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Productivity, Profitability, Investment and Corporate Growth: Evidence from China's Manufacturing

XIAODAN Yu
Scuola Superiore Sant'Anna
Economics
yuxd0830@gmail.com

Abstract

Several models predict heterogeneity in production efficiency and innovativeness to be the driver of firms' growth. The models by Jovanovic (1982), Hopenhayn (1992) and Ericson and Pakes (1995) are in neoclassical perspective. The others sharing an evolutionary perspective are Nelson and Winter (1982) and Silverberg et al. (1988) among the others. These theories predict that productivity is positively related to profitability and firm growth. It occurs through two ways: 1) more efficient firms gain market shares by setting lower prices; 2) more productive firms enjoy higher profit margins, then invest more and even grow more, especially under the condition of imperfect capital markets.

Bottazzi et al. (2010) address empirically the weak relationship between relative productivity and firm growth rates, based on French and Italian industries. Adopting refined regression techniques, Dosi et al. (2013) present that productivity growth explains a substantial portion of overall variance of firm growth rates in manufacturing industries of USA and three European countries. The effect of selection to be mediated via profitabilities has been much less studied. Coad (2007) does not find any robust association between profitabilities and subsequent growth. Grazzi et al. (2013) detect the effect of investment spikes on firm performances, based on French and Italian industries.

This article explores the dynamics of selection and reallocation through an investigation of the relationships linking productivity, profitability, investment and growth (in terms of sales), based on China's manufacturing firm-level dataset during the period 1998 - 2007.

In line with the method of Dosi et al. (2013), we use a correlated random effects model to measure the explanatory power of productivity and profitability to the variance of firms' growth rates (of sales). Then, after identifying investment spikes (a binary variable) that corrects for size dependence, we employ a random effect logistic regression to test the relationship between profitability and the probability of firm having investment spikes. Next, we use random effects model to identify the effect of investment spikes on firm performances.

First, we find that productivity variations, rather than relative levels, are the dominant productivity - related determinant of firm growth, which account for 15% - 20% of the variance in firms' growth rates. But profitability variables only contribute less than 5%. Profitability-growth relationship is mediated by investment. Firm's contemporaneous and lagged profitabilities display positive and significant effect on the probability of having an investment spike, which is an evidence of the existence of financial constraint, in particular, the degree of financial constraint is much more severe for China's domestic privately-owned firms than state-owned enterprises. Moreover, firms having invested at least once during the sample period enjoy higher growth than non-investing group.

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Jelcodes:L25,O30

Productivity, Profitability, Investment and Corporate Growth: Evidence from China's Manufacturing

Xiaodan Yu[a]

[a]Scuola Superiore Sant'Anna, Pisa, Italy

Abstract

This article explores the dynamics of selection and reallocation through an investigation of the relationships linking productivity, profitability, investment and growth (in terms of sales), based on China's manufacturing firm-level dataset during the period 1998 - 2007. First, we find that productivity variations, rather than relative levels, are the dominant productivity-related determinant of firm growth, which account for 15% - 20% of the variance in firms' growth rates, while profitability variables only contribute less than 5%. Profitability-growth relationship is mediated by investment. Firm's contemporaneous and lagged profitabilities display positive and significant effect on the probability of having an investment spike, the positive association between profitability and investment is as such evidence of the existence of some financial constraint (under financial market imperfection), which appears to be much more severe for China's domestic privately-owned firms than state-owned enterprises. Moreover, firms having invested at least once during the sample period enjoy higher growth than the non-investing group.

JEL codes: D22, L10, L20, L60, O30

Keywords: labour productivity, profitability, investment spike, corporate growth

1. Introduction

Most models of industrial dyanmics predict heterogeneity in production efficiency and innovativeness to be a useful driver of firms' growth. This applies to models in the neoclassical perspective such as (Jovanovic, 1982; Hopenhayn, 1992; Ericson and Pakes, 1995) and the most recent Luttmer (2007); Acemoglu et al. (2013). Other theories from an evolutionary one predict that productivity is positively related to profitability and firm growth, formally representing the process of selection among firms through some mechanism of the replicator-dynamics type (see Nelson and Winter (1982); Silverberg et al. (1988); Dosi et al. (1995a); Silverberg and Verspagen (1995); Metcalfe (1998)). It occurs through two ways. First, more efficient firms gain market shares by setting lower prices. In an evolutionary framework, if competitiveness is inversely related to prices, in turn prices inversely related to productivity, the law of motion of shares of firm i of a replicator-dynamics type in any one industry is that firms with above-average productivity should display above-average growth and increase their market shares, and vice versa for less productive firms. It assumes that innovation - rather than adjustments to some unchanged technological landscape - is the driving force of industrial change (Dosi et al., 1995b). Second, more efficient firms operating in a competitive, price-taking market would get higher profits and would invest more, especially under the condition of imperfect capital markets, and produce more relative to universe of competitors (Nelson and Winter, 1982; Bottazzi et al., 2001).

Bottazzi et al. (2010) address empirically the issue and find weak relationship between relative productivity and firm growth rates, based on French and Italian industries. The main finding there is that the variance of growth rates is accounted for only to a little extent by the variance of relative productivities or profitabilities, while a much greater room of explanation is left to fixed unobserved heterogeneity, ultimately capturing both idiosyncratic degrees of "strategic freedom" of individual firms and, together, the sheer ignorance of the researcher on the underlying drivers of the process. Dosi et al. (2013) argue that their method wash away the contribution of average efficiency of a firm over the observed period, thus yielding a systematic underestimation of the true contribution of the relative efficiency variable to relative firm growth. They correct for the latter bias in order to extract out from unobserved fixed effects the part which correlates with within-firm average productivities as distinct from the "independent" one. They find that productivity *growth* accounting for a substantial portion of overall variance of firm growth rates in manufacturing industries of USA and three European countries.

The first purpose of this paper is to investigate the effect and to what extent firms' relative productivities determine their growth for China's manufacturing, and whether the magnitudes of selection determined by productivity varies across different ownership types.

The effect of selection to be mediated via profitabilities has been much less studied. Among the few works, Coad (2007) does not find any robust association between profitabilities and subsequent growth, while Grazzi et al. (2013) detect an effect of profit on investment spikes which in turn influence firm performances. The assumption that more profitable firms would invest more and grow more predict that while there would be not direct link between profitability and growth, the effect of market selection might be determined by firm's investment decisions. Thus, to test such mechanisms, we need to resort to two strands of literatures. First, most of the empirical works explore the effect of profitabilities on investment have been nested in the literatures of investment decisions and financial constraints, through investigating whether firm's investment is sensitive to cash flow and/or profitabilities, grounded by the theories of Tobin's q (Fazzari et al., 1988; Devereux and Schiantarelli, 1990; Nilsen and Schiantarelli, 2003), Euler equation specification (Bond and Meghir, 1994; Bond et al., 2003) and accelerator-profit model (Mairesse et al., 1999; Bond et al., 2003).[1] Among these works, they argues that the simultaneity biases may arise from the joint determination of output and investment. To test the relationship in both directions, Hall et al. (1998) find that investment in tangible assets and R&D are more highly sensitive to cash flow and sales in the United States than in France and Japan. Both investment in tangible assets and R&D predict both cash flow and sales positively in the United States, while the impact is somewhat more mixed in the other countries. Investment appears unrelated to future sales in all three countries.

Second, the literatures concerning the effect of investment on firm growth mainly focus on investigating the role of financial constraints on firm growth, however, not directly detect the effect of investment on growth.[2] For instance, Oliveira and Fortunato (2006) find that smaller and younger firms have higher

[1] For example, Devereux and Schiantarelli (1990), using average q to control for the investment opportunities, find significant effect of cash flow on investment decisions of UK firms. They point out that cash flow may be a better proxy for market fundamentals than the market value of the firm, and entrepreneurs may respond only to fundamentals. Nilsen and Schiantarelli (2003) show that the response of investment to fundamentals is close to zero for low values of fundamentals (low q), but it increases sharply above the threshould of q. Bond and Meghir (1994) detect excess sensitivity of investment to cash flow for UK quoted firms. Bond et al. (2003) find that cash flow and profits appear to be both statistically and quantitatively more significant in the UK than in the three continental European countries (Belgium, France, Germany).

[2] The empirical literatures on liquidity constraints and firm growth relationship are particularly based on small and young firms, because the growth rate of small firms depends upon the availability of internal finance.

growth (in terms of employment) - cash flow sensitivitie than larger and more mature firms. Carpenter and Petersen (2002) investigate how possible finance constraints could affect the growth of total assets based on small-sized firms. On the other hand, large investment projects might induce firm's productivity cost, in turn, constraint growth in short run. For instance, (Sakellaris, 2004; Licandro et al., 2003) find productivity costs after large investment in fixed assets[3] Such lumpiness of firm-level investment: investment is intermittent, with frequent zero invesment periods alternating with large investment episode,[4] is likely to lead to increasing returns to the installation of new capital and increasing returns to retraining and restructuring of production activity, ultimately due to the adoption of new technologies and the ensuring learning of how to use them as well as from building and destroying a particular organization of production (Abel and Eberly, 2002; Cooper et al., 1995; Caballero and Engel, 1999).

This paper will focus on investment spikes, capturing only large investment episodes. The meaning of financial constraint with respect to investment spikes is different from the common definition. The unusually large investment decisions require a corresponding effort of financial commitment. Under the assumption of the lower price of internal finance than external finance, if the internally generated resources do not suffice, the firm has to rely on external finance to achieve the investment decision. In this framework, two possible outcomes are associated with such dependence on external financing. First, due to the indivisibility of the large investment and complete lack of access to external finance, investment activity might be limited to zero. Schiantarelli (1996), Audretsch and Elston (2002), Whited (2006). Second, the limited access to external finance would cause firm's investment and growth to be binding with internal financial conditions.

With respect to transition economies, the addtional variables explain reinvestment and firm growth are

[3]Sakellaris (2004), based on US manufacturing firms, find that the level of TFP drops after spikes in investment and recovers slowly afterward. Licandro et al. (2003), based on Spanish manufacturing firms, find that expansionary and innovative firms increase their productivity after an investment spike. However, long learning curves seems to be associated with innovative investments.

[4]Recent literatures document the nature of caital adjustment behavior at the micro level, including non-convex adjustment costs, indivisibilities and irreversibility of physical capital (Doms and Dunne, 1998; Cooper and Haltiwanger, 2006; Nilsen et al., 2009; Grazzi et al., 2013). For example, Cooper and Haltiwanger (2006) find that the nonlinear model between investment and profitability shock, which mixed both convex and non-convex adjustment costs and irreversibility fits the data best. Cooper et al. (1995) show that the probability of a plant experiencing a large investment episode, after an inital decrease, increases in the time elapsed since the last such episode. Nilsen and Schiantarelli (2003) find that the hazard for equipment investment is the highest in the period immediatly following a spike and falls sharply after that.

secure property rights and financial sector deveopment.[5] Cull and Xu (2005), based on a set of Chinese private firms, show that the extent of private ownership (as a proxy of secure property rights) is associated with greater reinvestment.

Cull and Xu (2003) document the imperfections of China's financial market. Access to bank loans by state enterprises could be much more reflective of a soft budget constraint than loans for private firms. Thus, China's domestic private firms have to rely heavily on internal financial conditions to finance their growth.[6]

The second part of this paper will investigate firm's internal financial conditions and demand shocks on investment decisions, under imperfect capital market conditions, and in turn, how firm's investment decisions determine growth?

This article is organized as follows. The second section introduces the dataset and variables. In the third section, we measure the contribution of productivity to growth. Using similar method, the mild effect of profitability to growth is shown in section four. In section five, we estimate the effect of profitability on firm-level investment. Then, section six presents the results of how investment stimulate growth. Section seven concludes.

2. Data and Variables

The dataset includes all industrial firms with sales above 5 million RMB covering period 1998-2007 (except 2004).[7] Each firm is classified into a sector according to the 4-digit Chinese Industry Classification (CIC)

[5]For Eastern European countries, Johnson et al. (2002) find that property rights is overwhelmingly important, while external finance explains little of firm reinvestment. Demirgüç-Kunt and Maksimovic (1998) find that access to external finance contributed to the sales growth of firms in 20 industrialized and ten developing countries.

[6]Cull and Xu (2003) present that "During the beginning of Twenty-first century, China's state-owned enterprises (SOEs) continue to receive a disproportionately large share of the credit extended by the main (and largely state-owned) banks in China, and the empirical research shows that state banks have grown increasingly inefficient in allocating credit as they have been increasinly forced to bail out poorly performing state-owned enterprises. These bailouts come in the form of stability loans to keep SOEs afloat, as many or most of them maintain excessive employment. They therefore view loans extended by state-owned banks to state enterprises as having a strong bailout component instead of as true external finance awarded on the basis of creditworthiness".

[7]Industry is defined to include mining, manufacturing and public utilities, according to National Bureau of Statistics of China (NBSC). Five million RMB is approximately $US 600,000. The total output and value added is not avaliable in 2004, thus, we do not use year 2004.

system that resembles the old U.S. SIC system.[8] Out of that, we extracted manufacturing only firms,[9] and we cleaned the data in order to eliminate visible recording errors, yielding what we call "China Micro Manufacturing" (CMM).[10]

We are interested in corporate performances as revealed by several major dimensions, namely, productivity, profitability, investment rate and growth. Productivity $\Pi_{i,t}$ is the ratio of value added, at constant prices, over the number of employees, $\Pi_{i,t} = \frac{VA_{i,t}}{N_{i,t}}$, where $VA_{i,t}$ is real value added, $N_{i,t}$ is number of employees, of firm i at year t.[11] Cost of labour $COL_{i,t}$ is defined as the sum of total wages and welfare. Profitability is defined as the ratio of gross profit margins and output: $P_{i,t} = \frac{VA_{i,t} - COL_{i,t}}{Output_{i,t}}$. Firm's growth is measured as the log difference of (constant price) sales in two consecutive years: $G_{i,t} = \log Sales_{i,t} - \log Sales_{i,t-1}$. Firm's investment rate at time t is defined as the ratio of investment at time t and capital stock at time $t-1$, which is $\frac{I_{i,t}}{K_{i,t-1}}$[12]. Investment is not reported in the data, thus, we calculate that investment at t equals the difference of firm's fixed assets at original value between time t and $t-1$[13]. we create investment at time t as the difference of firm's fixed assets at original value between t and $t-1$. The series of real capital stock are created following the perpetual inventory method, referring to Brandt et al. (2012). Table 1 reports mean statistics of the interested variables derived from the cleaned dataset.

We further disaggregate firms by ownership and governance structures. According to firm's registration status, we distinguish firms into seven ownership categories: State-owned enterprises (SOEs); collective-owned enterprises (COEs), Hong Kong, Macao and Taiwan-invested enterprises (HMTs); foreign-invested enterprises (FIEs), including foreign MNCs (FMNC) and joint ventures (JV) with a foreign share above 25%, shareholding enterprises (SHEs); private-owned enterprises (POEs); and other domestic enterprises

[8] In 2003, the classification system was revised to make room for further disaggregation for some sectors, while some other sectors were merged. To make the industry codes comparable across the entire period, we follow Brandt et al. (2012) which has constructed a harmonized classification.

[9] Manufacturing firms are those with Chinese Industrial Classification (CIC) code between 13 and 43, which spans over 29 two-digit sectors, 161 three-digit sectors, and 424 four-digit sectors.

[10] We drop firms with missing, zero or negative output, value-added, sales, original value of fixed assets, cost of labour; and also firms with a number of employees less than 8, since below that threshold they operate under another legal system (Brandt et al., 2012). NBS has modified its industrial classification after 2002, the dataset used in this paper has adjusted the industrial classification before 2003 into the new standard. Since CIC43 has emerged merely after 2002, we do not consider it here.

[11] Value-added is deflated by four-digit sectoral output deflators, from Brandt et al. (2012).

[12] Both the investment and capital stock are in real value

[13] According to NBSC, fixed assets include equipments and buildings

(ODEs). As shown in Table A.1, 23 registration categories have been aggregated into 7 larger ones, in line with Jefferson et al. (2003).

Year	Number of Firms	Output	Employee	Value-added	Sales	Cost of Labour	Labour Productivity	Profitability	Growth Rates
1998	98407	49062	388	13188	45204	3231	43.58	0.165	
1999	98407	52462	372	14308	49158	3313	47.92	0.158	0.037
2000	100320	60023	366	16093	57406	3659	54.12	0.162	0.049
2001	93773	67435	351	18118	64520	3958	61.09	0.148	0.023
2002	114469	71179	322	19476	68042	3926	70.38	0.170	0.097
2003	121435	85401	314	23173	83380	4233	80.40	0.176	0.129
2005	210704	92236	250	24483	90387	4270	100.63	0.196	
2006	210704	112930	258	29971	111258	5111	121.70	0.195	0.177
2007	235380	131307	248	34715	129103	5923	142.51	0.202	0.198

Table 1: Summary statistics (mean) of dataset used in this paper. Source: our elaboration on CMM. Note: output, value-added, sales and cost of labour are reported at current price, unit: thousands yuan. Labor productivity is reported at 1998 constant price, unit: thousands yuan per employee.

3. Relative productivities and firm growth

Figure 1 shows the positive linear relationship between productivity and firm's growth by kernel regression. Thus, we model the growth-productivity relationship through distributed lag linear model with additive heterogeneity (see Bottazzi et al. (2010) and Dosi et al. (2013)).[14] Based on sequential rejection of the statistical significance of longer lags structure, we choose our baseline equation a model with lag one productivity:

$$g_{i,t} = \alpha + \beta_0 \pi_{i,t} + \beta_1 \pi_{i,t-1} + b_t + u_i + \epsilon_{i,t} \quad (1)$$

where $g_{i,t}$ denotes the growth rate of firm i in terms of log-differences of sales between two consecutive years, $\pi_{i,t}$ is the (log) labour productivity, b_t is a time dummy, u_i is a firm-specific time invariant unobserved effect, and $\epsilon_{i,t}$ is the error term. The presence of time dummies is equivalent to consider the variables in deviation from their cross-sectional average, so that what matters is only the relative efficiency of firms in the industry.

The fixed effect estimates of Equation (1) are shown in Table A.2. In the majority of 3-digit sectors, the coeffieicnts $beta_0$ and $beta_1$ are significant at the 1% level. This suggests that relative productivity levels, both at time t and $t-1$, have effects on firm growth. The effect is robust to sector specificity.

[14] Lagged values are required for the strict exogeneity of the error term imposed for consistency of standard panel estimators.

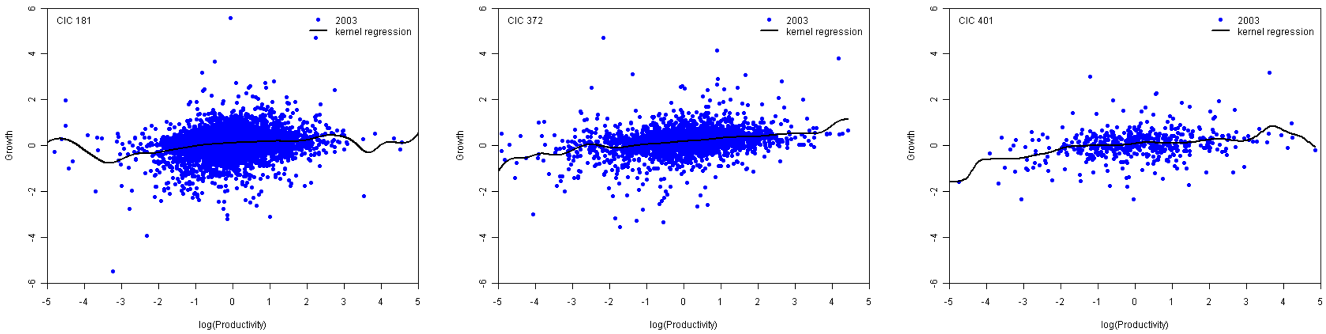

Figure 1: Productivity - Growth relationship in selected 3-digit sectors (textile clothing, automobiles and communication equipment) - kernel regression in 2003. Source: our elaboration on CMM.

Strong regularities of the two coefficients ermge across sectors. The distribution of parameters β_0, β_1 and $\beta_0 + \beta_1$ are shown in Figure 2. The absolute value of the two coefficients are quite stable across sectors with median 0.2. And the values β_0 and β_1 are on average equal in magnitude and opposite in sign, which confirms the regression-to-the-mean effect. 1% increase in productivity at time t or t-1 is related to an average increase of sales growth of 0.2.

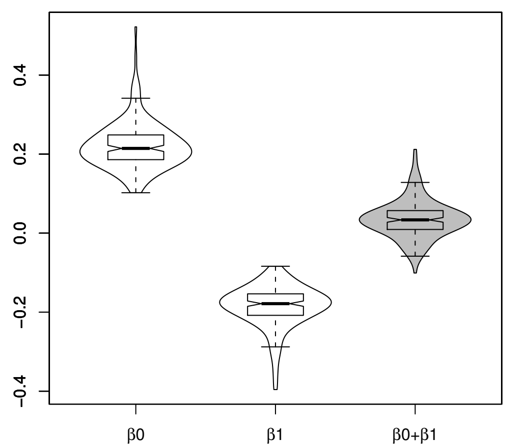

Figure 2: Productivity - Growth relationship. Distribution of parameters β_0, β_1 and $\beta_0 + \beta_1$ of the baseline model. Notes: Distributions, median values and interquartile ranges have been calculated according to the values reported in Table A.2.

Despite the statistical significance, the coefficient estimates to not pinpoint about to which extent firms are selected according to their relative productivity. To assess the strength of competitive selection, one needs to resort to a coefficient of determination, measuring the variance of firm growth explained by current and past relative productivity. Bottazzi et al. (2010) suggest that the current relative productivity appears to "explain" roughly between 3% and 5% of the overall variance in growth, while the contribution of firm's unobserved idiosyncratic characteristics is much larger. Nevertheless, Dosi et al. (2013) criticize that Bottazzi et al. (2010) systematically neglect the "productivity-related effect" hidden within the whole firm-specific effect u_i. They disentangle, within the unobserved effect u_i, the part which correlates with productivity from the part which does not. They re-estimate Equation (1) through a Correlated Random Effects model:

$$g_{i,t} = \alpha + \beta_0 \pi_{i,t} + \beta_1 \pi_{i,t-1} + \beta_{0a} \bar{\pi}_i + \beta_{1a} \bar{\pi}_{i,-1} + b_t + c_i + \epsilon_{i,t} \tag{2}$$

where $\bar{\pi}_i$ and $\bar{\pi}_{i,-1}$ are the within-firm time series averages of the (log) productivity up to time t and time $t-1$, respectively, while c_i is the new unobserved firm-specific heterogeneity term, uncorrelated with the productivity regressors after controlling for their averages. The advantage with respect to Equation (1) is that we are explicitly taking into account the contribution to sales growth also of productivity averages through time. The random effects estimation of Equation 2 does not change the value of the coefficients β_0 and β_1.

Then, we compute the following measure of the fraction of total variance of firm growth explained by productivity terms

$$S^2 = \frac{Var(\beta_0 \pi_{i,t} + \beta_1 \pi_{i,t-1} + \beta_{0a} \bar{\pi}_i + \beta_{1a} \bar{\pi}_{i,-1})}{Var(G_{i,t})}. \tag{3}$$

The conventional coefficient of determination of the overall fitness of the model

$$R^2 = \frac{Var(\beta_0 \pi_{i,t} + \beta_1 \pi_{i,t-1} + \beta_{0a} \bar{\pi}_i + \beta_{1a} \bar{\pi}_{i,-1}) + Var(u_i)}{Var(G_{i,t})} \tag{4}$$

takes into account the contribution of the heterogeneity term c_i, so that the difference between R^2 and S^2 delivers a measure of the variance explained by time invariant firm's unobserved effects.

Table A.3 reports the values of R^2 and S^2 across 3-digit sectors. Figure 3 shows the corresponding distributions of R^2 and S^2. Our model with levels and averages of productivity plus firm-level heterogeneity is able to account for 55% - 65% of the variance in sales growth. The median of R^2 is 0.53. The values of S^2, capturing only the contribution of the productivity regressors (both levels and averages), are in median 0.17. That is, productivity variables account for more than one fifth of the variance in firms'

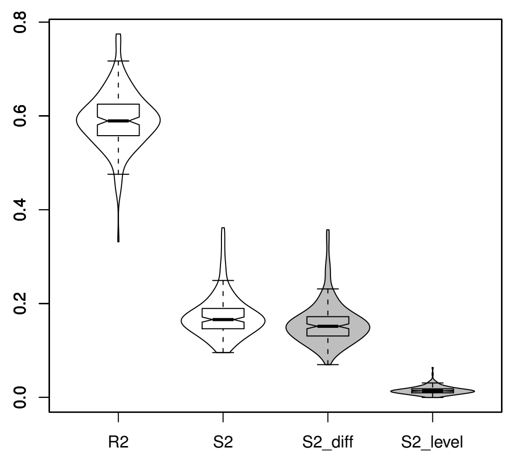

Figure 3: Productivity - Growth relationship. Distributions of R^2, S^2, S^2_Δ and S^2_a. The shaded violins refer to S^2_Δ and S^2_a, which are derived from the decomposition of S^2. Notes: Distributions, median values and interquartile ranges have been calculated according to the values reported in Table A.3.

growth rates. There seems to be some explanatory power of productivity variables, hinting at some role of efficiency-driven competitve selection.

We split firms within the same 3-digit sector by seven ownership types, then, replicate the same excercise to compare the maganitudes of the explanatory power of productivity variables to growth across different corporate ownership types. Table 2 and Figure 4 show that the values of S^2 of Shareholding and domestic private-owned firms are significantly higher than that of the others, based on ANOVA and post hoc Tukey pairwise comparisions. That is, the role of productivity variables in firms competitive selection and growth is more significant than the other ownership types.

Moreover, Dosi et al. (1995b) address that industries widely differ in (i) the intensity of their innovative efforts and the ways they pursue innovation - as reflected by different propensities to undertake R&D; (ii) their measurable innovative output, like patents and (iii) their rates of productivity growth (Dosi, 1988). And sectoral taxonomy has been developed to categorize industries based on the size and organizational characteristics of innovating firms (Pavitt, 1984) and the nature of innovative opportunities, learning processes and appropriability conditons (Levin et al., 1987; Malerba, 1992; Malerba and Orsenigo, 1993). We aggregate all 161 3-digit industris into five Pavitt sectors, which are supplier dominated (eg. textiles), scale intensive - continuous process (eg. foodstuffs), scale intensive - discontinuous process (eg. automobiles),

Explanatory power of productivity to growth			
Ownership	Number of sectors	S^2-mean (%)	S^2-median (%)
State-owned	108	14.37	13.64
Collective-owned	123	17.46	16.36
HMT-invested	104	14.48	13.88
Foreign-invested	113	15.47	14.44
Shareholding	119	18.73	17.98
Private-owned	143	21.47	21.16
Total	710	17.26	16.70

Table 2: Productivity - Growth relationship. Mean and median S^2 of six important ownership types among the sectors with the number of firms for each ownership category greater than 200. Source: our elaboration on CMM.

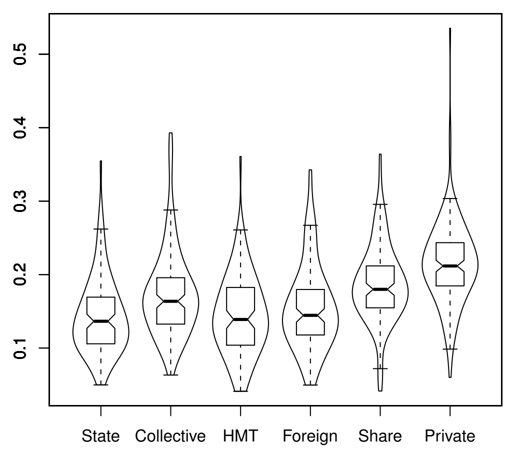

Figure 4: Productivity - Growth relationship. Distributions of S^2 of six important ownership types. Notes: Distributions, median values and interquartile ranges are shown in the violin plot.

Explanatory power of productivity to growth			
Pavitt Taxonomy	Number of sectors	S^2-mean (%)	S^2-median (%)
Supplier dominated	55	17.38	16.50
Scale intensive (continuous process)	47	18.47	17.29
Scale intensive (discontinuous process)	19	16.23	15.83
Specialized suppliers	25	16.26	16.47
Science based	15	17.14	17.02
Total	161	17.36	16.59

Table 3: Productivity - Growth relationship. Mean and median S^2 by Pavitt taxonomy. Source: our elaboration on CMM.

specialized suppliers (eg. machine-tools) and science-based (eg. communication equipments) sectors. However, there are no statistical differences of the explanatory power of productivity to growth across acorss Pavitt sectors, as shown in Table 3.

3.1. Productivity levels and productivity changes

Due to the statistical regularities of the coefficients of the current and lagged productivities, one may one may conjecture that the actual drivers of firms growth are not the relative level or productivity at any time period, but rather productivity variations over time (Dosi et al., 2013). We decompose the S^2 of productivity into two components, associated respectively with levels and variations, and rewrite baseline equation (1)

$$g_{i,t} = \alpha + \beta_\Delta \Delta\pi_{i,t} + \beta_m \bar{\pi}_{i,t} + b_t + u_i + \epsilon_{i,t} \tag{5}$$

where $\Delta\pi_{i,t}$ is the growth rate of productivity of firm i ($\Delta\pi_{i,t} = \pi_{i,t} - \pi_{i,t-1}$), which accounts for the growth of productivity, and $\bar{\pi}_{i,t}$ is the within-firm average productivity level over t and $t-1$ ($\bar{\pi}_{i,t} = \frac{1}{2}(\pi_{i,t} + \pi_{i,t-1})$), which captures productivity levels among firms.[15] If firms are selected and grow mostly according to their relative productivity-level, the explanatory power of $\bar{\pi}_{i,t}$ should be greater than that of $\Delta\pi_{i,t}$. On the contrary, if firms are competitively rewarded and grow mainly due to their productivity growth rates, the explanatory power of $\Delta\pi_{i,t}$ should dominate.

We adopt Correlated Random Effects model to estimate Equation (5). Results of the decomposition of S^2 are reported in the last two columns of Table A.3. The shaded violins in Figure 3 display the distributions of $S^2_{\Delta\pi_{i,t}}$ and $S^2_{\bar{\pi}_{i,t}}$. The variation of productivity ($S^2_{\Delta\pi_{i,t}}$) accounts for the majority part of S^2. This suggests that the competitive selection mechanism across firms in the same industry can be

[15] $\beta_0 = \frac{\beta_m}{2} + \beta_\Delta$ and $\beta_1 = \frac{\beta_m}{2} - \beta_\Delta$

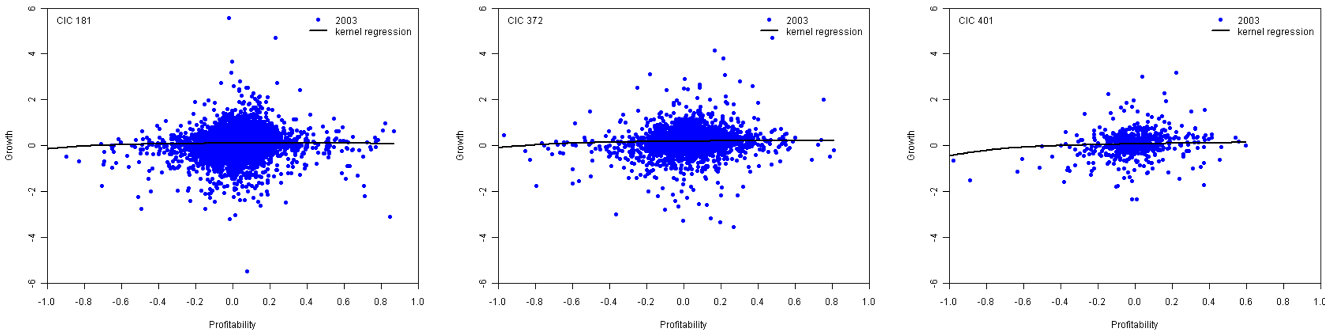

Figure 5: Profitability - Growth relationship in selected 3-digit sectors (textile clothing, automobiles and communication equipment) - kernel regression in 2003. Source: our elaboration on CMM.

explained to a greater extant by productivity *changes* rather than relative productivity *levels* across firms.

4. Relative profitabilities and firm growth

In line with the research methodology of productivity - growth relationship, we test the association between relative profitability and firm growth in this section. Figure 5 shows the positive linear relationship between profitability and growth by kernel regression. After some experimentations, we decide to keep the current and lagged one profitability in the model. So that the econometric analysis is consistent with previous section. The coefficients of current and lagged one profitabilities are statistically significant for the majority of 3-digit sectors, as shown in Table A.4. However, no strong statistical regularities concerning the signs and absolute values of the coefficients have emerged. Moreover, Table A.5 report the values of R^2 and S^2. The meidan of the overall fitness of the model is 0.55, while the explanatory power (S^2) of profitability variables to growth is 0.02 (median), as shown in Figure 6. Therefore, firm's unobserved idiocyncratic characteristics explain most of the variance of growth in profitability-growth relationship.

We distinguish firms in each 3-digit sectors by seven ownership types and estimate S^2 for each subsample. The mean and median values of S^2 are reported in Table 4 and the distributions are shown in Figure 7. The median S^2 of state-owned enterprises is 4.85, which is significantly higher than that of the other ownership types, based on ANOVA and post hoc Tukey pairwise comparisons. Although firm's growth has been explain to a little extent by current and lagged profitabilities, they are relatively important in driving the growth of state-owned enterprises.

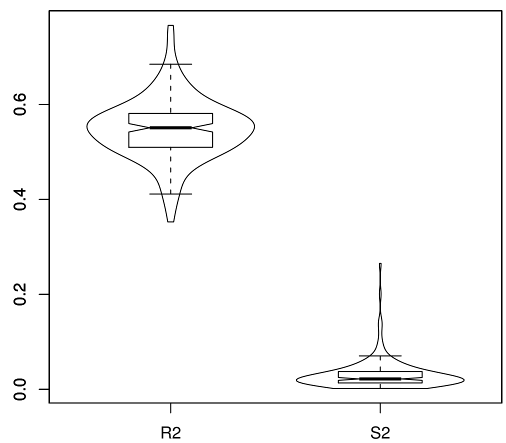

Figure 6: Profitability - Growth relationship. Distribution of R^2 and S^2. Notes: Distributions, median values and interquartile ranges have been calculated according to the values reported in Table A.5.

Explanatory power of profitability to growth			
Ownership	Number of sectors	S^2-mean (%)	S^2-median (%)
State-owned	108	6.35	4.85
Collective-owned	123	3.81	2.53
HMT-invested	104	3.37	2.39
Foreign-invested	113	3.59	2.41
Shareholding	119	3.83	2.69
Private-owned	143	2.57	2.11
Total	710	3.85	2.68

Table 4: Profitability - Growth relationship. Mean and median S^2 of six important ownership types among the sectors with the number of firms for each ownership category greater than 200. Source: our elaboration on CMM.

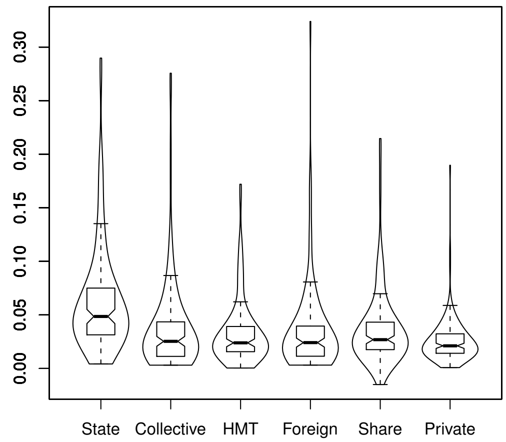

Figure 7: Profitability - Growth relationship. Distributions of S^2 of six important ownership types. Notes: Distributions, median values and interquartile ranges are shown in th violin plot.

Explanatory power of profitability to growth			
Pavitt Taxonomy	Number of sectors	S^2-mean (%)	S^2-median (%)
Supplier dominated	55	2.82	2.34
Scale intensive (continuous process)	47	3.42	2.10
Scale intensive (discountinuous process)	19	2.65	2.00
Specialized suppliers	25	2.73	2.08
Science based	15	4.44	3.26
Total	161	3.11	2.19

Table 5: Profitability - Growth relationship. Mean and median S^2 by Pavitt sectors. Source: our elaboration on CMM.

The 3-digit sectors are categorized into five Pavitt sectors. The median S^2 of scienced-based sectors is 3.26, which is higher than that of the other sectors. However, it is not statistically significant.

5. Profitability and investment

We have shown that profitability variables only explain less than 5% of the variance of growth rates of sales, which is very small, comparing to 17% of the explanatory power of productivity growth. According to the evolutionary theory of industrial dynamics, the missing link between profitability and growth would be captured by investment in fixed assets (under imperfect capital market), that the newly-purchased capital goods embodied the latest technology stimulate productivity and sales growth. We start this section by revealing the statistical properties of investment rate at the micro-level, then, investigate the effect of profit shocks on firm-level investment.

Figure 8 shows the distributions of investment rates, for selected years. For the majority of firms the investment rate is very low: in 1999, over 70% of firms reported an investment rate of 10% or lower; 9% of firms display an investment rate of 50% or more. In 2007, 60% of firms reported an investment rate of 10% or lower; 15% of firms display an investment rate of 50% or more. In the panel, investment of zeros occurs quite often: about 33.7% of the investment observations are zeros.

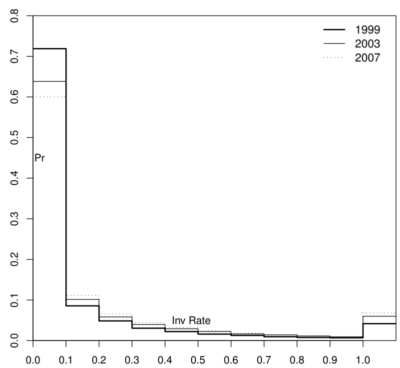

Figure 8: Histogram of investment rates in 1999, 2003 and 2007. Source: our elaboration on CMM.

To access the capital adjustment patterns of individual firms, if firms decide to allocate investment over a certain period of time, the profile of annual firm-level investment is rather flat, that would support the conjecture of a smooth process of capital adjustment at the firm-level. However, if we were to observe firm's investment concentrating in few periods, that is the evidence of investment lumpiness, revealed in Figure 9. We rank the investment shares over nine years for each firm. Then average or take median for each rank over all the firms in the balanced panel. The highest investment share on average accounts for 50% of total investment during the nine years[16]. Firms concentrate 80% of investment in three years, while investment shares are significantly lower in other years, revealing the lumpiness of the investment behavior across China's manufacturing firms.

In this paper, we assume that only very large investments are accompanied by "destructive" innovation, which represent a sudden and unusual burst of firm's investment activity. Therefore, for each firm, we are merely interested in very large investment episodes both relative to the investment history of the individual

[16]Investment is deflated by price index

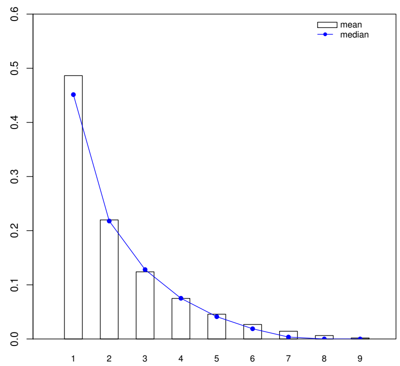

Figure 9: Average and median investment shares by rank (over firms in balanced panel - exist during 1998 - 2007). Source: our elaboration on CMM.

firm and relative to the cross-sectional dispersion of investment ratios within the industry (Nilsen et al., 2009). In order to identify such relative large investment, we resort to the literature of investment spikes, which is defined as a dictonomous variable. The advantages of using investment spike instead of investment rate as the main variable under our investigation are: (i) It captures rare investment events; (ii) Due to the only avaliable variable - the value of fixed capital stock at original price - in calculating real capital stock[17] and the way in which we generate real capital stock, the exact values of investment rate might be problematic.

We adopt kernel method to identify investment spikes conditional on firm's real capital stock Grazzi et al. (2013). Details are in Appendix. The performance of kernel method is shown in Table 6. 18% of observations are classified as spikes and they account for 68% of total investment. In addition, the share of observations that are spikes are less among small firms comparing with large ones (see Table 7).

5.1. Profit shocks and investment spikes

Conditional on firm's past investment behavior and on average investment behavior over the sample, does current and past profitabilities help to determine investment in the firm? The baseline model of estimating the relationship between profitability and investment is in the frame of an autoregressive-distributed lag

[17] According to NBSC, this book value is the sum of nominal values for different years. We calculate the real capital stock using the perpetual inventory method, assuming a depreciation rate of 9% and deflate it.

	All	$S_{i,t}=1$	$S_{i,t}=0$	All	$S_{i,t}=1$	$S_{i,t}=0$	All	$S_{i,t}=1$	$S_{i,t}=0$	All	$S_{i,t}=1$	$S_{i,t}=0$
	1999			2003			2007			99-07		
Mean investment rate	0.16	0.80	0.04	0.22	0.96	0.06	0.24	1.04	0.08	0.21	0.94	0.06
Median investment rate	0.01	0.59	0.00	0.03	0.76	0.01	0.05	0.83	0.02	0.03	0.74	0.01
% of spikes in # of obs.	15.87			17.17			17.32			16.93		
% of total investment accounted by spikes	70.28			68.12			67.66			68.35		

Table 6: Descpritive statistics of investment spikes - determined by kernel rule. Note: $S_{i,t}=1$ denotes the subsample of investment spikes, and $S_{i,t}=0$ denotes non-spike observations. Source: our elaboration on CMM.

Size class	1999	2003	2007	Pooled	% Obs that are spikes
< 20 employees	2.66%	2.40%	2.89%	2.66%	10.22%
20-300 employees	68.85%	73.74%	80.08%	75.03%	16.16%
300-1000 employees	21.69%	18.54%	13.43%	17.30%	19.57%
≥ 1000 employees	6.81%	5.32%	3.60%	5.00%	22.82%
Number of obs	91,078	109,056	214,812	887,138	16.93%
Number of firms				346,749	

Table 7: Distribution of firms and investment spikes by size class. Source: our elaboration on CMM.

of length m,

$$y_{i,t} = \alpha + \sum_{s=1}^{m} \beta_s y_{i,t-s} + \sum_{s=0}^{m} \gamma_s x_{i,t-s} + b_t + u_i + \epsilon_{i,t} \tag{6}$$

where $y_{i,t}$ denotes investment rate of firm i at time t, $y_{i,t-s}$ represents investment rate at time $t-s$, $x_{i,t-s}$ denotes profitability at time $t-s$, u_i is a correlatated firm effect and b_t are year dummies, $\epsilon_{i,t}$ is a serially uncorrelated disturbance.

Since our variable of interest is investment spike $SPIKE_{i,t}$, that takes value 1 if there is a spike and 0 if not, we estimate the refined version of the baseline model

$$SPIKE_{i,t} = \alpha + \beta_0 P_{i,t} + \beta_1 P_{i,t-1} + \beta_2 P_{i,t-2} + \beta_3 P_{i,t-3} + \gamma_1 D_{i,1} + \gamma_2 D_{i,2} + \gamma_3 D_{i,3} + b_t + u_i + \epsilon_{i,t} \tag{7}$$

where $P_{i,t}$, $P_{i,t-1}$, $P_{i,t-2}$ and $P_{i,t-3}$ are contemporaneous and lagged profitabilities and $D_{i,1}$, $D_{i,2}$ and $D_{i,3}$ are duration dummies capturing the time elapsed since last spike. $D_{i,1}$ takes value 1 if there is a spike in year $t-1$. $D_{i,2}$ takes value 1 if there is a spike in year $t-2$ but not in $t-1$. $D_{i,3}$ takes value 1 if there is a spike in year $t-3$ but not in $t-2$ or $t-1$. These dummy variables captures the effect of the length of the interval from the last high-investment episode on the probability of having a spike in year t (refer to Cooper et al. (1995); Grazzi et al. (2013); Bigsten et al. (2005)). u_i is a firm-specific unobserved effect and

$epsilon_{i,t}$ is a serially uncorrelated logistic disturbance term. Ownership, time (year) and sectoral (2-digit) dummies are also included in the regression.[18]

The effect of profitability on the probability of having a spike in year t is reported in Table 8. The results of random effect logistic regression is reported in column (iv), that controls for firm's heterogeneity.[19] The coefficients of current and lagged profitabilities are jointly significant, indicating investment spike is sensitive to profitability, which is the evidence of the existence of financial constraints - internal and external sources of finance are not perfectly substitutable. The sum of the marginal effects of contemperarous and lagged profitabilities is 0.074, that one additonal unit in profitabilites will induce 0.074 unit increase in the probability of having an investment spike. A higher profitability increases the probability of carrying out investment projects. The effect of past investment spike on the probability of having current investment spike decreases when the duration elapsed since last spike increases. Taking state-owned enterprises as the reference group, all the coefficients of ownership dummies are significantly higher than that of the reference group. In particular, the coefficient of private-owned enterprises is the largest, which is the evidence of the existence of much more severe financial constraints for China's domestic private-owned firms than SOEs, under an imperfect capital market. It also confirms the long-standing literature of soft-budget constraints on the investment of China's state-owned enterprises.

One step further, not only the short-term profitability shocks and firm's investment decisions are binding, we are also interested in testing whether augumenting long-term demand shock in the investment equation will wash away the effect of profitailities on investment. Under this purpose, we choose to adopt the accelerator-profit specification of investment equations to investigate both the roles of profitability shocks and long-term demand shocks. The framework of error-correction specification of accelerator-profit

[18] After some experimentations and compare the AIC and BIC critiria of the models, we decide to include three lags of profitability.

[19] The result of logitistic regression in column (v) are very similar with column (iv). Robustness check of the model is also reported in Table 8, column (i) through (iii). We exclude current profitability due to the endogeneity problem. The sum of the coefficients of profitabilities does not change significantly.

	Dependent Variable: Investment Spike									
	(i)		(ii)		(iii)		(iv)		(v)	
	Random Effect Logit		Random Effect Logit		Random Effect Logit		Random Effect Logit		Logit	
	Coef	Marginal Effects	Coef	Marginal Effects	Coef	Marginal Effects	Coef	Marginal Effects	Coef	Marginal Effects
P_t							0.274***	0.030***	0.273**	0.030**
							(0.100)	(0.011)	(0.127)	(0.014)
P_{t-1}	0.778***	0.070***	0.696***	0.063***	0.604***	0.054***	0.286**	0.031**	0.282**	0.031**
	(0.072)	(0.007)	(0.080)	(0.007)	(0.072)	(0.006)	(0.117)	(0.013)	(0.120)	(0.013)
P_{t-2}			0.182**	0.016**	0.066	0.006	-0.058	-0.006	-0.058	-0.006
			(0.077)	(0.007)	(0.072)	(0.006)	(0.088)	(0.009)	(0.068)	(0.008)
P_{t-3}					0.405***	0.036***	0.176**	0.019**	0.171**	0.019**
					(0.080)	(0.007)	(0.081)	(0.009)	(0.076)	(0.008)
Sum	0.778	0.070	0.878	0.079	1.075	0.096	0.678	0.074	0.668	0.074
Duration 1							0.800***	0.106***	0.822***	0.112***
							(0.030)	(0.005)	(0.026)	(0.004)
Duration 2							0.584***	0.074***	0.577***	0.074***
							(0.027)	(0.004)	(0.027)	(0.004)
Duration 3							0.345***	0.041***	0.342***	0.042***
							(0.030)	(0.004)	(0.030)	(0.004)
Collective-owned							0.489***	0.058***	0.484***	0.059***
							(0.039)	(0.005)	(0.036)	(0.005)
HMT-invested							0.480***	0.059***	0.475***	0.059***
							(0.045)	(0.006)	(0.041)	(0.006)
Foreign-invested							0.504***	0.063***	0.499***	0.064***
							(0.045)	(0.006)	(0.043)	(0.006)
Shareholding							0.674***	0.087***	0.666***	0.087***
							(0.040)	(0.006)	(0.038)	(0.006)
Private-owned							0.860***	0.116***	0.850***	0.116***
							(0.041)	(0.006)	(0.037)	(0.006)
Others							0.142	0.016	0.140	0.016
							(0.112)	(0.013)	(0.110)	(0.013)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs	94622		94622		94622		94622		94622	
Number of Groups	55647		55647		55647		55647			
Brier Score							0.1142		0.1142	
Pseudo R^2							0.032		0.0257	

Table 8: The effect of profitabilities and past investment spikes on current investment spikes. Notes: Models (i) through (iv) are random effects logistic regression with bootstrap errors. Model (v) is pooled logistic regression with cluster errors. Tables reports the results of both coefficients and marginal effects evaluated at the mean value of regressors, standard errors in parentheses. The reference group of ownership dummies is state-owned enterprises. Asterisks denote significance levels (***: p<1%; **: p<5%; * p<10%).

model has been explored by Mairesse et al. (1999).[20]

$$\begin{aligned}\Delta k_{i,t} = \alpha + \gamma\Delta k_{i,t-1} + \phi_0\Delta s_{i,t} + \phi_1\Delta s_{i,t-1} \\ + \lambda_1(k_{i,t-2} - s_{i,t-2}) + \lambda_2 s_{i,t-2} \\ + \beta_0 P_{i,t} + \beta_1 P_{i,t-1} + \beta_2 P_{i,t-2} + \beta_3 P_{i,t-3} + \eta_{i,t}\end{aligned} \tag{8}$$

where Δk is growth rate of capital stock, Δs is growth rate of sales, $k_{i,t-2} - s_{i,t-2}$ is the error-correcting term (the log of capital-sales ratio), $s_{i,t-2}$ is log of sales, the disturbance $\eta_{i,t} = u_i + b_t + \epsilon_{i,t}$ contains firm and year-specific effects u_i and d_t, as well as transitory shocks $\epsilon_{i,t}$. The growth rate of capital stock is a function of its own lagged growth rate, the growth in sales (current and lagged one), an error correction term $k_{i,t-2} - y_{i,t-2}$, a scale factor (log of sales) and the current and lagged profitability. The expected sign of error-correction term is negative, i.e., if the capital stock is above its desired level, future investment will be lower and vice versa. The sum of the coefficients on profitabilities $\beta = \beta_0 + \beta_1 + \beta_2 + \beta_3$ would capture effects which are associated with transitory effects of financial constraints, and the residual effect of demand shocks that are not fully accounted for by the sales growth variables.

The traditional empirical literatures of the error-correction model use investment rate as a proxy for the growth in capital stock. Due to the lumpiness of investment and only relative large investments matter in our paper, we are interested in investigating the effects of demand shocks on the probability of having investment spikes. Thus, we estimate Equation (8), replacing investment rates with spikes (the binary variable). Table 9 display the results. The total fitness (Pseudo R^2) of the model has been improved. Both the coefficients and marginal effects reported in column (ii) follow random effects logistic regression. The coeffiecients of sales growth are jointly significant, and the total marginal effects is 0.179, capturing the major contribution of demand shocks to investment. While the sum of the marginal effects of profitabilities drops to 0.039, but still jointly significant. The error-correction term are correctly signed (negative) and significant. The long-run effect of sales is positive and significant.

6. Investment spike and firm growth

Investment in new capital (embodied the latest technology) drives productivity growth and firm growth, that is the efficiency-driven competitive selection process. Or very large investment episodes are associated

[20]The main advantages of the error-correction specification are (i) allowe us to better characterize the longer term and shorter run aspects of the investment relation; (ii) neither the adjustment costs nor the expectations are explicitly formulated.

	Dependent Variable: Investment Spike				
	(i)		(ii)		(iii)
	Logit		Random Effect Logit		Linear Regression
	Coef	Marginal effects	Coef	Marginal effects	Coef
$SPIKE_{t-1}$	0.266***	0.030***	0.166***	0.017***	0.049***
	(0.018)	(0.002)	(0.022)	(0.002)	(0.003)
Δs_t	0.994***	0.105***	1.016***	0.102***	0.085***
	(0.020)	(0.002)	(0.016)	(0.002)	(0.002)
Δs_{t-1}	0.745***	0.079***	0.772***	0.077***	0.073***
	(0.018)	(0.002)	(0.013)	(0.001)	(0.002)
$k_{t-2} - s_{t-2}$	-0.256***	-0.027***	-0.271***	-0.027***	-0.027***
	(0.007)	(0.001)	(0.007)	(0.001)	(0.001)
s_{t-2}	0.213***	0.023***	0.221***	0.022***	0.021***
	(0.006)	(0.001)	(0.007)	(0.001)	(0.001)
P_t	-0.009***	-0.001***	-0.009	-0.001	-0.002*
	(0.002)	(0.000)	(0.024)	(0.002)	(0.001)
P_{t-1}	0.148**	0.016**	0.151***	0.015***	0.000
	(0.062)	(0.007)	(0.056)	(0.006)	(0.002)
P_{t-2}	0.064	0.007	0.066	0.007	0.004
	(0.070)	(0.007)	(0.068)	(0.007)	(0.004)
P_{t-3}	0.173***	0.018***	0.181***	0.018***	0.001***
	(0.055)	(0.006)	(0.062)	(0.006)	(0.000)
Collective-owned	0.151***	0.017***	0.148***	0.015***	0.002
	(0.027)	(0.003)	(0.024)	(0.003)	(0.003)
HMT-invested	0.098***	0.011***	0.093***	0.010***	-0.005*
	(0.030)	(0.003)	(0.027)	(0.003)	(0.003)
Foreign-invested	0.135***	0.015***	0.133***	0.014***	0.002
	(0.032)	(0.004)	(0.026)	(0.003)	(0.003)
Shareholding	0.384***	0.045***	0.392***	0.044***	0.032***
	(0.028)	(0.004)	(0.028)	(0.004)	(0.003)
Private-owned	0.502***	0.060***	0.515***	0.059***	0.049***
	(0.028)	(0.004)	(0.026)	(0.004)	(0.003)
Others	-0.177**	-0.018**	-0.190**	-0.018**	-0.033***
	(0.081)	(0.007)	(0.087)	(0.008)	(0.007)
Year dummies	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes
Number of Obs	174579		174579		174579
Number of firms	79957		79957		79957
Brier Score	0.1147		0.1148		
Pseudo R^2	0.0707		0.0631		
R^2					0.0508

Table 9: Results of error-correction framework of accelerator-profit model. Note: Model (i) is pooled logistic regression with robust standard errors. Model (ii) is random effects logistic regression with bootstrap errors. Model (iii) is pooled linear regression with robust standard errors. Table reports the results of both coefficients and marginal effects evaluated at the mean value of regressors, standard errors in parentheses. The reference group of ownership dummies is state-owned enterprises. Asterisks denote significance levels (***: p<1%; **: p<5%; * p<10%).

with the disruption of production, that reflects the negative effect of large investment on productivity or sales growth, due to the long learning curve. **?**Sakellaris (2004); Grazzi et al. (2013) find that the immediate impact of large investments on productivity is small, or even negative.

In this section, we investigate the dynamics of the interrelation between the timing of adjustment episodes and firm's growth, rely on the method proposed by Sakellaris (2004), Nilsen et al. (2009) and Grazzi et al. (2013). We estimate the following model:

$$X_{i,t} = \beta_0 Dt0_{i,t} + \beta_2 Dt1_{i,t} + \beta_3 Dt2_{i,t} + \gamma_1 DBefore_{i,t} + \gamma_2 DLeast_i + b_t + u_i + \epsilon_{i,t} \tag{9}$$

where $X_{i,t}$ is one of the performance variables (productivity growth or sales growth), $Dt0_{i,t}$, $Dt1_{i,t}$, $Dt2_{i,t}$ are duration dummies. $Dt0_{i,t}$ takes value 1 if the investment spike is contemporaneous, occurring in year t; $Dt1_{i,t}$ takes value 1 if the investment took place at $t-1$, but not in t, and $Dt2_{i,t}$ takes value 1 if the spike occurred at $t-2$, but not in $t-1$ or in t. $DBefore_{i,t}$ is a dummy that takes value 1 if the last investment spike was observed more than two years before t and zero otherwise. The coefficient γ_1 accounts for the effect of investment spikes on firm performance in the long run. The dummy $DLeast_i$ takes value 1 if firm i had at least one investment spike over the sample period and zero otherwise, thus it represents a sort of fixed effects for the group of firms reporting at least one investment spike. b_t are time dummies. u_i is a firm-specific unobserved random-effect and $\epsilon_{i,t}$ is the error term. Sectoral dummies are included. In model (vi) and (vii), we also report the coefficients of ownership dummies.

Table 10 report the estimates of the effects of investment spikes on productivity growth. The positive coefficients on the dummy variable $DLeast$ reveals that the group of investing firms has a higher productivity growth than their counterparts. As shown in column (ii), the overall contemporaneous effect of spikes on productivity growth ($Dt0 + DLeast$) is 0.059. The values of $Dt1 + DLeast$, $Dt2 + DLeast$, $DBefore + DLeast$ are 0.024, 0.016 and 0.003 respectively. This would suggest that current investment spikes generate positive shocks on productivity growth in the same year, and such positive effect vanishes over time. However, upon the subsample of firms having at least one investment spike (see column (iv)), the effect of current investment spike on productivity growth is negative and insignificant. Moreover, the magnitude of the negative shocks of past investment spikes on productivity growth increases over time.

Table 11 shows the effect of investment spikes on growth of sales. Firms having invested at least once during the sample period enjoy higher sales growth than their non-investing counterparts. The effect of contemporaneous investment spikes on firm growth is the largest (value of $D_{t0} + DLeast$ is 0.183 in

	Dependent variable: Growth rate of productivity						
				DLeast=1			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
	RE	RE	FE	RE	FE	RE	RE
Dt0	0.051***	-0.012*	0.018	-0.008	0.013	0.046***	-0.016**
	(0.004)	(0.007)	(0.011)	(0.007)	(0.011)	(0.004)	(0.007)
Dt1	0.021***	-0.042***	-0.002	-0.038***	-0.007	0.017***	-0.044***
	(0.005)	(0.007)	(0.011)	(0.007)	(0.012)	(0.005)	(0.007)
Dt2	0.008*	-0.055***	-0.004	-0.051***	-0.010	0.004	-0.057***
	(0.005)	(0.007)	(0.012)	(0.007)	(0.012)	(0.005)	(0.007)
DBefore	-0.004	-0.068***	-0.011	-0.062***	-0.019	-0.005	-0.067***
	(0.004)	(0.007)	(0.013)	(0.007)	(0.014)	(0.004)	(0.007)
DLeast		0.071***					0.069***
		(0.006)					(0.006)
Collective-owned						0.022***	0.020***
						(0.006)	(0.006)
HMT-invested						0.003	0.001
						(0.006)	(0.006)
Foreign-invested						-0.009	-0.012*
						(0.006)	(0.006)
Shareholding						0.024***	0.022***
						(0.006)	(0.006)
Private-owned						0.048***	0.045***
						(0.006)	(0.006)
Others						0.033*	0.031***
						(0.018)	(0.018)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs	226010	226010	226010	142187	142187	226010	226010
Number of Firms	107626	107626	107626	63967	63967	107626	107626
R^2 - overall	0.0033	0.0037	0.0002	0.0038	0.0005	0.0041	0.0045
R^2			0.4201		0.3826		

Table 10: Effect of Investment on growth of productivity. Notes: Columns (i) and (ii) are random effects regression. Column (iii) is fixed effects regression. Columns (iv) and (v) are random effects and fixed effects regression for a sub-sample firms with at least one investment spike. Column (vi) and (vii) are random effects regression with ownership dummies. Robust standard errors are in parentheses. Reference group of ownership dummies is state-owned enterprises. Asterisks denote significance levels (***: p<1%; **: p<5%; * p<10%).

column(ii)) and drops significantly afterwards. Within the group of firms having at least one investment spike (see column (iv) and (v)), the effect of contemporaneous investment spike on sales growth is positive significant. Past investment spikes contribute negatively to firm growth and the effect of negative shocks increases over time.

To test the effect of investment spikes on sales gowth at a finer level of disaggregation, we estimate the fixed effects model for each 2-digit sector, but only include $Dt0$ and $Dt1$ as regressors.[21] The fixed effects coefficients are reported in Table 12, together with R^2 and S^2 of the corresponding correlated random effects model. The explanatory power of current and lagged one investment spikes ranging from 0.004 to 0.033, taking median at 0.01. Firm's idiocyncratic characteristics explain the majority of the variances of growth.

7. Final remarks

In this work, we explores the dynamics of selection and reallocation through an investigation of the relationships linking productivity, profitability, investment and growth, based on China's manufacturing firm-level dataset during the period 1998 - 2007. First, we have shown an efficiency-driven competitive selection process, that productivity variations rather than relative levels, are the dominant productivity-related determinant of firm growth, which account for 15% - 20% of the variance in firms' growth rates, while profitability variables only contribute less than 5%. Such efficiency-driven selection is more significant within China's domestic private-owned enterprises and state-private joint ventures.

In the second part, we assume that profitability-growth relationship is mediated by investment. Firm's contemporaneous and lagged profitabilities display positive and significant effect on the probability of having an investment spike, the positive association between profitability and investment is as such evidence of the existence of some financial constraint (under financial market imperfection), which appears to be much more severe for China's domestic privately-owned firms than state-owned enterprises. Moreover, firms having invested at least once during the sample period enjoy higher growth than the non-investing group.

We will improve the paper in two aspects in the future. First, the econometric models will be refined in the future work, in order to solve the bias due to endogenous variables and unobserved firm-specific effects

[21] Because for all 2-digit sectors, the effects of investment spikes at time $t-2$ or before are not significant.

	Dependent variable: Growth rate of sales						
				DLeast=1			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
	RE	RE	FE	RE	FE	RE	RE
Dt0	0.159***	0.051***	0.081***	0.059***	0.078***	0.152***	0.049***
	(0.003)	(0.005)	(0.007)	(0.005)	(0.007)	(0.003)	(0.005)
Dt1	0.069***	-0.042***	0.014**	-0.035***	0.011	0.062***	-0.043***
	(0.003)	(0.005)	(0.007)	(0.005)	(0.007)	(0.003)	(0.005)
Dt2	0.035***	-0.076***	-0.007	-0.069***	-0.011	0.029***	-0.077***
	(0.003)	(0.005)	(0.007)	(0.005)	(0.007)	(0.003)	(0.005)
DBefore	0.006**	-0.109***	-0.011	-0.100***	-0.017**	0.003	-0.107***
	(0.003)	(0.005)	(0.008)	(0.005)	(0.008)	(0.003)	(0.005)
DLeast		0.132***					0.126***
		(0.004)					(0.004)
Collective-owned						0.044***	0.040***
						(0.005)	(0.005)
HMT-invested						0.046***	0.041***
						(0.005)	(0.005)
Foreign-invested						0.055***	0.049***
						(0.005)	(0.005)
Shareholding						0.055***	0.050***
						(0.005)	(0.005)
Private-owned						0.086***	0.080***
						(0.005)	(0.005)
Others						0.045***	0.041***
						(0.013)	(0.013)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs	226010	226010	226010	142187	142187	226010	226010
Number of Firms	107626	107626	107626	63967	63967	107626	107626
R^2 - overall	0.0250	0.0282	0.0048	0.0283	0.0098	0.0269	0.0300
R^2			0.5543		0.5145		

Table 11: Effect of Investment on growth of sales. Notes: Columns (i) and (ii) are random effects regression. Column (iii) is fixed effects regression. Columns (iv) and (v) are random effects and fixed effects regression for a sub-sample firms with at least one investment spike. Columns (vi) and (vii) are random effects regression with ownership dummies. Robust standard errors are in parentheses. Reference group of ownership dummies is state-owned enterprises. Asterisks denote significance levels (***: p<1%; **: p<5%; * p<10%).

CIC	SECTOR	Dt0	Star	Sdt.err	Dt1	Star	Sdt.err	R^2	S^2
13	Food processing of agricultural products	0.106	***	0.025	0.009		0.026	0.564	0.005
14	Other foodstuff	0.144	***	0.030	0.035		0.028	0.605	0.015
15	Beverages	0.190	***	0.040	0.074	*	0.040	0.544	0.030
16	Tobacco	0.033		0.067	0.047		0.066	0.629	0.014
17	Textile	0.104	***	0.014	0.032	**	0.014	0.590	0.016
18	Garments, footwear etc.	0.065	***	0.021	0.004		0.020	0.552	0.005
19	Leather, fur, feather etc.	0.142	***	0.027	0.053	*	0.027	0.586	0.012
20	Processing of timber, manuf. Of wood, bamboo, etc.	0.023		0.038	0.038		0.037	0.650	0.002
21	Furniture	0.097	**	0.040	-0.007		0.039	0.644	0.014
22	Paper and paper products	0.114	***	0.020	0.065	***	0.021	0.581	0.015
23	Printing, reproduction of recording media	0.079	***	0.022	0.011		0.021	0.552	0.009
24	Articles for culture, education and sports	0.050		0.031	0.084	***	0.032	0.503	0.009
25	Processing of petroleum, cokeries, nuclear fuel	0.128	*	0.066	0.127	*	0.066	0.544	0.024
26	Raw chemical materials and chemical products	0.086	***	0.015	0.034	**	0.014	0.538	0.009
27	Pharmaceuticals	0.039	*	0.022	-0.006		0.022	0.578	0.011
28	Chemical fibers	0.129	***	0.043	0.096	**	0.043	0.648	0.033
29	Rubber	0.082	***	0.032	0.030		0.032	0.635	0.009
30	Plastics	0.059	***	0.018	0.021		0.018	0.595	0.006
31	Non-metallic mineral products	0.123	***	0.013	0.025	*	0.013	0.549	0.013
32	Smelting and processing of ferrous metals	0.102	***	0.033	0.023		0.033	0.013	0.024
33	Smelting and processing of non-ferrous metals	0.045		0.035	0.013		0.035	0.620	0.009
34	Metal products	0.058	***	0.018	-0.013		0.018	0.602	0.005
35	General purpose machinery	0.064	***	0.012	0.007		0.013	0.596	0.012
36	Special purpose machinery	0.075	***	0.023	0.004		0.023	0.598	0.010
37	Transport equipment	0.057	***	0.018	-0.001		0.018	0.572	0.008
39	Electrical machinery and equipment	0.064	***	0.016	0.021		0.016	0.569	0.007
40	Communication equipments, computers etc.	0.106	***	0.022	0.036	*	0.021	0.569	0.010
41	Measuring instruments and machinery	0.095	***	0.032	0.006		0.032	0.589	0.014
42	Artwork and other	0.039		0.034	0.004		0.033	0.571	0.004

Table 12: Investmen spike timing and firm rowth relationship: fixed effects estimation with standard errors. R^2 and S^2 are derived from Correlated Random Effects model. Asterisks denote significance levels (***: p<1%; **: p<5%; * p<10%).

in the estimation of investment equations, and spike-growth relationship. GMM will be an alternative. Second, in the study of both the profit-investment relationship and the effect of investment spikes on firm growth, we will include additional control variables, such as size and age.

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A. Table Appendix

Table A.1: Aggregation of the 23 registration categories. Source: Jefferson et al. (2003), Annex I.

Code	Ownership category		Code	Registration status
1	State-owned		110	State-owned enterprises
			141	State-owned jointly operated enterprises
			151	Wholly State-owned companies
2	Collective-owned		120	Collective-owned enterprises
			130	Shareholding cooperatives
			142	Collective jointly operated enterprises
3	Hong Kong, Macao, Taiwan-invested		210	Overseas joint ventures
			220	Overseas cooperatives
			230	Overseas wholly-owned enterprises
			240	Overseas shareholding limited companies
4	Foreign-invested		310	Foreign joint ventures
		Joint ventures	320	Foreign cooperatives
			340	Foreign shareholding limited companies
		Foreign MNCs	330	Foreign wholly-owned enterprises
5	Shareholding		159	Other limited liability companies
			160	Shareholding limited companies
6	Private		171	Private wholly-owned enterprises
			172	Private cooperatives enterprises
			173	Private limited liability companies
			174	Private shareholding companies
7	Other domestic		143	State-collective jointly operated enterprises
			149	Other jointly operated enterprises
			190	Other enterprises

Table A.2: Productivity - Growth relationship: fixed effects estimation with standard errors. Asterisks denote significance levels (***: p<1%; **: p<5%; * p<10%).

CIC	SECTOR	β_0	Sdt.err	star	β_1	Sdt.err	star
131	Corn milling	0.236	0.011	***	-0.186	0.011	***
132	Feed	0.141	0.009	***	-0.126	0.009	***
133	Vegetable oil	0.279	0.014	***	-0.227	0.014	***
134	Sugar	0.194	0.027	***	-0.262	0.028	***
135	Slaughtering and meat	0.210	0.011	***	-0.178	0.011	***
136	Aquatic products	0.218	0.013	***	-0.195	0.012	***
137	Vegetables, fruit and nuts	0.188	0.013	***	-0.167	0.013	***
139	Other agricultural and subsidiary food	0.302	0.018	***	-0.234	0.018	***
141	Starch and starch products	0.187	0.016	***	-0.156	0.016	***
142	Candies, chocolates and candied fruit	0.157	0.024	***	-0.118	0.022	***
143	Convenience food	0.224	0.021	***	-0.186	0.021	***
144	Liquid milk and dairy products	0.156	0.018	***	-0.179	0.018	***
145	Canning	0.140	0.020	***	-0.095	0.019	***
146	Condiments and fermentation products	0.217	0.016	***	-0.211	0.016	***
149	Other food	0.186	0.018	***	-0.170	0.018	***
151	Neutral spirits	0.373	0.054	***	-0.360	0.047	***
152	Alcohols	0.279	0.011	***	-0.195	0.011	***
153	Soft drinks	0.235	0.016	***	-0.221	0.016	***
154	Purified tea	0.248	0.022	***	-0.100	0.021	***
161	Tobacco redrying	0.278	0.061	***	-0.139	0.065	**
162	Tobacco manufacture	0.386	0.031	***	-0.300	0.032	***
169	Other tobacco products	0.163	0.110	.	-0.105	0.111	.
171	Dyeing and finishing of cotton and chemical fiber textile	0.200	0.006	***	-0.186	0.006	***
172	Dyeing and finishing of wool textile	0.248	0.015	***	-0.189	0.015	***
173	Bast fibre	0.251	0.042	***	-0.269	0.041	***
174	Silk textile and finishing	0.275	0.011	***	-0.164	0.011	***
175	Textile finished products	0.187	0.009	***	-0.168	0.009	***
176	Knitgoods, knitworks and their products	0.244	0.009	***	-0.186	0.009	***
181	Textile clothing	0.231	0.005	***	-0.183	0.005	***
182	Textile fabric shoes	0.209	0.024	***	-0.139	0.022	***
183	Hats	0.254	0.035	***	-0.252	0.034	***
191	Leather tanning and processing	0.256	0.022	***	-0.178	0.021	***
192	Leather products	0.250	0.009	***	-0.208	0.008	***
193	Fur tanning and products processing	0.374	0.036	***	-0.223	0.039	***
194	Feather processing and products manufacturing	0.304	0.026	***	-0.174	0.025	***
201	Sawn timber and wood clip processing	0.211	0.033	***	-0.152	0.032	***
202	Hard board	0.274	0.013	***	-0.262	0.012	***
203	Wooden products	0.200	0.015	***	-0.187	0.014	***
204	Bamboo, rattan, palm and grass products	0.247	0.026	***	-0.153	0.025	***
211	Wood furniture	0.197	0.013	***	-0.201	0.012	***
212	Bamboo and rattan furniture	0.334	0.130	**	-0.385	0.115	***
213	Metal furniture	0.180	0.021	***	-0.194	0.022	***
214	Plastic furniture	0.522	0.176	***	-0.310	0.187	.
219	Other furniture	0.187	0.036	***	-0.288	0.035	***
221	Paper pulp	0.360	0.093	***	-0.334	0.097	***
222	Paper making	0.266	0.009	***	-0.210	0.009	***
223	Paper products	0.179	0.008	***	-0.159	0.008	***
231	Printing	0.181	0.007	***	-0.152	0.007	***
232	Binding and other printing services	0.234	0.018	***	-0.185	0.020	***
233	Copy of records media	0.105	0.045	**	-0.118	0.036	***
241	Stationery commodities	0.207	0.017	***	-0.161	0.017	***

Continued on next page

Table A.2 −continued from previous page

CIC	SECTOR	β_0	Sdt.err	star	β_1	Sdt.err	star
242	Sporting goods	0.260	0.017	***	-0.231	0.018	***
243	Musical instruments	0.146	0.029	***	-0.180	0.028	***
244	Toys	0.253	0.014	***	-0.209	0.013	***
245	Recreation facilities and entertainment products	0.102	0.070	.	-0.107	0.075	.
251	Refined petroleum products	0.172	0.015	***	-0.152	0.015	***
252	Coke	0.341	0.026	***	-0.396	0.024	***
253	Nuclear fuel	0.348	0.029	***	-0.177	0.029	***
261	Basic chemical raw materials	0.229	0.008	***	-0.200	0.007	***
262	Fertilizer	0.200	0.010	***	-0.159	0.010	***
263	Pesticide	0.201	0.018	***	-0.137	0.019	***
264	Coatings, inks, paints and other similar products	0.185	0.009	***	-0.128	0.008	***
265	Synthetic materials	0.129	0.014	***	-0.167	0.012	***
266	Special chemical products	0.216	0.008	***	-0.205	0.008	***
267	Daily chemical products	0.187	0.013	***	-0.155	0.013	***
271	Original drug of chemicals	0.225	0.016	***	-0.186	0.016	***
272	The preparation of chemicals	0.195	0.013	***	-0.164	0.012	***
273	Decoction pieces of Chinese medicine	0.212	0.012	***	-0.175	0.012	***
275	Veterinary drugs	0.262	0.028	***	-0.298	0.026	***
276	Biological and biochemical products	0.182	0.023	***	-0.218	0.022	***
277	Sanitation materials and medical supplies	0.173	0.029	***	-0.201	0.027	***
281	Cellulose and cellulose	0.201	0.044	***	-0.232	0.043	***
282	Synthetic fiber	0.229	0.015	***	-0.131	0.014	***
291	Tire	0.175	0.025	***	-0.138	0.026	***
292	Rubber plates, tubes and belts	0.210	0.022	***	-0.173	0.022	***
293	Rubber parts	0.198	0.026	***	-0.237	0.025	***
294	Reclaimed rubber	0.446	0.056	***	-0.344	0.059	***
295	Daily and medical rubber products	0.238	0.041	***	-0.197	0.041	***
296	Gumboots and rubber shoes	0.160	0.021	***	-0.154	0.022	***
299	Other rubber products	0.228	0.028	***	-0.159	0.024	***
301	Plastics film	0.155	0.013	***	-0.130	0.013	***
302	Plastic plates, tubes and profiles	0.207	0.013	***	-0.181	0.013	***
303	Plastic wire, rope and knitting	0.247	0.014	***	-0.204	0.014	***
304	Foam	0.172	0.012	***	-0.097	0.013	***
306	Plastic packing cases and containers	0.170	0.015	***	-0.159	0.016	***
307	Plastic parts	0.187	0.020	***	-0.164	0.018	***
308	Daily plastic manufacture	0.203	0.014	***	-0.163	0.013	***
309	Other plastic products	0.165	0.013	***	-0.131	0.012	***
311	Cement, limestone and gypsum	0.275	0.006	***	-0.214	0.006	***
312	Cement and gypsum products	0.246	0.010	***	-0.208	0.011	***
313	Brick, stone and other building materials	0.235	0.008	***	-0.194	0.008	***
314	Glass and glass products	0.264	0.010	***	-0.229	0.010	***
315	Ceramic products	0.287	0.014	***	-0.257	0.014	***
316	Refractory products	0.251	0.015	***	-0.199	0.015	***
319	Graphite and other non-metallic mineral products	0.232	0.015	***	-0.173	0.015	***
321	Iron-making	0.285	0.020	***	-0.307	0.019	***
322	Steel-making	0.313	0.034	***	-0.282	0.034	***
323	Steel calendering	0.182	0.010	***	-0.176	0.009	***
324	Ferroalloy smelting	0.265	0.020	***	-0.214	0.019	***
331	Common non-ferrous metal smelting	0.262	0.015	***	-0.207	0.014	***
332	Nobel metal smelting	0.281	0.037	***	-0.186	0.033	***
333	Smelting of rare earth metal in singularity	0.121	0.052	**	-0.120	0.060	**
334	Non-ferrous metal alloy	0.219	0.037	***	-0.084	0.038	**
335	Non-ferrous metal calendering	0.175	0.012	***	-0.141	0.011	***
341	Structural metal products	0.179	0.011	***	-0.181	0.011	***
342	Metal tools	0.216	0.013	***	-0.178	0.013	***

Continued on next page

Table A.2 −continued from previous page

CIC	SECTOR	β_0	Sdt.err	star	β_1	Sdt.err	star
343	Containers and metal packaging containers	0.200	0.013	***	-0.129	0.013	***
344	Metal wire and rope and their products	0.182	0.013	***	-0.154	0.013	***
345	Metal products used in construction and security	0.188	0.010	***	-0.184	0.010	***
346	Treatment and heat treatment processing	0.161	0.016	***	-0.179	0.015	***
347	Ceramic products	0.163	0.034	***	-0.152	0.038	***
348	Stainless steel and similar daily metal products	0.224	0.012	***	-0.218	0.012	***
351	Boilers and prime movers	0.229	0.013	***	-0.160	0.013	***
352	Metal processing machinery	0.192	0.012	***	-0.152	0.011	***
353	Lifting and transport equipments	0.150	0.015	***	-0.180	0.014	***
354	Pumps, valves, compressors and other similar machinery	0.210	0.009	***	-0.193	0.009	***
355	Bearing, gears and transmission & drive components	0.267	0.012	***	-0.181	0.012	***
356	Ovens, furnaces and electric furnaces	0.292	0.055	***	-0.101	0.047	**
357	Universal equipments like fans, weighing instruments and packing equipments	0.198	0.011	***	-0.149	0.011	***
358	General parts manufacture and mechanical	0.207	0.011	***	-0.175	0.011	***
359	Metal casting and forging processing	0.207	0.009	***	-0.200	0.008	***
361	Special equipments in mining, metallurgy and construction	0.197	0.012	***	-0.191	0.011	***
362	Chemical, timber and non-metallic processing equipments	0.266	0.013	***	-0.237	0.012	***
363	Special equipments in food, beverages, tobacco and feed production	0.275	0.021	***	-0.224	0.021	***
364	Special equipments in printing, pharmacy and daily chemical	0.236	0.017	***	-0.168	0.018	***
365	Special equipments in textile, clothing and leather industries	0.245	0.016	***	-0.117	0.017	***
366	Special equipments in electronic industry and electrical machinery	0.112	0.023	***	-0.134	0.024	***
367	Special equipments in agriculture, forestry, animal husbandry and fishery	0.289	0.017	***	-0.189	0.017	***
368	Medical equipments and appliances	0.197	0.017	***	-0.101	0.017	***
369	Environmental, social public security and other special equipments	0.204	0.018	***	-0.149	0.019	***
371	Rail transportation equipments	0.212	0.018	***	-0.162	0.019	***
372	Automobiles	0.226	0.006	***	-0.194	0.006	***
373	Autobikes	0.261	0.014	***	-0.225	0.014	***
374	Bicycles	0.147	0.018	***	-0.110	0.018	***
375	Ships and floating device	0.232	0.015	***	-0.124	0.015	***
376	Aerospace vehicles	0.180	0.025	***	-0.161	0.025	***
379	Transport equipments and other transport facilities	0.237	0.054	***	-0.266	0.050	***
391	Motors	0.248	0.013	***	-0.193	0.012	***
392	Power transmission & distribution and control equipments	0.215	0.008	***	-0.157	0.007	***
393	Wires, cables, optical cables and electrical equipments	0.221	0.008	***	-0.172	0.008	***
394	Batteries	0.233	0.019	***	-0.167	0.018	***
395	Household electrical	0.222	0.014	***	-0.203	0.014	***
396	Non-electrical household appliances	0.220	0.030	***	-0.211	0.032	***
397	Lighting equipments	0.214	0.012	***	-0.143	0.012	***
399	Other electrical machinery and equipments	0.193	0.031	***	-0.231	0.029	***
401	Communications equipment	0.216	0.015	***	-0.165	0.015	***
402	Radar and matching equipment	0.163	0.060	***	-0.227	0.049	***
403	Broadcasting and TV equipment	0.151	0.035	***	-0.161	0.035	***
404	Electronic computer	0.224	0.018	***	-0.215	0.019	***
405	Electronic parts	0.120	0.016	***	-0.178	0.014	***
406	Electronic components	0.187	0.009	***	-0.178	0.008	***
407	Home audio-visual equipment	0.224	0.020	***	-0.218	0.021	***
409	Other electronic equipment	0.165	0.031	***	-0.146	0.029	***
411	Common instruments and meters	0.225	0.013	***	-0.162	0.013	***
412	Special instruments and meters	0.280	0.021	***	-0.152	0.022	***
413	Watches and clocks	0.186	0.023	***	-0.188	0.023	***
414	Optical instruments and glasses	0.170	0.019	***	-0.130	0.019	***
415	Cultural and office machinery	0.160	0.027	***	-0.134	0.026	***
419	Other instruments and meters	0.132	0.045	***	-0.188	0.046	***
421	Arts and crafts	0.194	0.009	***	-0.142	0.009	***
422	Daily miscellaneous articles	0.192	0.021	***	-0.166	0.019	***

Table A.3: Productivity - Growth relationship: R^2, S^2 and decomposition of S^2

CIC	SECTOR	R^2	S^2	$S^2_{\Delta\pi_{i,t}}$	$S^2_{\bar{\pi}_{i,t}}$
131	Corn milling	0.53	0.15	0.13	0.01
132	Feed	0.58	0.15	0.14	0.02
133	Vegetable oil	0.57	0.17	0.16	0.01
134	Sugar	0.54	0.12	0.11	0.00
135	Slaughtering and meat	0.54	0.16	0.15	0.01
136	Aquatic products	0.56	0.15	0.14	0.01
137	Vegetables, fruit and nuts	0.64	0.17	0.16	0.00
139	Other agricultural and subsidiary food	0.61	0.23	0.22	0.01
141	Starch and starch products	0.59	0.15	0.13	0.02
142	Candies, chocolates and candied fruit	0.64	0.15	0.14	0.01
143	Convenience food	0.67	0.19	0.17	0.02
144	Liquid milk and dairy products	0.58	0.17	0.16	0.02
145	Canning	0.54	0.11	0.11	0.00
146	Condiments and fermentation products	0.57	0.15	0.13	0.02
149	Other food	0.59	0.16	0.15	0.01
151	Neutral spirits	0.67	0.35	0.35	0.00
152	Alcohols	0.55	0.19	0.17	0.02
153	Soft drinks	0.60	0.20	0.19	0.01
154	Purified tea	0.55	0.15	0.12	0.02
161	Tobacco redrying	0.45	0.10	0.09	0.02
162	Tobacco manufacture	0.50	0.23	0.19	0.04
169	Other tobacco products	0.33	0.13	0.10	0.03
171	Dyeing and finishing of cotton and chemical fiber textile	0.61	0.19	0.18	0.00
172	Dyeing and finishing of wool textile	0.52	0.17	0.15	0.01
173	Bast fibre	0.58	0.14	0.14	0.00
174	Silk textile and finishing	0.58	0.14	0.12	0.02
175	Textile finished products	0.62	0.15	0.13	0.02
176	Knitgoods, knitworks and their products	0.58	0.15	0.13	0.01
181	Textile clothing	0.53	0.14	0.14	0.01
182	Textile fabric shoes	0.61	0.13	0.11	0.02
183	Hats	0.53	0.18	0.16	0.01
191	Leather tanning and processing	0.63	0.17	0.16	0.01
192	Leather products	0.59	0.16	0.15	0.01
193	Fur tanning and products processing	0.60	0.26	0.23	0.02
194	Feather processing and products manufacturing	0.56	0.18	0.17	0.01
201	Sawn timber and wood clip processing	0.66	0.15	0.13	0.02
202	Hard board	0.68	0.27	0.26	0.01
203	Wooden products	0.60	0.18	0.17	0.01
204	Bamboo, rattan, palm and grass products	0.62	0.19	0.18	0.01
211	Wood furniture	0.63	0.17	0.15	0.01
212	Bamboo and rattan furniture	0.77	0.29	0.28	0.00
213	Metal furniture	0.65	0.17	0.16	0.01
214	Plastic furniture	0.76	0.31	0.25	0.06
219	Other furniture	0.63	0.17	0.16	0.01
221	Paper pulp	0.62	0.28	0.27	0.01
222	Paper making	0.53	0.18	0.17	0.01
223	Paper products	0.59	0.18	0.17	0.01
231	Printing	0.55	0.14	0.12	0.02
232	Binding and other printing services	0.56	0.20	0.15	0.05
233	Copy of records media	0.54	0.13	0.12	0.01
241	Stationery commodities	0.58	0.12	0.11	0.01

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Table A.3 –continued from previous page

CIC	SECTOR	R^2	S^2	$S^2_{\Delta\pi_{i,t}}$	$S^2_{\bar{\pi}_{i,t}}$
242	Sporting goods	0.59	0.18	0.16	0.01
243	Musical instruments	0.56	0.23	0.20	0.03
244	Toys	0.52	0.16	0.16	0.00
245	Recreation facilities and entertainment products	0.69	0.12	0.10	0.01
251	Refined petroleum products	0.63	0.17	0.16	0.01
252	Coke	0.67	0.22	0.22	0.00
253	Nuclear fuel	0.63	0.25	0.23	0.02
261	Basic chemical raw materials	0.60	0.20	0.19	0.01
262	Fertilizer	0.51	0.15	0.13	0.02
263	Pesticide	0.46	0.13	0.12	0.01
264	Coatings, inks, paints and other similar products	0.53	0.14	0.12	0.02
265	Synthetic materials	0.66	0.16	0.15	0.01
266	Special chemical products	0.65	0.22	0.21	0.01
267	Daily chemical products	0.60	0.17	0.16	0.01
271	Original drug of chemicals	0.58	0.18	0.17	0.01
272	The preparation of chemicals	0.55	0.18	0.16	0.01
273	Decoction pieces of Chinese medicine	0.48	0.12	0.12	0.01
275	Veterinary drugs	0.65	0.23	0.22	0.01
276	Biological and biochemical products	0.60	0.17	0.17	0.01
277	Sanitation materials and medical supplies	0.72	0.25	0.22	0.03
281	Cellulose and cellulose	0.63	0.17	0.16	0.01
282	Synthetic fiber	0.61	0.16	0.14	0.02
291	Tire	0.59	0.12	0.11	0.01
292	Rubber plates, tubes and belts	0.56	0.18	0.16	0.02
293	Rubber parts	0.59	0.15	0.13	0.02
294	Reclaimed rubber	0.66	0.36	0.36	0.00
295	Daily and medical rubber products	0.60	0.13	0.12	0.01
296	Gumboots and rubber shoes	0.57	0.14	0.10	0.03
299	Other rubber products	0.70	0.16	0.15	0.01
301	Plastics film	0.59	0.16	0.12	0.03
302	Plastic plates, tubes and profiles	0.65	0.20	0.19	0.01
303	Plastic wire, rope and knitting	0.60	0.18	0.16	0.02
304	Foam	0.60	0.16	0.14	0.02
306	Plastic packing cases and containers	0.64	0.17	0.15	0.02
307	Plastic parts	0.56	0.12	0.11	0.01
308	Daily plastic manufacture	0.60	0.15	0.13	0.02
309	Other plastic products	0.61	0.14	0.13	0.01
311	Cement, limestone and gypsum	0.48	0.19	0.18	0.01
312	Cement and gypsum products	0.58	0.19	0.19	0.01
313	Brick, stone and other building materials	0.56	0.17	0.16	0.01
314	Glass and glass products	0.58	0.20	0.19	0.01
315	Ceramic products	0.58	0.21	0.18	0.02
316	Refractory products	0.54	0.18	0.17	0.02
319	Graphite and other non-metallic mineral products	0.55	0.16	0.15	0.01
321	Iron-making	0.67	0.27	0.27	0.01
322	Steel-making	0.66	0.21	0.20	0.01
323	Steel calendering	0.61	0.17	0.15	0.01
324	Ferroalloy smelting	0.59	0.18	0.18	0.00
331	Common non-ferrous metal smelting	0.65	0.22	0.22	0.00
332	Nobel metal smelting	0.69	0.34	0.33	0.01
333	Smelting of rare earth metal in singularity	0.77	0.31	0.30	0.01
334	Non-ferrous metal alloy	0.61	0.12	0.11	0.01
335	Non-ferrous metal calendering	0.67	0.19	0.19	0.01
341	Structural metal products	0.63	0.15	0.14	0.01

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Table A.3 –continued from previous page

CIC	SECTOR	R^2	S^2	$S^2_{\Delta\pi_{i,t}}$	$S^2_{\bar{\pi}_{i,t}}$
342	Metal tools	0.58	0.18	0.16	0.02
343	Containers and metal packaging containers	0.59	0.15	0.14	0.01
344	Metal wire and rope and their products	0.59	0.18	0.16	0.02
345	Metal products used in construction and security	0.62	0.16	0.14	0.02
346	Treatment and heat treatment processing	0.54	0.14	0.13	0.01
347	Ceramic products	0.62	0.10	0.09	0.01
348	Stainless steel and similar daily metal products	0.63	0.18	0.16	0.01
351	Boilers and prime movers	0.52	0.15	0.12	0.02
352	Metal processing machinery	0.59	0.17	0.15	0.01
353	Lifting and transport equipments	0.55	0.12	0.10	0.02
354	Pumps, valves, compressors and other similar machinery	0.58	0.17	0.16	0.02
355	Bearing, gears and transmission & drive components	0.61	0.22	0.18	0.03
356	Ovens, furnaces and electric furnaces	0.63	0.21	0.18	0.03
357	Universal equipments like fans, weighing instruments and packing equipments	0.60	0.15	0.13	0.02
358	General parts manufacture and mechanical	0.63	0.15	0.14	0.01
359	Metal casting and forging processing	0.64	0.21	0.20	0.01
361	Special equipments in mining, metallurgy and construction	0.60	0.16	0.14	0.02
362	Chemical, timber and non-metallic processing equipments	0.60	0.18	0.17	0.01
363	Special equipments in food, beverages, tobacco and feed production	0.50	0.19	0.16	0.03
364	Special equipments in printing, pharmacy and daily chemical	0.55	0.18	0.17	0.01
365	Special equipments in textile, clothing and leather industries	0.57	0.17	0.14	0.03
366	Special equipments in electronic industry and electrical machinery	0.61	0.15	0.13	0.01
367	Special equipments in agriculture, forestry, animal husbandry and fishery	0.52	0.16	0.13	0.02
368	Medical equipments and appliances	0.58	0.15	0.14	0.01
369	Environmental, social public security and other special equipments	0.59	0.13	0.12	0.01
371	Rail transportation equipments	0.53	0.16	0.14	0.03
372	Automobiles	0.55	0.17	0.15	0.02
373	Autobikes	0.58	0.20	0.19	0.01
374	Bicycles	0.58	0.11	0.09	0.01
375	Ships and floating device	0.58	0.13	0,12	0.02
376	Aerospace vehicles	0.60	0.21	0.20	0.02
379	Transport equipments and other transport facilities	0,70	0.23	0.22	0.01
391	Motors	0.61	0.19	0.17	0.02
392	Power transmission & distribution and control equipments	0,56	0.16	0.15	0.01
393	Wires, cables, optical cables and electrical equipments	0.54	0.16	0.15	0.01
394	Batteries	0.62	0.17	0.16	0.01
395	Household electrical	0.57	0.18	0.16	0.02
396	Non-electrical household appliances	0.65	0.15	0.13	0.01
397	Lighting equipments	0.54	0.14	0.12	0.02
399	Other electrical machinery and equipments	0.69	0.17	0.17	0.01
401	Communications equipment	0.52	0.12	0.11	0.01
402	Radar and matching equipment	0.59	0.10	0.07	0.03
403	Broadcasting and TV equipment	0.66	0.22	0.20	0.02
404	Electronic computer	0.57	0.16	0.16	0.00
405	Electronic parts	0.59	0.16	0.15	0.01
406	Electronic components	0.61	0.15	0.14	0.01
407	Home audio-visual equipment	0.56	0.14	0.13	0.01
409	Other electronic equipment	0.61	0.12	0.11	0.01
411	Common instruments and meters	0.59	0.17	0.15	0.02
412	Special instruments and meters	0.61	0.21	0.18	0.03
413	Watches and clocks	0.44	0.11	0.10	0.01
414	Optical instruments and glasses	0.45	0.10	0.10	0.00
415	Cultural and office machinery	0.61	0.17	0.15	0.02
419	Other instruments and meters	0.76	0.16	0.14	0.02

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Table A.3 –continued from previous page

CIC	SECTOR	R^2	S^2	$S^2_{\Delta\pi_{i,t}}$	$S^2_{\bar{\pi}_{i,t}}$
421	Arts and crafts	0.54	0.14	0.12	0.02
422	Daily miscellaneous articles	0.60	0.16	0.14	0.02

Table A.4: Profitability - Growth relationship: fixed effects estimator. Asterisks denote significance levels (***: p<1%; **: p<5%; * p<10%).

CIC	SECTOR	β_0	Sdt.err	star	β_1	Sdt.err	star
131	Corn milling	0.143	0.025	***	-0.210	0.042	***
132	Feed	0.035	0.006	***	-0.165	0.013	***
133	Vegetable oil	0.096	0.017	***	-0.263	0.060	***
134	Sugar	0.642	0.115	***	-0.778	0.124	***
135	Slaughtering and meat	0.197	0.027	***	-0.125	0.048	***
136	Aquatic products	0.150	0.055	***	-0.284	0.079	***
137	Vegetables, fruit and nuts	0.148	0.088	*	-0.204	0.082	**
139	Other agricultural and subsidiary food	0.573	0.091	***	-0.318	0.111	***
141	Starch and starch products	0.243	0.035	***	0.032	0.047	.
142	Candies, chocolates and candied fruit	0.039	0.006	***	-0.206	0.134	.
143	Convenience food	0.570	0.080	***	0.127	0.075	*
144	Liquid milk and dairy products	0.220	0.093	**	-0.213	0.103	**
145	Canning	0.130	0.104	.	-0.006	0.041	.
146	Condiments and fermentation products	0.118	0.033	***	-0.329	0.055	***
149	Other food	0.144	0.029	***	-0.169	0.103	.
151	Neutral spirits	0.401	0.213	*	-0.304	0.399	.
152	Alcohols	0.039	0.011	***	0.024	0.012	**
153	Soft drinks	0.103	0.033	***	-0.317	0.072	***
154	Purified tea	0.298	0.052	***	0.040	0.056	.
161	Tobacco redrying	0.214	0.058	***	-0.021	0.125	.
162	Tobacco manufacture	0.145	0.145	.	-0.136	0.148	.
169	Other tobacco products	0.193	0.282	.	0.786	0.401	*
171	Dyeing and finishing of cotton and chemical fiber textile	0.224	0.035	***	-0.018	0.005	***
172	Dyeing and finishing of wool textile	0.003	0.003	.	-0.150	0.066	**
173	Bast fibre	0.584	0.122	***	-0.525	0.164	***
174	Silk textile and finishing	0.299	0.048	***	-0.335	0.065	***
175	Textile finished products	0.152	0.028	***	0.045	0.037	.
176	Knitgoods, knitworks and their products	0.307	0.029	***	-0.175	0.040	***
181	Textile clothing	0.021	0.004	***	-0.006	0.004	*
182	Textile fabric shoes	0.177	0.098	*	0.000	0.002	.
183	Hats	0.116	0.133	.	-0.130	0.131	.
191	Leather tanning and processing	0.461	0.040	***	0.140	0.125	.
192	Leather products	0.502	0.040	***	-0.321	0.040	***
193	Fur tanning and products processing	0.235	0.046	***	0.182	0.111	.
194	Feather processing and products manufacturing	0.458	0.149	***	-0.003	0.005	.
201	Sawn timber and wood clip processing	0.011	0.054	.	0.031	0.065	.
202	Hard board	0.556	0.068	***	-0.115	0.063	*
203	Wooden products	0.256	0.056	***	-0.320	0.083	***
204	Bamboo, rattan, palm and grass products	0.233	0.163	.	0.199	0.159	.
211	Wood furniture	0.095	0.063	.	-0.092	0.045	**
212	Bamboo and rattan furniture	-0.020	0.896	.	-1.025	0.832	.
213	Metal furniture	0.264	0.037	***	-0.310	0.132	**
214	Plastic furniture	-0.298	1.104	.	0.788	1.039	.

Continued on next page

Table A.4 −continued from previous page

CIC	SECTOR	β_0	Sdt.err	star	β_1	Sdt.err	star
219	Other furniture	0.456	0.213	**	-0.143	0.210	.
221	Paper pulp	1.539	0.658	**	-0,295	0.553	.
222	Paper making	0.227	0.023	***	-0.135	0.044	***
223	Paper products	0.269	0.037	***	-0.166	0.038	***
231	Printing	0.192	0.023	***	-0.148	0.025	***
232	Binding and other printing services	0.285	0.043	***	-0.009	0.053	.
233	Copy of records media	-0.037	0.211	.	-0.094	0.166	.
241	Stationery commodities	0.507	0.083	***	0.067	0.052	.
242	Sporting goods	0.082	0.013	***	-0.376	0.087	***
243	Musical instruments	-0.021	0.108	.	-0.129	0.128	.
244	Toys	0.433	0.065	***	-0.227	0.054	***
245	Recreation facilities and entertainment products	-0.039	0.393	.	-0.149	0.380	.
251	Refined petroleum products	0.002	0.089	.	0.188	0.091	**
252	Coke	0.419	0.174	**	-0.742	0.167	***
253	Nuclear fuel	0.249	0.051	***	-0.057	0.163	.
261	Basic chemical raw materials	0.113	0.015	***	-0.225	0.039	***
262	Fertilizer	0.145	0.016	***	-0.213	0.016	***
263	Pesticide	0.028	0.038	.	0.108	0.040	***
264	Coatings, inks, paints and other similar products	0.284	0.050	***	0.041	0.024	*
265	Synthetic materials	0.257	0.048	***	-0.226	0.049	***
266	Special chemical products	0.215	0.043	***	-0.340	0.042	***
267	Daily chemical products	0.171	0.050	***	-0.269	0.056	***
271	Original drug of chemicals	0.283	0.087	***	-0.367	0.087	***
272	The preparation of chemicals	0.369	0.060	***	-0.218	0.060	***
273	Decoction pieces of Chinese medicine	0.071	0.022	***	-0.009	0.022	.
275	Veterinary drugs	0.181	0.157	.	-0.901	0.143	***
276	Biological and biochemical products	0.222	0.060	***	-0.199	0.039	***
277	Sanitation materials and medical supplies	-0.224	0.112	**	-0.355	0.101	***
281	Cellulose and cellulose	-0.138	0.243	.	-0.297	0.266	.
282	Synthetic fiber	0.277	0.070	***	-0.016	0.093	.
291	Tire	0.096	0.131	.	0.021	0.159	.
292	Rubber plates, tubes and belts	0.373	0.118	***	-0.263	0.117	**
293	Rubber parts	0.159	0.117	.	-0.017	0.123	.
294	Reclaimed rubber	1.219	0.386	***	-0.187	0.383	.
295	Daily and medical rubber products	0.499	0.105	***	-0.136	0.222	.
296	Gumboots and rubber shoes	0.141	0.080	*	-0.247	0.082	***
299	Other rubber products	0.467	0.150	***	-0.145	0.129	.
301	Plastics film	0.071	0.016	***	-0.423	0.055	***
302	Plastic plates, tubes and profiles	0.302	0.074	***	-0.138	0.048	***
303	Plastic wire, rope and knitting	0.097	0.024	***	-0.300	0.076	***
304	Foam	0.223	0.080	***	0.072	0.084	.
306	Plastic packing cases and containers	0.079	0.079	.	-0.148	0.089	*
307	Plastic parts	0.653	0.093	***	-0.385	0.087	***
308	Daily plastic manufacture	0.255	0.032	***	-0.119	0.059	**
309	Other plastic products	0.362	0.052	***	-0.062	0.071	.
311	Cement, limestone and gypsum	0.140	0.021	***	0.047	0.021	**
312	Cement and gypsum products	0.321	0.037	***	-0.122	0.048	**
313	Brick, stone and other building materials	0.025	0.004	***	-0.088	0.024	***
314	Glass and glass products	0.210	0.035	***	-0.240	0.034	***
315	Ceramic products	0.442	0.058	***	-0.337	0.060	***
316	Refractory products	0.277	0.073	***	-0.208	0.071	***
319	Graphite and other non-metallic mineral products	0.292	0.056	***	0.044	0.082	.
321	Iron-making	0.312	0.127	**	-0.321	0.130	**
322	Steel-making	0.422	0.197	**	-0.332	0.266	.
323	Steel calendering	0.102	0.016	***	0.050	0.048	.

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Table A.4 –continued from previous page

CIC	SECTOR	β_0	Sdt.err	star	β_1	Sdt.err	star
324	Ferroalloy smelting	0.632	0.109	***	0.017	0.123	.
331	Common non-ferrous metal smelting	0.251	0.049	***	-0.294	0.059	***
332	Nobel metal smelting	0.122	0.219	.	0.187	0.213	.
333	Smelting of rare earth metal in singularity	-0.444	0.312	.	0.303	0.345	.
334	Non-ferrous metal alloy	0.264	0.015	***	0.418	0.214	*
335	Non-ferrous metal calendering	-0.066	0.082	.	-0.140	0.078	*
341	Structural metal products	0.100	0.021	***	-0.183	0.054	***
342	Metal tools	0.014	0.008	.	-0.314	0.067	***
343	Containers and metal packaging containers	0.216	0.021	***	-0.238	0.074	***
344	Metal wire and rope and their products	0.047	0.053	.	-0.230	0.052	***
345	Metal products used in construction and security	0.160	0.056	***	-0.094	0.051	*
346	Treatment and heat treatment processing	-0.074	0.081	.	0.060	0.082	.
347	Ceramic products	0.566	0.181	***	-0.143	0.229	.
348	Stainless steel and similar daily metal products	0.024	0.005	***	-0.284	0.075	***
351	Boilers and prime movers	0.090	0.020	***	-0.182	0.033	***
352	Metal processing machinery	0.168	0.039	***	0.060	0.015	***
353	Lifting and transport equipments	0.053	0.075	.	-0.363	0.071	***
354	Pumps, valves, compressors and other similar machinery	0.000	0.002	.	-0.239	0.032	***
355	Bearing, gears and transmission & drive components	0.122	0.011	***	0.046	0.016	***
356	Ovens, furnaces and electric furnaces	1.140	0.307	***	-0.003	0.256	.
357	Universal equipments like fans, weighing instruments and packing equipments	0.337	0.042	***	-0.049	0.042	.
358	General parts manufacture and mechanical	0.041	0.030	.	-0.062	0.040	.
359	Metal casting and forging processing	0.305	0.031	***	-0.173	0.047	***
361	Special equipments in mining, metallurgy and construction	0.423	0.043	***	-0.042	0.006	***
362	Chemical, timber and non-metallic processing equipments	0.214	0.048	***	-0.294	0.047	***
363	Special equipments in food, beverages, tobacco and feed production	0.196	0.070	***	-0.247	0.086	***
364	Special equipments in printing, pharmacy and daily chemical	0.329	0.043	***	0.091	0.018	***
365	Special equipments in textile, clothing and leather industries	0.247	0.040	***	-0.087	0.061	.
366	Special equipments in electronic industry and electrical machinery	0.094	0.108	.	-0.219	0.113	*
367	Special equipments in agriculture, forestry, animal husbandry and fishery	0.251	0.045	***	-0.122	0.047	***
368	Medical equipments and appliances	0.225	0.060	***	-0.064	0.055	.
369	Environmental, social public security and other special equipments	0.232	0.037	***	0.046	0.031	.
371	Rail transportation equipments	0.529	0.063	***	-0.299	0.076	***
372	Automobiles	0.107	0.006	***	-0.173	0.022	***
373	Autobikes	0.124	0.082	.	-0.330	0.086	***
374	Bicycles	0.031	0.044	.	-0.018	0.037	.
375	Ships and floating device	0.480	0.056	***	-0.085	0.068	.
376	Aerospace vehicles	0.317	0.092	***	-0.187	0.093	**
379	Transport equipments and other transport facilities	0.153	0.268	.	-0.385	0.223	*
391	Motors	0.507	0.063	***	-0.059	0.033	*
392	Power transmission & distribution and control equipments	0.206	0.025	***	-0.095	0.033	***
393	Wires, cables, optical cables and electrical equipments	0.484	0.050	***	-0.245	0.049	***
394	Batteries	0.429	0.104	***	-0.187	0.101	*
395	Household electrical	0.035	0.008	***	-0.223	0.079	***
396	Non-electrical household appliances	0.298	0.165	*	-0.062	0.185	.
397	Lighting equipments	0.516	0.069	***	-0.092	0.066	.
399	Other electrical machinery and equipments	0.285	0.140	**	-0.376	0.051	***
401	Communications equipment	0.404	0.057	***	-0.155	0.073	**
402	Radar and matching equipment	-0.062	0.038	.	-0.118	0.042	***
403	Broadcasting and TV equipment	0.266	0.194	.	-0.456	0.158	***
404	Electronic computer	0.075	0.032	**	-0.036	0.032	.
405	Electronic parts	0.051	0.052	.	-0.180	0.063	***
406	Electronic components	0.007	0.001	***	-0.247	0.036	***
407	Home audio-visual equipment	0.204	0.057	***	-0.165	0.057	***
409	Other electronic equipment	0.044	0.024	*	-0.107	0.057	*

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Table A.4 −continued from previous page

CIC	SECTOR	β_0	Sdt.err	star	β_1	Sdt.err	star
411	Common instruments and meters	0.205	0.029	***	-0.228	0.047	***
412	Special instruments and meters	0.035	0.037	.	-0.188	0.094	**
413	Watches and clocks	0.008	0.020	.	-0.330	0.078	***
414	Optical instruments and glasses	0.117	0.082	.	-0.134	0.093	.
415	Cultural and office machinery	0.064	0.013	***	-0.139	0.105	.
419	Other instruments and meters	0.412	0.235	*	-0.224	0.212	.
421	Arts and crafts	0.058	0.011	***	-0.042	0.032	.
422	Daily miscellaneous articles	0.035	0.110	.	0.007	0.102	.

Table A.5: Profitability - Growth: R^2 and S^2

CIC	SECTOR	R^2	S^2
131	Corn milling	0.49	0.01
132	Feed	0.56	0.02
133	Vegetable oil	0.50	0.01
134	Sugar	0.52	0.05
135	Slaughtering and meat	0.50	0.02
136	Aquatic products	0.51	0.03
137	Vegetables, fruit and nuts	0.61	0.01
139	Other agricultural and subsidiary food	0.54	0.02
141	Starch and starch products	0.56	0.03
142	Candies, chocolates and candied fruit	0.63	0.04
143	Convenience food	0.64	0.05
144	Liquid milk and dairy products	0.54	0.01
145	Canning	0.52	0.01
146	Condiments and fermentation products	0.52	0.03
149	Other food	0.56	0.01
151	Neutral spirits	0.58	0.14
152	Alcohols	0.48	0.02
153	Soft drinks	0.55	0.03
154	Purified tea	0.51	0.04
161	Tobacco redrying	0.43	0.07
162	Tobacco manufacture	0.35	0.03
169	Other tobacco products	0.37	0.14
171	Dyeing and finishing of cotton and chemical fiber textile	0.56	0.02
172	Dyeing and finishing of wool textile	0.46	0.01
173	Bast fibre	0.56	0.06
174	Silk textile and finishing	0.52	0.01
175	Textile finished products	0.58	0.02
176	Knitgoods, knitworks and their products	0.54	0.02
181	Textile clothing	0.47	0.00
182	Textile fabric shoes	0.58	0.01
183	Hats	0.45	0.02
191	Leather tanning and processing	0.62	0.08
192	Leather products	0.54	0.03
193	Fur tanning and products processing	0.51	0.04
194	Feather processing and products manufacturing	0.49	0.02
201	Sawn timber and wood clip processing	0.63	0.02
202	Hard board	0.62	0.02
203	Wooden products	0.55	0.02
204	Bamboo, rattan, palm and grass products	0.57	0.01

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Table A.5 −continued from previous page

CIC	SECTOR	R^2	S^2
211	Wood furniture	0.58	0.02
212	Bamboo and rattan furniture	0.68	0.02
213	Metal furniture	0.63	0.05
214	Plastic furniture	0.66	0.05
219	Other furniture	0.57	0.04
221	Paper pulp	0.56	0.10
222	Paper making	0.46	0.01
223	Paper products	0.55	0.02
231	Printing	0.51	0.02
232	Binding and other printing services	0.51	0.06
233	Copy of records media	0.50	0.04
241	Stationery commodities	0.54	0.01
242	Sporting goods	0.52	0.02
243	Musical instruments	0.52	0.05
244	Toys	0.45	0.03
245	Recreation facilities and entertainment products	0.68	0.03
251	Refined petroleum products	0.60	0.01
252	Coke	0.58	0.02
253	Nuclear fuel	0.55	0.05
261	Basic chemical raw materials	0.54	0.02
262	Fertilizer	0.49	0.06
263	Pesticide	0.42	0.01
264	Coatings, inks, paints and other similar products	0.49	0.01
265	Synthetic materials	0.63	0.04
266	Special chemical products	0.60	0.01
267	Daily chemical products	0.57	0.01
271	Original drug of chemicals	0.53	0.03
272	The preparation of chemicals	0.51	0.02
273	Decoction pieces of Chinese medicine	0.43	0.00
275	Veterinary drugs	0.58	0.04
276	Biological and biochemical products	0.55	0.05
277	Sanitation materials and medical supplies	0.69	0.06
281	Cellulose and cellulose	0.57	0.00
282	Synthetic fiber	0.55	0.01
291	Tire	0.56	0.01
292	Rubber plates, tubes and belts	0.51	0.04
293	Rubber parts	0.54	0.01
294	Reclaimed rubber	0.56	0.09
295	Daily and medical rubber products	0.58	0.06
296	Gumboots and rubber shoes	0.56	0.04
299	Other rubber products	0.65	0.02
301	Plastics film	0.56	0.03
302	Plastic plates, tubes and profiles	0.61	0.02
303	Plastic wire, rope and knitting	0.54	0.03
304	Foam	0.56	0.02
306	Plastic packing cases and containers	0.60	0.03
307	Plastic parts	0.55	0.03
308	Daily plastic manufacture	0.57	0.03
309	Other plastic products	0.58	0.04
311	Cement, limestone and gypsum	0.40	0.02
312	Cement and gypsum products	0.52	0.01
313	Brick, stone and other building materials	0.51	0.01
314	Glass and glass products	0.51	0.03
315	Ceramic products	0.51	0.04
316	Refractory products	0.48	0.02

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Table A.5 –continued from previous page

CIC	SECTOR	R^2	S^2
319	Graphite and other non-metallic mineral products	0.50	0.01
321	Iron-making	0.60	0.03
322	Steel-making	0.59	0.02
323	Steel calendering	0.58	0.01
324	Ferroalloy smelting	0.53	0.02
331	Common non-ferrous metal smelting	0.60	0.01
332	Nobel metal smelting	0.63	0.03
333	Smelting of rare earth metal in singularity	0.77	0.01
334	Non-ferrous metal alloy	0.75	0.27
335	Non-ferrous metal calendering	0.64	0.02
341	Structural metal products	0.59	0.02
342	Metal tools	0.53	0.01
343	Containers and metal packaging containers	0.56	0.04
344	Metal wire and rope and their products	0.55	0.03
345	Metal products used in construction and security	0.58	0.01
346	Treatment and heat treatment processing	0.49	0.01
347	Ceramic products	0.60	0.02
348	Stainless steel and similar daily metal products	0.58	0.01
351	Boilers and prime movers	0.48	0.02
352	Metal processing machinery	0.55	0.02
353	Lifting and transport equipments	0.51	0.01
354	Pumps, valves, compressors and other similar machinery	0.53	0.01
355	Bearing, gears and transmission & drive components	0.56	0.04
356	Ovens, furnaces and electric furnaces	0.58	0.07
357	Universal equipments like fans, weighing instruments and packing equipments	0.57	0.02
358	General parts manufacture and mechanical	0.59	0.00
359	Metal casting and forging processing	0.60	0.02
361	Special equipments in mining, metallurgy and construction	0.56	0.01
362	Chemical, timber and non-metallic processing equipments	0.54	0.03
363	Special equipments in food, beverages, tobacco and feed production	0.43	0.03
364	Special equipments in printing, pharmacy and daily chemical	0.51	0.05
365	Special equipments in textile, clothing and leather industries	0.53	0.02
366	Special equipments in electronic industry and electrical machinery	0.59	0.03
367	Special equipments in agriculture, forestry, animal husbandry and fishery	0.47	0.03
368	Medical equipments and appliances	0.54	0.01
369	Environmental, social public security and other special equipments	0.55	0.03
371	Rail transportation equipments	0.50	0.06
372	Automobiles	0.51	0.02
373	Autobikes	0.52	0.03
374	Bicycles	0.55	0.01
375	Ships and floating device	0.56	0.02
376	Aerospace vehicles	0.56	0.05
379	Transport equipments and other transport facilities	0.65	0.04
391	Motors	0.56	0.03
392	Power transmission & distribution and control equipments	0.51	0.02
393	Wires, cables, optical cables and electrical equipments	0.49	0.01
394	Batteries	0.58	0.02
395	Household electrical	0.53	0.01
396	Non-electrical household appliances	0.61	0.01
397	Lighting equipments	0.50	0.02
399	Other electrical machinery and equipments	0.66	0.08
401	Communications equipment	0.47	0.02
402	Radar and matching equipment	0.58	0.20
403	Broadcasting and TV equipment	0.64	0.12
404	Electronic computer	0.51	0.03

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Table A.5 –continued from previous page

CIC	SECTOR	R^2	S^2
405	Electronic parts	0.55	0.02
406	Electronic components	0.57	0.01
407	Home audio-visual equipment	0.51	0.02
409	Other electronic equipment	0.58	0.00
411	Common instruments and meters	0.53	0.03
412	Special instruments and meters	0.53	0.02
413	Watches and clocks	0.39	0.02
414	Optical instruments and glasses	0.41	0.01
415	Cultural and office machinery	0.60	0.07
419	Other instruments and meters	0.73	0.07
421	Arts and crafts	0.50	0.01
422	Daily miscellaneous articles	0.57	0.03

B. Investment spikes definition

In the literature, there are four methods of identifying investment spikes, (i) absolute method: investment rate greater than 20% (the volatility of these ratio decreases with the capital stock, spikes are much common for small than for large firms); (ii) relative method; (iii) linear method and (iv) kernel method, which are summarized and compared by Grazzi et al. (2013). In this paper, we adopt kernel method to identify the investment spikes:

$$S_{i,t} = \begin{cases} 1 & \text{if } I_t/K_{i,t-1} > \alpha E[(I_{i,t}/K_{i,t-1})|K_{i,t-1}] \\ 0 & \text{otherwise} \end{cases}$$

where α is set to 1.75 and the conditional expected value is obtained through kernel estimation within each 2-digit sector. For example, the threshold calculated by kernel regression for the overall sample is shown in Figure B.1. Investment rates above the threshold are defined as investment spikes.[22]

[22] In the data, 2% of firms have investment rate greater than 3. Thus, we delete firms with investment rate greater than 3 for at least one year.

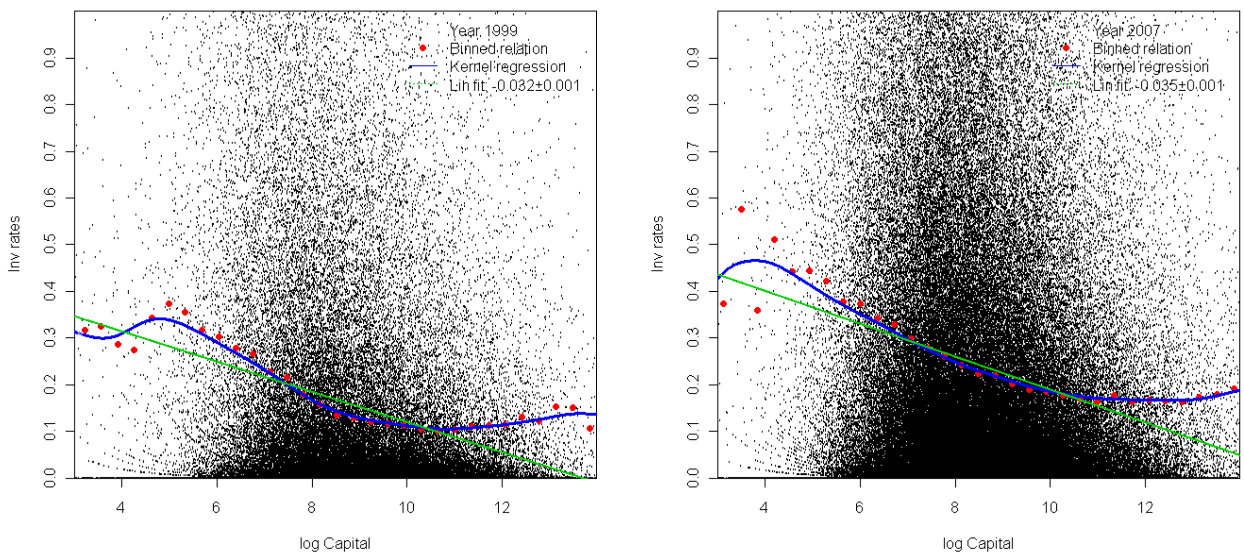

Figure B.1: Kernel regression (blue curve), binned relation (50 equal spaced bin; red dots) and OLS regression (green line) of investment rates (black dots) on log(capital) in 1999 and 2007. Source: our elaboration on CMM.