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

By

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Abstract

We use a panel of over 116,000 Chinese firms of different ownership types 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 fixed investment rates. This suggests that good working capital management may help firms to alleviate the effects of financing constraints on fixed investment.

JEL Classification: D92; E22.
Keywords: Investment; Cash flow; Financing constraints; Working capital.

Outline

Non-technical abstract

Having experienced spectacular growth rates in the past three decades, despite a poorly developed financial system, China can be seen as a counter-example to the vast macro literature which found a positive link between financial development and economic growth. Several explanations have been put forward in the literature to explain this puzzle: among these are the use of informal financial sources or trade credit, and the ability to team up with foreign firms, and to generate large amounts of cash flow internally, which may have enabled Chinese firms to invest and grow despite the significant financial constraints that they face.

Motivated by the observation that Chinese firms exhibit an average ratio of fixed to working capital of 66%, we question whether good working capital management also played a role in enabling firm to keep fixed investment, and hence growth high, despite cash flow fluctuations and financing constraints. In particular, as working capital is by definition very liquid, when a negative cash flow shock hits them, financially constrained firms can draw down their stock of working capital and replensih it following a positive cash flow shock, insulating in this way their fixed capital investment from cash flow fluctuations.

Making use of a panel of over 116,000 Chinese firms over the period 2000-2007, we found that contrary to private, foreign, and collective firms, state-owned enterprises always exhibit poorly determined sensitivities of fixed and working capital investment to cash flow. This suggests that these firms benefit from soft budget constraints and are hence financially unconstrained. Furthermore, focusing on non-state enterprises, 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.

To fully take into account the heterogeneity characterizing the firms in our sample, 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 fluctuations 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 fixed capital sensitivities and high working capital sensitivities 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 fixed investment to fixed capital ratios. Despite the financing constraints that they face, in the presence of cash flow shocks, these firms can maintain consistently high fixed 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.

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

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Abstract

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1. Introduction

In the last three decades, the Chinese economy has been characterized by persistently high fixed investment rates and phenomenal growth rates (Song et al., 2011)[1]. Yet, considering that the Chinese financial system is poorly developed, this can been seen as a puzzle (Allen et al., 2005)[2]. 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. (2011) 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, both generally (Bernanke and Gurkaynak, 2001; Bond and Schiantarelli, 2010) and in China (Ding and Knight, 2009, 2011)[3]. 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 average ratio of working capital to fixed capital (66.6%). Considering that contrary to fixed capital, working capital is highly reversible[4], and that firms

[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 fixed investment to capital ratio of 8.6%.

[2] A vast literature has used macro country-level data to investigate the links between broad measures of financial development and growth, and generally found a positive relationship (see Levine, 2005, for a survey). A number of studies have extended this literature making use of firm-level data for different countries (see for instance Love, 2003; and Beck et al., 2005).

[3] The fact that there is a positive association between high fixed investment and high growth is supported by our data, according to which those firms whose fixed investment rate falls in the top quartile of the distribution of the fixed 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 fixed investment rate falls in the bottom quartile of the distribution are -2.51% and 4.58%.

[4] A huge literature has focused on the effects of the irreversibility of fixed capital investment on firm behavior. Irreversibility arises when firms find it difficult or costly to reverse an investment decision because of a differential between the purchase price and resale price of capital goods, or because of fixed costs from divesting. The problem is particularly severe when capital goods are highly specialized or industry specific. See Section 2 in Chirinko and Schaller (2009) for a survey of recent studies on the effects of fixed investment irreversibility.

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, therefore alleviating 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 out cash flow fluctuations with working capital[5]. To the best of our knowledge, no such investigation has been undertaken for a developing country. We fill this gap in the literature, focusing on the Chinese case.

Our study is based on a panel of 116,724 firms over the period 2000-2007. We initially run standard fixed investment regressions as a function of cash flow, separately for state-owned, foreign, private, and collective enterprises. We find that the former always exhibit poorly determined sensitivities of fixed investment to cash flow, suggesting that state-owned enterprises (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 fixed investment to cash flow, which suggests that they suffer from significant liquidity constraints[6]. 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 fixed 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 but foreign firms, the sensitivity of fixed capital investment to cash flow is much lower for those firms with high working capital: these may therefore use their working capital to alleviate the effects of cash flow shocks on their fixed capital investment.

To fully take into account the heterogeneity characterizing firms in our sample, 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,

[5] Using a methodology similar to that in Fazzari and Petersen (2003), Brown and Petesen (2011) show that US firms are able to use cash reserves (which are one of the components of working capital) to smooth their highly irreversible R&D expenditures.

[6] It should be noted that the view that a positive link between cash flow and investment can be interpreted as an indicator of financial constraints has been challenged by Kaplan and Zingales (1997), Cleary (1999), and Cummins et al. (2006). See Hubbard (1998) and Bond and Van Reenen (2007) for surveys of the literature on financing constraints and firm behavior.

no other study in the literature has analyzed the links between investment in fixed capital, working capital, and financing constraints by making use of firm-level sensitivities. This represents our second contribution. 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[7]. 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 fixed investment to fixed capital ratios. Despite the financing constraints that they face, in the presence of adverse cash flow shocks, these firms can maintain high fixed 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 fixed 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. (2011), good working capital management may contribute to the explanation of 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

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

often used to measure a firm's liquidity. Liquidity is a precondition to ensure that firms are able to meet their short-term obligations. Insufficient liquidity can lead to bankruptcy (Dunn and Cheatham, 1993). Yet, too much liquidity can be detrimental to firms' profitability (Bhattacharya, 2001). Good management of working capital therefore requires striking a balance between liquidity and 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[8]. 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 to long-term capital markets[9]. 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. It is important to note that working capital is negative in 40% of the firm-year observations in our sample, which suggests that firms use working capital as an additional source of finance.

Another advantage of working capital, highlighted by Fazzari and Petersen (1993), is that it enables firms to alleviate the effect of cash flow shocks on fixed capital investment, which is characterized by high adjustment costs. In particular, when a negative cash flow shock hits them, firms can draw down their stock of working capital, and replenish it following a positive cash flow shock, insulating in this way their fixed capital investment from cash flow fluctuations[10]. Considering that most Chinese firms are financially constrained, good working capital management may be particularly important for them to constantly maintain relatively high levels of fixed investment, and could therefore be an important mechanism through which these firms cope with financing constraints. In the sections that follow, we verify whether or not this is the case.

[8] A stock-out is defined as a situation in which the demand for a product cannot be fulfilled from the current inventory.
[9] 55% of the firm-year observations in our dataset do not have access to long-term debt.
[10] In line with this argumemt and based on a survey of chief financial officers from firms in 29 countries, Lins et al. (2010) show that non-operational cash (one of the coponents of working capital) is held to hedge against negative cash flow shocks. Similarly, using survey data from the US, Campello et al. (2011) find that credit lines (another component of working capital) eased the impact of the financial crisis on capital investment, employment, and technology spending.

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 are in all 31 Chinese 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 eliminated firms that did not have complete records on our main regression variables. To control for the potential influence of outliers, we trimmed 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 116,724 mainly unlisted firms, which corresponds to 758,849 firm-year observations[11]. It is unbalanced, with the number of observations ranging from a minimum of 56,987 in 2000 to a maximum of 112,223 in 2003[12].

The NBS data contain information on the fraction of paid-in-capital contributed each year 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. Investors from Hong Kong, Macao, and Taiwan are separated from investors from other parts of the world, as they 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). Legal entities encompass both state legal entities and private legal entities[13]. Collective investors represent communities in urban or rural areas, managed by local governments.

[11] Publicly listed companies cannot be separately identified in our dataset: it is difficult to track these companies as their legal identification numbers were changed as they went public (Liu and Xiao, 2004). There were slightly more than 1000 listed companies operating in the manufacturing and mining sectors over the period considered, which amount to less than 0.3% of the total number of firms in our sample.

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

[13] Legal entities include 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 and so on.

As in Guariglia et al. (2011), we grouped investors from Hong-Kong, Macao, Taiwan, and other parts of the world into a single category (which we labelled *foreign*); and legal entities and individual investors into a category labelled *private*[14]. We then classified our firms into state-owned, foreign, private, and collective[15], on the basis of the average shares of paid-in-capital contributed by the four types of investors over the sample period, making use of a majority rule[16]. For instance, we classified a firm as state owned if the average share of its paid-in capital contributed by the state is at least 50% (see Dollar and Wei, 2007; and Ayyagari et al., 2010, for a similar approach)[17].

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 73.9%, 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%)[18]. 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. External liquidity needs, defined as the inventories to sales ratio, are also much higher for SOEs than for the other

[14] Within this category, firms owned by individuals make up approximately 60% of the total. As firms owned by legal entities include firms owned by state legal entities, their inclusion in the *private* category could be questioned. Because 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. However, according to Wei (2005), all legal entities are profit-oriented, which could justify their inclusion in the *private* category.

[15] Collective firms owned by communities in rural areas are known as Township and Village Enterprises or TVEs. 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.

[16] We did not use registration codes to define our ownership categories as these codes are not entirely reliable, being updated only with considerable delay (Dollar and Wei, 2007). Furthermore, firms might have an incentive to falsely register as foreign simply to take advantage of the tax benefits accorded to the latter.

[17] As our goal in this paper is not the analyis of the effects of firms' transitions from state-owned to private or foreign, we use time-invariant measures of ownership, which have the advantage of minimizing the effects of measurement error in the ownership variables that can affect individual years. Note that our way of classifying firms into ownership groups excludes from our sample firms with mixed ownership, for which no group has a majority share. For instance, a firm with 40% collective ownership, 30% state ownership, and 30% foreign ownership would be excluded. Firms of this type of mixed ownership make up less than 2% of our sample.

[18] 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.

groups of firms[19]. 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 affiliated[20], 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 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.

Consider 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 fixed capital ratios characterizing foreign firms can be explained by the fact that many foreign firms in China conduct export-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 that 94.3% of foreign firms are located in the coastal area.

Private firms display the highest sales growth rate (13.8%) 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. (2011), 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 in terms of real assets (424,360 yuan). They are also older than their private and foreign counterparts and

[19] 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).

[20] Political affiliation is measured using a dummy variable to indicate whether the firm is affiliated (has a *lishu* relationship) with the central or provincial government (Li, 2004; Tan et al., 2007; Xia et al., 2009). A *lishu* relationship is associated with government support and subsidies. In particular, governments can grant firms affiliated with them benefits such as bank loans at better conditions, waivers of import tariffs, tax reductions etc.

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 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 1.9 and 2.5 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 as preliminary evidence in favor of the view that firms use working capital to alleviate the effects of cash flow shocks on fixed investment.

Finally, our data also suggest that for all ownership groups, a higher fixed capital investment is also associated with a higher total assets growth (see figures in curly brackets in Table 1)[21].

4. Baseline specifications and estimation methodology

4.1 Baseline specifications

We initially estimate a fixed investment equation of the following type:

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

where I_{it} denotes firm i's fixed investment at time t; K_{it}, its fixed capital stock; and CF_{it}, its cash flow[22]. The error term in Equation (1) comprises a firm-specific time-invariant component (v_i), encompassing all time-invariant firm characteristics likely to influence fixed 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-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

[21] We report total assets growth for consistency with Guariglia et al. (2011). Similar trends (not reported) were observed for real sales growth.

[22] We estimate a static instead of a dynamic model because the specification tests described in section 4.2 tended to reject the latter.

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., 2011)[23].

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 fixed 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 generally 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. To test whether this is the case, we next estimate an equation of investment in working capital (IWK_{it}) as a function of cash flow. The equation takes the following form:

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

We would expect to see a high sensitivity of investment in working capital to cash flow, i.e. a large b_1 coefficient in Equation (2). If this were the case, firms could partially offset the effects of negative cash flow shocks on their fixed investment by drawing down their stock of working capital. Similarly, during periods characterized by positive cash flow shocks, they could rebuild their working capital stock in anticipation of future negative cash flow shocks.

[23] 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 fixed investment-cash flow sensitivities remain basically unchanged when different measures of investment opportunities are used.

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. Firms can be expected to optimize their working capital by equating the marginal benefit and the marginal cost of holding working capital. If firms that are more financially constrained have a higher marginal cost, they may choose a lower level of working capital, ceteris paribus, and have a higher marginal benefit. Yet, if firms include among the benefits the ability to adjust working capital in response to cash flow shocks, firms with high adjustment costs of varying fixed investment may choose to hold more working capital. On that basis, firms with less working capital may be less able or less willing to reduce their working capital in the face of negative cash flow shocks (Fazzari and Petersen, 1993; Carpenter et al., 1994)[24]. 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:

$$(IWK_{it}/K_{it}) = b_0 + b_{11}(CF_{it}/K_{i(t-1)})*LOWWK_{it} + b_{12}(CF_{it}/K_{i(t-1)})*HIGHWK_{it} + \\ + v_i + v_t + v_{jt} + e_{it} \quad (3)$$

where *LOWWK* (*HIGHWK*) is initially defined as 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[25]. For robustness, we also use an alternative definition for the *LOWWK* and *HIGHWK* dummies, whereby the former (latter) indicates a dummy equal to 1 if firm *i*'s working capital to fixed capital ratio at time *t* is negative (positive), and 0 otherwise

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

$$(I_{it}/K_{it}) = a_0 + a_{11}(CF_{it}/K_{i(t-1)})*LOWWK_{it} + a_{12}(CF_{it}/K_{i(t-1)})*HIGHWK_{it} + v_i + v_t + v_{jt} + e_{it} \quad (4)$$

If firms are able to use working capital to alleviate the effects of cash flow shocks on fixed investment, then this effect is supposed to be larger for firms with high working capital. Hence, we would expect the sensitivity of working capital investment to cash flow to be higher for firms with high working capital. Consequently, for those firms able to smooth cash

[24] 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.

[25] The *LOWWK* and *HIGHWK* dummy variables are constructed separately for each of our four ownership groups.

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 therefore 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 use working capital to minimize the effects of cash flow shocks on fixed investment. Accumulating working capital following positive cash flow shocks and using it up to offset negative cash flow shocks could hence be seen as an effective strategy to mitigate the severity of financing constraints on fixed investment.

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[26].

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

[26] It should be noted that when samples with a very large cross-sectional dimension are used in estimation, the Sargan test for overidentifying restrictions tends to over-reject the null hypothesis of instrument validity (Blundell et al., 2000; Benito, 2003; Becker and Sivadasan, 2010; Guariglia et al., 2011).

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[27].

5. Main empirical tests

We initially estimate equation (1) for our four ownership groups. The results are reported in Table 2[28]. In line with the literature (Chow and Fung, 1998, 2000; Héricourt and Poncet, 2009; Poncet et al., 2010; Guariglia et al., 2011), we find that fixed 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 private (0.4) and 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 indicates 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 in terms of the lower adjustment costs of working capital than of fixed capital[29].

In Tables 4 and 5, we investigate how having a high or low (columns 1, 3, 5, and 7) / positive or negative (columns 2, 4, 6, and 8) working capital to fixed capital ratio affects the cash flow sensitivities of investment in working capital and fixed capital, respectively. For

[27] 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.

[28] The number of observations in Table 2 is smaller than in Table 1 because observations are lost as a consequence of the first-differencing process and the use of lagged values of the regressors as instruments.

[29] In all specifications in this Table, the Sargan test indicates some problems with the specification of the model and/or the validity of the instruments. Yet, in the light of the arguments in footnote 26, and considering that the *m3* test does not highlight any problems, we conclude that our instruments and specification are generally adequate.

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 (or positive) working capital (Table 4). Focusing, for instance, on a negative cash flow shock, this finding suggests that only those firms with a relatively high working capital will be able or willing to adjust their working capital investment as a consequence of the shock. This can be explained considering that for firms with high working capital, the latter has a low marginal value and can be easily used to offset negative cash flow shocks (Fazzari and Petersen, 1993; Carpenter et al., 1994).

Columns 1, 3, 5, and 7 of Table 5 show 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 (the cash flow coefficient is respectively 0.85 and 0.42 for the two groups) compared to their counterparts with high working capital (for which the corresponding coefficients are 0.34 and 0.10)[30]. Similar results hold when we differentiate firms into those with positive and negative working capital (columns 2, 4, 6, and 8). For low working capital firms, 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 negative cash flow shocks[31]. Hence, they need to adjust their fixed capital investment instead. This does not hold for foreign firms: in their case, if working capital is high (or positive), investment in fixed capital reacts to cash flow innovations in a similar way to private and collective firms (the cash flow coefficient for high-working capital foreign firms is 0.23 compared to 0.34 and 0.10, respectively for private and foreign firms). Yet, if their working capital is low (or negative), contrary to the private and collective firms, their cash flow coefficient is poorly determined. This different behavior 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%) that are 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

[30] 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.

[31] Firms with negative working capital can be seen as an extreme case of firms with low working capital. These firms are likely to use working capital as an additional source of finance. In the presence of cash flow shocks, they may find it difficult to make their working capital even more negative.

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 (or those with positive and negative 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 (positive) working capital firms exhibit lower sensitivities of fixed investment to cash flow than their low (negative) working capital counterparts. This suggests that in the presence of cash flow shocks, low (negative) working capital firms are unable or unwilling 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 consistently maintaining fixed investment at high levels.

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[32]. Yet, each of these groups is made up of a large number of very heterogeneous firms (Guariglia et al., 2011). 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-

[32] 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.

investment sensitivities (*WKS*), on the one hand; and the characteristics of firms with different combinations of high/low *FKS*/*WKS*, on the other.[33] 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[34]. The firm-level cash flow sensitivities of investment in fixed capital (FKS_i) and working capital (WKS_i) are respectively calculated as follows:

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

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

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 arithmetic time-series average ratio[35]. 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[36], 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

[33] 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*.

[34] 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 was sensitive to cash flow.

[35] 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.

[36] This threshold level is similar to that used in Guariglia et al. (2011), who focus on the sensitivities of Chinese firms' assets growth to cash flow. Our results were robust to using a 50% cut-off point.

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 ex-post regressions for *FKS* and *WKS*

6.2.1 Desrcriptive statistics. Table 6 presents descriptive statistics for firms with high and low *FKS* (Panel A) and for firms with high and low *WKS* (Panel B)[37]. These 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 last group comprises 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 for the following reasons. Access to funds is likely to differ by region: firms operating in central and western areas may benefit from financial incentives owing to policies aimed at developing those regions (Goodman, 2004) whereas coastal areas may benefit from a more developed banking sector and the more widespread presence of foreign banks, which could make financing constraints less binding (Firth et al., 2009; Lin, 2011). Political connections are beneficial to 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 ratio of inventories to sales, which indicates lower external financing needs. A higher proportion of firms with low *FKS* are located in the coastal region.

[37] 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.

These statistics suggest that low *FKS* firms are generally financially healthier than their high *FKS* counterparts.

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 145.0% and 91.7% for foreign firms; 68.7% 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 that 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. Yet, they are typically smaller than their low *WKS* 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* have higher fixed capital investment to fixed capital ratios than their counterparts with low *WKS*.

6.2.2 Ex-post regressions for FKS and WKS. 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 fixed investment by more. 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[38]. These signs are exactly opposite to those in columns 1, 3, and 5 for the *FKS*. They suggest that larger, older, and slow-growing firms may be unable effectively to adjust their working capital in the presence of cash flow shocks, and are therefore forced to adjust their fixed capital instead. For all firms, the working capital to fixed 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.

To summarize, 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. Highly leveraged firms with low collateral are more active in adjusting their working capital than their fixed capital investment. The following question then arises: are financially constrained firms characterized by high *WKS* able to manage their working capital in such a way as to alleviate their financing constraints and to keep their investment in fixed capital consistently high despite fluctuations in cash flow? In the section that follows we attempt to answer this question by combining the two types of sensitivity.

[38] 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.

6.3 Combining *FKS* and *WKS*

6.3.1 Descriptive statistics. 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 cash flow shocks, high *WKS* firms adjust their working capital in a way that enables them to consistently 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 fixed investment.

Furthermore, among all ownership groups, it is the LH firms which exhibit the highest fixed investment to fixed capital ratios. LH firms also display the highest (or second highest in the case of private firms) working capital to fixed capital ratios and working capital investment to fixed 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 than firms in the other groups, whereas their high leverage and low collateral indicate that they are externally more financially constrained. In contrast, the LL firms are both internally and externally financially unconstrained: 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.

6.3.2 Multinomial logit regressions. 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. This analysis is aimed at understanding how different combinations of FKS and WKS relate to the degree of financing constraints faced by firms. 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 firms face significant external financing constraints.

The results of these multinomial logit regressions coupled with the summary statistics described in the previous section, suggest that despite being the most financially constrained group, the LH firms are characterized by the highest fixed investment to capital ratio. Working capital adjustment may therefore be seen as a strategy through which financially constrained firms can mitigate the effects of their financial constraints, so keeping fixed investment high[39]. To validate this interpretation, in the next section, we investigate the direct

[39] While it is reasonable to assume that a high *WKS* leads to a high fixed investment to capital ratio, as high-*WKS* firms can insulate their fixed investment from cash flow fluctuations, one cannot rule out the hypothesis that the LH firms, being very profitable, have high investment opportunities and benefit from frequent positive cash flow shocks. They are hence likely to invest significantly in both fixed and working capital following these shocks, which could in turn lead to a high *WKS*.

links between *WKS*, *FKS*, and combinations of these sensitivities on the one hand, and firms' fixed investment to capital ratios, on the other.

6.4 Linking *WKS*, *FKS*, and their combinations with fixed investment

Table 10 reports the results of cross-sectional regressions of fixed investment on *WKS*, *FKS*, and on the dummies defining combinations of these sensitivities. Panel A refers to foreign firms, panel B to private firms, and panel C to collective firms. In line with the descriptive statistics reported in Table 6, fixed investment is always positively related to *WKS*. This holds independently on whether or not we include controls for size, investment opportunities (proxied by sales growth), and industry dummies (columns 1 and 2 of all panels). On the contrary, we observe a negative association between *FKS* and fixed investment (coulmns 3 and 4 of all panels). These relationships are statistically significant for private and foreign firms, and confirm that those firms that are able to adjust their working capital instead of their fixed capital following cash flow shocks manage to keep high levels of fixed investment.

We next report the results of cross-sectional regressions of fixed investment on the LL, HL, and HH dummies (columns 5 and 6 of Table 10). The LH dummy is the omitted category. Both in the regressions with no additional controls (column 5), and in those that control for size, industry, and investment opportunities (column 6), the coefficients associated with the three dummies are negative and generally precisely determined: this confirms that, in line with the descriptive statistics reported in Table 8, the investment of the LH firms is always higher than that of the LL, HH, and HL firms. 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 is that in the presence of cash flow shocks, these firms are able to consistently maintain high fixed investment levels by adjusting working capital more than fixed capital. Good working capital management may therefore be a contributory explanation of why in the last three decades, Chinese firms, and in particular private firms, were able to invest and grow at phenomenal rates, despite being discriminated against by the financial system.

7. Conclusions

We have used a panel of over 116,000 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 fluctuations 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 fixed investment to fixed capital ratios. Despite the financing constraints that they face, in the presence of cash flow shocks, these firms can maintain consistently high fixed 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.

References

Abraham, F., Konings, J., and V. Slootmaekers (2010). "FDI spillovers in the Chinese manufacturing sector." *Economics of Transition,* 18, 143-82.

Allen, F., J. Qian, and M. Qian (2005). "Law, finance, and economic growth in China." *Journal of Financial Economics,* 77, 57-116.

Arellano, M. and S. Bond (1991). "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations." *Review of Economic Studies,* 58, 277-97.

Ayyagari, M., Demirgüç-Kunt, A., and V. Maksimovic (2010). "Formal versus informal finance: evidence from China". *Review of Financial Studies,* 23, 3048-3097.

Bai, C-E, Lu, J., and Z. Tao (2006). "The multitask theory of state enterprise reform: empirical evidence from China." *American Economic Review,* 96, 353-57.

Beck, T., Demirgüç-Kunt, A., and V. Maksimovic (2005). "Financial and legal constraints to firm growth: does size matter?" *Journal of Finance,* 60, 137–77.

Becker, B. and J. Sivadasan (2010). "The effects of financial development on the investment-cash flow relationship: cross-country evidence from Europe." *B.E. Journal of Economic Analysis & Policy (Advances),* 10, 1-47.

Benito, A. (2003). "The capital structure decisions of firms: is there a pecking order?" Bank of Spain Working Paper No. 0310.

Bernanke, B. and Gurkanyan, R. (2001). "Is growth exogenous? Taking Mankiw, Romer, and Weil seriously." National Bureau of Economic Research Annual. MIT Press, Cambridge, Massachusetts.

Bhattacharya, H. (2001). Working Capital Management: Strategies and Techniques, Prentice Hall, New Delhi.

Blundell, R., Bond, S., and F. Windmeijer (2000). "Estimation in dynamic panel data models: improving on the performance of the standard GMM estimators." In: B. Baltagi (ed.), *Nonstationary Panels, Panel Cointegration, and Dynamic Panels,* Advances in Econometrics 15, Amsterdam: JAI Press, Elsevier Science.

Bond, S. and F. Schiantarelli (2010). "Capital accumulation and growth. A new look at empirical evidence." *Journal of Applied Econometrics,* 25 (7), 1073-1099.

Bond, S. and J. Van Reenen (2007). Microeconometric models of investment and employment. In J. Heckman and E. Leamer (eds.), *Handbook of Econometrics,* Vol. 6, Edn 1, Chapter 65. North Holland: Elsevier, pp. 4417–98.

Brown, J., Fazzari, S., Petersen, B. (2009). “Financing innovation and growth: cash flow, external equity and the 1990s R&D boom.” *Journal of Finance*, 64, 1, 151-85.

Brown, J. and B. Petersen (2009). “Why has the investment-cash flow sensitivity declined so sharply? Rising R&D and equity market developments.” *Journal of Banking and Finance*, 33, 971-84.

Brown, J. and B. Petersen (2011). “Cash holdings and R&D smoothing.” *Journal of Corporate Finance* (forthcoming).

Campello, M., Giambona, E., Graham, J., and C. Harvey (2011). “Liquidity management and corporate investment during a financial crisis.” *Review of Financial Studies* (forrthcoming).

Carpenter, R., Fazzari, S., and B. Petersen (1994). “Inventory (dis)investment, internal finance fluctuations, and the business cycle.” *Brookings Papers in Economic Activity*, 2, 75-122.

Chirinko, R. and H. Schaller (2009). “The irreversibility premium.” *Journal of Monetary Economics*, 56, 390-408.

Chow, C.K.W. and M.K.Y. Fung (1998). “Ownership structure, lending bias, and liquidity constraints: evidence from Shanghai’s manufacturing sector.” *Journal of Comparative Economics*, 26, 300-16.

Chow, C.K.W., and M.K.Y. Fung (2000). “Small businesses and liquidity constraints in financing business investment: evidence from Shanghai’s manufacturing sector.” *Journal of Business Venturing*, 15, 363-383.

Cleary, S. (1999). “The relationship between firm investment and financial status.” *Journal of Finance*, 54, 673-92.

Cull, R., Xu, L.C., and T. Zhu (2009). “Formal finance and trade credit during China’s transition.” *Journal of Financial Intermediation*, 18, 173-192.

Cummins, J., K. Hasset, Oliner, S. (2006). “Investment behavior, observable expectations, and internal funds.” *American Economic Review*, 96, 796-810.

Deloof, D. (2003). “Does working capital management affect profitability of Belgian firms?” *Journal of Business Finance and Accounting*, 30, 573 – 587

D’Espallier, B. and A. Guariglia (2009). “Does the investment opportunities bias affect the investment-cash flow sensitivities of unlisted SMEs?” Discussion Paper No. 09/12. Center for Finance, Credit and Macroeconomics, University of Nottingham**.**

Ding, S. and Knight, J. (2009). "Can the augmented Solow Model explain China's remarkable economic growth? A cross-country panel data study." *Journal of Comparative Economics*, 37, 432-452.

Ding, S. and Knight, J. (2011). "Why has China grown so fast? The role of physical and human capital formation." *Oxford Bulletin of Economics and Statistics*, 73, 141-74.

Dollar, D. and S-J Wei (2007). "Das (wasted) capital: firm ownership and investment efficiency in China." NBER Working Paper No. 13103.

Duchin, R., Ozbas, and B. Sensoy (2010). "Costly external finance, corporate investment, and the subprime mortgage credit crisis." *Journal of Financial Economics*, 97, 418-435.

Dunn, P. and L. Cheatham (1993). "Fundamentals of small business financial management for start-up, survival, growth, and changing economic circumstances," *Managerial Finance*, 19, 1-13.

Fazzari, S. and B. Petersen (1993). "Working capital and fixed investment: new evidence on financing constraints." *The RAND Journal of Economics*, 24, 328-42.

Firth, M, Lin, C., Liu, P., and S. Wong (2009). "Inside the black box: bank credit allocation in China's private sector." *Journal of Banking and Finance*, 33, 1144-1155.

Goodman, D. (Ed.), 2004. China's campaign to 'open up the West' national, provincial and local perspectives. The China Quarterly Special Issues, 5, Cambridge University Press, Cambridge, U.K.

Guariglia, A. (2008). "Internal financial constraints, external financial constraints, and investment choice: evidence from a panel of UK firms." *Journal of Banking and Finance*, 32, 1795-1809.

Guariglia, A., Liu, X., and Song, L. (2011). "Internal finance and growth: microeconometric evidence on Chinese firms." *Journal of Development Economics* (forthcoming).

Héricourt, J. and S. Poncet (2009). "FDI and credit constraints: firm level evidence in China". *Economic Systems*, 33, 1-21.

Hovakimian (2009). "Determinants of investment cash flow sensitivity." *Financial Management*, Spring, 161-83.

Hovakimian, A. and G. Hovakimian (2009). "Cash flow sensitivity of investment." *European Financial Management* 15, 47-65.

Huang, Y. (2003). *Selling China: foreign direct investment during the reform era*. Cambridge University Press, New York.

Hubbard, G. (1998). "Capital market imperfections and investment." *Journal of Economic Literature*, 35, 193-225.

Kaplan, S. and Zingales, L. (1997). “Do investment-cash flow sensitivities provide useful measures of financing constraints?” *Quarterly Journal of Economics*, 112, 169-215.

Levine, R. (2005). “Finance and growth: theory and evidence”. In: Aghion, P., Durlauf, S. (Eds), *Handbook of Economic Growth*, Chapter 12, Elsevier Science, The Netherlands.

Li, S. (2004). “The puzzle of firm performance in China: an institutional explanation.” *Economics of Planning*, 37, 47-68.

Li, H., Meng, L., Wang, Q., Zhou L-A, (2008). “Political connections, financing and firm performance: evidence from Chinese private firms.” *Journal of Development Economics*, 87, 283-299.

Lin, H. (2011). “Foreign bank entry and firms’ access to bank credit: evidence from China.” *Journal of Banking and Finance*, 35, 1000-1010.

Lins, K., Servaes, H., and P. Tufano (2010). “What drives corporate liquidity? An international survey of cash holdings and lines of credit.” *Journal of Financial Economics*, 98, 160-76.

Liu, Q. and G. Xiao (2004). “Look who are disguising profits: an application to Chinese industrial firms.” *Mimeograph*, University of Hong Kong.

Long, M., I. Malitz and S.A. Ravid (1993). “Trade credit, quality guarantees, and product marketability.” *Financial Management*, 22, 117-127.

Love, I. (2003). “Financial development and financing constraint: international evidence from the structural investment model”. *Review of Financial Studies*, 16, 765–91.

Petersen, M. and R. Rajan (1997). “Trade credit: theories and evidence.” *Review of Financial Studies*, 10, 661-691.

Poncet, S., Steingress, W., and H. Vandenbussche (2010). “Financial constraints in China: firm-level evidence.” *China Economic Review* 21, 411-422.

Raddatz (2006). “Liquidity needs and vulnerability to financial underdevelopment.” *Journal of Financial Economics*, 80, 677-722.

Roodman, D. (2006). “How to do xtabond2: an introduction to “difference” and “system” GMM in Stata”. Working Paper No. 103, Center for Global Development, Washington.

Song, Z., Storesletten, K., and F. Zilibotti (2011). “Growing like China.” *American Economic Review* , 101, 196-233.

Tan, J., Li, S., and J. Xia (2007). "When iron fist, visible hand, and invisible hand meet: firm-level effects of varying institutional environments in China." *Journal of Business Research*, 60, 786-94.

Wei, Z, Xie, F., and S. Zhang (2005). "Ownership structure and firm value in China's privatized firms." *Journal of Financial and Quantitative Analysis*, 40, 87-108.

Xia, J., Li, S., and C. Long (2009). "The transformation of collectively owned enterprises and its outcomes in China, 2001-05." *World Development*, 37, 1651-62.

Appendix 1: Data

Structure of the unbalanced panel

Number of obs. per firm	*Number of observations*	*Percent*	*Cumulative*
5	169,730	22.37	22.37
6	143,778	18.95	41.31
7	176,253	23.23	64.54
8	269,088	35.46	100.00
Total	758,849	100.00	

Year	*Number of observations*	*Percent*	*Cumulative*
2000	56,987	7.51	7.51
2001	76,315	10.06	17.57
2002	92,033	12.13	29.69
2003	112,123	14.78	44.47
2004	111,798	14.73	59.20
2005	108,869	14.35	73.55
2006	104,010	13.71	87.26
2007	96,714	12.74	100.00
Total	758,849	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] {8.79; -7.78}	9.39 (6.94) [43.24] {17.50, -1.51}	9.78 (8.67) [50.68] {23.86, -1.22}	6.17 (5.22) [50.78] {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 (IWK/K)	2.74 (0.13) [81.892]	17.67 (8.65) [107.62]	10.92 (2.98) [106.10]	12.94 (3.40) [109.66]
Working capital/K (WK/K)	11.74 (-9.29)	116.74 (50.78)	56.74 (13.64)	82.93 (24.17)
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	482,443	64,353

Notes: Working capital and assets are expressed in thousands of yuan, and firm age in years. All other variables are expressed in percentage terms. 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 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) $_{it}$	-0.11 (0.36)	0.53*** (0.16)	0.43*** (0.14)	0.72*** (0.20)
J (p-value)	0.08	0.00	0.10	0.26
m1	-22.38	-38.76	-76.58	-27.11
m3	0.88	-0.73	1.35	-0.89
Observations	45,505	97,215	317,979	42,434

Notes: 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	*State-owned*	*Foreign*	*Foreign*	*Private*	*Private*	*Collective*	*Collective*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
*(Cash flow /tangible fixed assets)$_{it}$*LOWWK$_{it}$*	-1.46 (1.21)	-0.62 (1.05)	-0.79 (0.53)	-1.82 (1.05)	0.49 (0.40)	0.08 (0.41)	0.05 (0.34)	-0.13 (0.51)
*(Cash flow /tangible fixed assets)$_{it}$*HIGHWK$_{it}$*	0.08 (0.40)	-0.16 (0.47)	0.59*** (0.18)	0.54*** (0.18)	0.40*** (0.13)	0.42*** (0.13)	0.75*** (0.18)	0.74*** (0.19)
J (p-value)	0.09	0.09	0.001	0.01	0.02	0.05	0.26	0.29
m1	-17.31	-21.66	-32.73	-21.61	-65.89	-75.28	-27.01	-26.64
m3	-0.75	0.67	-0.85	-1.04	1.33	1.41	-0.40	-0.40
Observations	45,505	45,505	97,215	97,215	317,979	317,979	42,434	42,434

Notes: In columns 1, 3, 5, and 7, *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. In columns 2, 4, 6, and 8, *LOWWK* (*HIGHWK*) is a dummy variable equal to 1 if firm *i*'s working capital to fixed capital ratio at time *t* is negative (positive), and 0 otherwise. 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	*State-owned*	*Foreign*	*Foreign*	*Private*	*Private*	*Collective*	*Collective*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
*(Cash flow /tangible fixed assets)$_{it}$*LOWWK$_{it}$*	0.25 (0.27)	0.23 (0.27)	-0.21 (0.23)	-0.20 (0.40)	0.85*** (0.21)	0.70*** (0.20)	0.42** (0.18)	0.58** (0.27)
*(Cash flow /tangible fixed assets)$_{it}$*HIGHWK$_{it}$*	0.073 (0.13)	0.10 (0.14)	0.23*** (0.06)	0.22*** (0.05)	0.34*** (0.06)	0.34*** (0.06)	0.10*** (0.07)	0.17** (0.07)
J (p-value)	0.97	0.91	0.09	0.08	0.04	0.05	0.02	0.04
m1 *m3*	-25.53 -0.83	-25.48 0.82	-33.38 -0.23	-33.35 -0.27	-46.49 -0.50	-54.81 -0.46	-25.98 -0.77	-24.73 -0.69
Observations	52,020	52,020	105,608	105,608	336,341	336,341	47,117	47,117

Notes: 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	10.98	9.80	13.42	8.06	9.50
CF/K	28.82	39.17	26.94	33.33	26.99	41.56
IWK/K	12.67	15.61	7.14	6.96	5.19	11.71
WK/K	100.72	106.42	39.80	47.06	50.64	78.05
Working capital details						
Inventories/K	123.60	110.98	93.92	85.30	101.01	96.70
Fin. WK/K	-27.97	-7.84	-56.98	-40.60	-53.50	-21.77
General firm characteristics						
Assets	1019.86	1242.78	681.43	684.47	357.01	404.38
Age	8.45	7.83	10.17	8.83	17.80	15.85
Sales growth	8.81	11.61	11.47	14.10	6.11	9.22
Financial variables						
Leverage	50.16	47.61	61.00	58.57	64.03	59.60
Collateral	30.86	31.66	34.31	34.18	33.55	33.28
Inventories/Sales	22.46	19.86	19.92	15.31	23.65	17.68
China-specific variables						
Coast	93.87	94.37	67.91	74.54	63.42	70.50
Politically affiliated	2.43	3.03	4.10	2.99	2.43	2.34
Observations	36,161	107,427	122,098	360,237	16,131	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	11.69	10.20	13.24	12.28	9.87	8.90
CF/K	41.93	34.79	35.07	30.62	41.34	36.78
IWK/K	17.78	13.91	8.03	6.66	13.05	9.09
WK/K	145.00	91.67	68.74	37.41	110.52	58.09
Working capital details						
Inventories/K	164.05	97.49	118.75	77.02	135.32	85.26
Fin. WK/K	-23.39	-9.37	-53.23	-41.85	-28.40	-30.14
General firm characteristics						
Assets	860.34	1296.03	532.59	734.08	274.54	431.93
Age	7.72	8.07	8.82	9.72	15.98	16.46
Sales growth	11.22	10.81	13.27	13.50	7.99	8.59
Financial variables						
Leverage	53.89	46.33	62.43	58.09	63.66	59.72
Collateral	24.49	33.78	28.71	36.05	26.77	35.55
Inventories/Sales	19.88	20.72	17.59	16.09	19.09	19.21
China-specific variables						
Coast	95.00	93.99	73.17	72.79	69.28	68.55
Politically affiliated	2.58	2.98	3.51	3.18	2.76	2.23
Observations	35,244	108,339	119,795	362,540	15,983	48,333

Notes: I denotes investment in fixed capital; *K*, tangible fixed assets; *WK*, workig capital; *IWK*, investment in working capital; and *CF*, cash flow. *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. 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 are 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 WKS	*High FKS; Low WKS*	*Low FKS; High WKS*	*Low FKS; Low WKS*
Main regression variables				
I/K	10.70	8.82	12.09	10.63
CF/K	33.59	26.92	45.24	37.27
IWK/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	10,078	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	9.51	14.25	13.16
CF/K	30.29	25.67	36.88	32.20
IWK/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	7.72	10.19	9.28
CF/K	29.73	25.98	45.64	40.24
IWK/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. 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 10: Linking *WKS*, *FKS*, and their combinations with fixed investment: cross sectional regressions

Panel A: Foreign firms

Dep. var.: I/K	(1)	(2)	(3)	(4)	(5)	(6)
WKS	0.014***	0.011***				
	(0.003)	(0.003)				
FKS			-0.051***	-0.042***		
			(0.010)	(0.009)		
LL					-1.535***	-1.471***
					(0.305)	(0.294)
HL					-3.177***	-2.333***
					(0.374)	(0.363)
HH					-1.459***	-0.879*
					(0.546)	(0.530)
Sales growth		0.202***		0.201***		0.201***
		(0.007)		(0.007)		(0.007)
Log of assets		0.263***		0.259***		0.298***
		(0.080)		(0.079)		(0.080)
Observations	17,339	17,339	17,339	17,339	17,339	17,339

Panel B: Private firms

Dep. var.: I/K	(1)	(2)	(3)	(4)	(5)	(6)
WKS	0.009***	0.009***				
	(0.003)	(0.003)				
FKS			-0.083***	-0.070***		
			(0.007)	(0.007)		
LL					-1.501***	-1.541***
					(0.218)	(0.211)
HL					-5.291***	-4.571***
					(0.265)	(0.257)
HH					-3.884***	-3.306***
					(0.377)	(0.365)
Sales growth		0.225***		0.221***		0.221***
		(0.004)		(0.004)		(0.004)
Log of assets		0.299***		0.344***		0.339***
		(0.055)		(0.055)		(0.055)
Observations	46,132	46,132	46,132	46,132	46,132	46,132

Panel C: Collective firms

Dep. var.: I/K	(1)	(2)	(3)	(4)	(5)	(6)
WKS	0.009	0.008				
	(0.006)	(0.006)				
FKS			-0.021	-0.013		
			(0.022)	(0.022)		
LL					-0.876	-0.809
					(0.627)	(0.622)
HL					-2.266***	-1.538**
					(0.698)	(0.692)
HH					-0.752	-0.236
					(0.910)	(0.903)
Sales growth		0.175***		0.174***		0.174***
		(0.014)		(0.014)		(0.014)
Log of assets		-0.190		-0.188		-0.171
		(0.178)		(0.180)		(0.179)
Observations	5,497	5,497	5,497	5,497	5,497	5,497

Notes: All coefficients were obtained from cross-sectional OLS regressions. Industry dummies were included in columns 2, 4, and 6. *LL* is a dummy equal to 1 for firms with low *FKS* and low *WKS*, and 0 otherwise. *HL* is a dummy equal to 1 for firms with high *FKS* and low *WKS*, and 0 otherwise. *HH* is a dummy equal to 1 for firms with high *FKS* and high *WKS* and 0 otherwise. The omitted category is *LH*, a dummy equal to 1 for firms with low *FKS* and high *WKS*, and 0 otherwise. Robust standard errors are in parentheses. Also see Notes to Tables 1, 6, and 9. * 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 *Low FKS* (1)	*Foreign* *High FKS* (2)	*Private* *Low FKS* (3)	*Private* *High FKS* (4)	*Collective* *Low FKS* (5)	*Collective* *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 *Low WKS* (1)	*Foreign* *High WKS* (2)	*Private* *Low WKS* (3)	*Private* *High WKS* (4)	*Collective* *Low WKS* (5)	*Collective* *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: 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.