Investment and financing constraints in China: does working capital management make a difference?

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Abstract

We use a panel of over 120,000 Chinese firms owned by different agents over the period 2000-2007 to analyze the linkages between investment in fixed and working capital and financing constraints. We find that those firms characterized by high working capital display high sensitivities of investment in working capital to cash flow (*WKS*), and low sensitivities of investment in fixed capital to cash flow (*FKS*). We then construct and analyze firm-level *FKS* and *WKS* measures and find that, despite severe external financing constraints, those firms with low *FKS* and high *WKS* exhibit the highest investment rates. This suggests that good working capital management may help firms to alleviate the effects of financing constraints on investment.

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1. Introduction

In the last three decades, the Chinese economy has been characterized by persistently high investment rates and phenomenal growth rates (Song et al., 2010)[1]. Yet, considering that the Chinese financial system is poorly developed, this can been seen as a puzzle (Allen et al., 2005). Several authors have tried to find explanations for this puzzle. Among these, Ayaggari et al. (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. Cull et al. (2009) conclude that access to trade credit did not play a significant role in explaining the puzzle. Guariglia et al. (2010) demonstrate that the Chinese growth miracle was driven by the highly productive private firms, which were able to accumulate very high cash flows. According to their study, it is thanks to this abundant internal finance that Chinese private firms managed to finance their high growth rates despite their limited ability to obtain external finance.

In this paper, we focus on investment in fixed capital, which is a significant determinant of growth (Bernanke and Gurkaynak, 2001; Bond and Schiantarelli, 2004; Ding and Knight, 2009, 2010)[2]. Specifically, we explore the role played by working capital management in explaining why Chinese firms were able to invest at very high rates despite significant financing constraints. Working capital is defined as the difference between current assets and current liabilities, and is often taken to be a measure of liquidity. We chose to focus on working capital management motivated by the observation that, over the period 2000-2007, the Chinese firms in our dataset were characterized by a very high mean ratio of working capital to fixed capital (66.6%). Considering that working capital is highly reversible, and that firms can easily adjust it (Fazzari and Petersen, 1993; Carpenter et al., 1994), our aim is to investigate the extent to which, in the presence of fluctuations in cash flow, Chinese firms are able to adjust their working capital instead of their fixed capital investment, alleviating therefore the effects of cash flow shocks on the latter. Our analysis is related to Fazzari and Petersen (1993) who conduct a similar investigation on US firms, and find that these firms are indeed able to smooth fixed investment with working capital. To the

[1] According to our dataset, which is fully described in section 3, over the more recent period covering the years 2000-2007, Chinese firms were characterized by an average total assets growth rate of 9%, sales growth rate of 11.6%, and investment to capital ratio of 8.6%.

[2] The fact that there is a positive association between high investment and high growth is supported by our data, according to which those firms whose investment rate falls in the top quartile of the distribution of the investment rates of all firms in the sample, exhibit an assets growth rate of 20.46% and a sales growth rate of 18.60%, while the corresponding figures for those firms whose investment rate falls in the bottom quartile of the distribution are -2.51% and 4.58%.

best of our knowledge, no such investigation has been undertaken for a developing country. We fill this gap in the literature, by focusing on the Chinese case.

Our study is based on a panel of 121,237 firms over the period 2000-2007. We initially run standard investment regressions as a function of cash flow, separately for state-owned enterprises (SOEs), foreign, private, and collective enterprises. We find that the former always exhibit poorly determined sensitivities of investment to cash flow, suggesting that SOEs are not financially constrained. This can be explained by these firms' needs to fulfil political and social objectives as well as economic objectives (Bai et al., 2006) and the priority that central and local governments and the (predominant) state-owned banks accord to them. On the other hand, all other groups of firms exhibit high sensitivities of investment to cash flow, which suggests that they suffer from significant liquidity constraints. Moreover, all firms with the exception of SOEs exhibit significant sensitivities of working capital investment to cash flow. These findings indicate that, in the presence of fluctuations in cash flow, firms tend to adjust both their fixed and working capital investment. Yet, when we differentiate firms into those with a relatively high and a relatively low working capital to capital ratio, we find that, in the presence of cash flow shocks, it is only those firms with a high ratio that are able to adjust their working capital investment. Furthermore, for all firms with the exception of the foreign ones, the sensitivity of fixed capital investment to cash flow is much lower for firms with high working capital: the latter firms may therefore use their working capital to alleviate the effects of cash flow shocks on their fixed capital investment.

We then construct firm-level sensitivities of investment in fixed and working capital to cash flow (*FKS* and *WKS* respectively) and analyze their determinants. To the best of our knowledge, no other study in the literature has analyzed the links between investment in fixed capital, working capital, and financing constraints, making use of firm-level sensitivities. This represents our second contribution to the literature. We find that in the presence of cash flow shocks, older, larger, and slow growing firms typically adjust fixed capital investment, while smaller, younger, and fast growing firms are able to adjust working capital instead. Furthermore, firms with low cash flow, which are likely to face significant internal credit constraints, are particularly active in adjusting both their fixed and working capital investment, while highly leveraged firms with low collateral tend to adjust the latter more than the former. Combining the two sensitivities, we find that, compared to the other groups, those firms with low *FKS* and high *WKS* are more externally financially constrained (being younger, smaller, more indebted, and less collateralized), have high investment opportunities (exemplified by their high sales growth rates), and high working capital. Yet, they also have

the highest investment to capital ratios. Despite the financing constraints that they face, in the presence of adverse cash flow shocks, these firms can maintain high investment levels by adjusting working capital more than fixed capital. It is therefore possible that, although they face severe financial constraints, Chinese firms are able to maintain high investment and growth rates by effectively managing their working capital. In addition to the ability to accumulate high cash flows highlighted in Guariglia et al. (2010), good working capital management may contribute to the explanation for the Chinese growth puzzle.

The remainder of the paper is organized as follows. Section 2 provides some background about working capital management and its importance in the Chinese context. Section 3 describes our data and presents some descriptive statistics. Section 4 illustrates our baseline specification and estimation methodology. Section 5 presents our main empirical results, and section 6 our analysis of firm-level sensitivities of fixed and working capital investment to cash flow. Section 7 concludes.

2. Working capital management and its importance in the Chinese context

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. It is also 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 requires therefore striking a balance between liquidity and profitability in order to maximize the value of the firm. Specifically, holding large inventory stocks enables firms to avoid interruptions in the production process and costly stock-outs[3]. Moreover, granting trade credit to one's clients can stimulate sales, as it enables customers to verify the quality of the product before paying for it, and as it represents an additional source of credit for them (Long at al., 1993; Petersen and Rajan, 1997). Yet, the higher are inventories and trade credit, the less money is available to the firm for profitable investment, which suggests that finding the optimal level of working capital may be a difficult task for firm managers (Deloof, 2003). Working capital management is particularly important in the Chinese context, where firms have limited access

[3] A stock-out is defined as a situation in which the demand for a product cannot be fulfilled from the current inventory.

to long-term capital markets[4]. Such firms therefore need to rely on internally generated funds, short-term bank loans, and trade credit to finance investment in inventories, cash, and accounts receivables.

Another advantage of working capital, highlighted by Fazzari and Petersen (1993), is that it enables firms to smooth their fixed capital investment in the presence of cash flow shocks. As fixed capital investment is characterized by high adjustment costs, firms benefit from having smooth fixed investment. However, in the presence of negative cash flow shocks and financing constraints, it is mainly those firms which have sufficiently high levels of working capital that can absorb the shocks without having to reduce their fixed investment. Once again, because most Chinese firms are financially constrained, good working capital management may be particularly important for them to maintain relatively high and smooth levels of fixed investment. Good working capital management could therefore be an important mechanism through which Chinese firms cope with financing constraints. In the sections that follow, we verify whether or not this is the case.

3. Data and summary statistics

3.1 Data

Our data are drawn from the annual accounting reports filed by industrial firms with the National Bureau of Statistics (NBS) over the period 2000-2007. All state-owned enterprises and other types of enterprises with annual sales of five million yuan (about $650,000) or more are covered. These firms operate in the manufacturing and mining sectors and come from 31 provinces or province-equivalent municipal cities. Observations with negative sales, negative total assets minus total fixed assets, negative total assets minus liquid assets; and negative accumulated depreciation minus current depreciation, were dropped. We also dropped firms that did not have complete records on our main regression variables. To control for the potential influence of outliers, we deleted observations in the one percent tails of each of the regression variables. Finally, we dropped all firms with less than five years of consecutive observations. Our final panel covers 121,237 mainly unlisted firms, which

[4] 55% of the firm-year observations in our dataset do not have access to long-term debt.

corresponds to 790,229 firm-year observations[5]. It is unbalanced, with number of observations ranging from a minimum of 60,341 in 2000 to a maximum of 116,053 in 2003[6].

The NBS data contain a continuous measure of ownership, which is based on the fraction of paid-in-capital contributed by the following types of investors: the state; foreign investors (excluding those from Hong Kong, Macao, and Taiwan); investors from Hong Kong, Macao, and Taiwan; legal entities; individuals; and collective investors. The rationale for dividing foreign investors into those from Hong Kong, Macao, and Taiwan, and those from other parts of the world is that the former capture the so-called "round-tripping" foreign direct investment, whereby domestic firms may register as foreign invested firms from nearby regions to take advantage of the benefits (such as tax and legal benefits) granted to foreign invested firms (Huang, 2003). Ownership by legal entities is a mixture of ownership by state legal entities and private legal entities[7], which represents a form of corporate ownership. Finally, collective firms are typically owned collectively by communities in urban or rural areas (the latter are known as Township and Village Enterprises, or TVEs) and managed by local governments[8].

We grouped all foreign-owned firms (from Hong-Kong, Macao, Taiwan, and other parts of the world) into a single category (which we labelled *foreign*) and all firms owned by legal entities and individuals into a single category (labelled *private*)[9]. We then classified our firms into state-owned, foreign, private, and collective, based on the shares of paid-in-capital contributed by the four types of investors in each year. Specifically, we classified firms according to majority average ownership share. For instance, we classified a firm as privately

[5] The Chinese NBS dataset does not allow separate identification of publicly listed companies: it is difficult to track these companies as their legal identification numbers were changed as they went public (Liu and Xiao, 2004). Over the period considered, there were slightly more than 1000 listed companies operating in the manufacturing and mining sectors, which amounts to less than 0.3% of the total number of firms in our sample.

[6] See Appendix 1 for details about the structure of our panel, as well as for complete definitions of all variables used.

[7] Legal entities represent a mix of various domestic institutions, such as industrial enterprises, construction and real estate development companies, transportation and power companies, securities companies, trust and investment companies, foundations and funds, banks, technology and research institutions, etc.

[8] According to Abraham et al. (2010), although they used to be state-controlled, since the beginning of the 1990s, collective firms can be considered as private firms.

[9] Within this category, firms owned by individuals represent approximately 60% of the total. As firms owned by legal entities include firms owned by state legal entities, one could question their inclusion in the *private* category. One reason for including them is that while the state's primary interest is mainly political (i.e. aimed at maintaining employment levels or control over certain strategic industries), legal entities are profit-oriented (Wei et al., 2005). Since our dataset does not allow us to discriminate between state and non-state legal entities, we were unable to exclude the former from our *private* category.

owned in a given year if the share of its capital owned by private investors in that year is at least 50% (see Ayyagari et al., 2010; and Dollar and Wei, 2007, for a similar approach) [10].

As our objective in this paper is not the study of the effects of firms' transitions from state-owned to private or foreign, in our subsequent analysis we make use of time-invariant measures of ownership. Hence, we classify firms into our four ownership categories, based on majority average ownership share calculated over the sample period[11].

3.2 Summary statistics

Table 1 presents descriptive statistics of the variables used in our study for the four ownership groups. We can see that SOEs are characterized by very low fixed investment to fixed capital and cash flow to fixed capital ratios (2.2% and 11.8% respectively). Their working capital to fixed capital ratio (11.7%) and investment in working capital to fixed capital ratios (2.7%) are also much lower than those of other firms. Looking at the components of the working capital to fixed capital ratio, we see that their inventories to fixed capital ratio is 74.0%, whereas the ratio exceeds 100% for the other three groups. Similarly, the financial working capital to fixed capital ratio is negative for all groups of firms, but larger in absolute value for SOEs (-62.2%)[12]. Our statistics also suggest that SOEs are larger and older than the other groups. Their sales growth rate (2.4%) is much lower, while their leverage ratio (71.3%) and collateral (43.7%) are much higher. Focusing on their external liquidity needs defined as the inventories to sales ratio, this is also much higher for SOEs than for the other groups of firms[13]. Finally, only 43.7% of SOEs are located in coastal areas, compared to more than 65% for the other groups, and 33.3% of them are politically

[10] We derived ownership categories on the basis of the fraction of capital paid in by the various groups in every year, rather than using registration codes. Registration codes are not entirely reliable as they are updated only with considerable delay (Dollar and Wei, 2007). Moreover, firms might have an incentive to falsely register as foreign simply to take advantage of the tax benefits accorded to the latter. All our results were robust to using registration-based ownership categories. Note that our way of classifying firms into ownership groups excludes from our sample firms with mixed ownership in which no group has a majority share. For instance, a firm characterized by 40% private ownership, 30% state ownership, and 30% foreign ownership would be excluded. Firms of this type of mixed ownership make up only 1.5% of the sample.

[11] Defining ownership categories based on majority average ownership also has the advantage of minimizing the effects of measurement error in the ownership variables which can affect individual years.

[12] Financial working capital is defined as the difference between the sum of cash and equivalents and accounts receivable, and the sum of short term debt and accounts payable.

[13] The inventories to sales ratio captures the fraction of inventory investment that can be financed with ongoing revenue. As discussed in Raddatz (2006), "a higher value of this ratio means that a smaller fraction of inventory investment can be financed by ongoing revenue and therefore represents a higher level of external liquidity needs" (p. 685).

affiliated[14], compared to less than 4% for the other categories. In summary, these statistics indicate that SOEs are quite different from the other three groups of firms.

Focusing on the remaining three ownership groups, the fixed investment to fixed capital ratio ranges from 6.2% for collective firms to 9.8% for private firms. The cash flow to fixed capital ratio ranges from 37.2% for private firms to 43.9% for collective firms. Foreign firms have the highest working capital to fixed capital ratio and the highest investment in working capital to fixed capital ratio. The working capital to fixed capital ratio ranges in fact from 56.7% for private firms to 116.7% for foreign firms, and the investment in working capital to fixed capital ratio, from 10.9% for private firms to 17.7% for foreign firms. Focusing on the components of working capital, foreign firms exhibit the highest inventories to fixed capital ratio (127.4%) and the highest financial working capital to fixed capital ratio (-10.7%). The high inventories to capital ratios characterizing foreign firms can be explained by the fact that many foreign firms in China conduct import-processing business, i.e. they import raw materials and intermediary goods for processing and export the final products. These firms therefore hold very high stocks of inventories, and these are part of the current assets component of working capital. It is interesting to note that 94.3% of foreign firms are located in the coastal area.

Private firms display the highest sales growth ratio (13.7%) and the highest fixed investment to fixed capital ratio (9.8%). They also have the lowest inventories to sales ratio (21.8%), which suggests that they have relatively low external liquidity needs. This is consistent with Guariglia et al. (2010), according to which private firms in China have been able to grow at spectacular rates in recent years despite the financing constraints that they face, because they have been able to accumulate very high levels of cash flow. 73.2% of the private firms in our sample are located in the coastal region. As for the collective firms, they have the highest cash flow to fixed capital ratio (43.9%), and are the smallest groups in terms of real assets (424,000 yuan). They are also older than their private and foreign counterparts and have a slightly lower sales growth (7.9%). 68.8% of these firms are located in the coastal region.

For all groups of firms with the exception of SOEs, the standard deviation of the fixed investment to fixed capital ratio is less than the standard deviation of the cash flow to fixed capital ratio, which is in turn less than the standard deviation of the working capital

[14] We define a firm as politically affiliated if it is affiliated with either the central or the provincial government. Affiliation may take the form of the company's CEO and/or chairperson serving or having served in the central or provincial government (Fan et al., 2007). Alternatively, the firm could be conducting business transactions with the central or provincial government (Firth et al., 2009).

investment to fixed capital ratio (see figures in square brackets in Table 1). Furthermore, for all groups of firms, the standard deviation of the investment in working capital to fixed capital ratio is between 3.9 and 5.7 times higher than that of the fixed investment to fixed capital ratio. This can be seen as confirmation that it is easier and cheaper for firms to adjust their working capital than their fixed capital, and can be seen as preliminary evidence in favor of the fact that firms may use working capital to smooth fixed investment, in the presence of fluctuations in cash flow[15].

Our data also suggests that for all ownership groups, high fixed capital investment is associated with more stable investment (see figures in curly brackets in Table 1). A cross-sectional regression of firms' fixed investment to fixed capital ratios on the variance of this ratio, controlling for industry and provincial effects, shows a negative and highly significant coefficient on the variance term. Although this regression does not provide evidence of causality, it confirms that a more stable investment is associated with a higher investment[16]. Finally, a higher fixed capital investment is also associated with a higher total assets growth (see figures in double curly brackets in Table 1)[17].

4. Baseline specifications and estimation methodology

4.1 Baseline specifications

We initially estimate a fixed investment equation a-la Fazzari et al. (1988) of the following type:

$$(I_{it}/K_{it}) = a_0 + a_1(CF_{it}/K_{it}) + v_i + v_t + v_{jt} + e_{it} \qquad (1)$$

where I_{it} denotes firm i's fixed investment at time t; K_{it}, its fixed capital stock; and CF_{it}, its cash flow. The error term in Equation (1) comprises a firm-specific time-invariant component (v_i), encompassing all time-invariant firm characteristics likely to influence investment, as well as the time-invariant component of the measurement error affecting any of the regression variables; a time-specific component (v_t) accounting for possible business cycle effects; an industry-specific time-specific component (v_{jt}), which accounts for industry-

[15] In our full sample, working capital investment is negative in over 44% of our observations. This can be seen as further evidence in favor of the fact that working capital is a highly reversible asset, which firms can use to smooth out cash flow fluctuations.

[16] The results of this regression are not reported for brevity, but are available from the authors upon request.

[17] We report total assets growth for consistency with Guariglia et al. (2010). Similar trends (not reported) were observed for real sales growth.

specific business cycle effects; and an idiosyncratic component (e_{it}). We control for the firm-specific time-invariant component of the error term by estimating our equation in first-differences, for the time-specific component by including time dummies in all our specifications, and for the industry-specific time-specific component by including time dummies interacted with industry dummies.

As firms in our sample are not listed on the stock market, we are unable to include Tobin's *Q* in the regression to control for investment opportunities. Instead, we control for the latter by including time dummies interacted with industry dummies. This approach can be seen as an indirect way of accounting for investment opportunities, or more general demand factors, as the dummies account for all time-varying demand shocks at the industry level (Brown et al., 2009; Duchin et al., 2010; Guariglia et al., 2010)[18].

The cash flow coefficient a_1 can be interpreted as an indicator of the degree of financing constraints faced by firms. In the presence of a drop in cash flow, a financially constrained firm will in fact be forced to reduce or postpone its investment. We estimate Equation (1) separately for our four ownership groups, with the aim of assessing whether ownership affects the degree of financing constraints faced by firms. We expect SOEs to be the least constrained firms as they are likely to benefit from soft budget constraints and favoritism from the state-owned banks. On the other hand, private firms are expected to be the most constrained as banks are typically reluctant to lend to them.

As working capital is typically characterized by lower adjustment costs than investment in fixed capital (Fazzari and Petersen, 1993; Carpenter et al., 1994), firms should find it easier and cheaper to adjust the latter instead of the former in the presence of fluctuations in cash flow. This strategy should enable them to keep fixed investment high and relatively smooth. To test whether this is the case, we next estimate an equation of investment in working capital ($INVWK_{it}$) as a function of cash flow. The equation takes the following form:

$$(INVWK_{it}/K_{it}) = b_0 + b_1(CF_{it}/K_{it}) + v_i + v_t + v_{jt} + e_{it} \quad (2)$$

[18] All our results were robust to including sales growth in addition or in place of the industry-specific time dummies, to control for investment opportunities. It is noteworthy that according to D'Espallier and Guariglia (2009), the investment opportunity bias is not a serious problem for unlisted firms. Using a panel of Belgian firms, they find that the investment- cash flow sensitivities remain basically unchanged when different measures of investment opportunities are used.

In the presence of smoothing, we would expect to see a high sensitivity of investment in working capital to cash flow, i.e. a large b_1 coefficient.

The extent to which working capital can be adjusted in the presence of fluctuations in cash flow depends on the amount of working capital the firm has at hand. In the presence of a low working capital, there is little scope for this working capital to be used to smooth investment. This working capital would in fact have a very high marginal value and the opportunity cost of further liquidating it would be very high (Fazzari and Petersen, 1993; Carpenter et al., 1994)[19]. In order to take this into account, we differentiate the cash flow effect in the working capital regression across firms with relatively high and low working capital. This leads to the following equation:

$$(INVWK_{it}/K_{it}) = b_0 + b_{11}(CF_{it}/K_{i(t-1)})*LOWWK_{it} + b_{12}(CF_{it}/K_{i(t-1)})*HIGHWK_{it} + \\ + \nu_i + \nu_t + \nu_{jt} + e_{it} \quad (3)$$

where *LOWWK* (*HIGHWK*) is a dummy variable equal to 1 if firm *i*'s working capital to fixed capital ratio at time *t* is in the bottom (top) half of the distribution of the working capital of all firms operating in the same industry as firm *i* at time *t*, and 0 otherwise[20].

We also differentiate the cash flow effect in a similar way in our investment regression:

$$(I_{it}/K_{it}) = b_0 + a_{11}(CF_{it}/K_{i(t-1)})*LOWWK_{it} + a_{12}(CF_{it}/K_{i(t-1)})*HIGHWK_{it} + \nu_i + \nu_t + \nu_{jt} + e_{it} \quad (4)$$

If firms are able to smooth investment using working capital, then this effect is supposed to be larger for firms with large working capital. Hence, we would expect the sensitivity of working capital investment to cash flow to be higher for firms with large working capital. Consequently, for those firms able to smooth cash flow fluctuations with changes in working capital, the sensitivity of fixed capital investment to cash flow should be lower. The cash flow coefficient for firms with high working capital should be higher than that for their counterparts with low working capital in equation (3), while we should observe the opposite in equation (4). In other words, if b_{12} were larger than b_{11} in equation (3), but a_{11} were larger than a_{12} in equation (4), then we could deduce that firms are able to smooth fixed

[19] A low level of financial working capital and inventories would respectively lead to a low level of liquidity and a high probability of costly stock-outs, which would both make it difficult for the firm to maintain smooth operations.

[20] The *LOWWK* and *HIGHWK* dummy variables are constructe separtaely for each of our four ownership groups.

capital investment using working capital. Accumulating a high working capital could hence be seen as an effective strategy to mitigate the severity of financing constraints.

4.2 Estimation methodology

We estimate all our equations using a first-difference Generalized Method of Moments (GMM) approach (Arellano and Bond, 1991). The use of first-differencing controls for firm-specific, time-invariant effects. Lagged values of the regressors are used as instruments to control for the possible endogeneity of regressors.

To assess whether our instruments are legitimate and our model is correctly specified, we check whether the variables in our instrument set are uncorrelated with the error term in the relevant equation, making use of two tests. The first is the Sargan test (also known as *J* test) for overidentifying restrictions. Under the null of instrument validity, this test is asymptotically distributed as a chi-square with degrees of freedom equal to the number of instruments less the number of parameters.

Our second test is based on the serial correlation in the differenced residuals. We assess the presence of n^{th}-order serial correlation in the differenced residuals using the *m(n)* test, which is asymptotically distributed as a standard normal under the null of no n^{th}-order serial correlation of the differenced residuals. In the presence of serial correlation of order *n* in the differenced residuals, the instrument set needs to be restricted to lags *n*+1 and deeper. The latter instruments are valid in the absence of serial correlation of order *n*+1 in the differenced residuals (Brown and Petersen, 2009; Roodman, 2006).

We initially used our regressors lagged twice as instruments. Since the Sargan test and/or the test for second order autocorrelation of the differenced residuals systematically failed, we lagged all our instruments three times. In all the tables, we therefore report the test for third order autocorrelation of the differenced residuals[21].

[21] All tables report the *m*1 test for first-order serial correlation of the differenced residuals. Considering that our equations are estimated in first-differences, in most cases we find evidence of significant negative first-order serial correlation in the differenced residuals. Note that neither the *J* test nor the test for *n*-th order serial correlation in the differenced residuals allows us to discriminate between bad instruments and poor model specification.

5. Main empirical tests

We initially estimate equation (1) for our four ownership groups. The results are reported in Table 2. In line with the literature (Chow and Fung, 1998, 2000; Héricourt and Poncet, 2009; Poncet et al., 2010; Guariglia et al., 2010), we find that investment at SOEs is not sensitive to cash flow. This suggests that these firms benefit from soft budget constraints or favorable treatment from banks. On the other hand, foreign, private and collective firms all display positive and precisely determined cash flow coefficients. These are the largest for the private (0.4) and the collective firms (0.3), which are likely to be the most financially constrained groups, as state-owned banks typically discriminate against them (Allen et al., 2005). The cash flow elasticities evaluated at sample medians are respectively 0.68, 0.97, and 1.18 for foreign, private, and collective firms. Neither the Sargan test nor the test for third order autocorrelation of the differenced residuals indicate any problems with the validity of our instruments or the specification of the model.

We then estimate equation (2) and report the results in Table 3. With the exception of SOEs, cash flow strongly affects working capital investment of all firms: the cash flow coefficient for foreign firms is 0.5, that for private firms, 0.3, and that for collective firms, 0.6. All these coefficients are precisely determined. The cash flow elasticities evaluated at sample medians are 1.24, 2.35, and 3.76, respectively for foreign, private, and collective firms. Both these coefficients and elasticities are much higher than those in the fixed investment regressions. This can be explained considering the lower adjustment costs of working capital than of fixed capital.

In Tables 4 and 5 we investigate whether having a high or low working capital to capital ratio affects the sensitivities of investment in working capital and fixed capital to cash flow, respectively. For state-owned enterprises, cash flow affects neither of the two investment types. For all other firms, the sensitivity of investment in working capital to cash flow is only significant for firms with high working capital (Table 4). This finding suggests that in the presence of a drop in cash flow, only those firms with a relatively high working capital will tend to adjust their working capital investment. If the level of working capital is high, working capital has a low marginal value and the firm is willing to offset negative cash flow shocks with working capital (Fazzari and Petersen, 1993; Carpenter et al., 1994)[22].

[22] It is interesting to note that the sensitivities of private, foreign, and collective firms' working capital investment to cash flow are higher for those observation characterized by a cash flow to fixed capital ratio below the firm-specific mean, compared to those above the mean. Yet, there is no significant difference in the

Table 5 shows that for private and collective firms, the sensitivity of investment in fixed capital to cash flow is higher for firms characterized by low working capital[23]. For them, the marginal value of working capital is relatively high, and they are consequently unable to adjust their investment in working capital in the presence of cash flow shocks. Hence, they need to adjust their fixed capital investment instead. This does not hold for foreign firms: in their case, investment in fixed capital reacts to cash flow innovations if their working capital is high but not if it is low (Table 5). The different behaviour of foreign firms can be explained by their typically much higher working capital to fixed capital ratio than that of private and collective firms. Specifically, foreign firms with relatively low working capital have an average working capital to fixed capital ratio of -16.5%, which compares with much lower values for those private (-46.6%) and collective firms (-43.3%) also characterized by low working capital to fixed capital ratios. Furthermore, low working capital foreign firms appear to be significantly less externally financially constrained than their private and foreign counterparts: their average leverage ratio (defined as the ratio of total liabilities to total assets), is only 58.1%, compared to 71.0% for private and 73.6% for collective firms. Similarly, their coverage ratio (defined as the ratio of net income over total interest payments) is equal to 30.1%, compared to 12.2% for private and 14.9% for collective firms. Their relatively good financial health may therefore explain why low working capital foreign firms do not adjust their fixed capital investment: in the presence of cash flow shocks, they are likely to be able to easily access external finance.

In summary, our results so far suggest that in the presence of fluctuations in cash flow, SOEs adjust neither their investment in fixed capital nor their investment in working capital. As for the other firms, they adjust the latter more than the former. When differentiating firms into those with relatively high and low working capital, we find that it is only the former that are able to adjust their working capital. Furthermore, with the exception of foreign firms, high working capital firms exhibit lower sensitivities of fixed investment to cash flow than their low working capital counterparts. This suggests that in the presence of cash flow shocks, low working capital firms are unable to adjust their working capital and are forced to adjust their fixed capital investment instead. Accumulating a sufficiently high stock of working capital can therefore enable firms to reduce their fixed investment to cash flow sensitivities, so constantly maintaining investment at high levels.

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response of working capital investment to positive and negative cash flow shocks. These results are not reported for brevity, but are available upon request.

[23] For both groups of firms, the difference in the cash flow coefficients across firms with relatively high and low working capital to fixed capital ratios is statistically significant at the 10% level.

6. Analysis of firm-level fixed/working capital investment-cash flow sensitivities

6.1 Defining *FKS* and *WKS*

The above analysis has provided one single fixed investment-cash flow sensitivity coefficient and one single working capital investment-cash flow sensitivity coefficient for each of our four ownership groups[24]. Yet, each of these groups is made up of a large number of very heterogeneous firms (Guariglia et al., 2010). To account for this heterogeneity, in this section, we follow the methodology introduced by Hovakimian and Hovakimian (2009) to calculate firm-level sensitivities of investment in both fixed and working 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 (*FKS*), and firms with high and low working capital-investment sensitivities (*WKS*), on the one hand; and the characteristics of firms with different combinations of high/low *FKS*/*WKS*, on the other.[25] One objective of this exercise is to assess the extent to which these sensitivities are adequate measures of financing constraints. Another is to investigate whether, in the presence of cash flow shocks, firms can manage their working capital in such a way to alleviate the effects of financing constraints on fixed capital investment[26]. The firm-level cash flow sensitivities of investment in fixed capital (FKS_i) and working capital (WKS_i) are respectively calculated as follows:

$$FKS_i = \sum_{t=1}^{n}\left(\frac{\left(Cash\ flow/K\right)_{it}}{\sum_{t=1}^{n}\left(Cash\ flow/K\right)_{it}} * \left(\frac{I}{K}\right)_{it}\right) - \frac{1}{n}\sum_{t=1}^{n}\left(\frac{I}{K}\right)_{it} \quad (6)$$

$$WKS_i = \sum_{t=1}^{n}\left(\frac{\left(Cash\ flow/K\right)_{it}}{\sum_{t=1}^{n}\left(Cash\ flow/K\right)_{it}} * \left(\frac{\Delta WKI}{K}\right)_{it}\right) - \frac{1}{n}\sum_{t=1}^{n}\left(\frac{\Delta WKI}{K}\right)_{it} \quad (7)$$

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

[24] In those cases in which the cash flow coefficient was differentiated across firms with high and low working capital to capital ratios, two fixed and working capital investment–cash flow sensitivies were provided for each ownership group.

[25] The following combinations of *FKS*/*WKS* will be considered: high *FKS* and high *WKS*; low *FKS* and low *WKS*; high *FKS* and low *WKS*; low *FKS* and high *WKS*.

[26] The analysis that follows is limited to foreign, private, and collective firms. We exclude SOEs considering that neither their investment in fixed capital, nor their investment in working capital were sensitive to cash flow.

arithmetic time-series average ratio[27]. These differences will be higher for firms that tend to display higher investment in years with relatively high cash flow and lower investment in years with low cash flow. Firms whose investment tracks 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 investment because they are unable to obtain external finance at a reasonable cost. In theory, our firm-level sensitivities can therefore be interpreted as measures of the degree of financing constraints faced by each of our firms.

To see whether our sensitivities correctly identify firms, we classify firms into those with sensitivities above and below the third quartile of the distribution of the sensitivities of all firms in our sample[28], and run our fixed investment and working capital investment regressions on these two sub-samples. The results are reported in Table A1 in Appendix 2. Panel A shows that for observations with *FKS* above the third quartile of the distribution, the coefficient associated with cash flow in the fixed investment regressions is always large and statistically significant. In contrast, for firms with sensitivities below the third quartile, the corresponding coefficient is much smaller, although still precisely determined. Focusing on working capital investment (Panel B), firms with *WKS* below the third quartile of the distribution always have a poorly determined cash flow coefficient, while the corresponding coefficient for firms with high *WKS* is always large and precisely determined. These findings confirm that our firm-level cash flow sensitivities correctly identify firms.

6.2 Descriptive statistics and determinants of *FKS* and *WKS*

Table 6 presents descriptive statistics for firms with high and low *FKS* (Panel A) and for firms with high and low *WKS* (Panel B)[29]. Our descriptive statistics are grouped into those relative to variables used in the regressions reported in the previous section, those pertaining to working capital, general firm characteristics, financial variables, and China-specific variables. The latter are a dummy indicating whether the firm is located in the coastal area, and 0 otherwise; and a dummy indicating whether the firm is affiliated with the central or provincial government, and 0 otherwise. We introduce these dummies based on the following considerations. Contrary to firms operating in coastal areas, which face a severe competition for a limited pool of funds, firms operating in central and western areas may benefit from

[27] As in Hovakimian and Hovakimian (2009), to avoid negative and extreme weight values, negative cash flows in equations (6) and (7) are set equal to zero.

[28] This threshold level is similar to that used in Guariglia et al. (2010), who focus on the sensitivities of Chinese firms' assets growth to cash flow. Our results were robust to using a 50% cut-off point.

[29] As in section 6.1, firms with high/low *FKS/WKS* are defined as those firms whose *FKS/WKS* falls above (below) the third quartile of the distribution of the *FKS/WKS* of all firms in our sample.

financial incentives, thanks to policies aimed at developing those regions (Goodman, 2004). Yet, coastal areas are likely to benefit from a more developed banking sector, and from a more widespread presence of foreign banks, which could make financing constraints less binding (Firth et al., 2009; Lin, 2010). As for political connections these could be beneficial for firms, giving them "better access to key resources that are controlled by the Party and the government, such as business operation licenses, bank loans, land, and eligibility for favorable but discretionary government policies such as tax benefits and the waiver of "extralegal" fees" (Li et al., 2008, p. 288).

According to Panel A, for all ownership groups, firms with low *FKS* typically have higher investment in fixed capital, as well as higher cash flow to fixed capital ratios, and higher sales growth than their counterparts with high *FKS*. They are also characterized by lower leverage, and a lower inventories to sales ratio which indicates lower external financing needs. A higher proportion of firms with low *FKS* are located in the coastal region. These statistics suggest that low *FKS* firms are generally financially healthier than their high *FKS* counterparts. Focusing on investment volatility, measured by the standard deviation of the investment to capital ratio, we can see that, for all groups of firms, it is higher for high *FKS* firms. This is to be expected as high *FKS* firms typically adjust their fixed capital investment much more than their low *FKS* counterparts in response to cash flow shocks.

According to Panel B, firms with high *WKS* have higher working capital to fixed capital and working capital investment to fixed capital ratios than their counterparts with low *WKS*. It is interesting to note that the difference in the latter ratios across firms with high and low *WKS* is very strong. The respective figures are 144.9% and 91.7% for foreign firms; 68.9% and 37.4% for private firms; and 110.5% and 58.1% for collective firms. This confirms that it is mainly firms with sufficiently large working capital, which can afford to adjust their working capital investment in the presence of cash flow shocks. These huge differences in the working capital to fixed capital ratios are driven by the inventories to fixed capital ratio. The financial working capital to fixed capital ratio is in fact lower for high *WKS* private and foreign firms than for their low *WKS* counterparts, and it is similar for high and low *WKS* collective firms. Firms with high *WKS* also have higher cash flow to fixed capital ratios than their counterparts with low *WKS*. This gives the impression that they may face less stringent internal financing constraints[30]. Yet, they are typically smaller than their low *WKS*

[30] As in Guariglia (2008), we define as internally financially constrained those firms whose activities are constrained by the amount of internally generated funds they have at hand. Firms may also be susceptible to the effects of information asymmetries, which translate themselves into difficulties in obtaining external funds

counterparts, and are characterized by a higher leverage and lower collateral, which suggests that they may be more externally financially constrained. Finally, firms with high *WKS* also have higher fixed capital investment to capital ratios than their counterparts with low *WKS*. Yet, the volatility of the fixed investment to capital ratios, is always higher for firms with high *WKS*: those firms which make significant adjustments to their working capital in the presence of cash flow shocks may also need to adjust their fixed capital investment quite significantly.

Table 7 reports the regression results from the ex-post analysis in which the firm-varying *FKS* and *WKS* estimates are regressed against several proxies for financing constraints and other firm characteristics. Columns 1 and 2 refer to foreign firms; columns 3 and 4 to private firms; and columns 5 and 6 to collective firms. This analysis is aimed at showing whether the trends illustrated in Table 6 are statistically significant. Focusing on the determinants of *FKS* (columns 1, 3, and 5), we see that, for all groups of firms, larger, older and slow-growing firms are more likely to display higher fixed investment-cash flow sensitivities. This could be the case if these firms were unable to manage their working capital efficiently and were therefore forced to adjust their fixed capital investment in the presence of cash flow shocks (Chow and Fung, 2000). Coming to the financial variables, the cash flow to fixed capital ratio has a negative and significant coefficient both for private and foreign firms: for cash-flow-rich firms, changes in cash flow are not associated with large changes in fixed capital investment. Furthermore, for both private and collective firms, we observe a positive relationship between liquidity needs and *FKS*, indicating that in the presence of an adverse cash flow shock, those firms more in need of external finance are forced to reduce their investment. For private firms, a similar link is observed for leverage. In summary, in line with the descriptive statistics in Table 6, these regressions suggest that higher *FKS* can be linked with low cash flow, high external finance needs, and high leverage, i.e. with a higher degree of financing constraints.

The coefficients reported in columns 2, 4, and 6, which refer to the *WKS* regressions, show a negative sign on age and size, and a positive sign on sales growth[31]. These signs are exactly opposite to those observed in columns 1, 3, and 5 for the *FKS*. They suggest that larger, older, and slow-growing firms may be unable to effectively adjust their working capital in the presence of cash flow shocks, and are therefore forced to adjust their fixed

Along these lines, external financial constraints can be identified using criteria such as firms' size, age, leverage, collateral, dividend payout ratio, and so on.

[31] Whilst the coefficient on age is significant for all groups of firms, that on size is only significant for foreign firms, and that on sales growth is only significant for private and foreign firms.

capital instead. For all firms, the working capital to capital ratio has a positive coefficient (although not significant for collective firms): it is mainly those firms with a high working capital stock that can afford to adjust their working capital in the presence of cash flow shocks. Coming to the financial variables, lower collateral, lower cash flow, and higher leverage are all associated with higher *WKS*: highly indebted firms with low collateral and low cash flow (i.e. those firms more likely to face internal and external credit constraints) are particularly active in adjusting their working capital. The China-specific variables do not affect any of the sensitivities.

In summary, in the presence of cash flow shocks, different types of firms adjust fixed or working capital in different ways. Older, larger, and slow-growing firms typically adjust fixed capital investment, while smaller, younger, and fast-growing firms tend to adjust working capital instead. Furthermore, firms with low cash flow, which are likely to face significant internal credit constraints, are particularly active in adjusting both their working capital and their fixed capital investment. High leveraged firms with low collateral are more active in adjusting their working capital than their fixed capital investment. The question then arises of whether those financially constrained firms characterized by high *WKS* are able to manage their working capital in such a way as to alleviate their financing constraints, and to keep their investment in fixed capital high despite fluctuations in cash flow. We attempt to answer this question by combining the two types of sensitivity in the section that follows.

6.3 Combining *FKS* and *WKS*

Table 8 presents descriptive statistics for the following groups of firms: firms with high *FKS* and high *WKS* (HH); firms with high *FKS* and low *WKS* (HL); firms with low *FKS* and high *WKS* (LH); and firms with low *FKS* and low *WKS* (LL). Panel A refers to foreign firms; panel B to private firms; and panel C to collective firms. For all ownership groups, within both the low and high *FKS* categories, firms characterized by high *WKS* always have higher fixed capital investment to fixed capital ratios than their counterparts with low *WKS*. Our explanation is that in the presence of adverse cash flow shocks, high *WKS* firms adjust their working capital in such a way, which enables them to keep their fixed capital investment relatively high. This is preliminary evidence that good working capital management can be a strategy enabling firms to alleviate the effects of financing constraints on investment.

Furthermore, among all ownership groups, it is the LH firms which exhibit the highest fixed investment to fixed capital ratios. Interestingly, fixed capital investment volatility is highest for the HH and lowest for the LL firms. Although their investment to fixed capital

ratio is the highest, LH firms do not have the least volatile fixed capital investment. Even if they tend not to significantly adjust their investment in fixed capital in response to fluctuations in cash flow, it is still possible that these firms adjust it in response to changes in other factors such as, for instance, demand shocks.

LH firms also display the highest (or second highest in the case of private firms) working capital to capital ratios and working capital investment to capital ratios. The high working capital to fixed capital ratios (which is driven by high inventories to fixed capital ratios) can be explained in the light of the fact that, as discussed in section 5, only firms with sufficiently high working capital can afford to adjust it in the presence of cash flow shocks.

LH firms are the smallest and, except for collective firms, the youngest. They also have the highest cash flow to fixed capital ratios. Together with LL firms, they have much higher sales growth rates and much lower liquidity needs than the other groups of firms. Yet, they tend to have relatively high leverage and low collateral. Their high cash flow and low liquidity needs indicate that they are internally less financially constrained, whereas their high leverage and low collateral indicate that they are externally more financially constrained than firms in the other groups.

The LL firms are financially healthy: they display high cash flow and collateral, low liquidity needs and low leverage. When a cash flow shock hits them, these firms do not need to adjust either their fixed or working capital investment as much as other firms.

Table 9 reports the results of multinomial logit regressions for the determinants of being classified as LL (columns 1, 4, 7), HL (columns 2, 5, 8), and HH (columns 3, 6, 9) by comparison with LH. We set the LH firms as our baseline group because this is the group with highest fixed investment. Focusing on columns 1, 4, and 7, which refer respectively to foreign, private, and collective firms, we see that firms are more likely to be classified as LL as opposed to LH if they are larger, older (with the exception of collective firms), slower-growing firms (with the exception of collective firms), characterized by a lower working capital to fixed capital ratio, a higher collateral, a higher cash flow (with the exception of private firms), a lower leverage, and (for foreign and collective firms only) higher external financial needs. Hence, the propensity to be classified as LH as opposed to LL is higher if firms are more externally and internally financially constrained (being younger, smaller, more indebted, less collateralized, and having lower cash flow), have high investment opportunities (exemplified by their high sales growth rates), and high working capital.

Focusing respectively on columns 2, 5, and 8, on the one hand, and columns 3, 6, and 9, on the other, we see that firms with lower cash flow to fixed capital ratios are more likely

to be classified as HL and HH than as LH. This indicates that although they are relatively more internally financially constrained than LL firms, LH firms are relatively less internally financially constrained than HL and HH firms. Furthermore, firms with high external finance needs are more likely to be classified as HL than LH, and, in the case of private firms, are also more likely to be classified as HH than LH. Yet, despite a couple of exceptions, firms with lower leverage and higher collateral are more likely to be classified as HL and HH than as LH. Furthermore, larger, older, and slow-growing firms are also more likely to be classified a HL and HH than as LH. This suggests that compared to the HL and HH groups, the LH face significant external financing constraints.

In summary, it appears that, even though they face significant credit constraints, the LH firms are able to carry the highest fixed investment to fixed capital ratios. A possible explanation for this is that in the presence of adverse cash flow shocks, these firms are able to maintain high investment levels by adjusting working capital more than fixed capital. Working capital adjustment can therefore be seen as an avenue through which financially constrained firms can mitigate the effects of their financial constraints, so keeping investment high. Good working capital management may be a contributory explanation of why Chinese firms, and in particular private firms, were able to invest and grow at phenomenal rates in the last three decades, despite being discriminated against by the financial system.

7. Conclusions

We have used a panel of over 120,000 Chinese firms over the period 2000-2007 to analyze the extent to which firms owned by different agents are able to use working capital to mitigate the effects of financing constraints on their fixed capital investment. We found that those firms characterized by high working capital display high sensitivities of investment in working capital to cash flow, and (with the exception of foreign firms) low sensitivities of investment in fixed capital to cash flow. This suggests that they are able to use working capital to alleviate the effects of cash flow shocks on fixed capital investment.

We have then constructed firm-level sensitivities of investment in fixed and working capital to cash flow, and analyzed their determinants. We found that in the presence of fluctutions in cash flow, older, larger, and slow-growing firms typically adjust fixed capital investment, while smaller, younger, and fast growing firms tend to adjust working capital instead. Furthermore, firms with low cash flow, which are likely to face significant internal credit constraints, are particularly active in adjusting both their fixed and working capital investment, while highly leveraged firms with low collateral tend to adjust the latter more

than the former. Combining the two sensitivities, we found that, compared to the other groups, those firms with low *FKS* and high *WKS* are more externally financially constrained (being younger, smaller, more indebted, and less collateralized), have high investment opportunities (exemplified by their high sales growth rates), and high working capital. Yet, they also have the highest investment to capital ratios. Despite the financing constraints that they face, in the presence of adverse cash flow shocks, these firms can maintain high investment levels by adjusting working capital more than fixed capital. Good management of working capital may therefore be a means that China's many financially constrained firms could use to mitigate the constraints that they face.

These findings have policy implications. If policy-makers aim to increase firms' fixed investment by making more finance available to them, when deciding which firms to target, they should take into account the level of working capital available to them, as this affects the firms' propensity to adjust fixed capital investment.

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Appendix 1: Data

Structure of the unbalanced panel

Number of obs. per firm	*Number of observations*	*Percent*	*Cumulative*
5	173,185	21.92	21.92
6	149,382	18.90	40.82
7	181,734	23.00	63.82
8	285,928	36.18	100.00
Total	790,229	100.00	

Year	*Number of observations*	*Percent*	*Cumulative*
2000	60,341	7.64	7.64
2001	80,055	10.13	17.77
2002	96,159	12.17	29.93
2003	116,442	14.74	44.67
2004	116,053	14.69	59.36
2005	113,019	14.30	73.66
2006	107,882	13.65	87.31
2007	100,278	12.69	100.00
Total	790,229	100.00	

Definitions of the variables used

Fixed capital stock: book value of tangible fixed assets (which include land and building; fixtures and fittings; and plant and vehicles).

Fixed investment: difference between the book value of tangible fixed assets of end of year *t* and end of year *t*-1 adding depreciation of year *t*.

Cash flow: net income plus depreciation.

Financial working capital: working capital net of inventories.

Current liabilities: sum of the firm's bank loans, accounts payable, and other current liabilities.

Current assets: sum of the firm's inventories, accounts receivable, and other current assets.

Inventories: finished goods and work-in-progress stocks.

Working capital stock: difference between the firm's current assets and current liabilities.

Working capital investment: difference between the working capital stock of end of year *t* and end of year *t*-1.

Collateral: ratio of tangible assets to total assets.

Leverage: ratio of current liabilities plus non-current liabilities to total assets, where current liabilities include bank loans, accounts payable, and other current liabilities.

Coverage ratio: ratio of net income over total interest payments.

Coast: dummy variable equal to 1 if the firm is located in the coastal area, and 0 otherwise.

Politically affiliated: dummy equal to 1 if the firm is affiliated with the central or provincial government, and 0 otherwise.

Deflators: all variables are deflated using provincial ex-factory producer price indices taken from various issues of the China Statistical Yearbook.

Appendix 2: Verifying whether our firm-level *FKS* and *WKS* correctly identify firms

Table A1 reports estimates of our investment in fixed capital and working capital investment regressions for firms characterized by sensitivities above and below the third quartile of the distribution of the sensitivities of all firms in our sample. The aim of this exercise is to verify whether our firm-level *FKS* and *WKS* correctly identify firms.

Table 1: Sample means and medians (in parentheses)

	State-owned	*Foreign*	*Private*	*Collective*
	(1)	(2)	(3)	(4)
Variables included in the main regressions				
Fixed investment/ fixed capital (I/K)	2.18 (1.07) [41.92] {22.62; 47.01} {{8.79; -7.78}}	9.39 (6.94) [43.24] {22.99; 46.75} {{17.50, -1.51}}	9.78 (8.67) [50.68] {23.83; 55.32} {{23.86, -1.22}}	6.17 (5.22) [50.78] {24.18; 57.02} {{15.58, -4.63}}
Cash flow/K (CF/K)	11.77 (5.26) [40.95]	41.65 (22.44) [72.88]	37.19 (20.05) [61.75]	43.92 (21.32) [74.86]
Investment in working capital/K (INVWK/K)	2.74 (0.13)	17.67 (8.65)	10.92 (2.98)	12.94 (3.40)
Working capital/K (WK/K)	11.74 (-9.29) [178.60]	116.74 (50.78) [244.34]	56.74 (13.64) [196.44]	82.93 (24.17) [238.0]
Working capital details				
Working capital	-23.83 (-5.21)	110.96 (37.38)	28.52 (4.76)	19.64 (8.56)
Inventories/K	73.93 (30.48)	127.44 (56.51)	101.22 (45.84)	111.14 (45.84)
Financial working capital/K (FWK/K)	-62.18 (-48.71)	-10.69 (-14.48)	-44.48 (-38.68)	-28.21 (-28.82)
General firm characteristics				
Assets	3597.67 (315.64)	1274.09 (346.61)	758.10 (158.94)	424.36 (156.60)
Age	29.17 (31.00)	8.22 (8.00)	9.65 (7.00)	16.60 (13.00)
Sales growth	2.37 (4.44)	11.30 (10.36)	13.78 (12.40)	7.93 (8.09)
Financial variables				
Leverage	71.26 (68.24)	48.29 (47.73)	59.17 (60.87)	60.71 (60.91)
Collateral	43.70 (41.96)	32.23 (29.89)	34.65 (31.74)	33.97 (30.12)
Inventories/Sales	576.09 (23.99)	29.95 (14.68)	21.82 (10.36)	39.01 (10.40)
China-specific variables				
Coast	43.66 (0.00)	94.31 (1.00)	73.16 (1.00)	68.77 (1.00)
Politically affiliated	33.34 (0.00)	3.49 (0.00)	3.68 (0.00)	2.62 (0.00)
Observations	68,452	143,601	482,451	64,353

Notes: Working capital and assets are expressed in thousands of yuan, and firm age in years. Financial working capital is defined as the difference between the sum of cash and equivalents and accounts receivable, and the sum of short term debt and accounts payable. All other variables are expressed in percentage terms. *Coast* is a dummy variable equal to 1 if the firm is located in the coastal area, and 0 otherwise. *Politically affiliated* is a dummy equal to 1 if the firm is affiliated with the central or provincial government, and 0 otherwise. All yuan variables are deflated using provincial ex-factory producer price indices. The numbers in square brackets are standard deviations. The numbers in curly brackets are standard deviations of *I/K* for observations characterized by an *I/K* ratio in the upper and lower half of the distribution of all the *I/K* ratios in each ownership group. The numbers in double curly brackets are mean total assets growth rates for observations characterized by an *I/K* ratio in the upper and lower half of the distribution of all the *I/K* ratios in each ownership group.See Appendix 1 for definitions of all variables.

Table 2: Fixed investment model augmented with industry-specific time dummies

	State-owned	*Foreign*	*Private*	Collective
	(1)	(2)	(3)	(4)
(Cash flow /tangible fixed assets) $_{it}$	0.10 (0.11)	0.21*** (0.05)	0.42*** (0.07)	0.29*** (0.08)
J (p-value)	0.99	0.02	0.11	0.20
m1	-25.56	-37.31	-65.75	-26.44
m3	-0.86	-0.55	-0.74	-0.77
Observations	52,020	105,608	336,341	47,117

Notes: All specifications were estimated using a GMM first-difference specification. The figures reported in parentheses are asymptotic standard errors. Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are *(Cash flow / total assets)*$_{i(t-3)}$, time dummies, and time dummies interacted with industry dummies. The *J* statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. *m1* is a test for first-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. *m3* is a test for third-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. Also see Notes to Table 1, and Appendix 1 for complete definitions of all variables. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 3: Working capital investment model augmented with industry-specific time dummies

	State-owned	*Foreign*	*Private*	Collective
	(1)	(2)	(3)	(4)
(Cash flow /tangible fixed assets) $_{it}$	0.14 (0.34)	0.48*** (0.17)	0.35*** (0.14)	0.60*** (0.19)
J (p-value)	0.002	0.00	0.00	0.003
m1	-22.80	-38.80	-76.89	-27.47
m3	1.02	-0.75	1.33	-0.79
Observations	45,505	97,215	317,979	42,434

Notes: All specifications were estimated using a GMM first-difference specification. The figures reported in parentheses are asymptotic standard errors. Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are *(Cash flow / total assets)*$_{i(t-3)}$, time dummies, and time dummies interacted with industry dummies. Also see Notes to Tables 1 and 2. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 4: Working capital investment model augmented with industry-specific time dummies: differentiating firms on the basis of the level of their working capital

	State-owned	*Foreign*	*Private*	Collective
	(1)	(2)	(3)	(4)
*(Cash flow /tangible fixed assets)$_{it}$*LOWWK$_{it}$*	-1.46 (1.21)	-0.79 (0.53)	0.49 (0.40)	0.05 (0.34)
*(Cash flow /tangible fixed assets)$_{it}$*HIGHWK$_{it}$*	0.08 (0.40)	0.59*** (0.18)	0.40*** (0.13)	0.75*** (0.18)
J (p-value)	0.09	0.001	0.02	0.26
m1	-17.31	-32.73	-65.89	-27.01
m3	-0.75	-0.85	1.33	-0.40
Observations	45,505	97,215	317,979	42,434

Notes: LOWWK (*HIGHWK*) is a dummy variable equal to 1 if firm *i*'s working capital to fixed capital ratio at time *t* is in the bottom (top) half of the distribution of the working capital of all firms operating in the same industry as firm *i* at time *t*, and 0 otherwise. All specifications were estimated using a GMM first-difference specification. The figures reported in parentheses are asymptotic standard errors. Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are *(Cash flow / total assets)$_{i(t-3)}$*LOWWK$_{i(t-3)}$*, *(Cash flow / total assets)$_{i(t-3)}$*HIGHWK$_{i(t-3)}$*, time dummies, and time dummies interacted with industry dummies. Also see Notes to Tables 1 and 2. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 5: Fixed investment model augmented with industry-specific time dummies: differentiating firms on the basis of the level of their working capital

	State-owned	*Foreign*	*Private*	Collective
	(1)	(2)	(3)	(4)
*(Cash flow /tangible fixed assets)$_{it}$*LOWWK$_{it}$*	0.25 (0.27)	-0.21 (0.23)	0.85*** (0.21)	0.42** (0.18)
*(Cash flow /tangible fixed assets)$_{it}$*HIGHWK$_{it}$*	0.073 (0.13)	0.23*** (0.06)	0.34*** (0.06)	0.10*** (0.07)
J (p-value)	0.97	0.09	0.04	0.02
m1	-25.53	7.85	-46.49	-25.98
m3	-0.83	-0.23	-0.50	-0.77
Observations	52,020	105,608	336,341	47,117

Notes: All specifications were estimated using a GMM first-difference specification. The figures reported in parentheses are asymptotic standard errors. Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are *(Cash flow / total assets)$_{i(t-3)}$*LOWWK$_{i(t-3)}$*, *(Cash flow / total assets)$_{i(t-3)}$*HIGHWK$_{i(t-3)}$*, time dummies, and time dummies interacted with industry dummies. Also see Notes to Tables 1, 2, and 4. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 6: Firm characteristics by firm-specific investment in fixed and working capital to cash flow sensitivity (*FKS, WKS*) types

PANEL A	*Foreign*	*Foreign*	*Private*	*Private*	*Collective*	*Collective*
	High FKS	*Low FKS*	*High FKS*	*Low FKS*	*High FKS*	*Low FKS*
Main regression variables						
I/K	9.35 [39.31]	10.98 [28.25]	9.78 [45.16]	13.42 [34.74]	8.06 [43.98]	9.50 [33.72]
CF/K	28.81	39.17	26.97	33.33	26.99	41.56
INVWK/K	12.67	15.61	7.14	6.96	5.19	11.71
WK/K	110.70	106.42	39.93	47.06	50.64	78.05
Working capital details						
Inventories/K	123.58	110.98	94.12	85.30	101.01	96.70
Fin. WK/K	-27.97	-7.84	-57.06	-40.60	-53.50	-21.77
General firm characteristics						
Assets	1019.49	1242.78	680.81	684.47	357.01	404.38
Age	8.44	7.83	10.16	8.83	17.80	15.85
Sales growth	8.81	11.61	11.46	14.10	6.11	9.22
Financial variables						
Leverage	50.14	47.61	61.00	58.57	64.03	59.60
Collateral	30.85	31.66	34.27	34.18	33.55	33.28
Inventories/Sales	22.45	19.86	19.92	15.31	23.65	17.68
China-specific variables						
Coast	93.86	94.37	67.93	74.54	63.42	70.50
Politically affiliated	2.43	3.03	4.09	2.99	2.43	2.34
Observations	36,174	107,427	122,214	360,237	16,168	48,185

PANEL B	*Foreign*	*Foreign*	*Private*	*Private*	*Collective*	*Collective*
	High WKS	*Low WKS*	*High WKS*	*Low WKS*	*High WKS*	*Low WKS*
Main regression variables						
I/K	11.71 [38.48]	10.20 [28.53]	13.24 [46.56]	12.28 [34.28]	9.87 [47.23]	8.90 [32.63]
CF/K	41.92	34.79	35.09	30.62	41.34	36.78
INVWK/K	17.78	13.91	8.03	6.66	13.05	9.09
WK/K	144.94	91.67	68.86	37.41	110.52	58.09
Working capital details						
Inventories/K	164.01	97.49	118.94	77.02	135.32	85.26
Fin. WK/K	-23.40	-9.37	-53.30	-41.85	-28.40	-30.14
General firm characteristics						
Assets	859.89	1296.03	532.14	734.08	274.54	431.93
Age	7.72	8.07	8.81	9.72	15.98	16.46
Sales growth	11.22	10.81	13.26	13.50	7.99	8.59
Financial variables						
Leverage	53.96	46.33	62.45	58.09	63.66	59.72
Collateral	24.48	33.78	28.68	36.05	26.77	35.55
Inventories/Sales	19.88	20.72	17.60	16.09	19.09	19.21
China-specific variables						
Coast	95.00	93.99	73.18	72.79	69.28	68.55
Politically affiliated	2.58	2.98	3.18	3.18	2.76	2.23
Observations	35,262	108,344	119,911	362,540	16,020	48,333

Notes: FKS (*WKS*) represents the firm-specific investment in fixed (working) capital to cash flow sensitivities calculated using the methodology outlined in Hovakimian and Hovakimian (2009). Firms with high/low *FKS/WKS* are defined as those firms whose *FKS/WKS* falls above (below) the third quartile of the distribution of the *FKS/WKS* of all firms in our sample. The numbers reported in this table are means, with the exception of those in square brackets, which are standard deviations. Also See Note to Table 1.

Table 7: Ex post regressions for *FKS* and *WKS*

	Foreign	*Foreign*	*Private*	*Private*	*Collective*	*Collective*
	FKS (1)	*WKS* (2)	*FKS* (3)	*WKS* (4)	*FKS* (5)	*WKS* (6)
CF/K	-0.018***	-0.041***	-0.011***	-0.017**	-0.001	-0.010
	(0.003)	(0.012)	(0.003)	(0.008)	(0.007)	(0.016)
WK/K	0.002*	0.009*	0.001	0.013***	-0.002	0.010
	(0.001)	(0.004)	(0.001)	(0.003)	(0.003)	(0.007)
Age	0.224***	-0.332***	0.052***	-0.070***	0.080***	-0.134**
	(0.049)	(0.117)	(0.011)	(0.020)	(0.027)	(0.056)
Log of assets	0.449***	-1.757***	0.367***	0.020	0.322	-0.537
	(0.114)	(0.279)	(0.078)	(0.160)	(0.325)	(0.597)
Sales growth	-0.032***	0.068***	-0.055***	0.023*	-0.055***	0.025
	(0.010)	(0.025)	(0.006)	(0.013)	(0.020)	(0.044)
Leverage	0.009	0.144***	0.014***	0.092***	0.020	0.079**
	(0.008)	(0.021)	(0.005)	(0.012)	(0.012)	(0.033)
Collateral	0.004	-0.352***	-0.002	-0.136***	0.053**	-0.171***
	(0.015)	(0.034)	(0.008)	(0.016)	(0.023)	(0.042)
Inventories/Sales	0.010	-0.058***	0.025***	0.003	0.034***	-0.025
	(0.007)	(0.014)	(0.005)	(0.011)	(0.010)	(0.025)
Coast	-0.000	-0.045***	-0.006**	0.001	-0.002	-0.011
	(0.007)	(0.017)	(0.003)	(0.005)	(0.007)	(0.014)
Politically affiliated	0.019***	0.010	0.005	0.019*	-0.026	0.022
	(0.004)	(0.016)	(0.006)	(0.012)	(0.025)	(0.037)
Observations	17,339	17,339	46,132	46,132	5,497	5,497

Notes: All coefficients were obtained from cross-sectional OLS regressions. Industry dummies were included in all regressions. Robust standard errors in parentheses. Also see Notes to Tables 1 and 6. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 8: Firm characteristics combining *FKS* and *WKS*

Panel A: Foreign firms

	High FKS; High WS	*High FKS; Low WKS*	*Low FKS; High WKS*	*Low FKS; Low WKS*
Main regression variables				
I/K	10.70 [41.93]	8.82 [38.28]	12.09 [37.11]	10.63 [25.47]
CF/K	33.59	26.92	45.24	37.27
INVWK/K	15.24	11.65	18.79	14.62
WK/K	135.36	86.97	148.82	93.14
Working capital details				
Inventories/K	169.93	105.21	161.72	95.07
Fin. WK/K	-41.48	-22.61	-16.20	-5.21
General firm characteristics				
Assets	1059.51	1004.11	781.27	1387.51
Age	8.13	8.58	7.56	7.92
Sales growth	9.32	8.61	11.98	11.50
Financial variables				
Leverage	55.32	48.10	53.45	45.78
Collateral	24.21	33.49	24.61	33.88
Inventories/Sales	21.18	22.97	19.37	20.01
China-specific variables				
Coast	95.06	93.41	95.00	94.17
Politically affiliated	2.50	2.41	2.62	3.16
Observations	10,256	26,083	25,166	82,256

Panel B: Private firms

	High FKS; High WKS	*High FKS; Low WKS*	*Low FKS; High WKS*	*Low FKS; Low KFS*
Main regression variables				
I/K	10.56 [48.46]	9.51 [43.90]	14.25 [45.84]	13.16 [31.21]
CF/K	30.29	25.67	36.88	32.20
INVWK/K	8.46	6.65	7.87	6.67
WK/K	69.98	28.37	68.27	40.29
Working capital details				
Inventories/K	128.40	80.87	115.10	75.80
Fin. WK/K	-61.88	-55.12	-49.95	-37.61
General firm characteristics				
Assets	689.89	678.23	473.04	751.89
Age	10.32	10.11	8.27	9.02
Sales growth	11.30	11.53	14.01	14.13
Financial variables				
Leverage	62.67	60.33	62.33	57.37
Collateral	28.39	36.56	28.83	35.89
Inventories/Sales	22.07	19.11	15.90	15.12
China-specific variables				
Coast	68.69	67.62	74.87	74.44
Politically affiliated	5.04	3.74	2.93	3.00
Observations	33,206	88,892	86,589	273,648

Panel C: Collective firms

	High FKS; High WKS	*High FKS; Low WKS*	*Low FKS; High WKS*	*Low FKS; Low WKS*
Main regression variables				
I/K	9.01 [48.59]	7.72 [42.27]	10.19 [46.73]	9.28 [29.53]
CF/K	29.73	25.98	45.64	40.24
INVWK/K	7.27	4.42	15.19	10.59
WK/K	88.23	36.72	118.77	64.96
Working capital details				
Inventories/K	137.12	87.64	134.66	84.50
Fin. WK/K	-52.19	-53.99	-19.59	-22.47
General firm characteristics				
Assets	276.64	387.59	274.34	446.18
Age	9.01	18.13	15.60	15.93
Sales growth	5.82	6.20	8.79	9.36
Financial variables				
Leverage	65.71	63.35	62.85	58.56
Collateral	28.08	35.67	26.36	35.51
Inventories/Sales	22.78	23.98	17.72	17.68
China-specific variables				
Coast	63.76	63.19	71.23	70.27
Politically affiliated	2.14	2.49	2.94	2.15
Observations	4,275	11,856	11,708	36,477

Notes: The numbers reported in this table are means, with the exception of those in square brackets, which are standard deviations. Also See Notes to Tables 1 and 6.

Table 9: Multinomial logit regressions for the propensity of being classified as (Low *FKS*-Low *WKS*, *LL*), (High *FKS* - Low *WKS*, *HL*), and (High *FKS*-High *WKS*, *HH*) versus (Low *FKS*-High *WKS*, *LH*)

	Foreign *LL vs LH* (1)	*Foreign* *HL vs LH* (2)	*Foreign* *HH vs LH* (3)	*Private* *LL vs LH* (4)	*Private* *HL vs LH* (5)	*Private* *HH vs LH* (6)	*Collective* *LL vs LH* (7)	*Collective* *HL vs LH* (8)	*Collective* *HH vs LH* (9)
CF/K	0.002***	-0.006***	-0.006***	0.000	-0.004***	-0.004***	0.001*	-0.002*	-0.005***
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
WK/K	-0.001***	0.000	0.000	-0.001***	-0.001***	0.000***	-0.001***	-0.001***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	0.030***	0.077***	0.036***	0.010***	0.017***	0.016***	0.003	0.011***	0.004
	(0.007)	(0.008)	(0.010)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.005)
Log of assets	0.253***	0.178***	0.083***	0.091***	0.046***	0.049***	0.105***	0.091**	-0.022
	(0.018)	(0.022)	(0.029)	(0.011)	(0.014)	(0.018)	(0.036)	(0.045)	(0.060)
Sales growth	-0.004***	-0.008***	-0.005***	-0.001*	-0.006***	-0.005***	0.000	-0.009***	-0.004
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.004)
Leverage	-0.012***	-0.008***	0.002	-0.009***	-0.006***	-0.003***	-0.008***	-0.004**	0.001
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)
Collateral	0.033***	0.029***	-0.009***	0.024***	0.022***	-0.003	0.027***	0.023***	0.009**
	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)	(0.004)
Inventories/Sales	0.004***	0.004***	-0.000	0.000	0.005***	0.005***	0.003**	0.005***	0.004
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Coast	0.001	0.001	-0.000	0.001***	-0.001*	-0.002***	0.002**	-0.000	-0.003**
	(0.001)	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Politically affiliated	-0.001	-0.002	-0.001	-0.002**	-0.001	0.002*	-0.000	-0.001	-0.002
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.004)
Observations	17,339	17,339	17,339	46,132	46,132	46,132	5,497	5,497	5,497

Notes: All coefficients were obtained from multinomial logit regressions. Industry dummies were included in all regressions. Robust standard errors in parentheses. Also see Notes to Tables 1 and 6. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table A1: Investment model augmented with industry-specific time dummies, for firms characterized by high/low *FKS/WKS*

Panel A: *FKS*

	Foreign	*Foreign*	*Private*	*Private*	*Collective*	*Collective*
	Low FKS (1)	*High FKS* (2)	*Low FKS* (3)	*High FKS* (4)	*Low FKS* (5)	*High FKS* (6)
(Cash flow /tangible fixed assets)$_{it}$	0.116** (0.050)	0.465*** (0.166)	0.207*** (0.063)	1.038*** (0.193)	0.179** (0.079)	0.722*** (0.261)
J (p-value)	0.05	0.229	0.04	0.821	0.631	0.245
m1	-30.68	-20.94	-57.02	-32.70	-22.05	-14.93
m3	0.95	-2.73	-0.02	-1.39	-0.88	0.10
Observations	78,721	26,887	249,522	86,819	35,081	12,036

Panel B: *WKS*

	Foreign	*Foreign*	*Private*	*Private*	*Collective*	*Collective*
	Low WKS (1)	*High WKS* (2)	*Low WKS* (3)	*High WKS* (4)	*Low WKS* (5)	*High WKS* (6)
(Cash flow /tangible fixed assets)$_{it}$	0.414 (0.330)	0.603*** (0.187)	0.201 (0.306)	0.602*** (0.136)	0.486** (0.247)	1.155*** (0.279)
J (p-value)	0.048	0.004	0.507	0.131	0.457	0.006
m1	-25.80	-23.39	-44.73	-45.88	-19.59	-17.69
m3	-0.71	-0.26	1.51	0.78	-1.49	0.32
Observations	73,714	23,501	239,648	78,331	31,986	10,448

Notes: All specifications were estimated using a GMM first-difference specification. The figures reported in parentheses are asymptotic standard errors. Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are *(Cash flow / total assets)$_{i(t-3)}$*, time dummies, and time dummies interacted with industry dummies. Also see Notes to Tables 1, 2, and 6. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.