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Financial Constraints and Corporate Investment in China

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Abstract

Distortions in capital markets can create financial constraints that deter firms from pursuing optimal investment plans. This paper explores how much these constraints affect investment by ownership type in China, using a panel data model estimated with observations on listed firms for the period 2005–17. We find that privately owned enterprises (POEs) in China face greater financial constraints than state-owned enterprises (SOEs), as POE investment plans depend more on the availability of internally generated cash. Correspondingly, we find evidence that Chinese lenders appear less concerned about the credit risk of SOEs, and that an expansion in credit correlates with a disproportionally larger increase in investment for SOEs.

Topics: Financial markets; Firm dynamics
JEL codes: E22, G1, G3

Résumé

Les distorsions sur les marchés des capitaux peuvent créer des contraintes financières qui découragent les entreprises d'adopter des plans d'investissement optimaux. Dans cette étude, nous examinons dans quelle mesure ces contraintes influent sur les investissements par type de propriété en Chine. Pour ce faire, nous utilisons un modèle de données de panel estimé avec des observations sur des sociétés cotées en bourse pour la période de 2005 à 2017. Nous constatons que les entreprises privées en Chine sont confrontées à des contraintes financières plus importantes que les entreprises publiques, parce que leurs investissements dépendent davantage de la disponibilité de ressources d'autofinancement. Par conséquent, il ressort de notre analyse que les prêteurs chinois semblent moins préoccupés par le risque de crédit des entreprises publiques. Aussi, il semble qu'une expansion du crédit soit en corrélation avec une augmentation disproportionnellement plus élevée des investissements par les entreprises publiques.

Sujets: Dynamique des entreprises; Marchés financiers
Codes JEL: E22, G1, G3

1. Introduction

Investment has been an important driver of the Chinese economy, accounting for between 30% and 45% of nominal gross domestic product (GDP) over the past two decades. While the overall level of investment is high compared with other economies, concerns have also been raised that market distortions have made investment less productive during this period (Brandt et al. 2020). Since robust and efficient investment is vital to the long-term growth prospects of the Chinese economy, understanding the determinants of and major impediments to investment that Chinese firms may face is also vital.

In this paper, we estimate an investment equation for Chinese firms using a panel data model with observations for the period 2005 and 2017 on firms listed on stock markets. Given potential distortions in China's capital market, we focus on the role of financial constraints and financial distress in investment. Financially constrained firms are overly reliant on internal financing to fund investment projects, which can impede investment when internal funding is limited. Similarly, firms considered to be in greater financial distress face a risk premium on external financing costs, which can be an important drag on investment. In examining the investment function of Chinese firms, we distinguish between state-owned enterprises (SOEs) and privately owned enterprises (POEs) because these two types of firms face different constraints, in particular with respect to access to financing.[1]

We find that SOEs face significantly smaller financial constraints than POEs. We also find that a higher perceived degree of financial distress tends to lower investment, but, again, this constraint is significantly smaller for SOEs. These results suggest SOEs face less of a wedge in costs between external and internal financing. Lenders are less concerned about the credit risk of SOEs and prefer to lend to SOEs. Further, we find that a policy-driven growth in the supply of credit tends to support investment and that SOEs benefit disproportionally more from looser credit policy.

This paper contributes to the understanding of investment in China in three ways. First, we examine the prevalence of financial constraints firms faced during a relatively recent period: from 2005 to 2017. Despite further maturation of credit markets in China and some structural reform policies implemented by Chinese authorities, we find that financial constraints are still widespread and more significant for POEs than for SOEs during that period. Second, we examine a specific subset of Chinese firms—those listed on the Shanghai and Shenzhen exchanges—that are required to report financial information in a consistent manner. This reduces the chance that information asymmetry between lenders and borrowers could be the core driver for the differences in results for SOEs and POEs. Third, we also test for other factors including the age, credit history, collateral assets and industry type of firms that may explain or

[1] For example, between 2008 and 2016, SOEs accounted for roughly 60% of the growth in corporate debt (Lam et. al. 2017) but represented less than 30% of total output in the Chinese economy (Zhang 2019).

exacerbate the distinct financial constraints SOEs and POEs face. In general, we reject that these factors play a significant role in explaining the differences between SOEs and POEs.

The paper is organized as follows. **Section 2** reviews the relevant literature. **Section 3** discusses the methodology and data used in the analysis. **Section 4** highlights the most salient results from the empirical estimations. **Section 5** offers concluding remarks.

2. Literature review

In a perfect capital market scenario, such as the classic Modigliani and Miller (1958) setting, a firm's financial structure does not affect its fundamental value, meaning it should be indifferent about internal or external financing options to fund investment. In reality, however, capital markets are not perfect. Factors such as information asymmetry, the agency problem and tax schemes may increase the relative cost of external financing (Fazzari, Hubbard and Petersen 1988). The higher cost of external financing could prevent a firm from raising enough funds to make otherwise profitable investments. Fazzari, Hubbard and Petersen (1988) propose to detect financial constraints by observing if changes in investment behaviour correlate with shifts in the availability of internally generated cash flows. Empirical studies following this approach have generally documented a statistically significant correlation between investment and the availability of internal cash holdings or expected future cash flows (Hoshi, Kashyap and Scarfstein 1991; Bo, Lensink and Sterken 2003; Almeida, Campello and Weisbach 2004). Kaplan and Zingales (1997) question the validity of this approach. They classify firms as financially constrained or unconstrained by analyzing the text of firms' financial statements and find that investment of unconstrained firms is more sensitive to cash flow. Subsequent studies have tried to reconcile these different results. But strong theoretical and empirical support remains for the original hypothesis that cash sensitivity of investment indicates the presence of financial constraints (Fazzari, Hubbard and Petersen 2000; Harrison, Love and McMillan 2002; Moyen 2005).

A related line of research examines the relationship between financial distress and corporate investment. When there is an information imbalance between debtors and creditors, firms in greater financial distress are more likely to face relatively higher external financing costs than those of solvent firms. Consequently, investment by these firms may be less than optimal. Empirical studies generally confirm this negative relationship between the degree of financial distress and corporate investment (Lang, Ofek and Stultz 1996; Aivazian, Ge and Qiu 2005; Dang 2010). Moreover, these studies find that the negative relationship is nonlinear: investment falls rapidly and leverage increases in firms with poor performance and limited investment opportunities.

Previous empirical studies underscore important differences between SOEs and POEs when it comes to understanding the investment dynamics of Chinese firms. For example, Guariglia, Liu and Song (2008) find that financial constraints most severely affected private and collective

firms in China, while SOEs were little impacted. Similarly, Poncet, Steingress and Vandenbussche (2010) find that POEs are credit constrained while SOEs and foreign firms are not. Firth, Lin and Wong (2008) find a negative relationship between leverage and investment that is weaker for firms with greater state ownership.

Several possible explanations exist for the apparent preferential treatment of SOEs in China. One explanation is that SOEs provide stable job prospects, which are coveted in China due to a lack of a social safety net (Bai, Lu and Tao 2006). State and local governments seek to maintain social stability and therefore have incentives to keep SOEs in business with less regard for their profitability. Lenders likely perceive this as an implicit government guarantee for SOEs. SOEs also benefit from deeper political connections (Lu, Zhu and Zhang 2012).

3. Econometric specification and data

3.1 Econometric specification

Based on the literature on financial constraints, we start from a generic specification where a firm's fixed asset investment is modelled as a function of firm-level characteristics and macro conditions, where all variables are log-transformed.

$$INV_{i,t} = \beta_1 INV_{i,t-1} + \beta_2 CASH_{i,t-1} + \beta_3 CASH_{t-1}^2 + \beta_4 CF_{i,t} + \beta_5 FIN_{i,t} + \beta_6 IP_{t-1} + \beta_7 TSF_t + u_i, \quad (1)$$

The dependent variable, INV, is the nominal gross fixed asset investment for firm i as reported in its cash flow statement and is taken as a ratio to total assets. The first two explanatory variables capture the cash position for firm i. We include a measure for the net cash position of a firm ($CASH$). This variable is calculated as the ratio between a firm's cash holdings net of short-term loans and total assets. We include a squared cash holding term to allow for the possibility that the sensitivity of investment to cash flow is nonlinear. We also include a measure for cash flows, denoted as CF, that is calculated by taking the ratio between a firm's operating revenue and its total assets. Both net cash position and cash flow are included to act as a proxy for the cash a firm has readily available or may be expected to generate soon for investment. Absent financial constraints, firms should be indifferent about funding investments with either cash or debt, in which case the estimated β_2, β_3 and $\beta_4$would be statistically insignificant. Statistically significant positive coefficients for those terms indicate the presence of financial constraints (Fazzari, Hubbard and Petersen 1988).

We include a variable, FIN, to capture a firm's financial structure and perceived level of financial distress. *FIN* is a dummy variable whose value is set to 1 when a firm is in financial distress. Lenders likely have thresholds above which firms are deemed risky, but below which marginal changes in firms' financial conditions do not necessarily change their ability to acquire financing. We presume the estimated coefficient on *FIN* to be negative, as the costs of external financing could increase as firms become more highly leveraged, thus lessening their investment intensity. Two separate measures are used to identify financially distressed firms. In

one set of estimations, firms are deemed to be financially distressed if they are in the top quantile of the leverage ratio—a standard, broad measure calculated as the ratio between a firm's total liabilities (excluding own capital) and total assets. In another set of estimations, we use the interest coverage ratio (ICR) as the proxy for financial distress. The ICR provides information on cash available to meet the costs of servicing debts, in addition to the amount of debt. This may be especially relevant in the Chinese context since SOEs may receive preferential borrowing rates compared with their private counterparts. Specifically, the threshold for the interest coverage ratio is set at 2, below which firms are deemed to be in financial distress. This threshold also roughly captures the bottom quantile of firms with the lowest ICR.[2]

Our estimation also controls for the effect of macroeconomic conditions. We include the growth of industrial production (IP) as an indicator of aggregate demand in the economy. Growth in total social financing (TSF) is included to act as a proxy for the availability of credit in the economy. Chinese authorities are known to use credit policy to stimulate the economy.

Modelling investment in China requires special consideration of potential preference given to SOEs compared with POEs. We assess this preference by testing whether SOEs face fewer financial constraints or are less penalized for carrying a higher debt burden than POEs. Specially, we introduce interaction terms with a dummy for being an SOE in equation 2. We conclude that SOEs tend to face less financial constraint if β_3 is negative and statistically significant. Furthermore, if the coefficient of β_9 is positive and statistically significant, this would suggest that the investment intensity of SOEs is less affected by perceived financial distress compared with POEs.

$$INV_{i,t} = \beta_1 INV_{i,t-1} + \beta_2 CASH_{i,t-1} + \beta_3 CASH_{i,t-1} * SOE + + \beta_4 CASH_{t-1}^2 + \beta_5 CASH_{t-1}^2 * SOE + \beta_6 CF_{i,t} + \beta_7 CF_{i,t} * SOE + \beta_8 FIN_{i,t} + \beta_9 FIN_{i,t} * SOE + \beta_{10} IP_{t-1} + \beta_{11} IP_{t-1} * SOE + \beta_{12} TSF_t + \beta_{13} TSF_t * SOE + u_i \quad (2)$$

All variables in the regressions, except the dummy SOE, enter as natural logarithms. Following previous studies, our base-case specifications are estimated with firm fixed effects and robust estimators. However, given the short time frame of our dataset, the ordinary least squares coefficient estimates of the dynamic fixed effects model may be biased and inconsistent (Nickell 1981). Specifically, the de-meaning process for the within group to remove the fixed effects may create an artificial correlation between the error term and the regressors. As a robustness check against this potential Nickell bias, we also show estimated coefficients using a system-generalized method-of-moments framework developed by Blundell and Bond (1998). The framework imposes restrictions on the initial conditions of the data-generating process for the independent variable by including its own lags in both first difference and level as instruments.

[2] In robustness checks, we try different thresholds: ICR of 1 or 1.5 instead of 2 and the top 50th or 90th percentile of the most leveraged firms instead of the top 75th percentile. Results of the estimation are not significantly different. These estimates are available upon request.

3.2 Data sources

We analyze firm-level data for non-financial "A" share companies listed on the Shanghai and Shenzhen exchanges. These annual data are based on reported end-of-year financial statements obtained through the Wind Information Co., Ltd. database. The variable of interest that we attempt to model is annual gross fixed asset investment at the firm level. We are interested in testing investment behaviour for private firms and state-owned enterprises: faced with changes in the financial structure or macro conditions of each, does this investment behaviour respond differently.

Our estimation sample covers the period from 2005 to 2017. Our initial sample coverage more than doubles from 1,596 firms in 2005 to 3,337 firms in 2017, which is consistent with the rapid economic growth and development of financial markets in China over this period. For our empirical work, we rely on a balanced panel by limiting our sample to firms that existed and reported data throughout the entire estimation period. We also drop from our sample firms that did not report all necessary financial information in their annual statements (i.e., missing fixed asset investment information) or whose reports had anomalies (i.e., negative shareholder equity). We are left with a final sample of 1,424 firms.

Table 1: Firm sector coverage and share of activity by sector

	Number of companies	Total assets	Personnel	Total revenue	Operating margin	Value added
Manufacturing	812	33%	49%	37%	35%	32%
Services	264	14%	17%	15%	13%	47%
Construction	41	13%	10%	13%	8%	7%
Real estate	103	17%	4%	4%	7%	7%
Mining	45	14%	14%	27%	33%	3%
Other	159	9%	6%	4%	5%	4%
Total	1,424	100%	100%	100%	100%	100%

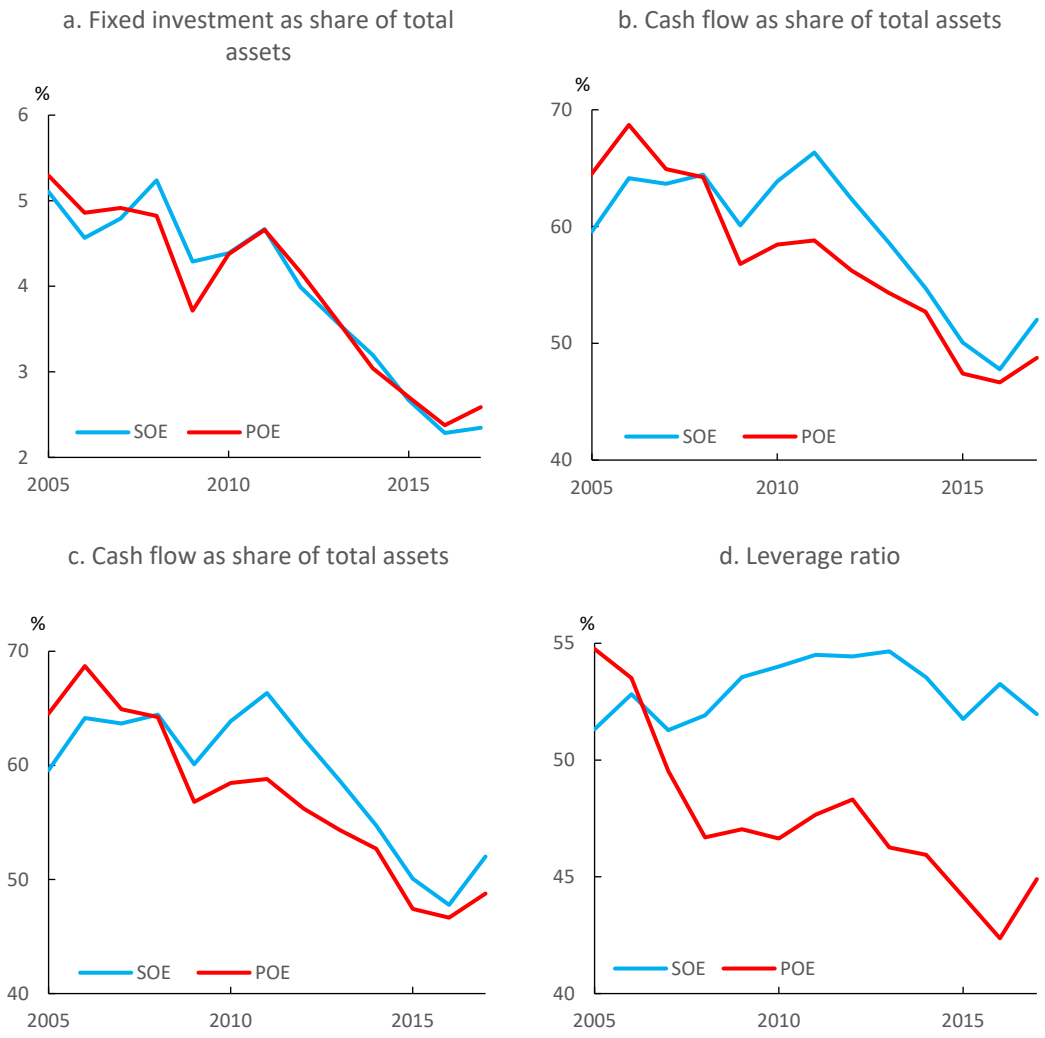
Note: This table presents values for 2017. Operating margin is calculated by subtracting operating costs from operating revenue. Columns may not add up to 100% because of rounding.
Sources: Wind Information Co., Ltd. and Bank of Canada calculations

Out of the 1,424 firms, 785 are considered SOEs.[3] These enterprises are on average larger than POEs, accounting for about three-quarters of total assets and employment. All major sectors of the economy are represented in our data. However, manufacturing and mining firms are over-represented in our sample relative to their importance in the national accounts (**Table 1**), whereas the services sector is under-represented. Furthermore, although sizable, our sample of listed firms represents a small share of Chinese corporations, leaving out firms that are listed on foreign stock markets, such as Alibaba, and small and medium-sized enterprise. These caveats are important when trying to generalize the findings presented in this paper.

[3] Ownership classifications are based on definitions provided by the Wind Information Co., Ltd. database. Specifically, central and local SOEs as well as collective enterprises are considered state-owned enterprises. Other firms, including foreign-owned, are classified as privately owned enterprises.

Chart 1 shows the median observations of key variables broken down by firm ownership type over time. **Table 2** shows the summary statistics for all variables used in our empirical estimation.

Chart 1: Median observations of key variables over time



Note: SOE and POE refer to state-owned enterprises and privately owned enterprises, respectively.
Sources: Wind Information Co., Ltd. and Bank of Canada calculations

A couple of important observations are worth highlighting. First, the intensity of fixed asset investment of listed Chinese firms in our sample has declined steadily since 2005, except for a temporary reprieve immediately after the Great Recession when a substantial stimulus of credit led to a surge in investment. The fall in investment intensity is observed for both SOEs and POEs. This observation is also consistent with the slowdown in the growth rate of investment and a decline in the share of investment in GDP over this period. Second, we observe a material divergence in leverage for SOEs and POEs over our sample period, especially after the global financial crisis. The leverage ratio for SOEs picked up between 2008 and 2015, partly driven by large government stimulus aimed at infrastructure projects during this period. In contrast, the

leverage ratio for POEs fell substantially over the same the period. The same divergence is also observed in the interest coverage ratio where POEs have more cash to cover interest obligations than SOEs do.

Table 2: Summary statistics for key variables in our data

Variable	Definition	Observations	Mean	Standard deviation	5th percentile	95th percentile
Dependent variable						
Investment intensity	Nominal gross fixed asset investment as a share of total assets	18,486	5.5	5.6	0.1	16.67
Cash availability						
Net cash	Ratio of cash holdings net of short-term loans to total assets (%)	18,486	0.3	15.2	-24.4	26.6
Cash flow	Operating revenue as a share of total assets (%)	18,486	71.1	62.1	14.8	172.5
Financial structure						
Leverage	Ratio of total liabilities to total assets	18,486	49.5	19.5	15.8	79.8
Interest coverage ratio	Ratio of net cash holdings to short-term interest obligations	15,137	34.2	668	-2.2	61.9
Other firm characteristics						
Age	Number of years since the firm's establishment	1,422	21.6	4.5	16	29
Size	Nominal total assets in billion Renminbi	18,486	14.6	74.0	0.5	46.5
Collateral	Ratio of fixed assets to total assets	18,485	26.1	18.5	1.3	87.5
Macro variables						
Industrial production	Annual growth rate	13	11.7	4.1	6	18.5
Total social financing	Annual growth rate	13	18.1	6.5	9.9	34.8

4. Results

Table 3 shows the results from the baseline fixed-effects regressions. Results from regressions without any interaction with the SOE dummies are generally in line with expectations (columns I and II of Table 3). The estimated coefficients on net cash position and cash flow are both positive and statistically significant. A very plausible interpretation of this sensitivity to available, internally generated cash is that Chinese firms on average face some degree of financial constraints. Moreover, we find this relationship to be nonlinear: the positive effect of cash holdings on investment declines as cash holdings increase, as indicated by the statistically significant negative coefficient on the squared term for net cash position. These regressions also confirm that firms facing perceived financial distress, specifically the most indebted firms or those with the least ability to repay debt in the near-term, tend to invest significantly less.

Table 3: Key estimated parameters

	I		II		III		IV	
Investment (t-1)	0.423	***	0.423	***	0.422	***	0.422	***
Net cash (t-1)	0.071	***	0.063	***	0.089	***	0.079	***
SOE interaction					-0.032	**	-0.029	*
Net cash^2 (t-1)	-0.003	***	-0.003	***	-0.004	***	-0.004	***
SOE interaction					0.002	**	0.002	**
Cash flow (t)	0.153	***	0.131	***	0.182	***	0.155	***
SOE interaction					-0.063		-0.052	
Leverage (t)	-0.108	***			-0.081	*		
SOE interaction					-0.046			
ICR (t)			-0.217	***			-0.266	***
SOE interaction							0.088	*
IP (t-1)	0.034	***	0.035	***	0.030	***	0.030	***
SOE interaction					0.009	**	0.009	**
TSF (t)	0.004	***	0.003	***	0.002		0.001	
SOE interaction					0.005	**	0.005	**

Note: Statistical significance at the 10%, 5% and 1% level are denoted by one, two or three asterisks, respectively. TSF refers to total social financing. SOE refers to state-owned enterprise.

All macro controls have the expected signs, and they are statistically significant. Specifically, investment is positively related to the state of the economy as measured by industrial production growth. Strong industrial production growth in the previous period indicates robust economic activity, which, all else equal, encourages firms to invest in additional production capacity. As expected, a positive and significant relationship also exists between investment intensity and the growth of credit as measured by total social financing.

We then introduce interaction terms with the dummy variable for SOEs to capture how various factors influence investment differently for SOEs and POEs. Columns III and IV of **Table 3** show

regressions where interaction terms with the SOE dummy are introduced for all relevant variables.[4]

4.1 Evidence of financial constraints

We find that SOEs in China are generally less dependent than POEs on internally generated cash to finance their investment plans. The interaction term between net cash position and the SOE dummy yields estimated coefficients that are negative and statistically significant. The estimated coefficients on this interacted term are about one-third the size of the net cash position variable that is not interacted. This result confirms that investment by SOEs is less sensitive to the amount of cash available compared with investment by POEs. We interpret this to indicate that SOEs face less of a wedge between external and internal sources of funding for new projects. For the cash flow variable, its interaction term with the SOE dummy yields a negative estimated coefficient that is not statistically significant.

4.2 Financial distress and investment

We find mixed results when interacting the various measures for financial distress with the SOE dummy. In regressions where financial distress is defined as a situation where a firm's interest coverage ratio is below a threshold, the interaction of the ICR and SOE dummies yields a positive and statistically significant estimated coefficient of about one-third the size of the non-interacted coefficient. This implies that while firms with smaller cash buffers against their interest payment obligations generally face higher financing costs and therefore invest less, this relationship is weaker for SOEs. A possible explanation of this result is that lenders are less likely to increase the costs of financing or tighten the monitoring of state-owned firms even when these firms have an elevated financial risk, given the perception of an implicit guarantee. As a result of this preferential treatment by lenders, SOEs are more likely to maintain a relatively higher investment intensity than POEs even when their interest coverage ratios are in the distressed range. The impact of high leverage on investment seems less convincing in regressions where financial distress is defined as a firm's broad leverage ratio being above a threshold. The coefficient is only significant at the 10% level, while the interaction of the leverage and SOE dummies yields an estimated coefficient that is not statistically different from zero. This finding weakly suggests that the highest leveraged firms are less likely to invest, regardless of their ownership type. This appears contrary to the conclusion from the regressions that identify financially distressed firms based on the ICR and to findings in previous studies. It also goes against our prior assumption that lenders should be less concerned about higher leverage in SOEs due to implicit government guarantees. We explore a possible explanation for this seemingly unintuitive result.

[4] Table A-1 in the Appendix shows additional regressions where the interaction terms are introduced sequentially for the key variables.

It may be that banks making loan decisions are concerned about leverage only when cash is not available for making short- to medium-term interest payments, as measured by the ICR. To test this hypothesis, we run two additional regressions based on the specifications shown in columns III and IV of **Table 3** that include interaction terms between the ICR and leverage dummies to assess which of these two factors are more relevant for investment intensity. The results are shown in **Table 4**. In the first instance (column I of Table 4), in addition to the base-case specification that uses leverage to identify financial distress, we include an interaction term between the leverage and ICR dummies, and between the leverage, ICR and SOE dummies. The coefficient on the leverage dummy interacted with the ICR dummy is negative and statistically significant (at the 1% level), while the coefficients on the leverage dummy and its interaction with the SOE dummy are no longer significant. The coefficient on the leverage dummy interacted with both the ICR and SOE dummies is also not significant. This result suggests that high leverage has a negative impact on a firm's investment intensity only when the firm's ICR is low. In the second instance (column II of Table 4), in addition to the base-case specification that uses ICR to identify financial distress, we include interaction terms between the ICR and leverage dummies, and between the ICR, leverage and SOE dummies. In this case, the coefficients on these additional dummies are not statistically significant, while the coefficients on the original ICR dummy and its interaction with the SOE dummy remain significant. Together, these results strongly suggest that rather than the leverage ratio, the ICR—and thus the ability to repay debt—is pivotal to investment.[5] The results are robust to different choices of cut-off points for the ICR (1.5 or 1.0 instead of 2.0) or for the leverage ratio (the median and 90th percentile instead of the 75th percentile; see **Table A-4** and **Table A-5** in the **Appendix**).

[5] The size, age or industry of the companies involved does not affect the distribution of the ICR, minimizing the possibility that the coefficients are picking up a different effect.

Table 4: Regressions focused on the interest coverage and leverage ratios

	I		II	
Investment (t-1)	0.422	***	0.422	***
Net cash (t-1)	0.085	***	0.079	***
SOE interaction	-0.032	**	-0.029	*
Net cash^2 (t-1)	-0.004	***	-0.004	***
SOE interaction	0.002	**	0.002	**
Cash flow (t)	0.173	***	0.155	***
SOE interaction	-0.058		-0.051	
Leverage (t-1)	0.003			
SOE interaction	-0.054			
ICR interaction	-0.235	***		
ICR and SOE interaction	0.075			
ICR (t)			-0.251	***
SOE interaction			0.108	*
Leverage interaction			-0.038	
Leverage and SOE interaction			-0.043	
IP (t-1)	0.029	***	0.030	***
SOE interaction	0.009	**	0.009	**
TSF (t)	0.001		0.001	
SOE interaction	0.004	*	0.005	**

Note: Statistical significance at the 10%, 5% and 1% level are denoted by one, two or three asterisks, respectively.

4.3 Influence of the macro environment

The interaction between the macro control variables and the SOE dummy also yields interesting results. We observe that investment intensity in both POEs and SOEs are positively related to improvements in economic activity, as measured by growth in industrial production. The interaction between industrial production growth and the SOE dummy is positive and statistically different from 0. This suggests that SOE investment is more sensitive to economic activity than POE investment is. This is puzzling at first sight, given that there is no clear reason why SOEs would be more responsive to economic activity. However, we also observe that SOEs have a marked advantage from government credit policy. Specifically, we observe an overall increase in investment during periods of strong growth in total social financing, which is a broad measure of credit in China. Our regressions further reveal that the direct boost from stronger credit growth to investment only occurs for SOEs. This finding is consistent with how Chinese authorities often manage credit flows to stimulate the economy. When authorities look to boost economic activity, they often initiate infrastructure projects and instruct banks to increase lending. Both channels are particularly advantageous to SOEs, which often take up infrastructure projects. And banks tend to favour lending to SOEs, especially if it satisfies government guidance. The same mechanism could also explain the greater sensitivity of SOE investment to economic activity, as captured by industrial production.

4.4 Robustness checks

We also perform several other robustness checks, and the key results do not change (see the **Appendix** for details).

We first explore whether key results from the baseline regressions are driven by the omission of other firm characteristics, such as age and size. This could be the case since SOEs in China are generally larger in size and longer established compared with POEs. Our baseline results would be misleading if banks were simply focused on these characteristics rather than the status and connection of an SOE when extending loans to these firms. We show that this is not the case in the sample of firms examined. Specifically, we continue to find differences between SOEs and POEs with respect to financial constraint and financial distress even after controlling for the age and the size of the firms (**Table A-6**, columns I and II).

Another explanation for these different results is that SOEs and POEs are unevenly represented across industries. Indeed, SOEs in China are concentrated in certain industries such as construction, telecommunications and natural resources. One possibility is that the sensitivity of investment to cash or leverage differs across industries rather than across ownership types. For example, firms heavily involved in infrastructure projects are likely to incur large amounts of debt while simultaneously receiving limited cash flows given the longer lifespans of projects. As a result, these firms may exhibit lower profit margins and productivity compared with firms in manufacturing, which may bias our estimation results. To test for this possibility, we run regressions controlling for industry and for special factors affecting a specific industry in a specific year, known as industry-year effects.[6] In general, we do not detect a significant difference in estimated parameters due to these effects. A key exception relates to firms in the construction industry where we observe a further reduction in cash sensitivity. Our estimation shows that the sensitivity of investment by an SOE that is primarily engaged in construction to the availability of cash is only one-quarter of the total sample average (**Table A-6**, column III). This finding underscores the fact that various levels of government often initiate large construction projects in China and direct banks to make available the necessary credit to the SOEs tasked with these projects.

We also test for a possible effect from the availability of collateral by including as a proxy the ratio of fixed to total assets. First, key results from the baseline regression continue to hold (i.e., SOEs and POEs have differentiated coefficients with respect to financial constraints and financial distress). Second, the estimated coefficient on the collateral variable is in line with the existing literature, as a higher availability of collateral is associated with higher investment intensity (**Table A-6**, column IV).[7] Moreover, we also interact the collateral variable with the SOE dummy and find that the coefficient is negative and statistically significant. This indicates

[6] One example of an industry-year effect is the historic fiscal stimulus from the Chinese government following the global financial crisis, which likely disproportionately boosted investment in the construction industry in subsequent years. We estimate the industry-year effect by interacting industry and dummy variables.

[7] See Fostel and Geanakoplos (2008) and Ding, Guariglia and Knight (2013).

that the availability of collateral is important in the investment equation for POEs, but much less so for SOEs.

As a robustness check to the empirical methodology, we re-estimate our model using a Blundell and Bond-modified generalized method-of-moments estimator. This estimator checks against the potential biased and inconsistent parameter estimates from the fixed-effects dynamic panel model estimators that are used in the base case. Results from this alternative estimation approach are shown in **Table A-2**, **Table A-3**, **Table A-4**, **Table A-5** and **Table A-7** of the **Appendix**. The various estimated coefficients are generally similar across the two different methodologies. Under the Blundell and Bond approach, the only noticeable difference is that the positive coefficient on the interaction terms between growth of total social financing and the SOE dummy is no longer statistically significant. This difference suggests that stimulus implemented via looser credit conditions may not disproportionately benefit SOEs. However, we also note that the positive coefficient on the interaction term between the ICR and the SOE dummy is about twice as large, which suggests that SOEs get a free pass from capital markets for having a weaker ICR than in the base-case specification. Taken together, these marginal changes on the estimated coefficients do not change the interpretation that Chinese SOEs enjoy a sizable advantage in obtaining external funding.

5. Concluding remarks

This paper examines the investment function of Chinese firms based on data for 1,422 listed firms over the period 2005–2017. We focus on whether distortions in the credit market affect investment of POEs more negatively than that of SOEs. Our findings confirm that investment is positively correlated with shifts in the availability of cash, which indicates the presence of financial constraints. We also show that firms facing financial distress tend to invest less, particularly when a firm has low capacity to make interest payments in the near-term. Importantly, we show that both of these effects are far less pronounced for SOEs than for POEs. One consistent, and in our view most plausible, explanation for these findings is that there are capital market distortions that result in preferential treatment for SOEs, allowing them easier access to external financing compared with POEs, irrespective of fundamentals. A future line of research would be to assess if this preferential treatment of SOEs plays a quantitatively important role in the falling productivity of investment facing the Chinese economy.

Appendix: Estimation results

Table A-1: Key estimated parameters – fixed-effect estimator

	I		II		III		IV		V		VI		VII		VIII	
Investment (t-1)	0.423	***	0.423	***	0.423	***	0.423	***	0.423	***	0.423	***	0.422	***	0.422	***
Net cash (t-1)	0.071	***	0.063	***	0.091	***	0.085	***	0.093	***	0.083	***	0.089	***	0.079	***
SOE interaction					-0.037	**	-0.041	***	-0.039	**	-0.036	**	-0.032	**	-0.029	*
Net cash^2 (t-1)	-0.003	***	-0.003	***	-0.004	***	-0.004	***	-0.004	***	-0.004	***	-0.004	***	-0.004	***
SOE interaction					0.002	**	0.002	***	0.002	**	0.002	**	0.002	**	0.002	**
Cash flow (t)	0.153	***	0.131	***	0.165	***	0.141	***	0.165	***	0.137	***	0.182	***	0.155	***
SOE interaction					-0.027		-0.024		-0.027		-0.016		-0.063		-0.052	
Leverage (t)	-0.108	***			-0.107	***			-0.081	*			-0.081	*		
SOE interaction									-0.050				-0.046			
Interest coverage ratio (t)			-0.217	***			-0.218	***			-0.263	***			-0.266	***
SOE interaction											0.081	*			0.088	*
Industrial production (t-1)	0.034	***	0.035	***	0.034	***	0.035	***	0.034	***	0.035	***	0.030	***	0.030	***
SOE interaction													0.009	**	0.009	**
Total social financing (t)	0.004	***	0.003	***	0.004	***	0.003	***	0.004	***	0.003	***	0.002		0.001	
SOE interaction													0.005	**	0.005	**

Note: Statistical significance at the 10%, 5% and 1% level are denoted by one, two or three asterisks, respectively. Columns I and II shows base-case regressions using leverage and the interest coverage ratio as the indicator of financial distress, respectively. Regressions in columns III and IV add an interaction term between the state-owned enterprise (SOE) dummy and the cash availability variables. Regressions in columns V and VI further include the SOE interaction term on the financial distress variable. Regressions in columns VII and VIII further include the SOE interaction term with the macroeconomic variables.

Table A-2: Key estimated parameters—Blundell and Bond estimator

	I		II		III		IV		V		VI		VII		VIII	
Investment (t-1)	0.450	***	0.446	***	0.450	***	0.446	***	0.450	***	0.447	***	0.450	***	0.447	***
Net cash (t-1)	0.067	***	0.065	***	0.094	***	0.091	***	0.094	***	0.090	***	0.094	***	0.090	***
SOE interaction					-0.053	**	-0.053	**	-0.053	**	-0.050	**	-0.053	**	-0.050	**
Net cash^2 (t-1)	-0.003	***	-0.003	***	-0.004	***	-0.004	***	-0.004	***	-0.004	***	-0.004	***	-0.004	***
SOE interaction					0.003	**	0.002	**	0.003	**	0.002	**	0.003	**	0.002	**
Cash flow (t)	0.279	***	0.261	***	0.313	***	0.297	***	0.313	***	0.289	***	0.313	***	0.289	***
SOE interaction					-0.095		-0.099		-0.093		-0.081		-0.092		-0.080	
Leverage (t)	-0.104	***			-0.105	***			-0.142	***			-0.141	***		
SOE interaction									0.072				0.070			
Interest coverage ratio (t)			-0.164	***			-0.164	***			-0.259	***			-0.256	***
SOE interaction											0.177	***			0.172	***
Industrial production (t-1)	0.029	***	0.030	***	0.029	***	0.030	***	0.030	***	0.030	***	0.024	***	0.026	***
SOE interaction													0.009		0.007	
Total social financing (t)	0.002		0.002	***	0.002	*	0.002		0.002		0.002		0.002		0.002	
SOE interaction													0.000		0.000	

Note: Statistical significance at the 10%, 5% and 1% level are denoted by one, two or three asterisks, respectively. Columns I and II shows base-case regressions using leverage and the interest coverage ratio as the indicator of financial distress, respectively. Regressions in columns III and IV add an interaction term between the state-owned enterprise (SOE) dummy and the cash availability variables. Regressions in columns V and VI further include the SOE interaction term on the financial distress variable. Regressions in columns VII and VIII further include the SOE interaction term with the macroeconomic variables.

Table A-3: Robustness regressions for interest coverage ratio and leverage using Blundell and Bond estimator

	Regression with leverage ratio		Regression with the interest coverage ratio	
Investment (t-1)	0.448	***	0.422	***
Net cash (t-1)	0.093	***	0.079	***
SOE interaction	-0.053	**	-0.030	*
Net cash^2 (t-1)	-0.004	***	-0.004	***
SOE interaction	0.003	**	0.002	**
Cash flow (t)	0.302	***	0.155	***
SOE interaction	-0.089		-0.054	
Leverage (t)	-0.062			
SOE interaction	0.050			
ICR interaction	-0.219	**		
ICR and SOE interaction	0.085			
ICR (t)			-0.283	***
SOE interaction			0.184	**
Leverage interaction			0.023	
Leverage and SOE interaction			-0.129	
IP (t-1)	0.025	***	0.030	***
SOE interaction	0.009		0.009	**
TSF (t)	0.002		0.001	
SOE interaction	0.000		0.005	**

Note: Statistical significance at the 10%, 5% and 1% level are denoted by one, two or three asterisks, respectively.

Table A-4: Robustness regressions for interest coverage ratio and leverage using lower ICR cut-off points

	Fixed-effects estimator						Blundell and Bond estimator					
	ICR<2.0		ICR<1.5		ICR<1.0		ICR<2.0		ICR<1.5		ICR<1.0	
Investment (t-1)	0.422	***	0.422	***	0.422	***	0.448	***	0.449	***	0.450	***
Net cash (t-1)	0.085	***	0.087	***	0.087	***	0.093	***	0.094	***	0.094	***
SOE interaction	-0.032	**	-0.033	**	-0.033	**	-0.053	**	-0.053	**	-0.053	**
Net cash^2 (t-1)	-0.004	***	-0.004	***	-0.004	***	-0.004	***	-0.004	***	-0.004	***
SOE interaction	0.002	**	0.002	**	0.002	**	0.003	**	0.003	**	0.003	**
Cash flow (t)	0.173	***	0.176	***	0.177	***	0.302	***	0.310	***	0.313	***
SOE interaction	-0.058		-0.063		-0.065		-0.089		-0.095		-0.098	
Leverage (t)	0.003		-0.040		-0.053		-0.062		-0.124	**	-0.141	**
SOE interaction	-0.054		-0.024		-0.031		0.050		0.087		0.093	
ICR interaction	-0.235	***	-0.162	**	-0.174	**	-0.219	**	-0.067		0.001	
ICR and SOE interaction	0.075		-0.022		-0.032		0.085		-0.037		-0.105	
ICR (t)												
SOE interaction												
Leverage interaction												
Leverage and SOE interaction												
IP (t-1)	0.029	***	0.030	***	0.029	***	0.025	***	0.025	***	0.024	***
SOE interaction	0.009	**	0.009	**	0.009	**	0.009		0.009		0.010	
TSF (t)	0.001		0.001		0.001		0.002		0.002		0.002	
SOE interaction	0.004	*	0.004	**	0.004	*	0.000		0.000		0.000	

Note: Statistical significance at the 10%, 5% and 1% level are denoted by one, two or three asterisks, respectively. Results for ICR<2.0 from Table 4 (column I) and Table A-3 (column I) have been included to facilitate comparison with the robustness checks (ICR<1.5 and ICR<1.0).

Table A-5: Robustness regressions for interest coverage ratio and leverage using different leverage cut-off points

	Fixed-effects estimator						Blundell and Bond estimator					
	Median		75th perc.		90th perc.		Median		75th perc.		90th perc.	
Investment (t-1)	0.422	***	0.422	***	0.422	***	0.447	***	0.446	***	0.447	***
Net cash (t-1)	0.079	***	0.079	***	0.079	***	0.091	***	0.091	***	0.090	***
SOE interaction	-0.030	*	-0.029	*	-0.030	*	-0.050	**	-0.050	**	-0.050	**
Net cash^2 (t-1)	-0.004	***	-0.004	***	-0.004	***	-0.004	***	-0.004	***	-0.004	***
SOE interaction	0.002	**	0.002	**	0.002	**	0.002	**	0.002	**	0.002	**
Cash flow (t)	0.155	***	0.155	***	0.155	***	0.289	***	0.287	***	0.288	***
SOE interaction	-0.054		-0.051		-0.051		-0.083		-0.079		-0.078	
Leverage (t)												
SOE interaction												
ICR interaction												
ICR and SOE interaction												
ICR (t)	-0.283	***	-0.251	***	-0.256	***	-0.296	***	-0.226	***	-0.238	***
SOE interaction	0.184	**	0.108	*	0.098	**	0.323	***	0.184	***	0.164	***
Leverage interaction	0.023		-0.038		-0.059		-0.060		-0.081		-0.110	
Leverage and SOE interaction	-0.129		-0.043		-0.048		-0.218	*	-0.027		0.046	
IP (t-1)	0.030	***	0.030	***	0.030	***	0.026	***	0.026	***	0.026	***
SOE interaction	0.009	**	0.009	**	0.009	**	0.007		0.007		0.007	
TSF (t)	0.001		0.001		0.001		0.002		0.002		0.002	
SOE interaction	0.005	**	0.005	**	0.005	**	0.000		0.000		0.000	

Note: Statistical significance at the 10%, 5% and 1% level are denoted by one, two or three asterisks, respectively. Results for use of the median leverage from Table 4 (column II) and Table A-3 (column II) have been included to facilitate comparison with the robustness checks (leverage cut-off point at 75th percentile and 90th percentile).

Table A-6: Robustness regressions involving size, age, industry and availability of collateral using fixed-effects estimator

	I		II		III		IV	
Investment (t-1)	0.423	***	0.423	***	0.422	***	0.406	***
Net cash (t-1)	0.088	***	0.078	***	0.080	***	0.086	***
SOE interaction	-0.032	**	-0.029	*	-0.031	*	-0.033	**
Construction sector					-0.030	**		
Age interaction	0.000		0.000					
Net cash^2 (t-1)	-0.004	***	-0.004	***	-0.004	***	-0.004	***
SOE interaction	0.002	**	0.002	**	0.002	**	0.002	**
Cash flow (t)	0.181	***	0.154	***	0.153	***	0.107	**
SOE interaction	-0.064		-0.053		-0.052		-0.017	
Leverage (t)	-0.078	*						
SOE interaction	-0.045							
ICR (t)			-0.264	***	-0.265	***	-0.306	***
SOE interaction			0.088	*	0.087	*	0.117	**
IP (t-1)	0.028	***	0.029	***	0.028	***	0.027	***
SOE interaction	0.009	**	0.010	**	0.010	**	0.012	***
TSF (t)	0.001		0.001		0.000		0.000	
SOE interaction	0.005	**	0.005	**	0.005	**	0.006	**
Size of the firm (t-1)	-0.018		-0.012		-0.013			
Collateral (t-1)							0.166	***
SOE interaction							-0.109	**

Note: Statistical significance at the 10%, 5% and 1% level are denoted by one, two or three asterisks, respectively. Columns I and II show results from regressions that include the age of the firm. Column III shows a regression that accounts for potential industry effects. Column IV shows a regression that accounts for the availability of collateral.

Table A-7: Robustness regressions involving size, age, industry and availability of collateral using Blundell and Bond estimator

	I		II		III		IV	
Investment (t-1)	0.450	***	0.447	***	0.447	***	0.446	***
Net cash (t-1)	0.096	***	0.092	***	0.095	***	0.092	***
SOE interaction	-0.054	**	-0.051	**	-0.054	**	-0.052	**
Construction sector					-0.033	*		
Age interaction	0.000		0.000					
Net cash^2 (t-1)	-0.004	***	-0.004	***	-0.004	***	-0.004	***
SOE interaction	0.003	**	0.002	**	0.003	**	0.002	**
Cash flow (t)	0.305	***	0.283	***	0.280	***	0.261	***
SOE interaction	-0.092		-0.080		-0.078		-0.053	
Leverage (t)	-0.139	**						
SOE interaction	0.084							
ICR (t)			-0.245	***	-0.248	***	-0.272	***
SOE interaction			0.170	***	0.173	***	0.187	***
IP (t-1)	0.016	***	0.020	***	0.020	***	0.025	***
SOE interaction	0.011		0.008		0.008		0.006	
TSF (t)	0.000		0.000		0.000		0.001	
SOE interaction	0.001		0.001		0.001		0.000	
Size of the firm (t)	-0.082	***	-0.066	**	-0.066	**		
Collateral (t-1)							0.116	*
SOE interaction							-0.096	

Note: Statistical significance at the 10%, 5% and 1% level are denoted by one, two or three asterisks, respectively. Columns I and II show results from regressions that include the age of the firm. Column III shows a regression that accounts for potential industry effects. Column IV shows a regression that accounts for the availability of collateral.

References

Aivazian, V. A., Y. Ge and J. Qiu. 2005. "The Impact of Leverage on Firm Investment: Canadian Evidence." *Journal of Corporate Finance* 11: 277–291.

Almeida, H., M. Campello and M. S. Weisbach. 2004. "The Cash Flow Sensitivity of Cash." *The Journal of Finance* 59 (4): 1777–1804.

Bai, C.-E., J. Lu and Z. Tao. 2006. "The Multitask Theory of State Enterprise Reform: Empirical Evidence from China." *American Economic Review* 96 (2): 353–357.

Blundell, R. and S. Bond. 1998. "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models." *Journal of Econometrics* 87: 115–143.

Bo, H., R. Lensink and E. Sterken. 2003. "Uncertainty and Financing Constraints." *Review of Finance* 7 (2): 297–321.

Brandt, L., J. Litwack, E. Mileva, L. Wang, Y. Zhang and L. Zhao. 2020. "China's Productivity Slowdown and Future Growth Potential." World Bank Policy Research Working Paper No. 9298.

Dang, V. A. 2010. "Leverage, Debt Maturity and Firm Investment: An Empirical Analysis." *Journal of Business Finance & Accounting* 38 (1–2): 225–258.

Guariglia, A., X. Li and L. Song. 2008. "Internal Finance and Growth: Microeconometric Evidence on Chinese Firms." University of Nottingham GEP Research Paper 2008/37.

Fazzari, S., R. G. Hubbard and B. C. Petersen. 1988. "Financing Constraints and Corporate Investment." *Brookings Paper on Economic Activity* 1: 141–195.

Fazzari, S., R. G. Hubbard and B. C. Petersen. 2000. "Investment-Cash Flow Sensitivities Are Useful: A Comment on Kaplan and Zingales." *The Quarterly Journal of Economics* 115 (2): 695–705.

Firth, M., C. Lin and S. M. L. Wong. 2008. "Leverage and Investment Under a State-Owned Bank Lending Environment: Evidence from China." *Journal of Corporate Finance* 14 (5): 642–653.

Fostel, A. and J. Geanakoplos. 2008. "Leverage Cycles and the Anxious Economy." *American Economic Review* 98 (4): 1211–1244.

Harrison, A., I. Love and M. McMillan. 2002. "Global Capital Flows and Financing Constraints." NBER Working Paper No. 8887.

Hoshi, T., A. Kashyap and D. Scarfstein. 1991. "Corporate Structure, Liquidity, and Investment: Evidence from Japanese Industrial Groups." *The Quarterly Journal of Economics* 106 (1): 33–60.

Hsieh, C.-T. and P. J. Klenow. 2009. "Misallocation and Manufacturing TFP in China and India." *The Quarterly Journal of Economics* 124 (4): 1403–1448.

Kaplan, S. and L. Zingales. 1997. "Do Investment Cash-Flow Sensitivities Provide Useful Measures of Financing Constraints?" *The Quarterly Journal of Economics* 112 (1): 169–215.

Lam, W. R., A. Schipke, Y. Tan and Z. Tan. 2017. "Resolving China's Zombies: Tackling Debt and Raising Productivity." IMF Working Paper No. 17/266.

Lang, L., E. Ofek and R. Stulz. 1996. "Leverage, Investment, and Firm Growth." *Journal of Financial Economics* 40 (1): 3–29.

Lu, Z., J. Zhu and W. Zhang. 2012. "Bank Discrimination, Holding Bank Ownership, and Economic Consequences: Evidence from China." *Journal of Banking and Finance* 36 (2): 341–354.

Modigliani, F., and M. Miller. 1958. "The Cost of Capital, Corporation Finance and the Theory of Investment." *The American Economic Review* 48 (3): 261-297.

Moyen, N. 2005. "Investment-Cash Flow Sensitivities: Constrained Versus Unconstrained Firms." *The Journal of Finance* 59 (5): 2061–2092.

Nickell, S. 1981. "Biases in Dynamic Models with Fixed Effects." *Econometrica* 49 (6): 1417–1426.

Poncet, S., W. Steingress and H. Vandenbussche. 2010. "Financial Constraints in China: Firm-Level Evidence." *China Economic Review* 21 (3): 411–422.

Ding, S., A. Guariglia and J. Knight. 2013. "Investment and Financing Constraints in China: Does Working Capital Management Make a Difference?" *Journal of Banking & Finance* 37 (5): 1490–1507.