{***}	Fixed assets	-0.0868^{***}
	(-49.07)		(-57.50)		(-62.35)		(-51.75)		(-57.11)
Negative growth	-0.1189^{***}	Negative growth	-0.1110^{***}	Negative growth	-0.1107^{***}	Negative growth	-0.1183^{***}	Negative growth	-0.1097^{***}
	(-23.50)		(-21.77)		(-21.81)		(-23.42)		(-21.55)
Positive growth	0.0063^{***}	Positive growth	0.0055^{***}	Positive growth	0.0052^{***}	Positive growth	0.0060^{***}	Positive growth	0.0054^{***}
	(6.57)		(5.79)		(5.53)		(6.33)		(5.75)
Profitability	-0.0004^{***}	Profitability	-0.0003^{***}	Profitability	-0.0004^{***}	Profitability	-0.0004^{***}	Profitability	-0.0003^{***}
	(-2.89)		(-2.84)		(-3.09)		(-3.04)		(-2.94)

Short-term debt	-0.0118**	Short-term debt	0.0049	Short-term debt	0.0157***	Short-term debt	-0.0132***	Short-term debt	-0.0019
	(-2.56)		(1.07)		(3.50)		(-2.87)		(-0.42)
Size	-0.0045***	Size	-0.0042***	Size	-0.0034***	Size	-0.0046***	Size	-0.0044***
	(-16.10)		(-15.21)		(-12.43)		(-16.66)		(-15.90)
Intercept	0.1860***	Intercept	0.2087***	Intercept	0.2041***	Intercept	0.1882***	Intercept	0.1688***
	(35.26)		(39.59)		(39.54)		(35.69)		(32.14)
Industry effects	No	Industry effects	No	Industry effects	No	Industry effects	No	Industry effects	No
Year effects	Yes	Year effects	Yes	Year effects	Yes	Year effects	Yes	Year effects	Yes
N	111,453	N	111,453	N	111,453	N	111,453	N	111,453
Adjusted R^2	0.096	Adjusted R^2	0.122	Adjusted R^2	0.153	Adjusted R^2	0.095	Adjusted R^2	0.114

Table 9: Macro-economic Conditions Influences on Trade Credit Provision

The table reports the regression results for model (2), which captures the effect of the recent financial crisis on the supply of trade credit by public and private firms. The model is estimated for the period 2004-2009. The crisis period is defined as from 2007 to 2009. The dependent variable is accounts receivable ratio is defined as accounts receivable to total sales. *Crisis* is a dummy variable that takes the value of 1 for the years 2007-2009, and 0 otherwise. *Public* is a dummy variable that takes the value of 1 for public firms, and 0 otherwise. $Cash_{pre\text{-}crisis}$ is the pre-crisis (2006) level of cash holdings. The model includes all the control variables, listed and defined as in Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Crisis	-0.0124***	-0.0159***	-0.0119***	-0.0154***	-0.0037***	-0.0070***
	(-15.81)	(-9.75)	(-14.96)	(-9.15)	(-4.13)	(-4.08)
Public	0.0292***	0.0287***	0.0305***	0.0296***	0.0386***	0.0377***
	(15.51)	(15.19)	(13.72)	(13.20)	(14.00)	(13.59)
Crisis×Public			-0.0028	-0.0019	-0.0088***	-0.0084***
			(-1.23)	(-0.87)	(-2.96)	(-2.80)
$Cash_{pre\text{-}crisis}$ ×Public					-0.0803***	-0.0849***
					(-21.98)	(-23.10)
$Cash_{pre\text{-}crisis}$ ×Crisis					-0.0540***	-0.0537***
					(-3.62)	(-3.61)
$Cash_{pre\text{-}crisis}$ ×Crisis × Public					0.0661***	0.0700***
					(3.40)	(3.60)
Intercept	0.1723***	0.1737***	0.1721***	0.1734***	0.1712***	0.1722***
	(23.60)	(23.58)	(23.58)	(23.54)	(23.53)	(23.46)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	No	Yes	No	Yes	No	Yes
N	60,526	60,526	60,526	60,526	60,526	60,526
Adjusted R^2	0.197	0.199	0.197	0.199	0.203	0.206

Appendix

Table A.1. Additional Robustness Checks

This table presents the regression results for model (1) after including additional control variables. Specifically, Column (1) includes accounts payable defined as accounts payable divided by total assets, Column (2) includes the gross margin and gross margin squared. Gross margin is defined as gross profit over total sales. Column (3) reports the regression results for an extended sample including utilities firms. The other independent variables are defined in Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. . ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)
Public	0.0305***	0.0138***	0.0332***
	(22.47)	(3.42)	(24.88)
ln(1+age)	-0.0121***	-0.0129***	-0.0139***
	(-4.94)	(-5.25)	(-5.73)
ln(1+age)2	0.0019***	0.0020***	0.0021***
	(5.38)	(5.44)	(5.83)
Fixed assets	-0.0754***	-0.0794***	-0.0809***
	(-43.87)	(-47.25)	(-44.04)
Negative growth	-0.1045***	-0.1063***	-0.0607***
	(-20.49)	(-20.90)	(-16.56)
Positive growth	0.0044***	0.0049***	0.0027***
	(4.70)	(5.24)	(3.02)
Profitability	-0.0003***	-0.0003***	-0.0003***
	(-3.04)	(-2.76)	(-3.17)
Short-term debt	0.0272***	0.0276***	0.0251***
	(6.27)	(6.35)	(5.85)
Size	-0.0038***	-0.0038***	-0.0044***
	(-13.82)	(-14.25)	(-16.20)
Accounts payable	0.0322***		
	(11.06)		
Gross margin		0.1236***	
		(9.84)	
Gross margin squared		-0.1152***	
		(-8.91)	
Intercept	0.1898***	0.1886***	0.1650***
	(31.19)	(27.09)	(13.49)
Industry effects	Yes	Yes	Yes
Year effects	Yes	Yes	Yes
N	111,453	111,453	117,451
Adjusted R^2	0.201	0.202	0.188

Table A.2. Macro-economic Conditions Influences on Trade Credit Provision- An Alternative Window for the Financial Crisis

The table reports the regression results for the effect of the recent financial crisis on the supply of trade credit by public and private firms, defining the crisis period as 2007- 2008. The model is estimated for the period 2004-2008. The dependent variable is accounts receivable ratio is defined as accounts receivable to total sales. *Crisis* is a dummy variable that takes the value of 1 for the years 2007-2008, and 0 otherwise. *Public* is a dummy variable that takes the value of 1 for public firms, and 0 otherwise. $Cash_{pre\text{-}crisis}$ is the pre-crisis (2006) level of cash holdings. The model includes all the control variables, listed and defined as in Table 3. T-statistics are reported in parentheses. Standard errors are heteroskedasticity robust. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Crisis	-0.0095***	-0.0155***	-0.0088***	-0.0150***	0.0011	-0.0057***
	(-11.46)	(-12.42)	(-10.46)	(-11.92)	(1.17)	(-4.27)
Public	0.0295***	0.0291***	0.0308***	0.0299***	0.0390***	0.0381***
	(14.44)	(14.16)	(13.37)	(12.90)	(13.78)	(13.37)
Crisis×Public			-0.0033	-0.0023	-0.0096***	-0.0087***
			(-1.32)	(-0.92)	(-2.91)	(-2.65)
$Cash_{pre\text{-}crisis}$ ×Public					-0.0553***	-0.0546***
					(-3.71)	(-3.66)
$Cash_{pre\text{-}crisis}$ ×Crisis					-0.0909***	-0.0935***
					(-20.82)	(-21.36)
$Cash_{pre\text{-}crisis}$ ×Crisis × Public					0.0647***	0.0662***
					(3.04)	(3.11)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	No	Yes	No	Yes	No	Yes
N	50,873	50,873	50,873	50,873	50,873	50,873
Adjusted R^2	0.205	0.206	0.205	0.206	0.212	0.213

Chapter 5
Conclusion

5.1. Summary of Results

This thesis presents three essays that explore under-researched areas in debt maturity and trade credit policies. I investigate the effect of an IPO on debt maturity in Chapter 2, compare the use of trade credit by public and private firms in Chapter 3, and examine the impact of a supplier's listing status on its trade credit provision in Chapter 4.

Chapter 2 examines the effect of an IPO on debt maturity structure using a sample of U.S. firms that went public between 1998 and 2011. My main finding is that firms use less short-term debt post-IPO. In particular, they decrease their short-term debt ratio by 7% (19% relative to the short-term debt ratio pre-IPO) in the first two years after the IPO and decrease their short-term ratio by 2.5% (7% relative to the pre-IPO level) post-IPO. These results remain robust to using a sample of new debt issues and a difference-in-differences regression of IPO and non-IPO firms. The robustness of the main findings is also confirmed when I control for the potential endogeneity of the listing decision and the simultaneity bias due to the joint determination of leverage and debt maturity. Overall, the results are consistent with arguments based on asymmetric information and the agency costs of equity, because the IPO effect on debt maturity is only evidenced in small and high-growth firms as well as in firms with a high dilution ratio. Inconsistent with theory based on the agency costs of debt, firms with high leverage decrease their short-term debt post-IPO. Further tests examining the impact of the recent financial crisis show that the IPO effect on debt maturity was more pronounced during the crisis period.

Chapter 3 compares the use of trade credit by U.S. public and private firms for the period 1995−2012. My results show that the level of trade credit in private firms is 40.4% higher than that in public firms. These results continue to hold in tests controlling for sample selection and endogeneity. Further, young, high-growth, and low-tangibility private firms use more trade credit than their public counterparts, indicating that firms with higher

degrees of asymmetric information and financial constraints, and more limited access to alternative sources of financing use more trade credit. Additional tests show that public firms adjust faster toward their target trade credit policies than private firms: the former firms have an adjustment speed of 29%, compared to a speed of 23% for private firms. This finding supports the argument that public firms face lower costs of adjusting their trade credit due to their greater bargaining power with suppliers as well as greater access to other forms of credit. Finally, I show that the recent financial crisis had differential effects on the use of trade credit by public and private firms. Public firms were able to use slightly more trade credit, while private firms were granted significantly less trade credit. The latter finding suggests that suppliers were less willing to provide trade credit to private firms during the crisis.

Chapter 4 investigates the impact of a supplier's listing status on its trade credit provision using data on U.S. public and private firms for the period 1994–2012. I find that the level of trade credit provided by public firms is 23.4% higher than that provided by private firms, which is consistent with the arguments that public firms have more incentives to supply trade credit thanks to their higher financial capability as well as better ability in handling the trade credit process and enforcing payments and contract terms. The result is statistically and economically significant, and is robust to models accounting for sample selection and the potential endogeneity associated with a firm's decision to go public. Additional tests show that public firms that are large, have low tangibility, high sales volatility, high bargaining power, and high growth opportunities provide more trade credit than comparative private firms. The findings also indicate that public firms grant more trade credit than private firms in differentiated and service industries, but less trade credit in concentrated industries and those with weaker customer-supplier relationships and high customer fraud such as retail and wholesale as well as standardized industries. During the recent financial crisis, both types of firms reduced the level of trade credit they provided, because of the shortage in liquidity and credit.

5.2. Implications and Scope for Further Research

The findings of this thesis improve our understanding of the effect of a company's listing status on its debt maturity as well as on its demand and supply of trade credit. They also have important implications for shareholders, non-financial stakeholders, practitioners, policy makers, and academic researchers. The finding of the second chapter that firms increase their debt maturity post-IPO highlights the expected benefits and costs related to the debt maturity of IPO firms. Such a finding is particularly beneficial for firms considering floating their shares for the first time as it confirms an advantage of the going public decision: the IPO provides an opportunity for firms to use more long-term debt post-IPO, which allows them to invest in more long-term and innovative projects. The finding on the impact of the supplier's listing status on its trade credit provision can benefit policy makers as it shows which type of supplier is expected to provide more trade credit in general and during crisis periods in particular, as well as across different industries. Related results also highlight the importance of market dynamics in the decision on trade credit provision.

Overall, the findings throughout the thesis show that the recent financial crisis had significant impacts on debt maturity and trade credit decisions of public and private firms. These findings may be informative to shareholders and stakeholders, in terms of increasing their awareness of the effects of macro-economic conditions on corporate financial policies as well as in enabling them to develop supportive procedures and policies for firms. For example, the results from the third chapter, which show trade credit is a very important source of short-term finance for private firms, although it was not an effective substitute for bank credit during the recent financial crisis, have relevant policy implications. They suggest policies aimed at improving the credit channel to private firms should be considered, especially during periods of bad macroeconomic conditions.

For academic researchers, the findings of my thesis have two implications. First, I have assessed and confirmed the quality of the accounting and financial data provided by a

relatively new database, S&P Capital IQ. My research hence opens up new opportunities for further research using this database. Second, the results of my thesis encourage future research in the areas related to debt maturity and trade credit. While my findings provide evidence of the IPO effect on debt maturity structure, it would be interesting to investigate whether firms also change the types of debt (such as bank debt versus non-bank debt) used post-IPO. This is a promising area of research, given that Pagano, Panetta, and Zingales (1998) argue that firms' default risk improves post-IPO while Dennis and Mihov (2003) show that firms' credit quality is one of the main determinants of the choice between different types of debt. In a similar context, we still know very little about whether firms display a more or less diversified debt structure post-IPO. Colla, Ippolito, and Li (2013) develop a measure for debt specialization and find that unrated public firms have less diversified debt structure. On the other hand, Rauh and Sufi (2010) find that firms with low credit quality (BB and lower ratings) use many types of debt. McCumber (2014) shows that private firms rely on more types of debt. Since private firms have high asymmetric information and low bargaining power with lenders (e.g. Brav, 2009; Schenone, 2010; Saunders and Steffen, 2011), they are expected to have less diversified debt structure. Further research investigating the question of debt specialization pre- and post-IPO will help to explain the mixed results documented in the literature and contribute to findings of these studies.

In terms of trade credit, future research can examine the effect of the recent Bankruptcy Abuse and Customer Protection Act 2005, which provides suppliers with more reclamations rights, on the demand and supply of trade credit using data on both public and private firms. I was unable to consider this empirical question in this thesis due to data limitations, as the best setting would be to have a matched sample of suppliers and their customers as well as customers' likelihood of bankruptcy. This research will complement a series of recent working papers on bankruptcy and trade credit by Yang and Birge (2011), Ivashina and Iverson (2014), Yang, Birge, and Parker (2014), Garcia-Appendini and

Montoriol-Garriga (2014). Future research can also build on my work and examine the effect of the listing status on inventory, another important component of working capital. Further, given the results regarding the effect of the recent financial crisis on two sides of trade credit (i.e. accounts receivable and payable), there is room for future analysis on the effect of financial crisis on the cash holding of public and private firms. Gao, Harford, and Li (2013) and Mortal and Riesel (2014) find that public firms have higher level of cash holdings; however, they do not consider whether this difference exists during bad macroeconomic conditions. Such an analysis would also complement Pinkowtiz, Stulz, and Williamson (2013), who compare the evolution of cash holdings of US public firms over pre- and post-financial crisis periods.

The main limitation of my research is data, which only comes from the S&P Capital IQ database: I was restricted by the number of public firms and the time period covered by the database. In addition, I was hindered from exploring, for instance, trade credit contract terms or the effect of multi-nationality on the use or supply of trade credit. Giannetti, Burkart, and Ellingsen (2011) and Klapper, Laeven, and Rajan (2012) examine the trade credit contract terms of U.S. SMEs and international firms, respectively. Hence, there is scope for future research on the trade credit contract terms used in public and private firms. In their survey study, Ng, Smith, and Smith (1999) argue that suppliers that have international customers may be faced with information problems regarding these customers' credit quality and therefore may be less willing to provide trade credit. On the other hand, international customers may prefer paying on credit because they may be unfamiliar with the supplier or have concerns about delivery delays; it will be fruitful for future empirical studies to examine these arguments.

Further References

Denis, D., and Mihov, V., 2003. The choice among bank debt, non-bank private debt, and public debt: Evidence from new corporate borrowings. *Journal of Financial Economics*, 70(1), pp. 3–28.

Garcia-Appendini, E., and Montoriol-Garriga, J., 2014. Trade credit and financial distress. Working Paper. University of St. Gallen.

Ivashina, V., and Iverson, B., 2014. Trade creditors' behavior in bankruptcy. Working Paper. University of Chicago.

McCumber, W., 2014. The capital structure of private firms. Working Paper. Louisiana Tech University.

Mortal, S., and Reisel, N., 2014. Do firms hold too much cash? Evidence from private and public firms. Working Paper. University of Memphis.

Pinkowitz, L., Stulz, R., and Williamson, R., 2013. Is there a US high cash holdings puzzle after the financial crisis? Working Paper. Ohio State University.

Rauh, J., and Sufi, A., 2010. Capital structure and debt structure. *Review of Financial Studies*, 23(12), pp. 4242–4280.

Yang, S., and Birge, J., 2011. Trade credit in supply chains: Multiple creditors and priority rules. Working Paper. London Business School.

Yang, S., Birge, J., and Parker, R., 2014. The supply chain effects of bankruptcy. Working Paper. London Business School.