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A fire sale without fire: An explanation of labor-intensive FDI in China

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ABSTRACT

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China's labor-intensive industries are characterized by low technology and high competition. The massive inflow of FDI in China's labor intensive industries is inconsistent with the conventional wisdom that FDI should be more prevalent in technology-intensive and low competition industries. To explain this puzzle, we offer a "fire sale" hypothesis: facing severe financial constraints, Chinese private firms give up their equity to form joint ventures with foreign firms in order to obtain financing. Using the garment industry as an example, we find that among domestic firms, the financial constraint index is highest for private firms and lowest for state-owned firms. We further estimate a probit model of joint-venture decisions by private firms. Our results suggest that those private firms with greater financial constraints are more likely to seek foreign joint ownership. The effect of financial constraints on joint venture decision is both statistically and economically significant. *Journal of Comparative Economics* **44**(4) (2016) 884–901. MIT Sloan School of Management, USA; Department of Economics and Finance, College of Business, City University of Hong Kong, Hong Kong; School of Management, Huazhong University of Science and Technology, China; Department of Economics, Chinese University of Hong Kong, Hong Kong.

1. Introduction

In a widely used textbook on foreign direct investment (FDI), Richard Caves writes, "MNEs [multinational enterprises] are logically incompatible with the purely competitive organization of an industry." The reason is, as Caves observes, a "purely competitive industry has ample new local entrants to compete down the windfall profits in the foreign market" (Caves 1996, p. 25). Despite this theoretical prediction, FDI has been massive in China's labor-intensive industries, which are characterized by low technology and high competition. Table 1 reports the labor intensity (labor-capital ratio), FDI share in total industry output, R&D intensity (R&D-value-added ratio), and top 8 firm concentration ratios (CR8) for the 29 two-digit manufacturing industries in 2005. The 10 most labor-intensive industries are also in the top 16 industries with the highest FDI share in

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Table 1
Overview of labor-intensive industries in China (2005).

Industry	Labor intensity	Rank	FDI Share	Rank	R&D intensity	Rank	CR8	Rank
Garment, foot ware, and caps	0.242	1	0.46	6	0.0032	27	0.062	24
Leather, fur, feathers	0.238	2	0.53	5	0.0028	28	0.071	20
Textiles	0.201	3	0.36	15	0.0040	25	0.061	25
Measuring Instruments	0.192	4	0.66	2	0.0067	11	0.072	19
Articles for culture and education	0.190	5	0.61	3	0.0040	24	0.074	18
Artwork and Other Manufacturing	0.184	6	0.40	9	0.0062	18	0.067	22
Processing of food	0.164	7	0.39	10	0.0020	29	0.064	23
Paper and paper products	0.163	8	0.35	16	0.0067	12	0.117	9
Foods	0.153	9	0.36	14	0.0064	15	0.110	11
Beverages	0.142	10	0.37	12	0.0060	19	0.144	8
Non-metallic mineral products	0.141	11	0.18	25	0.0045	23	0.030	29
Metal products	0.136	12	0.37	13	0.0051	21	0.047	28
Printing, recording media	0.121	13	0.32	17	0.0056	20	0.060	26
Plastics	0.119	14	0.43	8	0.0048	22	0.050	27
Timber, wood and bamboo	0.119	15	0.23	24	0.0063	17	0.083	16
Chemical Fibers	0.113	16	0.28	19	0.0064	14	0.260	3
Furniture	0.111	17	0.55	4	0.0065	13	0.090	15
Electrical Machinery and Equipment	0.102	18	0.29	18	0.0273	3	0.103	13
General purpose machinery	0.096	19	0.27	20	0.0157	6	0.070	21
Ferrous Metals	0.095	20	0.13	27	0.0123	10	0.177	5
Rubber	0.094	21	0.39	11	0.0127	9	0.197	4
Special Purpose Machinery	0.091	22	0.25	22	0.0256	4	0.079	17
Pressing of non-ferrous metals	0.084	23	0.15	26	0.0064	16	0.116	10
Raw chemical materials	0.079	24	0.26	21	0.0131	8	0.099	14
Communication and computers	0.078	25	0.84	1	0.0388	1	0.160	7
Tobacco	0.074	26	0.00	29	0.0033	26	0.391	1
Transport equipment	0.054	27	0.43	7	0.0354	2	0.171	6
Medicines	0.048	28	0.25	23	0.0255	5	0.104	12
Petroleum, coking, and nuclear fuel	0.041	29	0.11	28	0.0134	7	0.264	2

Notes: Labor intensity is defined as the employment-to-capital stock ratio. FDI share is the share of the foreign-invested firms' output in total output. R&D intensity is defined as the R&D expenditure to value-added ratio. CR8 is the concentration ratio of the top 8 firms in the industry. *Source:* Authors' calculations based on 2005 NBS above-scale firm dataset.

total industry output. From Table 1, we also see that labor-intensive industries generally have relatively low R&D intensity and a low concentration ratio, which indicates that these industries usually require less advanced technologies and the markets are generally very competitive. FDI in China's labor-intensive industries not only contributes a large share of their industry output, but also accounts for a significant share of total FDI inflows. According to Tseng and Zebregs (2002), about 50 percent of China's FDI inflows in the late 1990 s went into labor-intensive manufacturing industries. In 2005, the textile and garment industry alone — the industry on which our paper focuses — received a total of US$ 2.9 billion in FDI, most of which came from Hong Kong, Macao, and Taiwan (HMT) investors.[1]

In a labor-intensive and technology-simple industry, subcontracting should generate as many benefits as equity investment. Contract production proved to be a highly successful business model in labor intensive industries. For example, FDI was fairly small in the historically successful labor-intensive exporting economies of South Korea, Taiwan, and Hong Kong (Huang, 2003). In this paper, we examine why labor-intensive FDI is so substantial in China as compared to contract production, despite an opposite prediction in the major economic theories. The hypothesis we propose — and provide evidence to support — is that the financial constraints facing private firms in China are the principal factors driving up labor-intensive FDI. The private firms have to give up their equity to form joint ventures with foreign firms in order to obtain financing.

This explanation is consistent with the "fire-sale" hypothesis on foreign acquisitions that was first proposed by Krugman (2001) and later substantiated empirically by Aguiar and Gopinath (2005). Krugman observed that direct investment in Asian countries during the financial crisis surged at a time when foreign capital in general was fleeing. He coined the word "fire-sale FDI" to describe foreign takeovers of domestic assets when asset value is deeply discounted. The difference between our paper and previous research on fire-sale FDI is that the financial constraints in our paper are not induced by an exogenous macroeconomic shock — such as a financial crisis — but rather by the microeconomic distortions in the Chinese financial system. These distortions take the form of capital allocations on the basis of a political — as opposed to commercial — pecking order of firms that privileges the least efficient state-owned enterprises (SOEs) at the expense of the most efficient private firms (Song et al., 2011). Our hypothesis is a demand-side perspective on FDI rather than a supply-side perspective (foreign acquirer's perspective) that is common in traditional FDI theories.

A good case study is the joint venture between Hangzhou Wahaha Group and its French partner, Danone SA. In the early 1990 s, Wahaha has developed into one of the most successful Chinese bottled-water companies. Wahaha's remarkable

[1] Source: China FDI Report 2006 (*Zhongguo waishang touzi baogao 2006*), Beijing: Ministry of Commerce, 2006), chap. 4.

growth was mainly driven by its founder Zong Qinghou. However, lack of financing channels became a major operation obstacle for Wahaha (Liang, 2007). Danone came to China when Wahaha desperately needed funds to finance its growth. After short negotiation, Wahaha and Danone formed their first joint venture in 1996. Two years later Danone became the majority shareholder controlling 51% of the equity share. In fact, the joint venture continued to be managed by Zong. Other than financing, Danone did not contribute much in technology or management (Zhang and Qiu, 2007).

To empirically examine the effect of the financial constraints of private firms on labor-intensive FDI, we use a large firm-level panel dataset in the garment industry from the Chinese National Bureau of Statistics (NBS). Our data include all state-owned firms and all non-state firms with sales above 5 million yuan. This dataset is supplemented by a comprehensive private-firm survey conducted by the All-China Federation of Industry and Commerce in 2000.

Our empirical analysis focuses on the garment industry rather than all manufacturing industries because we want to control for those factors — such as technology and firm-specific capabilities — postulated by economists as central determinants of FDI. As shown in Table 1, the garment industry is the most labor-intensive industry. It is also among the industries with the lowest R&D intensity and lowest concentration ratio. Those factors that are normally related to hold-up and opportunism problems, by and large, are absent in the manufacturing segment of the garment industry.

As an additional control of the technological determinants of FDI, we limit our analysis to joint ventures with firms based in Hong Kong, Macao, and Taiwan (HMT). The three economies collectively accounted for about 40 percent of China's overall FDI during the sample period. Compared with non-HMT foreign firms (mostly OECD firms), HMT firms generally lack advanced technology and internationally recognized brand names (Tong, 2005). Limiting our sample to joint ventures with HMT firms in the garment industry thus has the effect of making the supply side of FDI as homogenous as possible. Any observed variations in the level of the FDI dynamics in our empirical estimations can then be attributed to demand-side influences.

To test our hypothesis, following Whited and Wu (2006), we estimate an investment Euler equation and construct a financial constraint index (WW index) for each firm. We further examine the pattern of the financial constraint index across firms of different ownership types. We find the following order in the financial constraint index from highest to lowest: private firms, collective firms, state-owned enterprises, and foreign firms. This finding is consistent with the political pecking order hypothesis that there is a severe lending bias in China's financial system against private firms in favor of state-owned firms.

In the next step, we estimate a probit model of joint-venture decisions by private firms. In our regressions, we try to control for confounding factors, including firm technology and productivity and the local foreign investment climate, as well as FDI tax incentives. We find that financial constraints play an important role in a domestic private firm's decision whether or not to form a joint venture — i.e., whether to share the claims on future profits — with an HMT firm. In our empirical estimations, we go beyond the binary decision whether or not to share equity and we study the effect of financial constraints on the extent the equity is shared with foreign firms and on the extent the control rights of the firm are ceded to foreign firms. To study the effect of the financial constraints on the transfer of control rights in joint ventures, we also estimate several specifications of the ordered probit model.

To reduce the impact of an endogeneity problem, in our estimation of the probit and ordered probit models all the independent variables precede the dependent variable by one year. As further robustness controls, we replace the WW index by the average WW index during the past 3 years. We also use alternative measures for various independent variables and alternative measures of financial constraints. Furthermore, we estimate a linear probability model with firm fixed effects to control for time-invariant unobservables.

Our estimation shows that, net of the normal business and economic dynamics that tilt toward foreign controls, greater financial constraints imposed by the Chinese financial system on a private firm are associated with a larger foreign equity share and a greater probability of foreign majority control of that firm. Taking advantage of a unique feature of our dataset — which allows us to know the identity of a firm's "legal person representative" — we are able to show that greater financial constraints are associated with a greater likelihood of the termination of the current legal person representative, most likely the CEO of the firm. Financing biases thus contribute to a loss of corporate control by indigenous Chinese entrepreneurs. There are some substantial welfare implications from our analysis.

Note that our emphasis on financial constraints as a principle driver of FDI in China's labor intensive industries does not imply that other well-established channels of FDI such as technology transfer do not have an impact. In our analysis of the financing channel, we try to control for these other channels carefully by taking advantage of our NBS dataset with rich firm-level information. Furthermore, we do not rule out the possibility that in non-labor-intensive industries, those factors postulated in the traditional FDI theories may still play a major role.

The remainder of the paper is organized as follows. We review the literature and develop the empirical hypotheses in Section 2. Section 3 describes the data. Section 4 discusses the methodology to estimate the financial constraint index. We test our main hypotheses regarding financial constraints and joint-venture decisions by private firms in Section 5. The paper concludes with Section 6.

2. Literature review and empirical hypotheses

Traditional FDI theory is based on an ownership-location-internalization paradigm (Dunning, 1990). Recent FDI theories emphasize the nature of incomplete contracts for know-how investment in which multinational enterprises (MNEs) will only

have an incentive to invest in a host country if the MNEs can own the assets (Antràs and Helpman, 2004; Helpman, 2006). In one way or another, these theories are based on a factual stylization that FDI is typically technology- or know-how-intensive. Labor-intensive FDI is puzzling from the point of view of contract-based theorization of FDI. Technological entry barriers are relatively low and market power, although not insignificant in the retail segment of the value chain, is mostly absent at the manufacturing stage. In China's labor-intensive manufacturing, there are standard and proven methods to solve buyer/seller disputes and quality problems without resorting to integration of production ownership. Foreign buying firms and domestic suppliers coordinate closely on a range of operating decisions, including quality control, selection of suppliers, the use of equipment, designs, specifications, and so forth.[2] Although brand names are important at the retail stage of the industry, labor intensive manufacturing usually relies on simple and nonproprietary technology. The conventional argument that foreign firms need to possess firm-specific technology or know-how advantages is less relevant here.

We argue that traditional FDI theories that focus heavily on the economic characteristics of MNEs are incomplete. Host-country characteristics, especially institutional characteristics, also have a significant impact on FDI patterns. This is an extension of Huang (2003). We hypothesize that the political pecking order of firms in China systematically disadvantages indigenous private firms in the form of severe and persistent credit constraints. Because of government interference in Chinese banks — especially the requirement that banks must fund state-owned enterprises — the domestic financial sector gives privilege to the least efficient state-owned enterprises and deprives the emerging private enterprises of access to bank funding. The political pecking order exists not only in the credit market but also in the equity market. For many years, the Chinese government enforced a strict system of listing quotas designed to ease the equity financing of SOEs. Private firms were often relegated to the end of the listing pipelines. Numerous studies on the Chinese economy document the severe financial constraints faced by Chinese private-sector firms. For example, according to an IFC report (Gregory et al., 2000), which uses data published by the People's Bank of China, loans made to private firms accounted for less than 1 percent of the total loans in 1998. A comprehensive firm survey by Guangdong provincial government in 2007 found that over 95 percent of small and medium-sized enterprises chose financial constraint as their biggest challenge.[3] In an empirical study, Manova et al. (2015) find that the financial constraints of private firms hamper their export growth, and this operating disadvantage is systematically greater in sectors with higher levels of financial vulnerability.

Given these severe financial constraints, it is puzzling how the Chinese private sector has managed to grow. One explanation hinges on informal finance (Allen et al., 2005). We offer another complementary hypothesis here — credit-constrained private entrepreneurs access equity capital from foreign firms by forming joint ventures with them. This is the main hypothesis to be explored in this paper — how financial constraints on private-sector firms in China serve to induce labor-intensive FDI. We hypothesize that a central contribution of FDI to Chinese growth is less about technology transfers and spillovers but about the easing of the financial constraints of China's dynamic private entrepreneurship. This conjecture is consistent with both the substantial role of FDI in China's export growth and with the fact that the empirical evidence on the technology spillover effects of FDI in China is very weak (Lin et al., 2009).

The political pecking order interpretation of labor-intensive FDI is more in line with the literature on asset fire sales than with contract theory of FDI. The existing literature on asset fire sales is primarily related to studies of financial crises (Shleifer and Vishny, 2011). The observation that financially constrained domestic firms can be taken over by foreign firms can be traced back to some 1970 s studies, mostly based on Canadian data. Reuber and Roseman (1972, p. 492) report that foreign mergers in Canada are negatively correlated with the supply of funds generated internally in firms, i.e., foreign mergers are positively related to the financial constraints. McKinnon (1972, p.516) points out that the "impact on merger activity of an internal financial constraints within Canadian firms was particularly interesting." Then he suggests that a less-developed economy with a more primitive banking system is more prone to foreign takeovers. However, as far as we are aware, McKinnon's hypothesis linking the nature of the banking system with FDI in a developing economy has not been fully explored.

A more recent treatment on fire-sale FDI focuses on the role of crises. Krugman (2001) formally proposed the theory of fire-sale FDI to explain the constant flow of FDI into the crisis economies in Asia, especially to liquidity-constrained local firms.[4] Blonigen (1997) shows that depreciation in a host country's currency will generate a fire sale of transferable assets to foreign firms. Aguiar and Gopinath (2005) suggest that when the financial crisis tightened the liquidity constraints of Asian firms, foreign investors quickly captured the opportunity and expanded their market shares. Acharya et al. (2011) provide a theory to model the fire-sale FDI in an agency-theoretic framework.

Another strand of the literature that links financing with FDI assesses the financial impact of FDI on domestic firms. Using firm-level data from the Ivory Coast, Harrison and McMillan (2003) find that when foreign firms borrow heavily from domestic banks, they crowd out local firms from the domestic capital market. However, in a cross-country study, Harrison et al. (2004) show that FDI inflows are associated with a reduction in firm-level financial constraints.

[2] As Woodruff (1998, pp. 984–985) observed on the footwear industry in Mexico: "Most important, both manufacturers and retailers recognized the right of retailers to inspect delivered merchandise for adherence to the order and for defective workmanship. Without this right, a manufacturer's incentives to produce products of quality workmanship would have been significantly reduced."

[3] "Guangdong surveys financing problem of small and medium-sized enterprises" (in Chinese), August 1, 2008. 21st Century Business Herald.

[4] In earlier research motivated by Shleifer and Vishny's (1992) industry-equilibrium model of asset liquidation, Pulvino (1998) finds that capital-constrained airlines in the U.S. are more likely to sell used aircraft to industry outsiders, especially during industry recessions.

Our paper is related to but also substantially distinct from these "fire-sale" or "crowding-out" studies. Our view that labor-intensive FDI is induced by financial constraints implies that there are "fire-sale" dimensions to our explanation. The difference, however, is that we focus on an equilibrium state—steady-state policy and institutional biases—as opposed to a sudden and deep macroeconomic shock. This is a fire sale but without the fire, so to speak. Another difference is our empirical focus. The firms in our dataset are relatively small and they engage in simple, labor-intensive manufacturing, as opposed to publicly-listed firms on the stock markets. A corollary of this empirical focus is that we cannot quantify precisely the discount effect of the fire sale, even though the underlying dynamics are quite similar to those described in the standard fire-sale literature.

Our paper differs from Harrison and McMillan (2003) and Harrison et al. (2004) in that we model FDI as an effect, rather than as a contributing cause, of local financing. We uncover some of the empirical regularities, similar to those reported by Guariglia and Poncet (2008). However, our study is based on a substantially more disaggregated dataset and, because of the panel nature of our data, we are able to produce a cleaner demonstration of the causal mechanisms.

3. The data

Our main dataset is from the annual census of above-scale manufacturing firms conducted by the National Bureau of Statistics (NBS) of China from 2001 to 2005.[5] We supplement this dataset with a private-firm survey conducted by the All-China Federation of Industry and Commerce in the year 2000 (mainly to produce an alternative index of the financial constraints). The NBS firm-level census data include all state-owned firms and all non-state firms with sales revenue of over 5 million yuan. The industry section of the *China Statistical Yearbook* is compiled based on this dataset. The dataset contains detailed information on over 100 variables, including firm ID, address, ownership, four-digit industry code, six-digit geographic code, as well as detailed financial information.[6] The firms in our sample accounted for 60 percent and 94 percent of the total industrial value-added in 2001 and 2005 respectively.[7] We delete those observations with missing values and those that fail to satisfy some basic error checks. The deflators of output and the construction of firm capital stock follow Brandt et al. (2012).

Previous work on the connections between financial constraints and FDI mainly relies on cross-sectional data. However, an endogeneity problem arises with cross-sectional data since we cannot distinguish between the financial constraint hypothesis — that is, the financial constraints induced FDI — from the crowding-out hypothesis which postulates that foreign firms draw financial resources away from local firms. A huge advantage of our dataset is that a large number of firms appear in multiple years in our dataset, allowing us to know the financing treatment of a firm prior to its decision to form a joint venture. We construct a panel dataset by matching these firms across different years. In our dataset, each firm has a unique numerical ID — called the legal person code — assigned by the Chinese government at the time when the firm was founded. We use this information to match firms across different years. However, the firm ID may change over time if the firm undergoes restructuring, a merger, or an acquisition. Therefore, in addition to matching by firm IDs, we also match the firms by using several of the following firm attributes: firm name, founding year, geographic code, industry code, phone number, name of the legal person representative, and address. This procedure minimizes errors from matching firms across different years.

Table 2 provides the summary statistics for all the key variables used in this paper. The full sample size is 11,402 private garment firms. The first row of Table 2 shows that among these 11,402 private firms, 26 percent formed new joint ventures with foreign investors from Hong Kong, Macao, and Taiwan during the sample period from 2001 to 2005. All these private firms experienced different levels of financial constraints. The Whited-Wu index shows that the lowest level of financial constraints for a firm is 0.64, and the highest is 1.67. None of the firms are financially constrained, as would have been implied by achieving a WW index of zero. The alternative measure for the financial constraints, given by the ratio of non-bank loans to total debt at the regional level, ranges from zero to one, which also reveals various levels of financial constraints in different regions.

Table 2 also shows the heterogeneous levels of the total factor productivity, export share, and R&D expenditure of the private garment firms in the sample. Because we have an unbalanced panel of firms, we calculate the TFP by the Levinsohn and Petrin (2003) semi-parametric procedure, which uses intermediate inputs as a proxy for the unobservable productivity shock to address the underlying input endogeneity issue.[8]

Finally, Table 2 presents some macroeconomic variables at the city and provincial levels. The provincial GDP per capita in logs and the provincial lawyer density where the firms are located are two macro variables that denote the investment environment in the Chinese provinces. The city-level tax rate differential will be defined in Section 5.

[5] We have the NBS dataset from 1998 to 2005. We choose to focus on the 2001–2005 sample for two reasons: (1) R&D expenditure is only available after 2001; (2) Later in this paper, we will use the average WW index during the past 3 years as an alternative measure of the financial constraints.

[6] See Brandt et al. (2014) for a detailed discussion of this database.

[7] This is calculated by dividing the total value-added in the dataset by the industrial GDP in the *China Statistical Yearbook* (2006).

[8] The Levinsohn-Petrin procedure is implemented using the Stata module "levpet," developed by Petrin et al. (2004).

Table 2
Summary statistics of private garment firms.

	Mean	Sd	min	max
New joint venture with HMT firms	0.26	0.44	0.00	1.00
WW index	0.95	0.05	0.64	1.67
Non-bank loan share	0.37	0.21	0.00	1.00
lnTFP	6.09	0.80	1.24	10.02
Export share	0.46	0.53	0.00	1.00
Firm size	9.58	0.86	2.08	13.87
Firm age	1.64	0.74	0.00	3.95
K/L ratio	18.15	32.15	0.39	1222.20
R&D	0.23	1.01	0.00	10.35
Tax rate differential	3.48	1.08	0.00	9.95
Provincial lawyer density	0.03	0.02	0.00	0.09
Regional income	9.22	0.59	7.97	10.92
Observations		11,402		
Sample period		2001-2005		

Notes: The new joint-venture variable is a 0-1 indicator, with 1 being a new joint venture with a Hong Kong, Macao, or Taiwan (HMT) firm, and 0 a pure domestic private firm. WW index is the Whited and Wu (2006) financial constraint index. A higher value on the index indicates a higher external financing cost. Non-bank loan share is the ratio of non-bank loans to total debt at the regional level. A higher value of the ratio indicates more difficulty for private firms in the region to raise funds. lnTFP is the natural logarithm of total factor productivity, calculated with the Levinsohn and Petrin (2003) semi-parametric procedure. Export share is the export value divided by the total sales of the firm. Firm size is the natural logarithm of the firm's total sales. Firm age is the natural logarithm of the firm age. K/L ratio is the ratio of capital to labor at the firm level. R&D is the firm's R&D expenditures. The tax-rate differential is the city-level average tax-rate differential between domestic private firms and foreign firms. The tax rate is the effective tax rate defined as the percentage of the total tax revenue over the value-added. Provincial lawyer density is the number of lawyers per 100,000 provincial population. Regional income is the natural logarithm of provincial real GDP per capita.

4. Estimating the financial constraint index

The financial constraint index constructed in this paper owes its origins to Whited (1992) and Whited and Wu (2006). The WW index is in fact the estimated shadow cost associated with external financing. It is the Lagrange multiplier derived from the firm's dynamic optimization model in which the firm maximizes its expected present discounted value of future dividends subject to its financial constraints. A financially constrained firm associated with a relatively high value of WW index that is facing a high financing cost would be forced to cut back its corporate investment more than a less constrained firm with a relatively low value of WW index, *ceteris paribus*. Whited and Wu (2006) argue that the advantage of WW index is its avoidance of serious sample selection, simultaneity, and measurement-error problems via structural estimation with a large data set.

Based on the Euler equation approach, the Whited–Wu financial constraint index (WW index) is constructed by the following formula:

$$\hat{\lambda} = 1.421 + 0.066ISG_{it} - 0.012SG_{it} - 0.046LNTA_{it} - 0.031CF_{it} - 0.149IDAR_{it} + 0.042TLTD_{it} \quad (1)$$

where the coefficients are estimated by the GMM estimation using the firm-level panel data for the private firms in the Chinese garment industry during the period from 2001 to 2005 (see the Appendix for details). A higher value of the WW index indicates a higher external financing cost.

All our estimated coefficients of the explanatory variables in the WW index in Eq. (1) have expected signs consistent with the theoretical predictions. For instance, the negative sign on the log of total assets (*LNTA*) captures the well-documented size effect (Beck et al., 2005): small firms are more likely than large firms to have financial constraints. The negative coefficient on the cash flow-to-assets ratio shows that financially healthier firms with a high cash flow are less likely to be constrained. The positive sign on the industry sales growth (*ISG*) and the negative sign on the firm sales growth (*SG*) indicate that only firms with good investment opportunities in high-growth industries are likely to make large investments and still be constrained. The positive parameter on the firm-level debt-to-assets ratios (*TLTD*) and the negative parameter on the industry-level debt-to-assets ratios (*IDAR*) reveal that financially constrained firms are likely to have high debt but they reside in low-debt-capacity industries.

As an alternative measure of the financial constraints, we use a private-firm survey conducted jointly by the United Front Work Department of the Central Committee of the Communist Party of China, the All-China Industry and Commerce Federation, and the Society of the Private Economy at the Chinese Academy of Social Sciences. The private-firm survey covers 3073 private firms in the year 2000. The survey included questions about total debts and the share of bank loans in total debts. We calculate the firm-level ratios of non-bank loans to the total debt as our alternative financial constraint index.

The assumption behind this measure is that loans from the formal financial sector are always cheaper than loans from the informal financial sector.[9]

We then aggregate these firm-level non-bank loan ratios to the 4-digit city level, as opposed to the usual 2-digit provincial measure in the literature, to obtain a more precise measure of the financial treatment of the private firms. Because the measure is at the city level, it reflects the financial constraints that an average private firm faces in that city rather than the specific constraints faced by the firms in the NBS dataset. Using the 6-digit regional codes in the NBS dataset, we are able to match the two datasets. Altogether, about 8100 firms in the NBS dataset — out of a total of 11,402 private firms — are located in those municipalities covered by the private-sector survey.

We calculate the mean of the WW index for each type of firm ownership. We find that foreign-invested firms actually have the least financial constraints among all firms in the Chinese garment industry. As expected, state-owned enterprises in China have lower financial constraints than collective-owned firms, and the latter in turn have lower constraints than private firms. Our findings confirm the widely acknowledged and well-established fact that a political pecking order exists in the Chinese economy; therefore we have greater confidence in the Euler equation approach that we have adopted.

5. Econometric test

One advantage of our dataset is that it spans multiple years (2001–2005). We can thus observe the timing of the formation of joint ventures. On the basis of the information in the firm ID (and other variables), we can track the ownership type of a firm over time to see if a private firm became a joint venture. This before-and-after feature of the dataset is critical as it allows us to control for those dynamics antecedent to the formation of the joint venture. We are able to make inferences about the motivations in a way that the previous research — based on cross-sectional data — could not. For example, Guariglia and Poncet (2008), while showing relationships between financial constraints and FDI that are directionally similar to those in our paper, cannot distinguish between FDI as the effect and FDI as the cause of the financial treatments of the private firms. In this paper, we are able to do this because of the before-after treatment of our approach.

5.1. Decision to form joint ventures

To study the decision making of private firms to form joint ventures with HMT firms, we estimate a probit model in which the dependent variable is an indicator with 1 being a new joint venture at time t and 0 otherwise. Our sample includes all garment private firms between 2001 and 2005. The specification of the probit model is as follows:

$$Z_{it} = F(WW\ index_{i,t-1}, export\ share_{i,t-1}, regional\ income_{i,t-1}, lawyer\ density_{i,t-1}, lnTFP_{i,t-1}, R\&D_{i,t-1}, tax\ rate\ differential_{i,t-1}, age_{i,t-1}, size_{i,t-1}, K/L_{i,t-1}, coast_{i,t-1}, year) + e_{it} \quad (2)$$

where:

Z_i = 0–1 indicator variable with 1 being a new joint venture with HMT firms, and 0 otherwise;
WW index = Whited-Wu financial constraint index;
export share = share of exports in the firm's total sales;
regional income = log of provincial GDP per capita;
lawyer density = number of lawyers per 100,000 persons;
lnTFP = log of total factor productivity;
R&D = R&D expenditure;
tax rate differential = city-level effective tax rate differential between domestic private firms and foreign firms;
age = log of firm age;
size = log of firm size measured by total sales;
K/L = capital-labor ratio;
coast = dummy variable for the coastal provinces;
year = a full set of year dummies.

We include a set of control variables to separate the effects of financial constraints on joint-venture decisions from other possible effects described in the literature. First, since HMT firms generally have more experience and better distribution channels in the export market, Chinese firms may seek HMT partners to boost their exports. In Eq. (2), we include the export share of sales revenue as an independent variable to control for such firm-specific advantages in HMT firms.

Second, previous studies find that local income and rule of law are important factors that affect foreign investment in China (Fung et al., 2002; Shang-Jin, 2000). We use provincial regional income and lawyer density to control for the local investment environment. The data come from various years of the *Chinese Statistical Yearbook*.

[9] Non-bank informal loans in China are always associated with much higher interest costs. A *New York Times* article describes the situation in the following terms: "More and more families with savings have been snubbing 2 percent interest on bank deposits for the double-digit returns from lending large amounts on their own. They lend to real estate speculators or to small businesses without the political connections to obtain loans from the banks." *New York Times*, November 9, 2004.

Table 3
Estimation of self-selection of private firms to form joint ventures.

	1	2	3	4	5	6	7
	Pooled Probit					Linear Probability Firm FE	
WW index	0.1042	0.1523	0.1320			0.2713	
	[0.009]***	[0.004]***	[0.008]***			[0.007]***	
WW index × lnTFP		0.0227	0.0159			0.0942	
		[0.029]**	[0.033]**			[0.025]**	
WW index (3-year average)				0.1020			0.1416
				[0.008]***			[0.021]**
WW index (3-year average) × lnTFP				0.0218			0.0735
				[0.037]**			[0.032]**
Non-bank loan share					0.0631		
					[0.016]**		
Non-bank loan share × lnTFP					0.0202		
					[0.037]**		
LnTFP	0.0018	0.0022	0.0016	0.0037	0.0010	0.0043	0.0065
	[0.032]**	[0.030]**	[0.038]**	[0.036]**	[0.033]**	[0.025]**	[0.041]**
Export share	0.0043	0.0055	0.0079	0.0043	0.0068	0.0066	0.0051
	[0.020]**	[0.012]**	[0.023]**	[0.036]**	[0.000]***	[0.091]*	[0.081]*
Firm size	0.0032	0.0024	0.0025	0.0018	0.0063	0.0030	0.0024
	[0.022]**	[0.028]**	[0.087]*	[0.035]**	[0.002]***	[0.120]	[0.108]
Firm age	−0.0031	−0.0027	−0.0016	−0.0027	−0.0026	−0.0096	−0.0128
	[0.054]*	[0.073]*	[0.092]*	[0.074]*	[0.078]*	[0.062]*	[0.061]*
K/L	−0.00001	−0.00001	−0.00001	−0.00002	−0.00001	−0.00004	−0.00005
	[0.033]**	[0.035]**	[0.029]**	[0.014]**	[0.029]**	[0.026]**	[0.012]**
R&D	−0.00003	−0.00006	−0.00005	−0.00004	−0.00004	−0.00007	−0.00006
	[0.124]	[0.115]	[0.428]	[0.116]	[0.156]	[0.129]	[0.112]
Tax–rate differential	0.0248	0.0251	0.0143	0.0198	0.0296	0.0457	0.0370
	[0.024]**	[0.025]**	[0.029]**	[0.028]**	[0.022]**	[0.018]**	[0.016]**
Coast dummy	0.0130	0.0125		0.0129	0.0106		
	[0.027]**	[0.019]**		[0.016]**	[0.043]**		
Provincial lawyer density	0.0024	0.0028		0.0023	0.0046	0.0024	0.0020
	[0.015]**	[0.018]**		[0.017]**	[0.009]***	[0.041]**	[0.040]**
Regional income	0.0053	0.0057		0.0054	0.0046	0.0360	0.0366
	[0.013]**	[0.014]**		[0.013]**	[0.007]***	[0.013]**	[0.012]**
Year dummies	yes	yes	–	yes	yes	yes	yes
Province × year fixed effect	no	no	yes	no	no	no	no
Observations	11,402	11,402	9908	11,402	8162	10,952	10,952
Pseudo R^2	0.160	0.164	0.298	0.160	0.184		
Adjusted R^2						0.470	0.462

Notes: This table presents regression results on the effect of financial constraints on the decision by Chinese private firms to form joint ventures. We run pooled probit regressions for columns 1–5 and linear probability regressions with firm fixed-effect for columns 6 and 7. The dependent variable is a 0–1 indicator, with 1 a new joint venture with Hong Kong, Macao, or Taiwan (HMT) ownership in the garment industry, and 0 for the remaining purely domestic private firms without any foreign equity. For the probit results, the coefficient estimates are transformed to represent the marginal effects evaluated at the means of the independent variables. The marginal effect of a dummy variable is calculated as the discrete change in the expected value of the dependent variable as the dummy variable changes from 0 to 1. *P*-values are presented in brackets and are computed by robust standard errors clustered for provinces and years. *, **, *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels respectively.

Third, to the extent that foreign firms often cherry-pick the best domestic firms to be their joint-venture targets, we include firm-level lnTFP and R&D to control for the cream-skimming effect (Razin and Sadka, 2007).

Fourth, in earlier years of the reform, the Chinese central government and local governments at all levels often offered tax breaks and other incentives to foreign investors. Due to local enforcement differences, the *de facto* tax rates facing foreign firms are often lower than those facing domestic enterprises (Huang and Tang, 2010). To control for the tax-incentive effects of FDI, we include a "*tax-rate differential*" variable to capture the city-level *de facto* tax differences. To calculate the tax-rate differential between domestic private firms and foreign firms, we first compute the ratio of the total tax revenue to the value-added for every firm, and then we calculate its average for the city in which the firm is located.

Table 3 reports the estimation results for Eq. (2). The coefficient estimates are transformed to marginal effects evaluated at the means of the independent variables from the probit regressions. Throughout this paper, the *p*-values are presented in brackets and are computed by robust standard errors clustered for province and year. In the first column, the coefficient of the WW index has a positive sign and is statistically significant. Column (2) includes an interaction term with a positive sign, indicating the strong interacting effect of high TFP and tight financial constraints (i.e., a high value on the WW index), inducing domestic private firms to source foreign equity capital. Although financial constraints increase the odds of forming joint ventures across the board, they do so especially vis-à-vis the most productive private firms.

Our estimates are not only statistically significant but they are also economically meaningful. Let us compare the firms in the top 25 percentile of our financial constraint measure with an average private firm in Zhejiang province. Zhejiang is

widely known in China for its pro-entrepreneurial business environment and for financial policies that are based more on an economic rather than a political pecking order. Not surprisingly, Zhejiang has the lowest WW index among all provinces in China. According to column (2) in Table 3, we calculate the predicted probability of joint venture, Z_i, when all variables are evaluated at their mean values of those firms in the top 25 percent of the most financial constraints. Then we replace the WW index with the mean value of Zhejiang firms and calculate another predicted probability. The difference of the two predicted probabilities is 15.7 percentage points, which implies that, controlling for all normal economic and business motivations to form a joint venture, the most constrained private firms would have been 15.7 percent less likely to share equity with foreign investors if they had faced the same financial constraints as firms located in Zhejiang.

One potential disadvantage of Eq. (2) is that the WW index might be endogeneous even if it is one year preceding the dependent variable in the joint-venture decision. One can argue that the financial situation during the past year might be affected by anticipation of forming a joint venture in the current year. We devised four methods to deal with the endogeneity problem.

First, we replace all provincial variables, coast dummy, and year dummies by province-year dummies to control for possible potential time-varying confounding regional factors. Those province-year cells with only one observation are dropped in this regression. The empirical results presented in column (3) are highly robust.

Second, we replace the WW index by the average WW index during the past 3 years under column (4). This is meant to capture the steady-state financing treatments of Chinese private firms. The result is consistent with what we obtained earlier. The positively significant 3-year average WW index demonstrates that persistently tight financial constraints for Chinese private firms make them more receptive to injections of foreign funds.

Our third method is to replace the WW index with an alternative regional financial constraint measure (calculated as the non-bank loan ratio on the basis of the private-sector survey in the year 2000). Unlike the WW index, the regional financial constraint measure is not specific to the firms in the NBS dataset. The endogeneity problem here should be minimal. Column (5) of Table 3 report the results with our alternative measure—regional non-bank loan share in total debt. We find that firms located in those regions with a lower non-bank loan share cede their equity to foreign firms at a higher rate. Our two measures of financial constraints produce coefficients that are directionally similar.

The fourth method is to exploit the panel data structure of our sample to check if our results are robust to the inclusion of firm fixed effects. Most of our firms have more than one observation in the sample. This enables us to run a panel regression with firm fixed effects that capture the time-invariant unobservables. Firms that have only one observation are dropped in this regression. Regional control variables such as coast dummies and our alternative regional financial constraint measure of the non-bank loan ratio for the year 2000 that are time invariant cannot be added to this regression, since they are all captured by the firm dummies. Furthermore, it is well-documented in the econometric literature that a panel probit (and also panel Tobit and panel ordered-probit models to be discussed later on) estimation is inconsistent (see Wooldridge, 2002, p.484). Hence we estimate a linear probability model, i.e., OLS model, with firm fixed effects for our panel data that should give a straightforward interpretation of the causal effect (Wooldridge, 2002, p.454). Columns (6) and (7) of Table 3 report the linear probability regressions with firm fixed effects for WW index and the three-year average WW index respectively. We find both WW indexes remain positively significant in both specifications. In summary, Table 3 strongly supports the hypothesis that private firms with greater financial constraints are more likely to seek foreign investment.

Our findings are quite consistent with general theories on the economic behavior and attributes of FDI, which provide another reason why we are confident in the findings on the nexus between the political pecking order and FDI. In Table 3 we find that private garment firms with a higher TFP, larger exports, larger sales, lower age, lower capital intensity, and located in the coastal region are more likely to form joint ventures with HMT firms. Investment climate variables and tax-rate differentials all bear the expected signs. We also note that, in all specifications, R&D expenditure does not appear statistically significant. This is not surprising since technology is not expected to be an important determinant of FDI dynamics in the garment industry, the very reason that we decided to focus on this industry in the first place.

In Table 4, we conduct more robustness checks. In column (1), we replace the WW index by the SA financial constraint index, developed by Hadlock and Pierce (2010, p.1929). The SA index uses direct accounting information of firm size and firm age, which are arguably relatively less endogenous than other variables such as leverage and cash flow (Hadlock and Pierce, 2010, p.1911), to measure financial constraints of firms. Whilst WW index employs six factors to capture all the aspects of financial constraints of firms, Hadlock and Pierce (2010, p.1923) argue that "the principal strength of the WW index is its reliance on firm size". Hadlock and Pierce (2010, p.1929) then supplement firm size with firm age to construct a new SA financial constraint index. The SA index has been widely applied in the finance literature (e.g., Berkowitz et al., 2015). The empirical results in column (1) of Table 4 reveal that both the SA index and its interaction with lnTFP are positive and are significant at the 5% level, indicating a robust financing channel of FDI.

Although we tried to construct a clean setup to pin down the causal relation from financial constraints to forming joint venture, other well-documented FDI channels such as transfer of technology and knowhow, and cost driven FDI using China as an export platform might still exist in the garment industry. In column (2) of Table 4, we further control for the expected increase of export and technology transfer after the formation of the joint venture, approximated by the change of export share and R&D. We find that the technology transfer channel is relatively weak in our setting: the expected increase of R&D from the joint venture is only marginally significant at the 10% level. However, the cost driven FDI channel evidenced by the expected increase of export share after the joint venture is founded is statistically significant at the 5% level, which supports the conventional wisdom that one of the motivations of FDI is to utilize China as an export platform by exploring

Table 4
More robustness tests.

	1	2	3	4
	JV of private firms with HMT		JV of private firms withnon-HMT	JV of SOEs with HMT
SA index	0.0163			
	[0.025]**			
SA index × lnTFP	0.0011			
	[0.039]**			
WW index		0.1248	0.0926	0.0579
		[0.006]***	[0.026]**	[0.081]*
WW index × lnTFP		0.0167	0.0135	0.0086
		[0.035]**	[0.024]**	[0.062]*
LnTFP	0.0012	0.0010	0.0052	-0.0008
	[0.014]**	[0.036]**	[0.024]**	[0.039]**
Export share	0.0031	0.0087	0.0108	–0.0016
	[0.034]**	[0.002]***	[0.001]***	[0.025]**
Firm size	0.0019	0.0026	0.0054	0.0076
	[0.055]*	[0.082]*	[0.015]**	[0.057]*
Firm age	–0.0023	–0.0025	–0.0098	–0.0025
	[0.030]**	[0.110]	[0.007]***	[0.042]**
K/L	–0.00001	–0.00001	–0.00001	–0.00001
	[0.030]**	[0.027]**	[0.031]**	[0.028]**
R&D	–0.00002	–0.00004	–0.00002	–0.00010
	[0.341]	[0.195]	[0.043]**	[0.376]
Tax–rate differential	0.0241	0.0243	0.0289	0.0137
	[0.026]**	[0.027]**	[0.013]**	[0.059]*
Coast dummy	0.0189	0.0186	0.0210	0.0231
	[0.068]*	[0.090]*	[0.121]	[0.036]**
Provincial lawyer density	0.0029	0.0026	0.0012	0.0018
	[0.017]**	[0.021]**	[0.039]**	[0.014]**
Regional income	0.0054	0.0074	0.0020	0.0049
	[0.014]**	[0.013]**	[0.016]**	[0.017]**
Δ(Export share) $_t$		0.0062		
		[0.027]**		
Δ R&D $_t$		0.00007		
		[0.087]*		
Year dummies	yes	yes	yes	yes
Observations	11,416	10,388	7917	3775
Pseudo R^2	0.177	0.186	0.324	0.245

Notes: In this table, columns 1–4 present the pooled probit regression results on the effect of financial constraints on the decision by Chinese firms to form joint ventures. For columns 1 and 2, the dependent variable is a 0–1 indicator, with 1 a new joint venture with Hong Kong, Macao, or Taiwan (HMT) ownership in the garment industry, and 0 for the remaining purely domestic private firms without any foreign equity. In column 3, the dependent variable is a 0–1 indicator, with 1 a new joint venture with foreign ownership (non-HMT) other than Hong Kong, Macao, and Taiwan in the garment industry, and 0 for the remaining purely domestic private firms without any foreign equity. In column 4, the dependent variable is a 0–1 indicator, with 1 a new joint venture of state-owned enterprises (SOEs) with Hong Kong, Macao, and Taiwan (HMT) ownership in the garment industry, and 0 for the remaining SOEs without any foreign equity. SA index is the Hadlock and Pierce (2010) financial constraint index. A higher value on SA index indicates a higher external financing cost. Δ(Export share) $_t$ is the change of export share and Δ R&D$_t$ is the change of R&D expenditure. In columns 1, 2 and 3, the tax-rate differential is the city-level average tax-rate differential between domestic private and foreign firms. In column 4, the tax-rate differential is the city-level average tax-rate differential between SOEs and foreign firms. Definitions of all the other variables are reported in the note to Table 2. The coefficient estimates from the probit regressions are transformed to represent the marginal effects evaluated at the means of the independent variables. The marginal effect of a dummy variable is calculated as the discrete change in the expected value of the dependent variable as the dummy variable changes from 0 to 1. *P*-values are presented in brackets and are computed by robust standard errors clustered for provinces and years. *, **, *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels respectively.

Chinese cheap labor and land. After controlling for these conventional FDI channels, the financing channel remains statistically significant. Both the WW index and its interaction with lnTFP remain positive and are significant at the 1% and 5% level, respectively.

To contrast our empirical findings that exclusively focused on joint ventures between Chinese private firms and HMT investors in garment industry, we also examined (1) the joint ventures between Chinese private firms and the foreigners outside Hong Kong, Macao, and Taiwan (non-HMT), and (2) the joint ventures between Chinese SOEs and HMT investors in Table 4.

In column (3) of Table 4, we report the pooled probit regression results on the decision by Chinese private firms to form joint ventures with non-HMT foreign investors. Comparing the coefficients of WW index and the interaction term of WW index × lnTFP, it shows that both coefficients in column (3) are positive and significant at the 5% level, yet smaller in magnitudes than the corresponding coefficients in column (2) of Table 3 for the HMT joint ventures. The financing channel

Table 5
Estimation of the equity share in HMT joint ventures.

	1	2	3	4	5	6
	Pooled Tobit				Linear Probability Firm FE	
WW index	0.7598	0.6703			1.0236	
	[0.034]**	[0.035]**			[0.012]**	
WW index × lnTFP		0.0278			0.0523	
		[0.005]***			[0.003]***	
WW index (3-year average)		0.5701			1.1240	
			[0.022]**			[0.021]**
WW index (3-year average) × lnTFP		0.0238			0.0468	
			[0.003]***			[0.002]***
Non-bank loan share				0.3590		
				[0.018]**		
Non-bank loan share × lnTFP		0.0281				
				[0.016]**		
LnTFP	0.1138	0.0832	0.0889	0.0669	0.6379	0.4494
	[0.029]**	[0.030]**	[0.029]**	[0.015]**	[0.011]**	[0.012]**
Export share	0.0597	0.0603	0.0602	0.0698	0.0528	0.0485
	[0.004]***	[0.009]***	[0.001]***	[0.005]***	[0.059]*	[0.016]**
Firm size	0.0712	0.0580	0.0846	0.2544	0.0951	0.2307
	[0.035]**	[0.029]**	[0.042]**	[0.031]**	[0.038]**	[0.037]**
Firm age	–0.0267	–0.0271	–0.0240	–0.0434	–0.0310	–0.0293
	[0.014]**	[0.012]**	[0.032]**	[0.036]**	[0.090]*	[0.123]
K/L	–0.0004	–0.0005	–0.0003	–0.0014	–0.0026	–0.0010
	[0.015]**	[0.038]**	[0.036]**	[0.029]**	[0.017]**	[0.015]**
R&D	–0.0003	–0.0006	–0.0005	–0.0001	–0.0008	–0.0007
	[0.157]	[0.148]	[0.134]	[0.172]	[0.165]	[0.140]
Tax–rate differential	0.0512	0.0551	0.0322	0.1184	0.0688	0.0412
	[0.031]**	[0.031]**	[0.032]**	[0.015]**	[0.012]**	[0.011]**
Coast dummy	0.0638	0.0596	0.0546	0.0679		
	[0.038]**	[0.032]**	[0.029]**	[0.019]**		
Lawyer density	0.0516	0.0518	0.0521	0.0206	0.1361	0.1308
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Regional income	0.0969	0.0959	0.0982	0.2438	0.4135	0.4406
	[0.026]**	[0.018]**	[0.017]**	[0.014]**	[0.020]**	[0.018]**
Year dummies	yes	yes	yes	yes	yes	yes
Observations	11,402	11,402	11,402	8162	10,952	10,952
Pseudo R^2	0.194	0.192	0.186	0.214		
Adjusted R^2					0.532	0.514

Notes: This table presents regression results on the effect of financial constraints on the level of foreign equity shares in the garment industry. We run pooled Tobit regressions for columns 1– 4 and linear probability regressions with firm fixed effects for columns 5 and 6. The dependent variable is the equity shares of HMT investors. It takes the value of zero for purely domestic private firms without any foreign equity. In columns 1–4, the coefficient estimates are transformed to represent the marginal effects evaluated at the means of the independent variables. The marginal effect of a dummy variable is calculated as the discrete change in the expected value of the dependent variable as the dummy variable changes from 0 to 1. The *P*-values are presented in brackets and are computed by robust standard errors clustered for provinces and years. *, **, *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels respectively.

is stronger for the HMT investors than the non-HMT investors, probably due to the fact that the HMT firms appear to lack advanced technology and are therefore expected to engage in less technology transfers than the non-HMT counterparts.

Column (4) presents the regression results on the joint ventures between Chinese SOEs and HMT investors. The findings seem to suggest that Chinese SOEs have different motivation to form joint ventures from Chinese private firms. The coefficients of WW index and its interaction with lnTFP are positive yet only marginally significant at the 10% level. Comparing the coefficients of lnTFP and export share, we find that both coefficients in column (4) for SOEs are negative and significant at the 5% level, whilst the corresponding coefficients in column (2) of Table 3 for the Chinese private firms exhibit positive signs. It suggests that the financing channel for SOEs is much weaker but the main motivation here is to improve the competitiveness of SOEs in terms of TFP growth and penetration into overseas market via foreign acquirers.

An alternative specification of Eq. (2) is to define the dependent variable as foreign equity share, a continuous variable. Since foreign equity share is bounded between 0 and 1, we estimate a tobit model with the same independent variables as in Table 3. The results reported in Table 5 are qualitatively consistent with those in Table 3. Again, we can compare the top 25 percent of the most financially constrained firms with a typical firm in Zhejiang province. Using the estimates in column (2), the difference in the predicted foreign equity share is 38.4 percentage points. In other words, the firms in the top 25 percent of the most financially constrained firms could have avoided losing 38.4 percent of their equity share to foreign firms if they had faced the same financial constraint as an average Zhejiang firm. Since most of the theoretically-relevant economic and business factors are already controlled for, the 38.4 percent difference is a concrete illustration of the fire-sale dynamics (minus the actual financial-crisis fire).

Table 6
Ordered probit estimation of change in equity control.

	1	2	3	4	5	6	7	8
	Parameter	Marginal Effects (dP/dx)			Parameter	Marginal Effects (dP/dx)		
		(0, 25%)	[25%–50%]	(50%, 1]		(0, 25%)	[25%–50%]	(50%,1]
WW index	2.7328	0.0482	0.1361	0.6302				
	[0.037]**	[0.037]**	[0.032]**	[0.035]**				
WW index × lnTFP	0.6112	0.0112	0.0346	0.1576				
	[0.027]**	[0.028]**	[0.023]**	[0.025]**				
Non-bank loan share					1.8843	0.0371	0.1216	0.4907
					[0.029]**	[0.032]**	[0.020]**	[0.029]**
Non-bank loan share × lnTFP				0.2817	0.0055	0.0168	0.0717	
					[0.032]**	[0.034]**	[0.033]**	[0.039]**
LnTFP	0.0523	0.0010	0.0028	0.0129	0.0409	0.0008	0.0024	0.0106
	[0.028]**	[0.031]**	[0.022]**	[0.028]**	[0.025]**	[0.030]**	[0.028]**	[0.030]**
Export share	0.1247	0.0022	0.0067	0.0314	0.1760	0.0034	0.0104	0.0424
	[0.019]**	[0.028]**	[0.030]**	[0.015]**	[0.008]***	[0.012]**	[0.019]**	[0.000]***
Firm size	0.0959	0.0017	0.0051	0.0236	0.1381	0.0027	0.0082	0.0364
	[0.036]**	[0.037]**	[0.033]**	[0.041]**	[0.003]***	[0.015]**	[0.002]***	[0.009]***
Firm age	−0.0144	−0.0002	−0.0008	−0.0037	−0.0148	−0.0003	−0.0009	−0.0036
	[0.056]*	[0.061]*	[0.063]*	[0.061]*	[0.067]*	[0.075]*	[0.080]*	[0.072]*
K/L	−0.0018	−0.00003	−0.00010	−0.00049	−0.0025	−0.00005	−0.00014	−0.00065
	[0.025]**	[0.024]**	[0.022]**	[0.027]**	[0.036]**	[0.036]**	[0.039]**	[0.034]**
R&D	−0.0029	−0.0001	−0.0002	−0.0007	−0.0030	−0.0001	−0.0002	−0.0007
	[0.123]	[0.119]	[0.121]	[0.138]	[0.168]	[0.132]	[0.166]	[0.175]
Tax–rate differential	0.9063	0.0033	0.0108	0.0289	1.0723	0.0040	0.0145	0.0277
	[0.026]**	[0.026]**	[0.025]**	[0.020]**	[0.026]**	[0.026]**	[0.024]**	[0.021]**
Coast dummy	0.4565	0.0079	0.0236	0.0793	0.2697	0.0051	0.0150	0.0787
	[0.020]**	[0.010]***	[0.014]**	[0.013]**	[0.029]**	[0.037]**	[0.036]**	[0.041]**
Lawyer density	0.0727	0.0013	0.0038	0.0181	0.1265	0.0025	0.0075	0.0321
	[0.011]**	[0.016]**	[0.017]**	[0.003]***	[0.000]***	[0.006]***	[0.001]***	[0.004]***
Regional income	0.2453	0.0043	0.0131	0.0609	0.1510	0.0030	0.0090	0.0374
	[0.017]**	[0.047]**	[0.029]**	[0.015]**	[0.028]**	[0.039]**	[0.038]**	[0.030]**
Year dummies	yes				yes			
Observations	11,402				8162			
Pseudo R^2	0.179				0.196			

Notes: This table presents ordered-probit regression results on the effect of financial constraints on the status of foreign equity control. The dependent variable is the equity control status of Hong Kong, Macao, and Taiwan (HMT) investors in the garment industry: 0 stands for no foreign share and no foreign control; 1 stands for a foreign share above 0 but less than 25%, 2 stands for a foreign share above 25% but no more than 50%; 3 stands for a foreign share above 50%. The marginal effects are evaluated at the means of the independent variables. The marginal effect of a dummy variable is calculated as the discrete change in the expected value of the dependent variable as the dummy variable changes from 0 to 1. The *P*–values are presented in brackets and are computed by robust standard errors clustered for provinces and years. *, **, *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels respectively.

5.2. Corporate control in the joint venture

Economists in general recognize the value of corporate control. There is a large literature on corporate control after merger and acquisition (e.g., Lehn and Zhao, 2006). Our next analysis is to ascertain whether the financial constraints were severe enough not only to induce Chinese private entrepreneurs to substitute equity financing for credit financing but also to do so to the extent of losing control of their firms. We use an ordered probit model to examine the effect of financial constraints on the transfer of control rights to foreign firms, devising a number of ways to denote "control" and its transfer.

According to the NBS definition, the criterion for foreign-invested firms is that the foreign equity share should be no less than 25 percent. Since we have detailed information on the equity structure of each firm, we define the dependent variable of foreign control as follows: 0 for no foreign share, 1 for a foreign share above 0 but less than 25 percent, 2 for a foreign share above 25 percent but no more than 50 percent, and 3 for a foreign share above 50 percent. We report the estimation results of the ordered probit model in Table 6. We use the WW index in the first four columns and the non-bank loan share in the next four columns as our measure of the financial constraints. The financial constraint variables are positive and significant in all three specifications, suggesting that firms that are more financially constrained may have to relinquish more control rights to foreign partners.

As a robustness check, we redefine foreign control in the following way: 0 for no foreign share, 1 for a relative minority share, and 2 for a relative majority share. The results in Table 7 are consistent with those in Table 6. In column (7), to control for the firm fixed-effect by a linear probability model, we select a sub-sample of firms that formed new joint ventures. In other words, we drop those firms that did not form a joint venture. The dependent variable is a dummy that equals one if HMT investors have majority equity control, and zero if they only have minority control. The estimation results of this

Table 7
Estimation of the majority share in HMT joint ventures.

	1	2	3	4	5	6	7
	Pooled ordered-probit						Linear Probability Firm FE
	Parameter	Marginal Effects (dP/dx)		Parameter	Marginal Effects (dP/dx)		
		Minority	Majority		Minority	Majority	
WW index	1.9080	0.2464	0.6922				1.1432
	[0.014]**	[0.012]**	[0.023]**				[0.027]**
WW index × lnTFP	0.5718	0.0527	0.1807				0.3452
	[0.028]**	[0.028]**	[0.021]**				[0.027]**
Non-bank loan share				1.5945	0.0412	0.5048	
				[0.017]**	[0.019]**	[0.016]**	
Non-bank loan share × lnTFP			0.1860	0.0053	0.0756		
				[0.026]**	[0.034]**	[0.026]**	
lnTFP	0.0517	0.0014	0.0162	0.0331	0.0008	0.0110	0.0450
	[0.030]**	[0.023]**	[0.036]**	[0.023]**	[0.024]**	[0.028]**	[0.023]**
Export share	0.1263	0.0043	0.0399	0.1770	0.0062	0.0531	0.09321
	[0.019]**	[0.036]**	[0.012]**	[0.000]***	[0.003]***	[0.000]***	[0.207]
Firm size	0.1252	0.0051	0.0324	0.1762	0.0049	0.0528	0.0459
	[0.031]**	[0.036]**	[0.031]**	[0.000]***	[0.000]***	[0.000]***	[0.155]
Firm age	−0.0141	−0.0005	−0.0045	−0.0129	−0.0004	−0.0039	−0.0238
	[0.076]*	[0.073]*	[0.078]*	[0.079]*	[0.086]*	[0.088]*	[0.076]*
K/L	−0.0020	−0.0002	−0.0011	−0.0030	−0.0001	−0.0009	−0.0049
	[0.022]**	[0.026]**	[0.036]**	[0.022]**	[0.026]**	[0.021]**	[0.029]**
R&D	−0.0032	−0.0001	−0.0012	−0.0026	−0.0001	−0.0008	−0.0023
	[0.106]	[0.105]	[0.128]	[0.168]	[0.147]	[0.180]	[0.162]
Tax–rate differential	0.5906	0.0045	0.0235	0.8550	0.0076	0.0293	0.0832
	[0.028]**	[0.028]**	[0.022]**	[0.027]**	[0.027]**	[0.024]**	[0.025]**
Coast dummy	0.4678	0.0204	0.1455	0.2071	0.0043	0.0538	
	[0.007]***	[0.002]***	[0.002]***	[0.037]**	[0.041]**	[0.039]**	
Lawyer density	0.0727	0.0025	0.0229	0.1244	0.0041	0.0373	0.0366
	[0.032]**	[0.030]**	[0.012]**	[0.025]**	[0.009]***	[0.000]***	[0.043]**
Regional income	0.2489	0.0085	0.0786	0.1584	0.0044	0.0475	0.1398
	[0.015]**	[0.032]**	[0.045]**	[0.035]**	[0.046]**	[0.038]**	[0.035]**
Year dummies	yes			yes			yes
Observations	11,402			8162			2964
Pseudo R^2	0.182			0.200			
Adjusted R^2							0.342

Notes: This table conducts a robustness test of the effect of financial constraints on the status of foreign majority share control. Columns 1– 6 are based on pooled ordered-probit regressions. The dependent variable for columns 1 to 6 is the equity control status of Hong Kong, Macao, and Taiwan (HMT) investors in the garment industry: 0 stands for no foreign share and no foreign control; 1 stands for the foreign investor having minority equity control; 2 stands for the foreign investor having majority equity control. Column 7 is via linear probability regressions with firm fixed-effect for a sub-sample of firms that formed new joint ventures with HMT investors. The dependent variable for column 7 is a dummy that equals one if foreign investors have majority equity control, and zero otherwise. In columns 1–6, the marginal effects are evaluated at the means of the independent variables. The marginal effect of a dummy variable is calculated as the discrete change in the expected value of the dependent variable as the dummy variable changes from 0 to 1. The *P*-values are presented in brackets and are computed by robust standard errors clustered for provinces and years. *, **, *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels respectively.

panel linear probability model are also robust. A higher financial constraint is associated with a higher probability of a joint venture in which the foreign investor holds a majority share.

To further check the sensitivity of our definition of foreign control, we define the dependent variable in terms of a change in the legal person representative. In our dataset, each firm reports the name of its "legal person representative." According to Chinese Company Law, firms are required to register the name of a legal person representative, who is usually the CEO of the firm. When a new joint venture registers a different legal person representative, it is very likely that the private entrepreneurs have lost control of the firm, at least in a legal sense. Thus, we define foreign control as follows: 0 for no foreign share, 1 for a positive foreign share but no change in the legal person representative, and 2 for a positive foreign share and a change in the legal person representative. The results reported in Table 8 are quite similar to those we find in Tables 6 and 7. Private entrepreneurs with greater financial constraints are more likely to lose their legal person representation and presumably lose control of their firms to their foreign partners. To control for the firm fixed-effect in a linear probability model, we select a sub-sample of firms that formed new joint ventures and report its estimation in column (7) of Table 8. The dependent variable is a dummy that equals to one if there is a change in the legal person representative after a joint venture is formed, and zero otherwise. The estimation results of this panel linear probability model are consistent with ordered probit results.

Table 8
Change in the legal person representative.

	1	2	3	4	5	6	7
	Pooled ordered-probit						Linear Probability Firm FE
	Parameter	Marginal Effects (dP/dx)		Parameter	Marginal Effects (dP/dx)		
		Unchanged	Changed		Unchanged	Changed	
WW index	2.6240	0.2351	0.6776				0.7849
	[0.034]**	[0.037]**	[0.029]**				[0.025]**
WW index × LnTFP	0.6725	0.0622	0.1965				0.4822
	[0.024]**	[0.032]**	[0.025]**				[0.027]**
Non-bank loan share				2.0111	0.1837	0.6394	
				[0.011]**	[0.019]**	[0.011]**	
Non-bank loan share × LnTFP			0.3102	0.0283	0.0882		
				[0.016]**	[0.026]**	[0.016]**	
LnTFP	0.0629	0.0058	0.0178	0.0490	0.0044	0.0143	0.0657
	[0.027]**	[0.037]**	[0.022]**	[0.027]**	[0.029]**	[0.032]**	[0.032]**
Export share	0.1340	0.0124	0.0406	0.1837	0.0164	0.0534	0.0902
	[0.012]**	[0.040]**	[0.006]***	[0.000]***	[0.004]***	[0.001]***	[0.083]*
Firm size	0.1208	0.0126	0.0381	0.1835	0.0164	0.0493	0.0664
	[0.026]**	[0.020]**	[0.031]**	[0.001]***	[0.012]**	[0.006]***	[0.156]
Firm age	−0.0178	−0.0016	−0.0052	−0.0131	−0.0014	−0.0037	−0.0215
	[0.064]*	[0.072]*	[0.076]*	[0.054]*	[0.072]*	[0.068]*	[0.018]**
K/L	−0.0026	−0.0002	−0.0008	−0.0011	−0.0001	−0.0003	−0.0036
	[0.018]**	[0.022]**	[0.033]**	[0.024]**	[0.035]**	[0.034]**	[0.019]**
R&D	−0.0029	−0.0003	−0.0009	−0.0023	−0.0002	−0.0007	−0.0014
	[0.105]	[0.155]	[0.117]	[0.152]	[0.133]	[0.154]	[0.129]
Tax rate differential	0.8074	0.0057	0.0329	0.5553	0.0030	0.0211	0.1240
	[0.026]**	[0.026]**	[0.026]**	[0.029]**	[0.029]**	[0.029]**	[0.017]**
Coast dummy	0.4510	0.0310	0.1159	0.2216	0.0227	0.0676	
	[0.015]**	[0.009]***	[0.007]***	[0.036]**	[0.038]**	[0.036]**	
Lawyer density	0.0728	0.0068	0.0220	0.1206	0.0107	0.0370	0.0172
	[0.025]**	[0.026]**	[0.019]**	[0.000]***	[0.001]***	[0.007]***	[0.019]**
Regional income	0.2406	0.0223	0.0755	0.1603	0.0143	0.0502	0.3870
	[0.012]**	[0.042]**	[0.039]**	[0.030]**	[0.043]**	[0.044]**	[0.043]**
Year dummies	yes			yes			yes
Observations	11,402			8162			2964
Pseudo R^2	0.186			0.203			
Adjusted R^2							0.194

Notes: This table presents regression results on the effect of financial constraints on a change in legal person representative. Columns 1 to 6 are based on the pooled ordered-probit regressions The dependent variable is an indicator of a change in the legal person representative in Hong Kong, Macao, and Taiwan (HMT) joint ventures in the garment industry: 0 stands for no foreign investment; 1 stands for the legal person remaining unchanged after a joint venture is formed; 2 stands for a change in the legal person representative after a joint venture is formed. Column 7 is via linear probability regressions with firm fixed-effect for a sub-sample of firms that formed new joint ventures with HMT investors in the garment industry. The dependent variable for column 7 is a dummy that equals one if there is a change in the legal person representative after a joint venture is formed, and zero otherwise. In columns 1–6, the marginal effects are evaluated at the means of the independent variables. The marginal effect of a dummy variable is calculated as the discrete change in the expected value of the dependent variable as the dummy variable changes from 0 to 1. *P*-values are presented in brackets and are computed by robust standard errors clustered for provinces and years. *, **, *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels respectively.

6. Conclusions and policy implications

Economists have long held the view that FDI is a technological rather than a financial phenomenon. This paper shows that finance is an important factor explaining China's FDI patterns. In particular, financial constraints go some way toward explaining an otherwise puzzling phenomenon — that FDI abounds in a sector devoid of normal FDI drivers (such as technology and market failures). We first show the existence of a political pecking order of firms in China that is biased against private-sector firms. Then we show that this political pecking order of firms — in the form of financial constraints on private-sector firms — may induce labor-intensive FDI. In the empirical tests, we use a large firm-level panel dataset from the Chinese National Bureau of Statistics, supplemented by a comprehensive survey of private enterprises conducted in 2000. Following Whited and Wu (2006), we estimate the investment Euler equation and construct a financial constraint index for each firm. Our Euler equation estimation results show that the financial constraint index is higher for private and collective firms and lower for foreign- and state-owned firms. Our estimation of both probit model and linear probability model with firm fixed effects suggests that private firms with greater financial constraints are more likely to be acquired and controlled by foreign firms. Such effects are both statistically and economically significant.

In conclusion, if private firms could seek foreign ownership to mitigate the financial distortions, it seems to suggest that FDI plays a role of alleviating the financial constraints of private firms. Government policies that restrict FDI while failing to improve financial system can be counterproductive.

Seeking foreign source of funding does not come without a cost. According to our estimates, those firms in the top 25 percentile of our financial constraint measure could have avoided losing 38.4 percent of their equity share to foreigners had they faced the same favorable financial constraints as a typical firm in Zhejiang province. This is evidence that an inefficient political pecking order has some real welfare implications for corporate control and for the claims of Chinese private entrepreneurs on future profits.

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Appendix. Estimating the financial constraint index

This Appendix provides details on how to estimate the firm-level financial constraint. We follow the approach developed by Whited (1992) and Whited and Wu (2006) to construct the WW index.

There have been two common approaches to estimate the extent of financial constraints: the Q-theory model and the Euler equation. Both approaches are based on the same dynamic optimization theory of investment. They differ in the way they rearrange the first-order conditions. However, it is more data-demanding to estimate the Q-theory model than it is to estimate the Euler equation. The marginal q is unobservable and a proxy has to be found in the Q-model by, for example, the market valuation of capital. In many developing countries, financial markets are imperfect and therefore it is difficult to obtain a good estimation of the market valuation of capital. The Q-model is also subject to a measurement error and identification problems (see Kaplan and Zingales, 1997; Erickson and Whited, 2000; Love, 2003). Therefore, the Euler equation approach is the preferred estimation of financial constraints in the context of developing countries. We adopt the Euler approach in this paper.

Suppose firm i is to maximize the expected discounted value of the dividends subject to the dividends identity and capital accumulation constraints:

$$V_{it} = \max D_{it} + E_{it} \sum_{s=1}^{\infty} \beta_{t+s-1} D_{i,t+s} \tag{A.1}$$

subject to

$$D_{it} = \pi(K_{it}, u_{it}) - C(I_{it}, K_{it}) - I_{it} + B_{i,t+1} - (1 + r_t) B_{it} \tag{A.2}$$

$$K_{i,t+1} = I_{it} + (1 - \delta_i) K_{it} \tag{A.3}$$

where V_{it} is the value of firm i at time t, E_{it} is the expectation operator, β_{t+s-1} is the discount factor from time $t+s$ to time t. Eq. (A.2) defines the firm's dividends D_{it} and Eq. (A.3) governs the capital stock accumulation K_{it}. $\pi(K_{it}, u_{it})$ is the restricted profit function that is maximized with respect to variable costs, u_{it} is the productivity shock, $C(I_{it}, K_{it})$ is the real adjustment cost of investment, I_{it} is the investment expenditure of the firm, B_{it} and r_t are the stock of debt and the coupon rate on the debt, respectively, and δ_i is the depreciation rate of the capital stock.

The firm also faces two external finance constraints:

$$D_{it} \geq D_{it}^{*} \tag{A.4}$$

$$B_{i,t+1} \leq B_{i,t+1}^{*} \tag{A.5}$$

where D_{it}^{*} is the lower limit on dividends of the firm, and $B_{i,t+1}^{*}$ is the upper limit on the stock of debt.

The financial frictions are introduced via a constraint on dividends [Eq. (A.4)] and a constraint on external borrowing [Eq. (A.5)]. Whited and Wu (2006) point out that it is difficult to separate the identification of the Lagrange multipliers on the dividends constraint and on the debt constraint. Therefore, we follow the approach of Whited and Wu (2006) and focus on the identification of the Lagrange multiplier on the dividends constraint, which is denoted as λ_{it}. This multiplier is equal to the shadow cost associated with raising new equity, which implies that external equity financing is costly. Hence,

a higher value of λ_{it} indicates a higher cost of external financing. If the external equity financial constraint is not binding, then the shadow cost of external finance is zero, $\lambda_{it} = 0$.

The Euler equation is obtained from the first-order condition with respect to investment expenditure:

$$E_{it}\beta_t\Lambda_{i.t+1}\left[\left(\frac{\partial\pi}{\partial K_{i,t+1}} - \frac{\partial C}{\partial K_{i,t+1}}\right) + (1-\delta_i)\left(\frac{\partial C}{\partial I_{i,t+1}} + 1\right)\right] = \frac{\partial C}{\partial I_{it}} + 1 \tag{A.6}$$

where $\frac{\partial C}{\partial I_{it}}$ is the marginal adjustment cost of investment, $\frac{\partial\pi}{\partial K_{i,t+1}} - \frac{\partial C}{\partial K_{i,t+1}}$ is the marginal "net profit" of capital (MPK), and $\Lambda_{i.t+1} = \frac{1+\lambda_{i.t+1}}{1+\lambda_{it}}$ is the relative shadow cost of external finance.

The Euler Eq. (A.6) indicates that the marginal adjustment and purchasing costs of investing today (on the right-hand side) should be equal to the discounted marginal cost of postponing investment until tomorrow (on the left-hand side). The latter is equal to the sum of the forgone marginal net profit of capital stock (given by MPK), plus the adjustment cost and the price of investment tomorrow. In other words, the optimal investment decision of a firm should be made such that, on the margin, the firm must be indifferent about investing today or transferring those resources to tomorrow.

In the absence of a financial constraint, the shadow cost of external finance is zero, λ_{it}=0. This implies that $\Lambda_{i.t+1} = \frac{1+\lambda_{i.t+1}}{1+\lambda_{it}} = 1$. However, if the equity finance is binding, then $\Lambda_{i,t+1} \neq 1$.

To estimate the Euler Eq. (A.6), Whited and Wu (2006) made the following simplifying assumptions. The marginal restricted profit of capital is given by:

$$\frac{\partial\pi}{\partial K_{it}} = \frac{Y_{it} - \mu C_{it}}{K_{it}} \tag{A.7}$$

where Y_{it} is output, C_{it} is the variable costs, and μ is a constant mark-up.

The real adjustment cost of investment is defined as:

$$C(I_{it}, K_{it}) = \left[\alpha_0 + \sum_{m=2}^{3}\frac{\alpha_m}{m}\left(\frac{I_{it}}{K_{it}}\right)^m\right]K_{it} \tag{A.8}$$

where α_m (m=2,3) are the parameters to be estimated.

Finally, the unobservable shadow cost of external finance λ_{it} is specified by the Whited–Wu index as follows:

$$\lambda_{it} = b_0 + b_1 ISG_{it} + b_2 SG_{it} + b_3 LNTA_{it} + b_4 CF_{it} + b_5 IDAR_{it} + b_6 TLTD_{it} + b_7 CASH_{it} \tag{A.9}$$

where b_i is a parameter to be estimated; ISG is the firm's 3-digit industry sales growth; SG is the firm's sales growth; LNTA is the natural log of total assets; CF is the ratio of cash flows to total assets; IDAR is the firm's 3-digit industry debt-to-assets ratio; TLTD is the ratio of the long-term debt to total assets; and CASH is the ratio of liquid assets to total assets.

Harrison and McMillan (2003) and Harrison, Love, McMillan (2004) also include FDI as an explanatory variable in Eq. (A.9). They substitute Eqs. (A.7), (A.8), and (A.9) into Euler Eq. (A.6) to derive a linear reduced-form equation for empirical estimation. Hence they can only test whether FDI affects the firms' financial constraint, but they cannot estimate the financial constraint index *per se*.

We follow Whited and Wu (2006) to estimate the nonlinear structural Euler equation by substituting Eqs. (A.7), (A.8), and (A.9) into Euler Eq. (A.6) and by replacing the expectations operator with an uncorrelated expectational error, $\varepsilon_{i,t+1}$. This gives us the transformed Eq. (A.6) as:

$$\begin{aligned}&\beta_t\left(\tfrac{1+\lambda_{i.t+1}}{1+\lambda_{it}}\right)\left\{\left[\tfrac{Y_{i.t+1}-\mu C_{i.t+1}}{K_{i.t+1}} - \alpha_0 + \sum_{m=2}^{3}\tfrac{(m-1)\alpha_m}{m}\left(\tfrac{I_{i.t+1}}{K_{i.t+1}}\right)^m\right] + (1-\delta_i)\left[\sum_{m=2}^{3}\alpha_m\left(\tfrac{I_{i.t+1}}{K_{i.t+1}}\right)^{m-1} + 1\right]\right\}\\ &= \sum_{m=2}^{3}\alpha_m\left(\tfrac{I_{it}}{K_{it}}\right)^{m-1} + 1 + \varepsilon_{i,t+1}\end{aligned} \tag{A.10}$$

We apply the GMM estimator to Eq. (A.10) in its first differences to eliminate the fixed firm effects. Because of the richness of our dataset, we are able to instrument all of the variables required by the Euler Eq. (A.10), as well as inventories, depreciation, current assets, current liabilities, the net value of capital stock, and tax payments. All of these instrumental variables are normalized by total assets. We also include a dummy if the net profit was positive at time *t*-1. All of the instrumental variables are lagged two periods in the GMM estimation.

Similar to Whited and Wu (2006), two constraints are imposed on our GMM estimation. First, we impose an unconditional restriction[10] that the value of the stochastic discount factor β_t is equal to $1/(1+r_{f,t})$, where $r_{f,t}$ is the risk-free rate and

[10] Whited and Wu (2006) imposed a weaker unconditional moment restriction for their US listed firms: the expected value of the stochastic discount factor β_t is equal to $1/(1+r_{f,t})$. Due to data unavailability, we could not estimate the Fama-French three-factor model of β_t as Whited and Wu (2006) did in their paper. An alternative stronger restriction imposed by Liu and Siu (2011, p.1839, Equation 1) was to assume β_t is a constant in their study of investment decisions of Chinese manufacturing firms.

Table A.1
Euler equation estimates.

	1	2	3	4
α_0	1.219	1.218	1.243	1.509
	[0.002]***	[0.002]***	[0.001]***	[0.001]***
α_2	0.188	0.188	0.190	0.204
	[0.035]**	[0.037]**	[0.047]**	[0.034]**
α_3	−0.214	−0.215	−0.217	−0.224
	[0.046]**	[0.047]**	[0.045]**	[0.038]**
μ	1.035	1.035	1.033	1.009
	[0.000]***	[0.000]***	[0.000]***	[0.000]***
b_0	1.433	1.421	1.414	
	[0.045]**	[0.040]**	[0.043]**	
ISG	0.063	0.066	0.063	
	[0.018]**	[0.015]**	[0.013]**	
SG	−0.012	−0.012	−0.012	
	[0.021]**	[0.022]**	[0.027]**	
LNTA	−0.046	−0.046	−0.043	
	[0.000]***	[0.000]***	[0.000]***	
CF	−0.031	−0.031	−0.034	
	[0.031]**	[0.031]**	[0.033]**	
IDAR	−0.149	−0.149	−0.149	
	[0.000]***	[0.000]***	[0.000]***	
TLTD	0.048	0.042		
	[0.041]**	[0.043]**		
CASH	−0.012			
	[0.2533]			
Observations	7515	7515	7515	7515
pv of *J*-test	0.261	0.223	0.041	0.002
pv of *L*-test	n.a.	0.181	0.003	0.001

Notes: The unbalanced panel sample consists of garment industry firms during the period from 2001 to 2005. The Euler equation is given by Eq. (A.10) of Whited and Wu (2006). The nonlinear GMM estimation is carried out with the model in first differences with twice lagged instruments. α_i is the investment adjustment cost parameter, and μ is a mark-up. ISG is the firm's 3-digit industry sales growth; SG is the firm's sales growth; LNTA is the natural log of total assets; CF is the ratio of cash flows to total assets; IDAR is the firm's 3-digit industry debt-to-assets ratio; TLTD is the ratio of the long-term debt to total assets; and CASH is the ratio of liquid assets to total assets. The *P*-values are reported in brackets. The p-values of the J-test and L-test on the model specification are reported in the last two rows.

is approximated by the official real interest rate of 5-year deposits.[11] Second, we impose a non-negative constraint on the shadow cost of finance $E(\lambda_{it}) \geq 0$ in the GMM estimation.

Appendix Table A.1 presents the results of the GMM estimation of the Euler Eq. (A.10). Column (1) is the general specification of the model, which includes all seven explanatory variables of the Whited-Wu financial constraint index in Eq. (A.9). The *J*-test of over-identification restrictions does not reject this model at the 5 percent significance level. All of the parameters of the Euler equation are significant at the 5 percent level, except the ratio of liquid assets to total assets (*CASH*) in the Whited-Wu index. However, if we exclude all of the explanatory variables in Eq. (A.9) of the Whited-Wu index [see the GMM estimation results in column (4)], the *J*-test significantly rejects this specification at the 5 percent level. This implies that the traditional Euler equation without a financial constraint is an inappropriate model for our dataset. Indeed, the *L*-test for the exclusion restrictions of all these explanatory variables in the Whited-Wu index also rejects the null hypothesis that the parameters of these variables are jointly equal to zero at the 5 percent significance level.

Column (2) of Table A.1 presents the GMM estimation results after deleting the insignificant variable *CASH* from column (1). Neither the *J*-test of over-identification restrictions nor the *L*-test of exclusion restrictions reject this model at the 5 percent significance level. If we delete one more variable (*TLTD*) that has the smallest *t*-value from column (2), the model is then rejected by both the *J*-test and the *L*-test at the 5 percent significance level [see column (3)].

Hence column (2) is our preferred specification for both the Euler equation and the Whited-Wu index equation. Note that all of the explanatory variables of the Whited-Wu index in column (2) have the expected signs, which is consistent with the theoretical predictions. For instance, the negative sign on the log of total assets (*LNTA*) captures the well-documented size effect (see, for example, Beck et al., 2005): small firms are more likely than large firms to have financial constraints. The negative coefficient on the cash flow-to-assets ratio shows that financially healthier firms with a high cash flow are less likely to be constrained. The positive sign on the industry sales growth (*ISG*) and the negative sign on the firm sales growth (*SG*) indicate that only firms with good investment opportunities in high-growth industries are likely to make large investments and still be constrained. The positive parameter on the firm-level debt-to-assets ratios (*TLTD*) and the nega-

[11] We use the nominal interest rates on enterprise deposits (5-year) minus inflation as a proxy. Source: Table 20–10 and Table 9–1, *China Statistical Yearbook* (2006).

tive parameter on the industry-level debt-to-assets ratios (*IDAR*) reveal that financially constrained firms are likely to have high debt but reside in low-debt capacity industries. Finally, the mark-up (μ) and adjustment-cost coefficient (α_2) are both positive and significantly different from zero.

Our estimated Whited-Wu financial constraint index can be constructed from the Euler equation in column (2) of Table A.1:

$$\hat{\lambda}_{it} = 1.421 + 0.066ISG_{it} - 0.012SG_{it} - 0.046LNTA_{it} - 0.031CF_{it} - 0.149IDAR_{it} + 0.042TLTD_{it} \quad (A.11)$$

which is Eq. (1) in the main text.

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