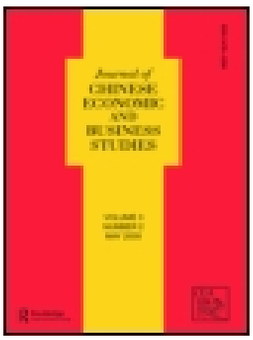

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Journal of Chinese Economic and Business Studies

ISSN: 1476-5284 (Print) 1476-5292 (Online) Journal homepage: http://www.tandfonline.com/loi/rcea20

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To cite this article: Dongyang Zhang (2017): Is working capital management value-enhancing through alleviating financial constraints? Evidence from Chinese non-listed firms, Journal of Chinese Economic and Business Studies, DOI: 10.1080/14765284.2017.1346929

To link to this article: http://dx.doi.org/10.1080/14765284.2017.1346929

Published online: 12 Jul 2017.

JOURNAL OF CHINESE ECONOMIC AND BUSINESS STUDIES, 2017
https://doi.org/10.1080/14765284.2017.1346929

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Is working capital management value-enhancing through alleviating financial constraints? Evidence from Chinese non-listed firms

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ABSTRACT

Financial factors have been found highly important in influencing firms' real activities and in promoting aggregate growth. Yet, the linkage between finance and firm-level total factor productivity (TFP) has been overlooked in the literature. I fill this gap using 147,310 non-listed Chinese firms over the period 1999–2007 to estimate a TFP model augmented with working capital. I find that TFP is strongly and significantly associated with working capital for private and foreign firms, but not for SOEs. More specifically, an increase in working capital has a negative (positive) effect on TFP in firms with positive (negative) working capital. Furthermore, highly external financial constrained, highly internal financial constrained, under-developed institutional regions and small size private and foreign firms are more sensitive to working capital.

ARTICLE HISTORY
Received 17 January 2016
Accepted 31 May 2017

KEYWORDS
TFP; working capital; financial constraints; Chinese non-listed firms

1. Introduction

It is widely acknowledged in the literature that a well-developed financial system positively influences growth (Levine 2005). At the firm-level, finance has been demonstrated to influence firms' activities such as investment in fixed capital (Fazzari et al. 1988) and employment (Nickell and Layard 1999), and these activities are the main factor inputs for firm production. Due to its successful economic transition in the past three decades, the Chinese economy has been characterized by persistently high fixed investment rates and a phenomenal growth rates (Song, Storesletten, and Zilibotti 2011; Ding, Guariglia, and Knight 2013). Yet China is a counterexample to these findings: In spite of a malfunctioning financial system, it is one of the fastest growing economies in the world (Allen, Qian, and Qian 2005). Several authors have tried to find explanations for this puzzle. Among these, Ayyagari, Demirgüç-Kunt, and Maksimovic (2010) focus on the role of informal finance and conclude that it is not because of their access to informal financial sources that Chinese firms were able to grow, despite limited access to external finance. However, Cull, Xu, and Zhu (2009) demonstrate that access to trade credit does not play a significant role in explaining the puzzle. Guariglia, Liu, and Song (2011), Chen and Guariglia (2013) conclude that the high rate of growth in China has

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been driven by the highly productive private firms which are able to accumulate very high cash flows.

Working capital management is particularly important in the Chinese context where firms have limited access to long-term capital markets or firms are facing financial constraints (Ding, Guariglia, and Knight 2013). Such firms, therefore, need to rely on internally generated funds, short-term bank loans and trade credit to finance their activities. In line with this argument, it has been shown that effective working capital management has played a particularly important role in alleviating the effects of the recent financial crisis in China (KPMG China, 2011) and investment behavior in China (Ding, Guariglia, and Knight 2013). In addition, the presence of financial constraints and its effects on firms' investment decisions and performance have received intense interest in the corporate finance literature. Studies of this evolution generally characterize market competition as a selection process essentially determined by the link between firms' productivity and their likelihood of survival (Asplund and Nocke 2006). They demonstrate that the market enhances productivity by weeding out inefficient firms and reallocating resources from low-productivity firms to high-productivity ones. Because lower productivity firms are more likely to suffer continuous decreases in market share, these firms are more likely to exit due to their poor performance. There is considerable evidence that financial constraints are an impediment to the investment and growth of firms in developing economies (Hubbard 1998; Stein 2003) and to firms' likelihood of survival (Liu and Li 2015). For these firms, working capital may be used as an additional source of financing. In fact, little is known about whether and how working capital functions and how much economic activity it supports in China – especially if there are financial constraints.

In this paper, I focus on total factor productivity (TFP) which has been found to be significantly associated with growth (Chen and Guariglia 2013). Specifically, I explore the role played by working capital management in explaining why Chinese firms are able to grow at high rates despite significant financial constraints. Using an extensive, nationally representative database of non-listed Chinese firms (GUOTAIAN non-listed Chinese firms database), I hope to fill a part of that gap by examining the extension of working capital management – one method suggested by Hale and Long (2011), Ding, Guariglia, and Knight (2013) and Aktas, Croci, and Petmezas (2015) as being an important financial intermediation for Chinese firms' growth, investment, and profitability.

My study is based on a panel of 147,310 firms over the period of 1999 to 2007. I initially run a TFP regression – as a function of working capital and other financial variables – separately for state-owned, private and foreign firms[1]. I find that SOEs (state-owned enterprises) always exhibit an insignificant relationship between TFP and working capital, suggesting that the performance of SOEs is not determined by working capital. This can be explained by these firms' need to fulfill political, social, and economic objectives (Bai, Jiangyong, and Tao 2006). Also, this may reflect the priority that central and local governments and the (predominantly) state-owned banks accord to them (Ding, Guariglia, and Knight 2013). On the other hand, private and foreign firms exhibit a strong and significant relationship between firm performance and working capital which may indicate that firms tend to adjust working capital to help them perform better.

To fully account for the heterogeneity characterizing firms in my sample, I construct firm-level financial constraints proxies – the size-age (SA) index, the investment-cash flow sensitivity, the marketization level, size and ownership – which are then analyzed by how they

influence the relationship between working capital and TFP. To the best of my knowledge, no other study in the literature has analyzed the links between firm performance – especially TFP, working capital and financial constraints – by making use of firm-level sensitivities. This represents my second contribution. I find that more financially constrained firms as measured by the SA index and the ICFS (investment-cash flow sensitivity) are particularly active in adjusting working capital. It is possible that working capital can alleviate the financially constrained firms' investment activities to firms' TFP (Ding, Guariglia, and Knight 2013). I also supply a new empirical study to support and further develop FHP's financial constraints theory. Furthermore, firms in under-developed marketization regions are more financially constrained and adjust working capital more actively. In addition, compared to larger firms, smaller firms have a higher level of financial constraints, and these firms are particularly active in maintaining their TFP level by adjusting working capital. This paper draws on classic as well as newer research on ownership and control (e.g. La Porta, Lo' pez-de-Silanes, and Shleifer 1999; Claessens, Djankov, and Lang 2000; Gompers, Ishii, and Metrick 2010; Lin et al. 2011) by linking working capital management to external financial constraints. In addition to the ability to accumulate high cash flow highlighted in Guariglia, Liu, and Song (2011) and Chen and Guariglia (2013), active working capital management may contribute to the explanation of the Chinese growth puzzle.

The remainder of this paper is organized as follows: Section 2 provides a literature review and hypothesis development. Section 3 describes my data and presents some descriptive statistics. Section 4 illustrates my baseline specification and estimation methodology. Section 5 presents my main empirical results. Section 6 shows some robustness tests. Section 7 concludes.

2. Literature review and hypothesis development

2.1. Literature review

Working capital is defined as the difference between firms' current assets (which include accounts receivable, inventories and cash) and current liabilities (which include accounts payable and short term debt). It represents the source and use of short-term capital. Working capital is often used to measure a firm's liquidity. Liquidity is a precondition to ensure that firms are able to meet their short-term obligations. Insufficient liquidity can lead to bankruptcy (Dunn and Cheatham 1993). Yet, too much liquidity can be detrimental to firms' profitability (Bhattacharya 2001). Good management of working capital, therefore, requires striking a balance between liquidity and firm performance in order to maximize the value of a firm. The advantages of holding inventories and extending trade credit to customers have been outlined below. In general, the higher the inventories and account of receivable, the less money is available to the firm for profitable investment. This suggests that finding the optimal level of working capital may be a difficult task for firm managers (Deloof 2003). The literature proposes several theoretical arguments to understand the relationship between working capital and firm performance.

On the one hand, additional investment in working capital is expected to have positive effects – especially for firms with low levels of working capital. This is because working capital allows firms to grow by increasing sales and earnings. Larger inventories are known to reduce supply cost, provide a hedge against input price fluctuations, and minimize lost sales due

to potential stock-outs (see e.g. Blinder and Maccini 1991; Fazzari and Petersen 1993; Corsten and Gruen 2004), among other things. Supplying credit to customers also may positively affect firm sales because it allows for price discrimination, serves as a warranty for product quality and fosters long-term relationships with customers (see e.g. Brennan, Maksimovic, and Zechner 1988; Long, Malitz, and Ravid 1993 and Summers and Wilson 2002). Fazzari and Petersen (1993) suggest that investments in working capital are more sensitive to financing constraints than investments in fixed capital. Accordingly, since a positive working capital level needs financing, one would expect the optimal level of working capital to be lower for more financially constrained firms. In fact, empirical evidence has demonstrated that investment in working capital depends on a firm's financing conditions. Specifically, Hill, Kelly, and Highfield (2010) show that firms with a greater internal financing capacity and access to capital markets access hold a higher level of working capital level.

On the other hand, overinvestment in working capital may generate adverse effects and lead to an erosion of value for shareholders. Like any investment, increases in working capital require additional financing which involves financing and opportunity costs (see e.g. Kieschnick, Laplante, and Moussawi 2013). Therefore, *ceteris paribus*, firms that hold high working capital on their balance sheets potentially face high interest expenses and risk bankruptcy. Moreover, too much cash tied up in net working capital might impede firms from implementing value-enhancing investment projects in the short run (see e.g. Ek and Guerin 2011). The existence of potential benefits and costs implies, therefore, a non-linear relationship between working capital and firm performance; the expected relationship would be negative for firms with a high level of working capital (i.e. overinvestment in net working capital) and positive for firms with a low level of working capital (i.e. underinvestment in net working capital) (Baños-Caballero, García-Teruel, and Martínez-Solano 2014; Aktas, Croci, and Petmezas 2015; Mun and Jang 2015).

Additionally, the human capital of firms plays a role in the relationship between working capital and total-factor productivity (TFP). van Ark and Piatkowski (2004) has classified the drivers of TFP. They include the economy (strongly affected by information and communications technology or ICT) and ICT capital; human capital and knowledge capital (e.g. education and experience) realized in the labor input; and organizational capital (e.g. a manipulation of inputs) realized in the production process. The effects of ICT capital on TFP have been analyzed by van Ark (2002), Oliner and Sichel (2003), among others, who have estimated the TFP growth contribution from the ICT sector. The effects of human capital and knowledge capital on TFP have been investigated, as human capital accumulation can be important in enhancing TFP growth. Accumulation of human capital can have a dual impact on output growth. First, human capital has an immediate, static impact on output growth as an accumulable production input. More importantly, human capital also may have a dynamic effect on output growth through its role in facilitating TFP growth. The most important contribution of human capital to output growth may lie not in its static effect as a direct production input, but in its dynamic role in promoting TFP growth (Benhabib and Spiegel 1994; Herbertsson 2003).

In China, evidence shows that human capital accumulation has played an important role in promoting region TFP growth through working capital management (Jiang 2014). Work experience shapes an entrepreneurship's managerial expertise and skills (human capital) (Dalziel, Gentry, and Bowerman 2011). In China, privatization and enhanced market competition have increased the need for managerial expertise (Child and Markoczy 1993). However,

due to decades of central planning, Chinese managers may have excellent educational attainments, but relatively little entrepreneurial knowledge or skill (Smallbone and Welter 2006). Chinese CEOs with higher education are exposed more often to modern, competition-based strategic decision-making. This is likely to provide them with knowledge on how to use financial intermediations more efficiently, such as adjusting working capital to alleviate financial constraints to help firms' TFP growth. Furthermore, professional CEOs can better overcome the information asymmetry between insiders and outsiders, and in turn further reinforce their power and help firm performance (Khanna and Palepu 2000). Chinese firms – both listed and non-listed ones – are typically chaired by CEOs (Peng, Zhang, and Li 2007). The market environment and legal institutions in China remain underdeveloped in comparison to other countries, and inadequate financial management practices decrease firms' disclosures. Additionally, the distribution of human capital (e.g. professional entrepreneurs and managers) is unbalanced, and is strongly constrained by the market environment and legal institution development level. Many studies have explored how the institutional environment determines the allocation of entrepreneurial efforts among different types of activities (e.g. Bowen and De Clercq 2008). High- level human capital (e.g. educational resources and advanced training programs) is concentrated in more developed regions in China. Following Schumpeter (1934, 1942), productive entrepreneurship can be considered the primary source of efficiency. More recent papers by Baumol (1990, 2002) have conceded that within the contexts of imperfect institutions, entrepreneurship also could be unproductive and even destructive. Thus, in relatively developed regions, entrepreneurs' professional knowledge and experience can be used to efficiently handle firm performance through capital management and market strategy. They can contribute to their firms' TFP by managing working capital.

The extant literature on the impact of working capital on the TFP of Chinese non-listed firms suffers from three limitations which I aim to overcome in this paper. First, to the best of my knowledge, the direct link between working capital and TFP has not been tested so far, so I fill this gap in the field. Second, both external and internal – direct and indirect measurements of financial constraints are substantial for non-listed firms in China. However, all the studies in the literature on the impact of financing tunnels on financial constraints are rough, implying that these studies are based on an econometric specification that is potentially misleading. In this paper, I do not suffer from this limitation. Third, distinguishing the impact of working capital and other financing intermediations on TFP allows us to shed light on how working capital alleviates financial constraints under different levels of heterogeneities, so I fill this gap in this work.

My analysis is related to five distinct studies about the financial markets and financial constraints faced by firms. I discuss each in turn.

2.2. Hypothesis development

2.2.1. General hypothesis

Literatures demonstrate that the market enhances productivity by weeding out inefficient firms and reallocating resources from low-productivity firms to high-productivity ones. Because lower productivity firms are more likely to suffer continuous decreases in market share, these firms are more likely to exit the market due to their poor performance. Liu and Li (2015) demonstrate that a Chinese firms' likelihood of survival is significantly affected by

financial constraints. For these financially constrained firms, working capital may be used as an additional source of financing. In fact, little is known about whether and how working capital functions and how much economic activity it supports in China – especially when there are financing constraints.

Net working capital, also known as liquidity, is defined as the difference between a firm's current assets and its current liabilities, normalized by total assets. The availability of more liquid assets increases firms' ability to raise cash at short notice: Liquid firms can quickly access some of their assets in case they need extra funds to finance uncertain productivity-enhancing activities. For firms with excessive working capital, I propose corporate investment as a possible channel through which the decrease in unnecessary working capital from one period to the next translates into better firm performance. If a firm cuts working capital to redeploy underutilized resources to higher-valued uses, working capital reductions should be associated with an increase in firm performance (see e.g. Atanassov and Han Kim 2009). Motivated by prior literature which suggests that working capital could be considered a source of internal funds (Fazzari and Petersen 1993) or a substitute for cash (Bates, Kahle, and Stulz 2009), I argue that corporate investment is a potential channel through which improvement in working capital management (WCM) should affect firm performance. Indeed, the decrease in unnecessary net working capital (NWC) through time increases a firm's financial flexibility in the short run thanks to the release of unnecessary cash invested in working capital, and also in the long run thanks to relatively lower financing needs to fund day-to-day operating activities. Additionally, financially flexible firms have a greater ability to take investment opportunities (see e.g. Denis and Sibilkov 2010; Duchin, Ozbas, and Sensoy 2010).

By contrast, illiquid firms may not be able to do the same and are hence likely to be more dependent on their cash flow for productivity-enhancing activities. Therefore, to firms with unnecessary NWC, I expect a negative relationship between NWC and corporate investment (i.e. a positive relationship between the decrease in unnecessary NWC across time and corporate investment). For firms with an already low level of NWC, corporate investment sourced by working capital reductions is almost impossible. Thus, I do not expect a negative relationship between NWC and corporate investment for firms with underinvestment in NWC. Fazzari and Petersen (1993) and Ding, Guariglia, and Knight (2013) find that firms with higher liquidity exhibit lower sensitivities of fixed investment to cash flow than their counterparts with lower liquidity, for U.S. and Chinese firms, respectively. Similarly, Nucci, Pozzolo, and Schivardi (2005) find that Italian firms with lower liquidity suffer from stronger negative effects of leverage on their TFP than their counterparts with higher liquidity.

Hypothesis 1: If a firm's working capital is positive (negative), the firm's working capital will have a negative (positive) influence on its TFP.

2.2.2. Ownership

I first differentiate the linkages between working capital and TFP across groups of firms based on ownership. Ayyagari, Demirgüç-Kunt, and Maksimovic (2010) suggest that despite the weaknesses of China's formal financial system and the dominance of the use of internal or informal finance by firms, financing from formal financial institutions does not harm labor productivity and TFP growth. Specifically, in China, the TFP of SOEs and collective firms has not been significantly affected by financial constraints, as these firms typically benefit from soft budget constraints and thus do not suffer from financing constraints (Bai, Jiangyong, and Tao 2006; Chen and Guariglia 2013). By contrast, the TFP of private firms tends to be

significantly affected by financing constraints – as private firms in China face a high degree of financing constraints (Allen, Qian, and Qian 2005; Poncet, Steingress, and Vandenbussche 2010; Guariglia, Liu, and Song 2011). As for foreign firms, the extent to which they are subject to financing constraints is controversial in the literature. Poncet, Steingress, and Vandenbussche (2010) and Manova, Wei, and Zhang (2015) claim that these firms are less financially constrained than other types of firms, as they can access financing from their parent companies. Yet Guariglia, Liu, and Song (2011), Ding, Guariglia, and Knight (2013), and Chen and Guariglia (2013) show that they suffer from significant financing constraints. The paper draws on classic literature as well as new research on ownership and control (e.g. La Porta, Lo' pez-de-Silanes, and Shleifer 1999; Claessens, Djankov, and Lang 2000; Gompers, Ishii, and Metrick 2010; Lin et al., 2011) by linking working capital management to external financial constraints.

My sample is divided into state-owned enterprises (SOEs), privately owned firms and foreign firms. A lending bias has long existed in China due to the state-dominated financial system. SOEs typically benefit from soft budget constraints and do not suffer from financing constraints (Bai, Jiangyong, and Tao 2006); therefore, I expect the TFP of SOEs not to be significantly affected by the availability of working capital. By contrast, I expect the TFP of private firms to be significantly affected by working capital because private firms in China typically face a high degree of financing constraints (Allen, Qian, and Qian 2005; Poncet, Steingress, and Vandenbussche 2010; Guariglia, Liu, and Song 2011; Chen and Guariglia 2013). As for foreign firms, the extent to which they are subject to financing constraints is controversial in the literature. The World Bank (2006) document that fully foreign-owned firms operating in China have limited access to domestic direct finance and have to finance much of their investments from abroad. Guariglia, Liu, and Song (2011) and Ding, Guariglia, and Knight (2013) show that they suffer from significant financing constraints. Yet Poncet, Steingress, and Vandenbussche (2010) and Manova, Wei, and Zhang (2015) claim that these firms are less financially constrained than private firms, as they can access finance from their parent companies. Thus, when privately and foreign-owned firms are financially constrained, they have to manage their working capital to smooth the financing constraints to contribute to TFP. In this study, I demonstrate that privately and foreign- owned firms relied more on WCM than on SOEs in raising firm TFP.

Using another approach, my data show that SOEs manage working capital least efficiently among the three categories. Ding, Guariglia, and Knight (2013) reported that SOEs have the longest terms of days payable outstanding, cash conversion cycle, and the lowest inventory turnover ratio. The long time span between the disbursement and collection of cash observed for SOEs suggests poorer working capital management efficiency, and this may not even contribute to the low TFP characterizing these firms.

Analyzing the linkages between their TFP and working capital may shed further light on the extent of the financing constraints faced by these firms. In combination with Section 2.1, I propose the following hypothesis:

> *Hypothesis 2*: Working capital is significantly associated with TFP in privately and foreign- owned firms, while not significantly associated with TFP in SOEs.

2.2.3. External financial constraints

External financial constraints have been demonstrated to influence firm investment behavior, financing environment as well as TFP. As TFP has been highly correlated with the level of

financial constraints, and high TFP benefits from the financial health of firms (Silva 2011). Previous studies have shown that internal financing plays a more important role on TFP or investment than external financing of Chinese firms that are facing financial constraints (Héricourt and Poncet 2009; Poncet, Steingress, and Vandenbussche 2010; Guariglia, Liu, and Song 2011; Chen and Guariglia 2013; Ding, Guariglia, and Knight 2013). Fazzari and Petersen (1993) and Ding, Guariglia, and Knight (2013) find that firms with high working capital exhibit lower sensitivities of fixed investment to cash flow than their counterparts with lower working capital, for U.S. and Chinese firms, respectively. Similarly, Chen and Guariglia (2013) find that having higher working capital can alleviate a firm's dependence on internal financing, thus enhancing their TFP. Furthermore, firms that are financially constrained lack efficient financing options, and the availability of working capital increases firms' ability to raise cash at short notice. Thus, firms that are highly constrained financially can quickly liquidize some of their working capital in case they need extra funds to finance uncertain productivity enhancing activities; therefore, it seems that working capital is more sensitive to TFP. By contrast, firms that are not financially constrained may not be able to do the same and are likely to be less dependent on their working capital for TFP-enhancing activities.

Hypothesis 3: Working capital is more sensitive to TFP in firms that face external financing financial constraints in comparison to firms that do not face external financial constraints.

2.2.4. Internal financial constraints

A few theoretical studies have discussed the issue of determinants of capital structure choices. There are two widely acknowledged competing theories of capital structure: the static tradeoff theory (or the optimal capital structure theory) (Myers 1977) and pecking order theory (Myers 1984; Myers and Majluf 1984). Although the applicability of these theories has been extensively tested, consensus has yet to be reached (Helwege and Liang 1996; Shyam-Sunder and Myers 1999; Fama and French 2002; Frank and Goyal 2003). However, both of these theories agree that firms have preferred using internal rather than external financing.

The static trade-off theory rests on the costs (agency cost and financial constraints) and benefits of debt financing. In China, these conditions are only partially met. On one hand, enterprises do not benefit from debt financing; for example, taxes protect interest and lenders by monitoring the opportunistic behaviors of management. On the other hand, Chinese central and local governments have been reluctant to bankrupt SOEs because the government has the responsibility to maintain employment and social stability (Zou and Xiao 2006).

Additionally, Chinese firms still face some significant indirect costs of financial constraints, such as difficulty obtaining debt (Zou, Fang, and Zhao 2003). In particular, indirect costs are usually larger than direct cost (Warner 1997). Large blocks of state control may raise moral hazard problems among borrowers (e.g. SOE mangers are reluctant to commit to loan repayment schedules given the low chance of liquidation), inducing credit risks for lenders (Zou and Adams 2008).

The pecking order theory assumes the existence of information asymmetry. It predicts that enterprises will prefer internal financing to other sources, namely debt and issuing security. Chinese enterprises also rely heavily on short-term leverage, with managers tending to prefer equity financing to debt financing (Chen 2004).

Internal financial shocks have effects that differ across constrained and unconstrained firms. A firm with greater internal cash flow may find it easier to obtain external financing as it will be perceived as less risky by lenders, since a high internal cash flow can be seen as evidence of managers' commitment to their investment projects (Brealey, Leland, and Pyle 1977). Also, a high internal cash flow can decrease the risk of default and liquidation (Cleary, Povel, and Raith 2007). Thus, firms with enough internal financing generally do not have external financial constraints. And even if they did, they might prefer to use internal financing to meet capital requirements to enhance and contribute to TFP, relying less on working capital. Conversely, firms that have internal financial constraints will find it more difficult to obtain external financing. According to Cleary, Povel, and Raith (2007), for firms with internal financial constraints, a large portion of any loan has to be transferred to pay existing debts or cover fixed costs, in an attempt to have a positive cash flow. Therefore, in the presence of a decreasing cash flow, these firms would have to increase their investments in order to generate sufficient revenue. Hence working capital can be used as an alternative financial intermediation to ease the cash flow of firms with internal financial constraints (Fazzari and Petersen 1993; Chen and Guariglia 2013; Ding, Guariglia, and Knight 2013). Moreover, the availability of working capital increases firms' ability to raise cash at short notice; therefore, working capital can ease the internal financial constraints in order to increase firm performance, i.e. investment and TFP.

In this study, my data are obtained from non-listed enterprises which do not participate in the stock market. Therefore, debt and cash flow should have a greater impact. After controlling debt and cash flow variables in my model, my data samples supply us an interesting test environment to investigate how working capital impacts TFP. I use cash flow to measure internal financial constraints as it should be more reliable.

Hypothesis 4: Working capital is more sensitive to TFP in firms that have higher internal financial constraints than firms that have lower internal financial constraints.

2.2.5. Financial constraints and firm size

Many studies have used firm size as a measure of financial constraints (Guariglia 2008). In the literature, small firms have been presumed to have less access to financing because they lack collateral and credit histories, making it difficult for banks to assess their credit worthiness (Berger and Udell 2006; Beck, Demirgüç-Kunt, and Pería 2011). Large firms are usually considered to have better access to external financial markets than small firms (Kusnadi and Wei 2011). In China, weaker connections with government could put small firms in an even more disadvantageous situation when obtaining external funds. It is suggested that financing small firms is significantly constrained by accessibility to external finance because these firms are particularly susceptible to the effects of asymmetrical information. Smaller firms also are disadvantaged as they cannot exploit scale economies and have fewer overall physical assets that could serve as collateral compared to larger capital intensive companies. Thus, they are more motivated to rely on internal financing. In addition, managing their working capital is an efficient way for them to ease financial constraints.

Hypothesis 5: Working capital is more sensitive to TFP in smaller firms than in larger firms.

2.2.6. Financial constraints and marketization

Myers (1984), Myers and Majluf (1984), Petersen and Rajan (1994), and Shleifer and Vishny (1997) have argued that credit market development and firm-creditor relationships can

affect a firm's financing costs. Love (2003) and Islam and Mozumdar (2007) show that financial constraints decrease with financial market development. Therefore, a well-developed financial market and institutional environment can reduce the degree of asymmetric information for both the financing lender and receiver and reduce debt financing costs, further easing the financial constraints. In China, although the same legal system is in effect in different regions, the effectiveness of law enforcement and the quality of law services are quite heterogeneous across regions. Hence I expect that firms in well developed markets and institutions would be less financially constrained. Firth, Gong, and Shan (2013) used Chinese provincial data and showed that higher administrative expenditures by provincial governments can lead to a firm's lower valuation and poorer stock and operating productivity. By defining the institutional environment as a combination of credit market development, legal environment and government intervention, I hypothesize:

Hypothesis 6: Working capital is more sensitive to the TFP of the firms in under-developed markets and institutional environments than the firms in well-developed markets and institutional environments.

3. Empirical specifications and estimation methodology

3.1. Baseline specification

As one of the most important measurements of growth, TFP can reveal differences in economic growth and income levels across countries and regions (Caselli and Gennaioli 2005; Hsieh and Klenow 2010). Based on Chen and Guariglia's (2013) empirical model of cash flow and firm performance, I establish a model to find the determinants of TFP and reveal whether financial factors exert any effect. Specifically, I estimate my model as follows:

$$\mathrm{TFP}_{it} = \alpha_0 + \alpha_1 \mathrm{TFP}_{i,t-1} + \alpha_2 \mathrm{WK}_{it}{*}\mathrm{Pos} + \alpha_3 \mathrm{WK}_{it}{*}\mathrm{Neg} + \alpha_4 X_{it} + v_i + v_j + v_t + v_{jt} + \varepsilon_{it}, \quad (1)$$

where TFP_{it}[2] indicates the total factor productivity of firm i at time t; the estimation of TFP is explained by 3.2. X_{it} is a vector of a firm's characteristics including firm size, firm age, cash flow, leverage and sales growth.[3] Working capital (WK) is my key explanatory variable. Current assets minus current liabilities scaled by total assets is used to evaluate working capital.[4] All data in this paper have been deflated by deflators.[5] In order to better observe the difference in positive and negative WK, I divide my WK into two groups in following work by Carpenter and Guariglia (2008), Guariglia (2008) and Ding, Guariglia, and Knight (2013). Pos and neg are dummy variables. If WK is negative (positive), and Pos (Neg) equals to 1, or else equals to 0. This formulation allows the parameters of the model to differ across observations in the two sub-samples.

The variable v_i is a firm-specific effect, which I control for regressing Equation (1) in first differences, and v_j is an industry-specific effect measured by an industry dummy. There are 37 industries including the most basic industry of textile manufacturing (Brandt et al. 2012). The variable v_t is a time-specific effect, and I control it using a time dummy. The variable v_{jt} is used to control industry-specific business cycle effects (Guariglia, Liu, and Song 2011; Chen and Guariglia 2013). Finally, ε_{it} is an idiosyncratic error term. This specification enables us to test how working capital influences Chinese firms' productivity.

3.2. Estimating a TFP equation

I assume that the production function of China's manufacturing non-listed firms takes Cobb–Douglas form (Chen and Guariglia 2013; Ding, Guariglia, and Knight 2013):

$$Y_{it} = A_{it} L_{it}^{\beta_l} K_{it}^{\beta_k} M_{it}^{\beta_m}, \tag{2}$$

where Y_{it} represents physical output of firm i in period t; there are three inputs: labor, which is freely variable (L_{it}); capital, which is a state variable (L_{it}); and another freely variable intermediate input (M_{it}) (e.g. materials or energy). A_{it} is the Hicks neutral efficiency level of firm i in period t. Taking natural logs and differentiating the equation yields a linear production function as follows:

$$y_{it} = \ln A_{it} + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it}, \tag{3}$$

$$\text{TFP}_{it} = y_{it} - \beta_l l_{it} - \beta_k k_{it} - \beta_m m_{it}, \tag{4}$$

There are various methods to estimate TFP. The simplest model is the Solow residual method (Solow 1957) estimated by OLS. However, econometric issues arise because firm productivity can affect input choices. Petrin et al. (2004) point out that the demand function for m_{it} is given by $m_{it} = m_{it}(\ln A_{it}, k_{it})$ and is assumed to be strictly increasing in $\ln A_{it}$. Because $\ln A_{it}$ is observed by the firm, but not by the econometrician, a firms' unobserved productivity is in fact likely to be correlated with its input decisions: Productive firms tend to use more capital and labor due to higher current and anticipated future investment opportunities. This implies that estimation of Equation (4) by OLS would suffer from endogeneity and selection problems. A number of solutions have been proposed in the literature to overcome this problem, including firm-level fixed effects by Jefferson, Rawski, and Zhang (2008), the Olley and Pakes's method (OP Method, 1996) and the Levinsohn and Petrin's method (LP Method, 2003).

To better cope with the simultaneity and sample selected problem, Olley and Pakes (1996) and Levinsohn and Petrin (2003) suggest using investment and intermediate inputs, respectively, as proxies for unobserved productivity. Both methods assume a monotonic relationship between the proxy variable and the true productivity shocks. They implicitly require positive investment or intermediate inputs, given that productivity shocks cannot be negative. Hence, the Olley and Pakes (1996) method will systematically drop observations with a non-positive investment. Because a significant number of Chinese firms exhibit this characteristic (Chen and Guariglia 2013; Ding, Guariglia, and Knight 2013), I choose not to use this method as the main regression method in this study. On the other hand, most of my firms have a positive intermediate input, such as materials and energy consumption. Therefore, I use the Levinsohn and Petrin (2003) estimator to calculate TFP. I estimate Equation (4) separately by two-digit industries to allow for technological differences across industries. I regress my TFP by LP method and use TFP regressed by OP method as part of my robustness tests. β_l, β_k, and β_m are estimated using LP method, OP method, and OLS method, respectively.[6]

3.3. Accounting for firm heterogeneity

3.3.1. Investment-cash flow sensitivity

To study the role of financial constraints on firm behavior, the literature has suggested many possibilities including ICFS (investment-cash flow sensitivity) (Fazzari et al. 1988; Fazzari, Hubbard, and Petersen 2000). Studies have demonstrated that investment can be more sensitive to cash flow for firms that have a high degree of financial constraints (Cleary 1999; Erickson and Whited 2000; Alti 2003; Moyen 2004; Cummins, Hassett, and Oliner 2006). This sensitivity is defined as the difference between the cash flow weighted time-series average investment in fixed capital to fixed capital ratio of a firm and its simple arithmetic time-series average ratio.[7] These differences will be higher for firms that tend to display higher investment in years with a relatively higher cash flow and lower investment in years with a lower cash flow. Firms whose investments track cash flow are likely to face more severe financing constraints: If they suffer an adverse cash flow shock, these firms may need to cut their investments because they may be unable to obtain external finance at a reasonable cost. In theory, my firm-level sensitivities can be interpreted as measures of the degree of financing constraints faced by each of my firms. Nevertheless, ICFS as an indicator of financial constraints is not without criticism. In an in-depth study of investment-cash flow sensitivity, Kaplan and Zingales (1997) argue that firms identified as financially constrained by the FHP method are actually not constrained at all. Chen and Chen (2012) document that investment-cash flow sensitivity has declined and disappeared, even during the credit crunch of 2007–2009. Farre-Mensa and Ljungqvist (2016) cast several doubts on 'financial constraint indexes' which includes ICSF. However, there are two reasons in this study that demonstrate ICSF can be used to measure financial constraints. Chinese non-listed firms mainly rely on formal financing (e.g. long-term bank loans), internal (e.g. cash flow) and 'informal' (working capital's smoothing effect, referred to in other papers as 'trade credit'). If a firm's ICFS is high, there are mainly two possibilities. One is FHP's financial constraints hypothesis as used in this paper. The other is the pecking order hypothesis; it also means the cost of external financing is high, so they have to rely on cash flow. This also means the firms' external financing costs are difficult for them to afford. I extend my paper's analysis from these perspectives.

A few studies have empirically shown that the investment-cash flow sensitivities financial constraints hypothesis holds for Chinese firms' activities. Consistent with my results, my paper also finds that although Chinese enterprises are generally financially constrained, SOEs and foreign enterprises are shown to be less constrained (Héricourt and Poncet 2009; Poncet, Steingress, and Vandenbussche 2010; Firth et al. 2012; Chen and Guariglia 2013; Ding, Guariglia, and Knight 2013; Cull et al. 2015; Liu and Li 2015).

To account for this heterogeneity, in this section I follow the methodology introduced by Hovakimian and Hovakimian (2009) to calculate firm-level sensitivities of investment in fixed capital to cash flow. We then use these firm-level sensitivities to identify the characteristics of firms with high and low fixed investment-cash flow sensitivities, and the characteristics of firms with different combinations of high/low FKS. One objective of this exercise is to assess the extent to which these sensitivities are adequate measures of financing constraints. Another is to investigate the extent to which, in the presence of cash flow shocks, firms can manage their working capital in such a way as to alleviate the effects of financing constraints on fixed capital investment. The firm-level cash flow sensitivities of investment in fixed capital is calculated as follows:

$$\mathrm{ICFS}_{it} = \sum_{t=1}^{n} \left(\frac{(\mathrm{cashflow}/K)_{it}}{\sum_{t=1}^{n} (\mathrm{cashflow}/K)_{it}} * \left(\frac{I}{K} \right)_{it} \right) - \frac{1}{n} \sum_{t=1}^{n} \left(\frac{I}{K} \right)_{it} \quad (5)$$

where n is the number of annual observations for firm i, and t indicates time. This sensitivity is given by the difference between the cash flow weighted time-series average investment in fixed capital to fixed capital ratio of a firm and its simple arithmetic time-series average ratio.

Therefore, I separate firms according to their levels of financing constraints as measured by the ICFS, and I consider firms with the ICFS above (below) the sample median to be more (less) likely to be financially constrained.

3.3.2. External financial constraints measurements

Nevertheless, investment-cash flow sensitivity as an indicator of financial constraints is not without criticism.[8] In an in-depth study of investment-cash flow sensitivity, Kaplan and Zingales (1997) argue that firms identified as financially constrained by the FHP method are not constrained at all. The KZ index[9] is produced by the estimated coefficients from one of the Lamont, Polk and Saa-Requejo models (Lamont, Polk, and Saa-Requejo 2001). A firm with a high KZ index is considered more financially constrained when its internal and external costs for funds increase. Lin and Bo (2012) apply the KZ index to an analysis of Chinese listed firms from 1999 to 2008 and find that although an average sample firm experienced some degree of financial constraints, state-owned property did not help reduce the firms' financial constraints on investment.

Compared with the common KZ index, Whited and Wu (2006) further introduce the WW index[10] of financial constraints, and argue that their index is more consistent, with firm characteristics related to financial constraints. Using this index, Huang, Zhang, and Zhu (2008) find that among domestic firms, the financial constraints index is the highest for private firms and the lowest for state-owned firms. Furthermore, Hadlock and Pierce (2010) update Kaplan and Zingales (1997) text and introduce the size-age (SA) index.[11] The SA index avoids the problem in which the same information is mechanically built into both the dependent and independent variables. Furthermore, it is relatively easy to calculate and could better avoid endogeneity bias in the financial factors.

I select the SA index in my research for three reasons. First, the KZ index needs Tobin's Q which is not available for my sample of Chinese non-listed firms. Second, the WW index needs a dividends variable which is not available for my database, so I correct and use it in my robustness test.[12] And third, compared with the SA index, the KZ and the WW indexes incorporate more financial factors which may pose greater endogeneity problems. To bridge the gap in the research literature, according to my knowledge, I am the first to use the SA index to evaluate the level of financial constraints in Chinese non-listed firms. I include the SA index in my econometrics model to evaluate the financial constraint levels of my samples.

The firm-level cash flow sensitivities of investment in fixed capital is calculated as follows:

$$\mathrm{SA}_{it} = 0.737^{*}\mathrm{Size}_{it} + 0.043^{*}\mathrm{Size}_{it}^{2} - 0.040^{*}\mathrm{Age}_{it} \quad (6)$$

Thus I separate firms according to their level of financial constraints as measured by the SA index, and I consider firms with the SA index above (below) the sample median to be less (more) likely to be financially constrained.

3.3.3. Internal financial constraints measurements

Cash flow has been widely used in the investment literature as a measure of internal financing (e.g. Hubbard 1998; Bond, Harhoff, and Van Reenen 2005; Guariglia 2008). To measure internal financial constraints, I utilize cash flow as a proxy. Therefore, I separate firms according to their internal financial constraints level, measured by cash flow, and I consider firms with cash flow above (below) the sample median to be less (more) likely to be financially constrained.

3.3.4. Firm size

Many studies have used firm size as an inverse proxy of financial constraints (Carpenter et al. 1994; Almeida, Campello, and Weisbach 2004; Faulkender and Wang 2006) following the notion that smaller firms face higher informational asymmetry and agency costs and thus will be more financially constrained. In fact, Whited (1992) indicates that larger firms have better access to capital markets, so they face lower borrowing constraints and lower costs of external financing. Therefore, I separate firms according to their size, measured by the natural logarithm of total assets, and I consider firms with size above (below) the sample median to be less (more) likely to be financially constrained.

3.3.5. Institutional environment measurement

To measure the institutional environment of each province, municipality and autonomous region, I make use of the National Economic Research Institute Index of Marketization (NERI Index).[13] The NERI Index captures the following five aspects of the institutional environment in China: (1) government decentralization, (2) development of non-state sectors, (3) development of product markets, (4) production factor markets and (5) market intermediaries and the legal environment. Each of these five sub-indices has at least two sub-items to better reflect each of the dimensions. Each of these sub-indices has a score ranging from 0 to 10, calculated based on the statistics of the government authorities and the authors' surveys. Excluding Hong Kong, Macau and Taiwan, China has 31 provinces, municipalities and autonomous regions. Therefore, all the non-listed firms are classified into two groups according to their institutional and marketization development level, measured by the NERI Index. I consider firms with scores above (below) the sample median to be less (more) likely to be financially constrained.

3.4. Endogeneity problem

In examining the relationship between working capital and TFP, one issue is the potential endogeneity of explanatory variables with respect to TFP. The System GMM (generalized method of moments) estimation allows us to address a potential endogeneity problem because firms anticipate shocks to productivity and accordingly adjust input throughout the production process (Coricelli et al. 2012). Unobservable corporate-specific fixed effects affect ownership and financial constraints; with simultaneous causality for financial constraints (Shailer and Wang 2015); dynamic panel bias (Nickell 1981; Arellano and Bond 1991;

Bond 2002). Some other problems with omitted variables, such as human capital, cannot be observed in this database.

This paper's model and methodology are closely related to Chen and Guariglia (2013)'s research. All my equations are estimated by the system GMM estimator developed by Arellano and Bond (1991) and Blundell and Bond (2000), which enables us to control for the possible simultaneity and endogeneity problems in regressions. The estimator combines in a system the equation in first-differences with an equation in levels. By adding the original equation in levels to the system and exploiting the additional moment conditions, Blundell and Bond (2000) demonstrate that there is a dramatic improvement in efficiency and a significant reduction in finite sample bias compared with the simple first-differenced GMM.

Lagged values of the regressors are used as instruments to control for the possible endogeneity of regressors. Following Chen and Guariglia (2013)'s paper, I treat all the regressors in my equations (except age) as endogenous instruments. I use their lagged levels in the differenced equation and their lagged differences in the levels equation. I also include year dummies, two-digit industry dummies, year dummies that interacted with industry dummies, and province dummies in all my regressions and instrument sets.

In addition, I use two criteria to test that my estimations are reasonable. First, I assessed the presence of the *n*th-order serial correlation in the different residuals which are denoted as an $m(n)$ test. The estimations that I regress can be considered reasonable if these specifications are exempt from the derailed correlation in the 1st-difference residuals. In the presence of a serial correlation of order n, lags $n+1$ and deeper are required strictly in the instrument set (Brown and Petersen 2009; Roodman 2009). The $m(n)$ test is asymptotically distributed as a standard normal distribution under the null hypothesis for no n-order serial correlation of the differenced residuals.

Second, to evaluate whether my instruments are legitimate and whether my model is correctly specified, I assess whether the variables in the instrument set are uncorrelated with the error term in the relevant equations. I use Sargan test and Hansen test (J test) to test over identifying restrictions. The result of this test for instrument validity is asymptotically distributed as a chi-square with degrees of freedom equal to the number of instruments less than the number of parameters. However, using system GMM to estimate a production function based on a large panel data, the Sargan test tends to over-reject the null hypothesis of instrument validity (Benito and Hernando 2007; Becker and Sivadasan 2010). Since my panel data are of large number, I choose Hansen test as a major reference.

4. Data and descriptive statistics

4.1. Data

I use data drawn from the annual financial accounts filed by non-listed industrial firms from the GTA (GuoTaiAn) database via CSMAR (China Securities Market & Accounting Research) during the period of 1999–2007. The legal unit of a GTA non-listed firms database's observation is a firm. In China, the GTA non-listed firms' database observes annual firm-level data for 'above-scale' industrial firms, also called firms above designated size. My data cover 41 industries and includes enterprises with annual sales of five million yuan or more from 1998 to 2007. The GTA non-listed firms' database includes a full industrial firm census that covers all active non-listed firms, irrespective of size or ownership. They include identifying

information with detailed industry and geographic codes. Firm ownership can be identified using the official registration type or from the share of paid capital of different groups. Stock variables include various measures of assets, debt, inventory and accounts receivable. Flow variables detail various dimensions of output, including export, inputs and taxes. Aspects of firm performance – on both the revenue and the cost side – are reported separately for the main line of business and limited to operational activities. This database includes various employment benefits beyond salaries, e.g. pension benefits. Some other useful pieces of information (e.g. accounts payable, number of female employees, and cash flow variables) are now reported as well. I choose 2007 as my sample end year to avoid confounding effects of significant changes in China's financing environment on firms' cost of debt and financial constraints following the global financial crisis (Levinger 2014; Shailer and Wang 2015).[14] Due to data restrictions, observations with negative sales, negative total assets minus total fixed assets, negative total assets minus liquid assets, and negative accumulated depreciation minus current depreciation are omitted. Firms without complete records on main regression variables also are omitted. To control the potential influence of outliers, I excluded observations in the one percent tails of each of the regression variables. Firms with fewer than five years of consecutive observations are also exclude from my samples (Guariglia and Mateut 2010). In addition to the above treatment, I further matched the address, telephone number and industry code of firms, and omitted observations for firms with fewer than eight employees (Brandt et al. 2012). Finally, my unbalanced panel covers 118,356 non-listed firms, corresponding to 625,618 firm-year observations.[15]

4.2. Descriptive statistics

Table 1 displays the descriptive statistics of my key variables by year. With respect to firm productivity, there is a steady increase in TFP (3.588–4.795). Turning to the financial variables, net working capital increases steadily (0.036–0.084). By further dividing the net working capital according to positive and negative, I find that generally the positive (negative) working capital increases (decreases) steadily (0.036–0.084/−0.088 to −0.073). Cash flow increases from 0.080 to 0.119, while leverage decreases from 0.616 to 0.566.

Table 1. Summary statistics by year.

Variable	2000	2001	2002	2003	2004	2005	2006	2007
TFP^{LP}	3.588	3.602	3.719	3.846	4.057	4.296	4.525	4.795
TFP^{OP}	1.677	1.693	1.722	1.766	1.797	1.826	1.854	1.881
Ros	0.015	0.015	0.017	0.020	0.021	0.023	0.026	0.031
WK	0.036	0.045	0.049	0.052	0.054	0.064	0.075	0.084
WK (Positive)	0.126	0.134	0.137	0.140	0.140	0.146	0.154	0.158
WK (Negative)	−0.088	−0.088	−0.086	−0.086	−0.084	−0.081	−0.077	−0.073
Cash flow	0.080	0.083	0.087	0.091	0.093	0.104	0.110	0.119
Leverage	0.616	0.602	0.595	0.587	0.591	0.578	0.571	0.566
Sales growth	0.018	0.003	0.054	0.047	0.018	0.033	0.026	0.041
Size	9.939	9.870	9.860	9.861	9.984	10.094	10.204	10.331
Age	2.268	2.168	2.170	2.115	2.160	2.265	2.360	2.440
SA	−3.095	−3.100	−3.102	−3.099	−3.087	−3.078	−3.067	−3.051
Observations	77,519	95,677	111,564	134,786	119,761	115,811	109,806	102,757

Notes: See Appendix 1 for precise definitions of all variables. This table reports the summary statistics for the sample firms by year during 2000–2007.

Table 2 displays the descriptive statistics of my key variables by ownership. With respect to productivity, the average value for firms with different ownership types generally fluctuates around 4.0. The foreign group has the highest TFP (4.304) while the SOEs group has the lowest (3.653). This echoes the fact that in China SOEs generally have lower productivity compared to firms with other types of ownership.[16] Turning to the financial variables, net working capital of the foreign group is the highest (0.110) while that of the SOEs is the lowest (0.013). In addition, I find that in general, the positive working capital fluctuate around 0.141, whereas the negative working capital accounts for about −0.083. Consistent with the previous results, in terms of both positive and negative working capital, the SOEs group is the lowest (0.121 and −0.104, respectively) while the foreign group is the highest (0.175 and −0.064, respectively). Leverage of the foreign group is the lowest (0.544) while that of SOEs is the highest (0.647). This is consistent with the fact that in China, SOEs can easily get access to loans and other debts from banks and other financial institutions, while foreign firms typically rely more on their own country's capital market. Additionally, turning to the financing constraints proxies, cash flow, firm size and SA index, the SOE group is of the weakest financial constraints (0.071, 10.407 and −3.085), while the private group is the strongest (0.104, 9.847 and −3.105). These three proxies are consistent with each other.

Table 3 shows the correlation coefficients of the key variables. All the correlation coefficients are smaller than 0.6 and most of them are very small. This can alleviate the concern of multi collinearity problem when they are used simultaneously in the same regression.

5. Regression results

5.1. Baseline results and ownership

Table 4 presents the results of system GMM regression analyses to investigate the relationship between WK and TFP using Equation (1) by ownership. Positive and negative WK groups are examined separately to identify the unique relationship patterns of the two groups. As presented in columns 1–3, for the positive WK group, the coefficients of TFP on WK for private and foreign firms are significantly negative; in contrast, the coefficients of TFP on WK for

Table 2. Summary statistics by ownership.

Variable	Full sample	SOEs	Private	Foreign	Diff. (*S*/*P*)	Diff. (*P*/*F*)	Diff. (*F*/*S*)
TFP^{LP}	4.026	3.653	3.952	4.304	−0.295***	0.352***	−1.117***
TFP^{OP}	1.772	1.700	1.776	1.806	−0.075***	0.030***	−0.154***
Ros	0.020	0.002	0.027	0.023	−0.025***	−0.005***	−0.020***
WK	0.056	0.013	0.048	0.110	−0.034***	0.062***	−0.129***
WK (Positive)	0.141	0.121	0.133	0.175	−0.012***	0.043***	−0.075***
WK (Negative)	−0.083	−0.104	−0.084	−0.064	−0.020***	0.020***	−0.052***
Cash flow	0.095	0.071	0.104	0.098	−0.033***	−0.006***	−0.024***
Leverage	0.590	0.647	0.594	0.544	0.052***	−0.050***	0.151***
Sales growth	0.031	−0.024	0.052	0.031	−0.076***	−0.029***	−0.058***
Size	10.011	10.407	9.847	10.190	0.210***	0.344***	−0.456***
Age	2.239	2.707	2.108	2.251	0.599***	0.143***	0.638***
SA	−3.085	−3.038	−3.105	−3.063	0.010***	0.042***	−0.090***
Observations	890,987	106,038	554,669	170,280			

Notes: See Appendix 1 for precise definitions of all variables. This table reports the summary statistics for the sample firms during 1999–2007 and tests comparing SOEs and private firms, private and foreign firms, SOEs and foreign firms. The significance of test statistic for the equality of variables' mean are shown by ***, ** and *. ***, ** and * represent statistical significance at the 1, 5 and 10% percent level, respectively.

Table 3. Correlation matrix between independent variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
WK	1									
WK (Positive)	0.354	1								
WK (Negative)	0.354	−0.438	1							
Cash flow	0.103	0.205	0.149	1						
Leverage	−0.269	−0.578	−0.519	−0.304	1					
Sales growth	0.021	0.002	0.049	0.177	−0.033	1				
Size	0.124	−0.089	−0.002	−0.129	0.021	0.042	1			
Age	−0.010	−0.033	−0.054	−0.106	0.101	−0.086	0.124	1		
ICFS	0.000	0.000	0.001	0.002	−0.004	0.002	0.001	−0.001	1	
SA	0.160	−0.068	0.022	−0.062	−0.010	0.050	0.898	−0.014	−0.000	1

Notes: See Appendix 1 for precise definitions of all variables. This table reports the correlation matrix between independent variables of the sample firms during 1999–2007.

Table 4. Baseline Results.

	(1)	(2)	(3)
	Dependent variable: TFP		
Variables	SOEs	Private	Foreign
$TFP_{i,t-1}$	0.916***	0.951***	0.898***
	(0.065)	(0.018)	(0.063)
WK × Pos	−0.405	−0.772***	−0.529**
	(0.361)	(0.098)	(0.263)
WK × Neg	0.221	0.563***	0.241***
	(0.138)	(0.038)	(0.046)
Cash flow	0.347	1.403***	1.285***
	(0.916)	(0.096)	(0.182)
Leverage	−0.077	0.154***	0.037
	(0.258)	(0.037)	(0.128)
Sales growth	0.278*	0.355***	1.505***
	(0.160)	(0.093)	(0.065)
Size	0.109	0.106***	0.165
	(0.109)	(0.028)	(0.125)
Age	−0.043***	−0.041***	−0.021
	(0.012)	(0.005)	(0.017)
Constant	−0.329	−0.633***	−1.074
	(0.963)	(0.225)	(1.095)
Year dummy	YES	YES	YES
Industry dummy	YES	YES	YES
M(3)	0.404	0.080	0.365
Hansen (*J*) test	0.221	0.106	0.278
Wald test	0.069	0.000	0.003
Observations	63,659	432,579	129,380

Notes: See Appendix 1 for precise definitions of all variables. This table presents the results from regressions using two-step GMM model. *M(n)* is a test for n-order serial correlation in the first-differenced residuals, asymptotically distributed as *N*(0,1) under the null of no serial correlation. The Hansen *(J)* statistics is test of overidentifying restrictions, distributed under the null of instrument validity. The numbers in the rows of Wald test testing whether the impact of Working Capital on TFP is the same across positive and negative Working Capital firm-years are the *p*-values associated with *F*-test for general restrictions. Robust standard errors are in parentheses. ***, ** and * represent statistical significance at the 1, 5 and 10% percent level, respectively.

private and foreign firms are significantly positive for the negative WK group, while the SOEs are not. These findings seem to support hypotheses 1 and 2. Table 4 indicates that positive (negative) WK plays a significantly negative (positive) role on TFP in private and foreign owned firms, but not in SOEs. This suggests that firms can boost their productivity by increasing working capital efficiency for private and foreign firms, i.e. minimizing receivables and

inventory or maximizing payables when WK is positive, or maximizing receivables and inventory or minimizing payables when WK is negative. However, WK most likely is not an efficient tool to enhance the firm performance of SOEs.

5.2. Investment-cash flow sensitivity

In order to test whether firms' ICFS plays a moderating role on the relationship between WK and TFP, I divide each ownership into two groups by the ICFS index evaluated by Equation (5). The results are shown in Table 5. Columns (1–2) show that WK does not significantly impact TFP for SOEs in either the high ICFS group or the low ICFS group. Columns (3–4, 5–6) present the results of high and low ICFS groups for private and foreign firms separately. High ICFS firms' working capital is more sensitive to TFP. This indicate that when a firm's investment behavior strongly relies on internal financing and firms' external financing tunnels are tighter, firms can boost their performance by managing working capital more efficiently. The results imply that when ICFS is high and WK is positive, firms can use trade credit as an alternative financial intermediation in the production process, and reduce inventory and raise sales to supplement cash flow (enhance the TFP). But when WK is negative, firms can raise inventory

Table 5. Regressions by investment-cash flow sensitivity level.

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable:TFP					
	ICS high	ICS low	ICS high	ICS low	ICS high	ICS low
Variables	SOEs	SOEs	Private	Private	Foreign	Foreign
$TFP_{i,t-1}$	0.808***	0.889***	0.974***	0.929***	0.889***	0.891***
	(0.048)	(0.060)	(0.027)	(0.025)	(0.085)	(0.056)
WK × Pos	0.010	0.284	−1.046***	−0.520***	−1.283***	−0.789***
	(0.424)	(0.440)	(0.156)	(0.132)	(0.482)	(0.211)
WK × Neg	0.134	0.145	0.645***	0.500***	0.925***	0.610***
	(0.084)	(0.100)	(0.066)	(0.046)	(0.132)	(0.223)
Cash flow	0.897	0.045	1.537***	1.393***	3.684***	2.146***
	(0.596)	(0.833)	(0.147)	(0.138)	(0.451)	(0.641)
Leverage	0.083	0.229*	0.140***	0.180***	0.338	0.035
	(0.129)	(0.130)	(0.054)	(0.053)	(0.227)	(0.124)
Sales growth	1.169***	1.276***	0.261*	0.399***	−0.663	0.134
	(0.045)	(0.052)	(0.142)	(0.132)	(0.404)	(0.918)
Size	0.295***	0.173*	0.021	0.182***	0.093	0.202**
	(0.093)	(0.100)	(0.043)	(0.039)	(0.168)	(0.088)
Age	−0.043***	−0.036**	−0.036***	−0.046***	−0.106***	−0.074
	(0.014)	(0.016)	(0.007)	(0.008)	(0.029)	(0.068)
Constant	−1.909**	−1.278	0.147	−1.362***	−0.240	−1.335**
	(0.756)	(0.835)	(0.348)	(0.315)	(1.563)	(0.631)
Year dummy	YES	YES	YES	YES	YES	YES
Industry dummy	YES	YES	YES	YES	YES	YES
M(3)	0.760	0.949	0.122	0.056	0.408	0.672
Hansen (*J*) test	0.435	0.087	0.257	0.425	0.266	0.242
Wald test	0.794	0.786	0.000	0.000	0.000	0.000
Observations	35,053	28,717	205,029	227,550	68,860	59,967

Notes: See Appendix 1 for precise definitions of all variables. This table presents the results from regressions using two-step GMM model. *M(n)* is a test for n-order serial correlation in the first-differenced residuals, asymptotically distributed as *N*(0,1) under the null of no serial correlation. The Hansen *(J)* statistics is test of overidentifying restrictions, distributed under the null of instrument validity. The numbers in the rows of Wald test testing whether the impact of Working Capital on TFP is the same across positive and negative Working Capital firm-years are the *p*-values associated with *F*-test for general restrictions. Robust standard errors are in parentheses. ***, ** and * represent statistical significance at the 1, 5 and 10% percent level, respectively.

to avoid the risk or running out of stock and decreasing supply costs. Further, I also find that when firms' ICFS is higher, the coefficients of cash flow on TFP is larger. This means that when ICFS is high, cash flow is more important for TFP. This result enriches the findings in Ding, Guariglia, and Knight (2013) and Chen and Guariglia (2013).

5.3. External financial constraints index-SA index

Table 6 examines the influence of direct external financial constraints on the relationship between working capital and TFP. I divide ownership into two groups by the SA index. Consistent with previous results, working capital is not significantly related to firm performance of SOEs. Columns (3–4, 5–6) illustrate that financially constrained private and foreign firms' WK is more sensitive than that of less financially constrained firms. This relationship exists in the relationship between positive and negative WK and TFP. Furthermore, I find that cash flow influences TFP more strongly when firms are facing sever external financial constraints. And leverage plays a positive and significant role on TFP in less external financially constrained firms. These findings suggest that firms can increase their productivity through WK management, especially when their external financial constraints are high. Cash flow is a more important financial intermediation for highly constrained financial firms. Strategies to combat this would include using more trade credit or reducing inventory or sales.

Table 6. Regressions by financial constraints level.

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable:TFP					
	SA high	SA low	SA high	sa low	SA high	SA low
Variables	SOEs	SOEs	Private	Private	Foreign	Foreign
$TFP_{i,t-1}$	0.715***	0.832***	0.875***	0.920***	0.718***	0.869***
	(0.117)	(0.054)	(0.087)	(0.019)	(0.148)	(0.049)
WK×Pos	0.597	−0.329	−0.998***	−0.356**	−0.553**	−0.326*
	(0.462)	(0.744)	(0.261)	(0.154)	(0.257)	(0.181)
WK×Neg	0.047	0.183	0.713***	0.375**	0.599***	0.452***
	(0.200)	(0.179)	(0.145)	(0.155)	(0.158)	(0.085)
Cash flow	0.467	0.291	2.396***	1.736***	2.172***	1.721***
	(1.046)	(0.765)	(0.806)	(0.108)	(0.607)	(0.204)
Leverage	0.168	0.114	0.223	0.311***	0.107	0.388***
	(0.270)	(0.150)	(0.192)	(0.056)	(0.151)	(0.082)
Sales growth	0.853***	1.450***	0.566	0.984***	0.575	1.670***
	(0.072)	(0.057)	(0.540)	(0.140)	(0.587)	(0.062)
Size	0.107*	0.540***	−0.043	0.217***	0.126	0.133
	(0.058)	(0.174)	(0.104)	(0.046)	(0.214)	(0.157)
Age	−0.040**	−0.113***	−0.012	−0.045***	−0.066	−0.031
	(0.018)	(0.032)	(0.020)	(0.009)	(0.074)	(0.055)
Constant	0.103	−4.654***	0.790	−1.907***	−0.138	−0.713
	(0.349)	(1.664)	(0.838)	(0.433)	(1.556)	(1.489)
Year dummy	YES	YES	YES	YES	YES	YES
Industry dummy	YES	YES	YES	YES	YES	YES
M(3)	0.379	0.833	0.451	0.084	0.858	0.131
Hansen (*J*) test	0.131	0.144	0.609	0.315	0.466	0.090
Wald test	0.326	0.561	0.000	0.008	0.001	0.000
Observations	26,046	38,009	226,767	205,812	41,576	88,404

Notes: See Appendix 1 for precise definitions of all variables. This table presents the results from regressions using two-step GMM model. *M(n)* is a test for n-order serial correlation in the first-differenced residuals, asymptotically distributed as *N*(0,1) under the null of no serial correlation. The Hansen (*J*) statistics is test of overidentifying restrictions, distributed under the null of instrument validity. The numbers in the rows of Wald test testing whether the impact of Working Capital on TFP is the same across positive and negative Working Capital firm-years are the *p*-values associated with *F*-test for general restrictions. Robust standard errors are in parentheses. ***, ** and * represent statistical significance at the 1, 5 and 10% percent level, respectively.

5.4. Internal financial constraints

In Sections 5.2 and 5.3, I discuss the financial constraints that firms face from investment and external financial constraints. I find that cash flow is very important when firms are financially constrained. Also, cash flow can be considered a proxy for internal financial constraints. Table 7 presents the results when I divide each ownership by level of internal financial constraints. Columns (3–4, 5–6) show that private firms with internal financial constraints and foreign firms' WK are more sensitive than that of firms with less internal financing constraints. These findings suggest that when firms' cash level is low, firms can increase their TFP through WK management. The likely reason is that WK can be converted into cash flow quickly and efficiently (Chen and Guariglia 2013; Mun and Jang 2015).

5.5. Firm size

Similarly, I estimate a regression for the sample of small and large firms separately. The results in Table 8 illustrate that the effect of WK on TFP is more pronounced for small firms than for large firms. WK management is more efficient for small firms to maintain their productivity. This corroborates the findings that smaller firms tend to have more financial constraints, and WK typically is more sensitive for smaller firms.

Table 7. Regressions by cash flow level.

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable:TFP					
	CF Low	CF High	CF Low	CF High	CF Low	CF High
Variables	SOEs	SOEs	Private	Private	Foreign	Foreign
$TFP_{i,t-1}$	0.812***	0.891***	0.973***	0.949***	0.871***	0.866***
	(0.043)	(0.062)	(0.026)	(0.022)	(0.062)	(0.036)
WK × Pos	0.394	−0.056	−0.696***	−0.157***	−0.818***	−0.310***
	(0.494)	(0.558)	(0.170)	(0.055)	(0.310)	(0.111)
WK × Neg	0.016	0.966	0.351***	0.182*	0.806**	0.281***
	(0.081)	(1.065)	(0.092)	(0.105)	(0.346)	(0.051)
Cash flow	0.956	1.060***	1.700*	0.681***	1.887**	1.162***
	(3.211)	(0.188)	(0.939)	(0.087)	(0.828)	(0.135)
Leverage	0.105	0.585	0.041	0.121***	0.086	0.081
	(0.085)	(0.432)	(0.079)	(0.038)	(0.197)	(0.075)
Sales growth	1.101***	1.599***	0.574	1.331***	0.304	1.644***
	(0.061)	(0.072)	(0.479)	(0.047)	(0.740)	(0.052)
Size	0.223***	0.155**	−0.011	0.128***	0.181**	0.198**
	(0.074)	(0.068)	(0.041)	(0.032)	(0.078)	(0.077)
Age	−0.033***	−0.012	−0.019	−0.011**	−0.060	−0.046
	(0.012)	(0.011)	(0.017)	(0.004)	(0.097)	(0.046)
Constant	−1.298*	−1.244**	0.472	−0.975***	−0.940	−1.213*
	(0.745)	(0.487)	(0.359)	(0.248)	(0.591)	(0.717)
Year dummy	YES	YES	YES	YES	YES	YES
Industry dummy	YES	YES	YES	YES	YES	YES
M(3)	0.330	0.941	0.105	0.106	0.081	0.549
Hansen (*J*) test	0.733	0.078	0.125	0.136	0.800	0.251
Wald test	0.493	0.410	0.000	0.011	0.002	0.000
Observations	27,777	28,440	185,826	203,242	45,550	83,830

Notes: See Appendix 1 for precise definitions of all variables. This table presents the results from regressions using two-step GMM model. *M(n)* is a test for n-order serial correlation in the first-differenced residuals, asymptotically distributed as *N*(0,1) under the null of no serial correlation. The Hansen *(J)* statistics is test of overidentifying restrictions, distributed under the null of instrument validity. The numbers in the rows of Wald test testing whether the impact of Working Capital on TFP is the same across positive and negative Working Capital firm-years are the *p*-values associated with *F*-test for general restrictions. Robust standard errors are in parentheses. ***, ** and * represent statistical significance at the 1, 5 and 10% percent level, respectively.

Table 8. Regressions by firm size.

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable:TFP					
	Small	Large	Small	Large	Small	Large
Variables	SOEs	SOEs	Private	Private	Foreign	Foreign
$TFP_{i,t-1}$	0.609***	0.863***	0.853***	0.921***	0.732***	0.950***
	(0.099)	(0.032)	(0.085)	(0.019)	(0.102)	(0.032)
WK×Pos	−0.386	−0.158	−0.916**	−0.356**	−0.821***	−0.430*
	(0.411)	(0.666)	(0.420)	(0.151)	(0.224)	(0.237)
WK×Neg	0.709	0.181	0.570***	0.375**	0.529***	0.478*
	(0.706)	(0.352)	(0.149)	(0.147)	(0.128)	(0.244)
Cash flow	1.054	1.577***	2.314***	1.694***	1.832***	1.520***
	(0.935)	(0.231)	(0.711)	(0.112)	(0.408)	(0.148)
Leverage	0.156	0.231	0.064	0.313***	0.048	0.389
	(0.271)	(0.205)	(0.402)	(0.054)	(0.120)	(0.288)
Sales growth	0.784***	1.415***	0.335	0.979***	0.022	1.811***
	(0.065)	(0.032)	(0.487)	(0.156)	(0.397)	(0.041)
Size	0.134***	0.184***	0.172*	0.211***	0.133*	0.114**
	(0.044)	(0.041)	(0.094)	(0.044)	(0.071)	(0.052)
Age	−0.070***	−0.021***	−0.048***	−0.029***	−0.564***	−0.059***
	(0.018)	(0.008)	(0.016)	(0.005)	(0.189)	(0.013)
Constant	0.522**	−1.255***	−0.917	−1.889***	−1.250***	−1.212**
	(0.259)	(0.363)	(0.722)	(0.427)	(0.375)	(0.486)
Year dummy	YES	YES	YES	YES	YES	YES
Industry dummy	YES	YES	YES	YES	YES	YES
M(3)	0.791	0.761	0.096	0.097	0.782	0.592
Hansen (*J*) test	0.464	0.173	0.321	0.410	0.142	0.116
Wald test	0.240	0.675	0.000	0.006	0.000	0.001
Observations	0.791	0.761	0.096	0.097	0.782	0.592

Notes: See Appendix 1 for precise definitions of all variables. This table presents the results from regressions using two-step GMM model. *M(n)* is a test for n-order serial correlation in the first-differenced residuals, asymptotically distributed as *N*(0,1) under the null of no serial correlation. The Hansen (*J*) statistics is test of overidentifying restrictions, distributed under the null of instrument validity. The numbers in the rows of Wald test testing whether the impact of Working Capital on TFP is the same across positive and negative Working Capital firm-years are the *p*-values associated with *F*-test for general restrictions. Robust standard errors are in parentheses. ***, ** and * represent statistical significance at the 1, 5 and 10% percent level, respectively.

5.6. Institutional and marketization

Institutional and market development levels in the regions impact the financial environment that firms face. Table 9 presents the results of well-developed and under-developed institutional regions. In the under-developed institutional group, positive and negative WK are more sensitive to TFP. This implies that firms in the under-developed institutional regions manage WK to maintain firms' performance in order to overcome the financial constraints created by institutional and marketization.

6. Robustness tests

6.1. Alternative productivity and profitability measures

TFP estimated by OP method (Olley and Pakes 1996) is used as an alternative measure of firm productivity. The regression results are presented in Table 10. The relationship between WK (positive and negative) and TFP^{OP} is consistent with TFP^{LP}, indicating that the measurement of TFP cannot change my results.

Table 9. Regressions by institutional and marketization level.

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable:TFP					
	No-good	Good	No-good	Good	No-good	Good
Variables	SOEs	SOEs	Private	Private	Foreign	Foreign
$TFP_{i,t-1}$	0.820***	0.786***	0.979***	0.962***	0.894***	0.870***
	(0.044)	(0.078)	(0.100)	(0.019)	(0.101)	(0.040)
WK×Pos	−0.044	0.719	−1.081***	−0.612***	−0.625**	−0.221*
	(0.280)	(0.521)	(0.399)	(0.106)	(0.302)	(0.129)
WK×Neg	0.285	0.324	0.632***	0.462***	0.808***	0.563***
	(0.337)	(0.508)	(0.106)	(0.103)	(0.206)	(0.173)
Cash flow	0.757	0.874	1.414***	1.252***	2.589***	1.738***
	(0.584)	(0.818)	(0.411)	(0.111)	(0.879)	(0.566)
Leverage	0.136	0.511*	0.096	0.144***	0.504***	0.514***
	(0.148)	(0.297)	(0.133)	(0.052)	(0.165)	(0.101)
Sales growth	1.192***	1.187***	0.120	0.662***	0.101	1.169**
	(0.039)	(0.072)	(0.394)	(0.102)	(0.784)	(0.592)
Size	0.262***	0.340**	0.027	0.091***	0.202	0.203***
	(0.079)	(0.149)	(0.130)	(0.029)	(0.126)	(0.068)
Age	−0.043***	−0.031	−0.081	−0.018***	−0.121**	0.004
	(0.011)	(0.023)	(0.203)	(0.005)	(0.050)	(0.046)
Constant	−1.781***	−2.774**	−0.140	−0.672***	−1.451	−1.700***
	(0.639)	(1.236)	(0.961)	(0.243)	(0.929)	(0.507)
Year dummy	YES	YES	YES	YES	YES	YES
Industry dummy	YES	YES	YES	YES	YES	YES
M(3)	0.854	0.597	0.270	0.109	0.883	0.183
Hansen (*J*) test	0.234	0.269	0.292	0.066	0.102	0.533
Wald test	0.504	0.586	0.000	0.000	0.000	0.004
Observations	49,588	14,182	182,254	224,798	32,135	96,171

Notes: See Appendix 1 for precise definitions of all variables. This table presents the results from regressions using two-step GMM model. *M(n)* is a test for n-order serial correlation in the first-differenced residuals, asymptotically distributed as *N*(0,1) under the null of no serial correlation. The Hansen (*J*) statistics is test of overidentifying restrictions, distributed under the null of instrument validity. The numbers in the rows of Wald test testing whether the impact of Working Capital on TFP is the same across positive and negative Working Capital firm-years are the *p*-values associated with *F*-test for general restrictions. Robust standard errors are in parentheses. ***, ** and * represent statistical significance at the 1, 5 and 10% percent level, respectively.

Mun and Jang (2015), Enqvist, Graham, and Nikkinen (2014) and Baños-Caballero, García-Teruel, and Martínez-Solano (2014) have demonstrated that there is a non-linear relationship between working capital management and profitability. Profitability is another proxy to measure firm performance. Table 11 reports the regression results. I find that there is a non-linear relationship between working capital and ROS. This indicates that firms have an optimal working capital level that maximizes their profitability.

6.2. Alternative measures of financial constraints

The literature provides alternative ways to measure a firm's financial constraints, which include the financial constraints index developed by Whited and Wu (2006). Their method estimates a non-linear investment Euler equation using a GMM framework to construct a linear representation of several key financial terms to estimate a firm's financial constraints index. Table 12 reports the results that financial constraints level is evaluated by the WW index. I also find that in the highly financially constrained group of private and foreign firms, both positive and negative WK are more sensitive to TFP. Moreover, working capital management is more efficient for firm performance in this group. All the results in Table 12 are

Table 10. Alternative of dependent variable.

	(1)	(2)	(3)
	Dependent variable: TFP^{OP}		
Variables	SOEs	Private	Foreign
$TFP_{i,t-1}$	0.683***	0.723***	0.640***
	(0.084)	(0.047)	(0.095)
WK×Pos	0.170	−0.142**	−0.304**
	(0.107)	(0.067)	(0.138)
WK×Neg	0.013	0.209***	0.330***
	(0.145)	(0.020)	(0.045)
Cash flow	0.044	0.410***	1.157***
	(0.381)	(0.036)	(0.125)
Leverage	0.034	0.084***	0.102***
	(0.046)	(0.016)	(0.039)
Sales growth	0.308***	0.069	0.566***
	(0.023)	(0.050)	(0.145)
Size	0.005	0.014***	0.038*
	(0.023)	(0.004)	(0.020)
Age	−0.008**	−0.004*	−0.022**
	(0.004)	(0.002)	(0.011)
Constant	0.585**	0.634***	1.058***
	(0.267)	(0.076)	(0.212)
Year Dummy	YES	YES	YES
Industry Dummy	YES	YES	YES
M(3)	0.867	0.225	0.737
Hansen (J) Test	0.261	0.246	0.613
Wald Test	0.485	0.000	0.000
Observations	62,396	427,793	127,172

Notes: See Appendix 1 for precise definitions of all variables. This table presents the results from regressions using two-step GMM model. *M(n)* is a test for n-order serial correlation in the first-differenced residuals, asymptotically distributed as *N*(0,1) under the null of no serial correlation. The Hansen *(J)* statistics is test of overidentifying restrictions, distributed under the null of instrument validity. The numbers in the rows of Wald test testing whether the impact of Working Capital on TFP^{OP} is the same across positive and negative Working Capital firm-years are the *p*-values associated with *F*-test for general restrictions. Robust standard errors are in parentheses. ***, ** and * represent statistical significance at the 1, 5 and 10% percent level, respectively.

consistent with the results reported in Table 6. This illustrates that my results are not changed by the different measures of financial constraints.

6.3. Q Model regressions

I directly use an original Q Model estimation framework of investment-cash flow sensitivity to test the direct link between TFP-cash flow sensitivity (Fazzari et al. 1988; Fazzari, Hubbard, and Petersen 2000; Chen and Guariglia 2013). This model shows how working capital impacts the nexus. I estimate the equation as follows:

$$TFP_{it} = \alpha_0 + \alpha_1 TFP_{i,t-1} + \alpha_2 CF_{it} + \alpha_3 CF_{it} * D^{negative*wk} + \alpha_4 X_{it} + v_i + v_j + v_t + v_{jt} + \varepsilon_{it}, \quad (7)$$

$$TFP_{it} = \alpha_0 + \alpha_1 TFP_{i,t-1} + \alpha_2 CF_{it} + \alpha_3 CF_{it} * WK + \alpha_4 WK_{it} + \alpha_5 X_{it} + v_i + v_j + v_t + v_{jt} + \varepsilon_{it}, \quad (8)$$

where $D^{negative*wk}$ is a dummy variable. If working capital is negative, this variable equals 1; otherwise is 0. Since the non-listed firms do not have Tobin's Q, I use sales growth to control for investment opportunities (see Guariglia 2008; Bakucs, Fertő, and Fogarasi 2009; Chen and Guariglia 2013) in my regressions.

Table 11. Alternative of dependent variable.

	(1)	(2)	(3)
	Dependent variable: ROS		
Variables	SOEs	Private	Foreign
$ROS_{i,t-1}$	0.213**	0.704***	0.427***
	(0.098)	(0.090)	(0.063)
WK×Pos	−0.114	−0.052***	−0.035**
	(0.106)	(0.016)	(0.017)
WK×Neg	0.094	0.032***	0.054***
	(0.068)	(0.005)	(0.007)
Cash flow	0.427	0.065**	0.395***
	(0.317)	(0.027)	(0.007)
Leverage	−0.056	−0.015	−0.005
	(0.039)	(0.009)	(0.011)
Sales growth	0.037***	0.019***	0.025***
	(0.007)	(0.002)	(0.002)
Size	0.020***	0.002	0.002
	(0.005)	(0.002)	(0.004)
Age	−0.006**	−0.001**	−0.001
	(0.003)	(0.000)	(0.001)
Constant	−0.134**	0.002	−0.041
	(0.061)	(0.020)	(0.039)
Year dummy	YES	YES	YES
Industry dummy	YES	YES	YES
M(2)	0.868		
M(3)		0.645	0.967
Hansen (*J*) test	0.158	0.601	0.131
Wald test	0.141	0.000	0.000
Observations	63,919	432,358	128,138

Notes: See Appendix 1 for precise definitions of all variables. This table presents the results from regressions using two-step GMM model. *M(n)* is a test for n-order serial correlation in the first-differenced residuals, asymptotically distributed as *N*(0,1) under the null of no serial correlation. The Hansen *(J)* statistics is test of overidentifying restrictions, distributed under the null of instrument validity. The numbers in the rows of Wald test testing whether the impact of Working Capital on ROS is the same across positive and negative Working Capital firm-years are the *p*-values associated with *F*-test for general restrictions. Robust standard errors are in parentheses. ***, ** and * represent statistical significance at the 1, 5 and 10% percent level, respectively.

Columns 1–3 of Table 13 present estimates of Equation (7) which include cash flow and its interaction with the negative liquidity dummy. I observe that both the coefficients on cash flow and on the interaction term are positive with a precisely determined coefficient for both non-state and foreign firms. This finding confirms that cash flow has a stronger positive effect on the productivity of illiquid firms.

Columns 4–6 present estimates of Equation (8) which contains both cash flow and its interaction with the continuous working capital variable. I observe that the cash flow coefficient is positive and statistically significant, while the interaction of cash flow with the continuous working capital variable exhibits a negative and precisely determined coefficient. Having high liquidity can therefore, alleviate firms' dependence on internal financing which can enhance TFP. This finding extends the results of Ding, Guariglia, and Knight (2013) and Chen and Guariglia (2013) who find that working capital plays an important role in alleviating the effects of cash flow shocks on Chinese firms' fixed investment and TFP.

Table 12. Alternative of financial constraints level.

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable:TFP					
	Small	Large	Small	Large	Small	Large
Variables	SOEs	SOEs	Private	Private	Foreign	Foreign
$TFP_{i,t-1}$	0.625***	0.862***	0.777***	0.969***	0.880***	0.892***
	(0.082)	(0.057)	(0.077)	(0.035)	(0.110)	(0.054)
WK × Pos	−0.124	−0.276	−1.476**	−0.605***	−0.923***	−0.297**
	(0.286)	(0.610)	(0.679)	(0.146)	(0.337)	(0.138)
WK × Neg	0.329	0.196	0.978***	0.479***	2.952*	0.580***
	(0.376)	(0.203)	(0.253)	(0.043)	(1.692)	(0.103)
Cash flow	0.698	1.133	1.207***	0.815***	0.918***	1.061*
	(0.762)	(0.832)	(0.429)	(0.296)	(0.236)	(0.638)
Leverage	0.130	0.094	0.228	0.197**	0.377	0.397***
	(0.176)	(0.152)	(0.368)	(0.079)	(0.323)	(0.132)
Sales growth	0.799***	1.755***	1.174***	1.828***	0.945***	1.688***
	(0.051)	(0.061)	(0.129)	(0.230)	(0.139)	(0.245)
Size	0.086	0.394**	0.323***	0.073	0.088	0.217***
	(0.139)	(0.189)	(0.060)	(0.088)	(0.097)	(0.084)
Age	−0.064***	−0.045***	−0.013	−0.002	−0.007	0.239
	(0.017)	(0.015)	(0.012)	(0.017)	(0.027)	(0.214)
Constant	0.495	−3.469*	−1.772***	−0.567	−0.199	−2.427**
	(1.191)	(1.873)	(0.567)	(0.796)	(0.594)	(1.028)
Year dummy	YES	YES	YES	YES	YES	YES
Industry dummy	YES	YES	YES	YES	YES	YES
M(3)	0.714	0.865	0.230	0.658	0.885	0.067
Hansen (*J*) test	0.728	0.535	0.296	0.154	0.232	0.321
Wald test	0.382	0.525	0.004	0.000	0.045	0.000
Observations	27,777	28,440	185,826	203,242	45,550	83,830

Notes: See Appendix 1 for precise definitions of all variables. This table presents the results from regressions using two-step GMM model. *M(n)* is a test for n-order serial correlation in the first-differenced residuals, asymptotically distributed as *N*(0,1) under the null of no serial correlation. The Hansen (*J*) statistics is test of overidentifying restrictions, distributed under the null of instrument validity. The numbers in the rows of Wald test testing whether the impact of Working Capital on TFP is the same across positive and negative Working Capital firm-years are the *p*-values associated with *F*-test for general restrictions. Robust standard errors are in parentheses. ***, ** and * represent statistical significance at the 1, 5 and 10% percent level, respectively.

7. Conclusions

I have used data for Chinese non-listed firms from 1999 to 2007 to study the relationship between working capital and firm performance. Moving beyond the existing literature, I have considered a wide range of firm performance and accounting TFP, and I investigate how working capital management impacts TFP.

I find that there is an inverted U-shaped relationship between working capital and its TFP. If a firm's working capital is positive (negative), the firm's working capital has a negative (positive) influence on its TFP. Working capital is significantly associated with TFP in privately and foreign-owned firms, but not significantly associated with TFP in SOEs. This suggests that working capital management is an efficient tool that enhances firm productivity of non-SOEs.

Furthermore, I focus on the role that working capital plays on TFP under different levels of financial constraints. First, I find that working capital in firms with higher ICFS (investment-cash flow sensitivity) is more sensitive to TFP. This indicates that when firms' investment behaviors strongly rely on internal financing and firms' external financing tunnels are tighter, firms can boost their TFP by managing working capital more efficiently. Second, external

Table 13. Effects of cash flow and working capital on firms' TFP.

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable:TFP					
Variables	SOEs	Private	Foreign	SOEs	Private	Foreign
Lag dependent *i*, *t*−1	0.923***	0.986***	0.834***	0.927***	0.951***	0.879***
	(0.051)	(0.024)	(0.029)	(0.053)	(0.022)	(0.052)
Cash flow	0.501	0.017	−0.453	0.040	0.986**	2.272***
	(1.206)	(0.290)	(0.314)	(0.976)	(0.416)	(0.757)
Cash flow × $WK^{negative}$	−0.454	0.501*	1.007***			
	(2.364)	(0.287)	(0.194)			
Leverage	−0.001	−0.047	0.209***	0.055	0.305***	0.567***
	(0.080)	(0.082)	(0.045)	(0.048)	(0.108)	(0.199)
Sales growth	0.635***	1.281**	1.181***	0.584**	1.056**	1.666***
	(0.226)	(0.513)	(0.197)	(0.250)	(0.441)	(0.518)
Size	0.093**	0.048	0.360***	0.094*	0.098**	0.209**
	(0.047)	(0.050)	(0.066)	(0.050)	(0.039)	(0.102)
Age	−0.032***	−0.009	−0.055***	−0.032***	−0.020	0.008
	(0.009)	(0.016)	(0.021)	(0.008)	(0.017)	(0.040)
WK				0.015	0.356***	0.668
				(0.109)	(0.121)	(0.427)
WK × Cash flow				2.964	−1.324*	−5.423**
				(2.387)	(0.714)	(2.689)
Constant	−0.464	−0.191	−2.733***	−0.514	−0.804**	−2.001**
	(0.335)	(0.397)	(0.559)	(0.370)	(0.332)	(0.849)
Year dummy	YES	YES	YES	YES	YES	YES
Industry dummy	YES	YES	YES	YES	YES	YES
M(3)	0.691	0.065	0.149	0.486	0.190	0.432
Hansen (*J*) test	0.637	0.551	0.088	0.687	0.151	0. 317
Observations	63,919	435,617	129,467	63,919	432,358	128,138

Notes: See Appendix 1 for precise definitions of all variables. This table presents the results from regressions using two-step GMM model. *M(n)* is a test for n-order serial correlation in the first-differenced residuals, asymptotically distributed as *N*(0,1) under the null of no serial correlation. The Hansen *(J)* statistics is test of overidentifying restrictions, distributed under the null of instrument validity. Robust standard errors are in parentheses. ***, ** and * represent statistical significance at the 1, 5 and 10% percent level, respectively.

financing constraints on private and foreign firms' working capital is more sensitive than that of less financially constrained firms whose external financial constraints levels are evaluated by the SA index. Third, internal financing constraints on private and foreign firms' WK is more sensitive than that of firms with lower internal financing constraints. Fourth, the effect of working capital on TFP is more pronounced for small firms than for large firms. This corroborates the findings that small firms have been more financially constrained, and working capital has been more sensitive for small firms. Finally, I find that firms in under-developed institutional groups with positive and negative working capital are more sensitive to TFP. This implies that firms in the under-developed institutional regions manage working capital to maintain performance in order to overcome the financial constraints created by institutional and marketization.

Notes

1. The paper draws on classical as well as newer research on ownership and control (e.g. La Porta, Lo' pez-de-Silanes, and Shleifer 1999; Claessens, Djankov, and Lang 2000; Gompers, Ishii, and Metrick 2010; Lin, Ma, and Xuan 2011; Lin et al. 2011) by linking working capital management to external financial constraints.
2. Due to the serial correlation of TFP (TFP follows a first-order Markov process (Levinsohn and Petrin 2003), lagged TFP should be included to control for this problem.

3. All variables used in this paper are defined in Appendix 1.
4. Consistent with previous studies (Fazzari and Petersen 1993; Ding, Guariglia, and Knight 2013), the working capital variable is scaled by total assets.
5. Our data have been deflated by the deflators taken from the China Statistical Yearbook (various issues) published by the National Bureau of Statistics of China. We use the provincial capital goods deflator to deflate the capital variable and the gross domestic product (GDP) deflator to deflate other variables.
6. The coefficients of β_l, β_k, and β_m regressed by LP method and OP method are reported in Appendix 2.
7. As in Hovakimian and Hovakimian (2009), to avoid negative and extreme weight values, negative cash flows are set equal to zero.
8. Chen and Chen (2012) document that investment-cash flow sensitivity has declined and disappeared in the U.S. – even during the credit crunch of 2007–2009.
9. The KZ index (Lamont, Polk, and Saa-Requejo 2001) is loaded positively on leverage and Tobin's Q and negatively on cash flow, cash levels and dividends.
10. The WW index is created using the Euler equation approach from a structural model of investment, and it is loaded on cash flow, a dividend dummy, leverage, size and the growth rate of industry and firms using COMPUSTAT for data analysis. The definition of the WW index is illustrated in Appendix 1.
11. Hadlock and Pierce (2010) updated Kaplan and Zingales (1997) text-based approach by searching the 10-Ks of 356 randomly selected firms over the period of 1995 to 2004 for evidence of firms identifying themselves as financially constrained.
12. As WW index need dividends dummy information, while our data are non-listed firms' information, we take dividends dummy as 0 in our analysis.
13. The NERI Index was first constructed and published by Fan and Wang of the National Economic Research Institute of China in 2001 and then updated frequently – although not regularly – by Fan et al., in 2003, 2004, 2007, 2010 and 2011. To the best of our knowledge, the NERI Index is the only index that provides a systematic annual measurement of the institutional environment for each province of mainland China.
14. Our period selection is also based on that some main variables (e.g. input intermediation to calculate TFP by LP method) are not available in our database after 2007.
15. In fact, our original panels cover 134,768 non-listed firms, corresponding to 935,623 firm-year observations from 1999 to 2007. As identified five different types of firm ownerships: state, collective, legal person, domestic private and foreign. 'Collective firms are distinct from state-owned in that they are either owned by township-villages governments or collectively by the employees. Legal-person share is a mixture of ownership by state legal persons and private legal persons' (Cull, Xu, and Zhu 2009). By the end of the 1990s, nearly two-thirds of all TVEs had been privatized in the provinces, although considerable differences exist across townships as to the extent of privatization (Brandt and Li 2003). Therefore, we discuss three typical ownerships state, private and foreign in this paper, as the ownerships of collective and legal persons are ambiguous.
16. Our results are consistent with previous studies (e.g. Chen and Guariglia 2013), foreign and private firms have higher TFP and profitability.

Disclosure statement

No potential conflict of interest was reported by the author.

Funding

This paper is supported by the Fundamental Research Funds for the Central Universities, and the Research Funds of Renmin University of China [grant number15XNI006].

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Appendix 1. Variable name definition

TFP^{LP}	Total Factor Productivity, measured by Levinsohn and Petrin (2003)
TFP^{OP}	Total Factor Productivity, measured by Olley and Pakes (1996)
ROS	Return on Sales, measured by net profit divided by total sales
Working capital (WK)	Current assets minus current liabilities divided by total assets
Cash flow	Net income and depreciation divided by total assets
Leverage	Current liabilities and non-current liabilities divided by total assets
Sales growth	Difference between sales in period *t* and *t–1* over sales in period *t–1*
Firm size	Natural logarithm of total assets
Firm age	Natural logarithm of the number of years since the open year
SA index	$-0.737*size + 0.043*size^2 - 0.040*age$
WW index	$-0.091*cf - 0.062*divpos + 0.021*tltd - 0.044*lnta + 0.102*isg - 0.035*sg$
Fixed investment	Difference between the book value of fixed assets of end of year *t* and end of year *t*–1
Fixed capital stock	Book value of fixed assets

Appendix 2. TFP regressions report

	(1)	(2)
	Dependent variable:log (Sales)	
Variables	LP method	OP method
log (Labor)	0.037***(0.001)	0.049*** (0.000)
log (Capital)	0.045*** (0.019)	0.058*** (0.001)
log (Input)	0.604*** (0.005)	0.895*** (0.001)
Industry dummy	YES	YES
Province dummy	YES	YES
Year dummy	YES	YES
Observations	1,101,917	990,977

Note: Dependent variable is the logarithm of sales, and labor, capital and input are measured by the logarithm of total employees, total fixed assets and intermediate input. The proxy variable of LP is intermediate input, and that of OP is net investment calculated by the perpetual inventory method.