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Inside the Virtuous Cycle between Productivity, Profitability, Investment and Corporate Growth: An Anatomy of China Industrialization

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Abstract

This article explores the dynamics of market selection by investigating of the relationships linking productivity, profitability, investment and growth, based on China's manufacturing firm-level dataset over the period 1998 - 2007. First, we find that productivity variations, rather than relative levels, are the dominant productivity-related determinant of firm growth, and account for 15% - 20% of the variance in firms' growth rates. The direct relation between profitability and firm growth is much weaker as it contributes for less than 5% to explain the different patterns of firm growth. On the other hand, the profitability-growth relationship is mediated via investment. Firm's contemporaneous and lagged profitabilities display positive and significant effect on the probability to report an investment spike, and, in turn, investment activity is related to higher firm growth.

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

Keywords: Productivity, Market selection, Profitability, Investment spike, Firm growth, Chinese economy

1. Introduction

The last three decades witnessed an impressive growth of the Chinese economy. Several factors contributed to increase in the levels of GDP per capita. The contribution to growth due to human capital accumulation and increased labor participation, although much important in absolute terms, almost fade away when compared to the contribution due to productivity growth (Zhu, 2012). Firm level evidence further confirms such aggregate stylized fact and refines it shedding new light on the role of firms in the catching up of productivity for the Chinese economy. In this respect Brandt et al. (2012) report that productivity increase due to improvements in continuing firms and entrants is the main source of productivity growth over the 1998-2007 period. On the contrary, the contribution to the aggregate productivity growth due to reallocation, that is inputs shifting from less to more productive firms, is remarkably small.

The present paper investigates the sources of firm growth in this period of dramatic development of the Chinese economy. In particular, we focus on the contribution of productivity, both in levels and growth rates, in accounting for the different patterns of firm growth that one observes in China over the 1998-2007 period. In so doing, we also investigates for the role exerted by different governance and ownership structures of Chinese firms. Finally, we consider for the possibility that the relation between productivity and firm growth does not occur directly, but is mediated via profitability and investment in tangible assets.

Our work is rooted in a tradition of models in industrial dynamics that predict heterogeneity in production efficiency and innovativeness to be a relevant drivers of the differential patterns of firms' growth. This is the case for "equilibrium models" such as Jovanovic (1982), Hopenhayn (1992), Ericson and Pakes (1995) and the more recent Luttmer (2007) and Acemoglu et al. (2013). And it does apply also to Schumpeterian evolutionary models, including the classic Nelson and Winter, 1982, and also a family of models formally representing the process of selection among firms through some mechanism of the replicator-dynamics type (see, among the others, Silverberg et al., 1988; Dosi et al., 1995; Silverberg and Verspagen, 1995; Metcalfe, 1998). There exists two channels through which productivity fuels firm growth. A first, *direct*, channel is that in which more efficient firms gain market shares and grow more than competitors by setting lower prices. If competitiveness is inversely related to prices, and in turn prices are inversely related to productivity, the law of motion of shares of firm i of a replicator-dynamics type in any one industry is such that firms with above-average productivity should display above-average growth and increase their market shares, and vice versa for less productive firms.[1] A second, *indirect* channel is that in which more efficient firms operating in a competitive, price-taking market would enjoy higher profits and hence would invest more, especially in presence of imperfect capital markets, and consequently gain market shares at the expenses of competitors (Nelson and Winter, 1982; Bottazzi et al., 2001).

In particular, the dynamics of firms and industries in an emerging market is certainly richer and more dramatic than that observed in more "mature" economies.[2] In particular, the case of China was characterized still in the late 90s by widespread differences in firm level productivities, both within and across industrial sectors and ownership types (Dosi et al., 2013). Such dispersion in productivities significantly shrank in more recent years due to exit, but also more importantly, because of organizational change involving deep transformations in governance and technological learning. This makes of China an appropriate institutional setting over which investigating the determinants of corporate growth.

In order to investigate the extent to which higher relative efficiencies *directly* translates into higher firm growth one has to tackle some methodological issues. In this respect a similar work by Bottazzi et al. (2010) report that productivity levels of the firms have surprisingly low power in explaining the variance of firms' growth rates. On the contrary, the latter are mostly accounted for by time invariant unobserved heterogeneity, ultimately capturing idiosyncratic degrees of "strategic freedom" of individual firms. This is a rather common issue that is faced when the explanatory variable, productivity level in this case, is rather invariant over time so that is collinear with the firm fixed effect (see also Section 2.1 in Arellano, 2003). Hence resorting to plain fixed effects models washes away the contribution of average efficiency of a firm over the observed period, which result in a systematic underestimation of the true contribution of the relative efficiency variable to relative firm growth. A solution to alleviate the issue is proposed in Dosi et al. (forthcoming) where the authors propose a different panel techniques in order to extract out from unobserved fixed effects the part which correlates with within-firm average productivities as distinct from the "independent" one. This is the path that we also take to address such econometric issue.

There also exists an *indirect* channel through which higher profitability might contribute to firm growth. This is related to the possibility offered by internal resources to untie financial constraints and hence allow the acquisition of new capital vintage, which in turn might foster firm growth. Empirical research on the dynamics of firm level investment has for long been limited, if not precluded, due to lack of data on the

[1]This argument is based on *physical* productivity, if one can use proper price index to deflate output (Foster et al., 2008).

[2]Note however that there remains non-negligible degrees of heterogeneity in the patterns of productivity, levels and growth rates, even in more "stagnant" economies, see for instance, Dosi et al. (2012).

stock of capital of firms. One of the first attempt in this direction is the work by Doms and Dunne (1998) on US data which in turn inspired a growing body of work related to other countries. A common finding of these studies is the *lumpy* nature of the activity of firm-level investment: years of inactivity or repair and maintenance are followed by one or several years of heavy investment - with respect to both the firm and the industry as a whole.

Rather intuitively, large investment projects require correspondingly conspicuous financial resources. If those available internally are insufficient, the firm will have to rely on external finance to realize the project and this might lead to two consequences. *First*, the acquisition of new equipment and capital stock will be limited, that is, the firm's desired level of investment is curbed (set to zero) because of poor (complete lack of) access to external finance Schiantarelli (1996); Audretsch and Elston (2002); Whited (2006). *Second*, to the extent that investment is associated to firm growth, the existence of financial constraints will preclude the possibility to exploit opportunities for growth. In this respect, limited access to external finance in turn constraints firm growth (see, among the others Oliveira and Fortunato, 2006; Whited, 2006). Notice that matters related to the development and to the imperfections of the financial system are certainly more pronounced for an emerging economy such as China (see among the others Cull and Xu, 2003; Allen et al., 2012; Chen and Guariglia, 2013). In particular, in investigating the relevance of financial constraints among Chinese firms, it is much relevant to account for the different ownership structures. Indeed, as already shown in Guariglia et al. (2011), over the period 2000-2007, state owned enterprises were not affected, while the availability of internal finance represents a binding constraint for the growth of private firms.

2. Data and Variables

For the empirical analysis, the present paper draws upon firm level data collected by the Chinese National Bureau of Statistics (NBS). The database includes all industrial firms with sales above 5 million RMB covering period 1998-2007 and has already been employed in some empirical investigations, see among the other, Hu et al. (2005); Fu and Gong (2011).[3] Each firm is assigned to a sector according to the 4-digit Chinese Industry Classification (CIC) system that closely matches the Standard Industrial Classification

[3]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 are not available in 2004, thus, we do not use data for 2004.

(SIC) employed by the U.S. Bureau of Census.[4] Out of the comprehensive set of all firms, we focus on manufacturing firms only. Table A.3 in the Appendix reports the full names of the three digit sectors that have been employed in the analysis. We then applied a set cleaning procedures to the resulting set of data in order to eliminate visible recording errors (see Table A.1). We will refer to the final version of the database as "China Micro Manufacturing" (CMM).[5]

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,[6] $N_{i,t}$ is number of employees, of firm i at year t.[7] Cost of labour $COL_{i,t}$ is defined as the sum of total wages and social security contribution. Our proxy for profitability is the ratio of gross profit margins, divided by output: $P_{i,t} = \frac{VA_{i,t} - COL_{i,t}}{Output_{i,t}}$.[8] 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 $t-1$, where both investment and capital stock are in real value. Investment is not directly observed in the data, thus, we compute investment at time t as the difference of firm's fixed assets at original value between time t and $t-1$.[9] The series of real capital stock are then computed following the perpetual inventory method, and the rate of depreciation is 9% (see also Brandt et al., 2012). Table 1 reports statistics of the mean values of the variables of interest.

We identify seven categories of firms according to their ownership and governance structures. They are

[4] In 2003, the classification system was revised. Some sectors were further disaggregated, while others were merged together. To make the industry codes comparable over time, we adopted the harmonized classification proposed in Brandt et al. (2012).

[5] We applied the following cleaning procedure. We dropped 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). Finally, note that NBSC modified industrial classification after 2002. In this paper we employ the industrial classification in use before 2003. Since CIC43 was emerged during the observation period, we do not consider it here.

[6] According to the definition of NBSC, value added = gross output - intermediate input + value added tax. Gross industrial output value: "the total volume of final industrial products produced and industrial services provided during a given period. It reflects the total achievements and overall scale of industrial production during a given period" (China Statistical Yearbook, 2007).

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

[8] We use output as the denominator instead of sales in order to be consistent with the NBSC methodology of computing value added, which is the difference between output and intermediate input. Also notice that the two varaibles, output and sales, are highly correlated, with 0.99 correlation coefficient.

[9] According to NBSC, fixed assets include equipment and buildings.

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. 2004 is not consider because output and value added are not available.

respectively, 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 (ODEs). As reported in Table A.2, 23 registration categories have been aggregated into seven broader ones, in line with Jefferson et al. (2003).

3. Relative productivities and firm growth

We start by looking at the relationship between firm productivities and growth rates by means of a simple bivariate kernel regression. Figure 1 reports the productivity-growth relationship for three different 3-digit sectors. The plots highlight the existence of a positive but mild relation between contemporaneous (relative) productivities and relative growth rates, which is in line to what shown in Bottazzi et al. (2005).

In order to allow for a richer structure in the productivity-growth relationship, we employ a distributed lag linear model with additive heterogeneity (Bottazzi et al., 2010; Dosi et al., forthcoming).[10] Based on sequential rejection of the statistical significance of longer lags structure, we choose as our baseline equation a model with one lag for productivity:

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

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

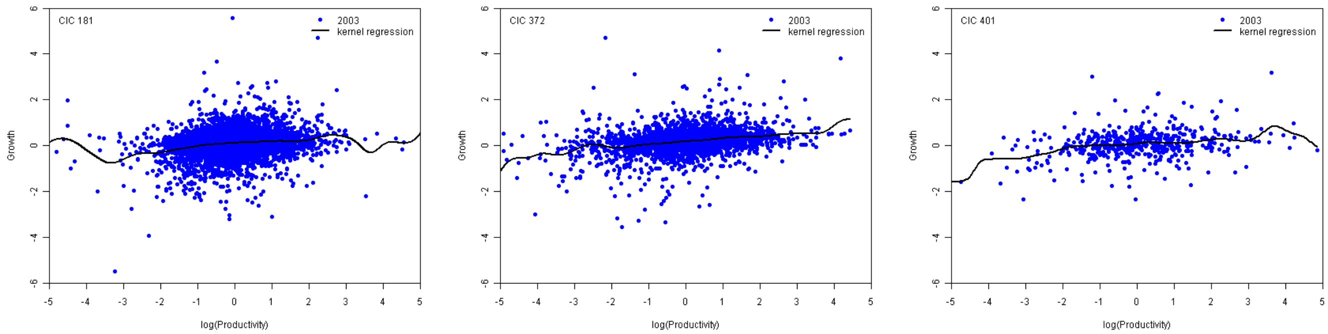

Figure 1: Productivity - Growth relationship in selected 3-digit sectors (textile clothing, automobiles and communication equipment) - kernel regression of 2003. Source: our elaboration on CMM.

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 reported in Table A.3. In the majority of 3-digit sectors, the coefficients β_0 and β_1 are significant at the 1% level and have opposite signs, positive and negative, respectively. 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. Strong regularities of the two coefficients emerge across sectors. The distributions of parameters β_0, β_1 and $\beta_0 + \beta_1$ are shown in Figure 2. The absolute values 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. On average a 1% increase in productivity at time t is related to an average increase of sales growth of 0.2%.

Despite the statistical significance, the coefficient estimates are not much revealing of the extent to which firms are selected according to their relative productivity. To assess the strength of competitive selection, one needs to resort to a coefficient of determination to assess the proportion of the variance of firm growth explained by current and past relative productivities. Bottazzi et al. (2010) report 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. In order to tell apart the effects due to average productivity levels from the firm fixed-effects component we investigate

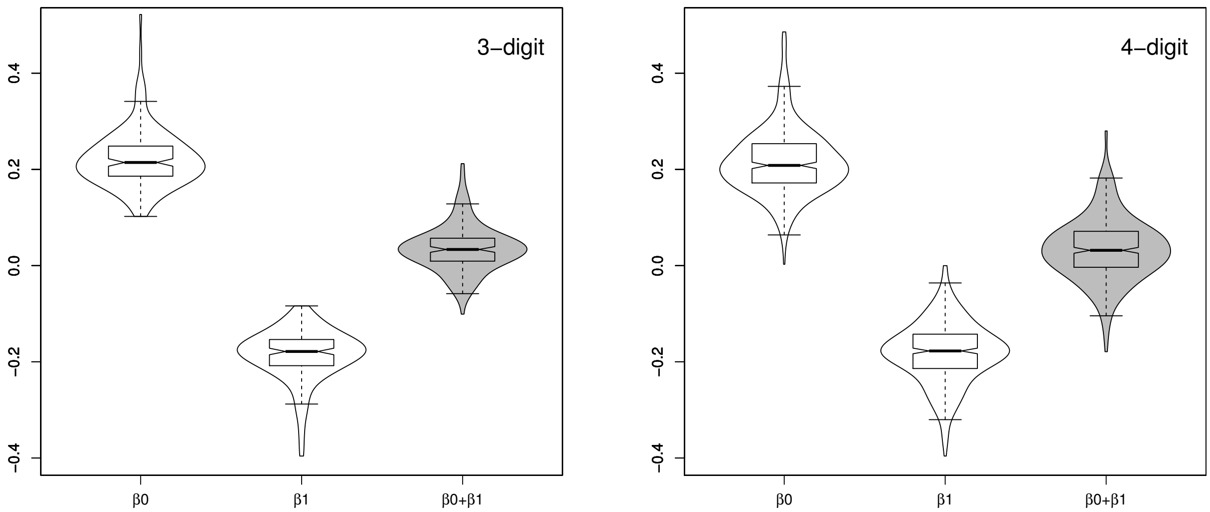

Figure 2: Productivity - Growth relationship at 3-digit and 4-digit sectoral level respectively. Distribution of parameters β_0, β_1 and β_0+β_1 of the baseline model. Notes: Distributions, median values and interquartile ranges have been calculated according to the values reported in Table A.3.

within the unobserved effect u_i, the part which correlates with productivity from the part which does not (see also Dosi et al., forthcoming). It is then possible to re-estimate Equation (1) through a Correlated Random Effects model:

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

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 μ_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 over time. The random effects estimation of Equation (2) does not change the value of the coefficients β_0 and β_1.[11]

However, our main interest lies in getting a measure of the fraction of total variance of firm growth explained by productivity terms, and we compute it as follows

[11] Results are available upon requests.

	Labour Productivity				TFP			
	3-DIGIT		4-DIGIT		3-DIGIT		4-DIGIT	
	Mean (%)	Median (%)	Mean (%)	Median (%)	Mean (%)	Median (%)	Mean (%)	Median (%)
R^2	59.25	58.93	60.49	60.74	62.26	62.41	63.72	64.09
S^2	17.36	16.59	17.67	16.91	19.85	19.60	20.20	19.87
S^2_Δ	15.87	15.16	16.00	15.28	18.72	18.39	19.03	18.81
S^2_a	1.49	1.39	1.67	1.45	1.14	0.86	1.16	0.93

Table 2: Mean and medians of the distributions of R^2, S^2, S^2_Δ and S^2_a at 3-digit and at 4-digit levels respectively.

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

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

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

takes into account the contribution of the heterogeneity term μ_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.4 reports the values of R^2 and S^2 across 3-digit sectors and 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 median value of S^2, capturing only the contribution of the productivity regressors (both levels and averages), is 0.17. That is, productivity variables account for around one fifth of the variance in firms' growth rates. There seems to be some explanatory power of productivity variables, hinting at some role of efficiency-driven competitive selection.[12]

The last four columns of Table 2 also show the values of explanatory power based on total factor productivity at 3- and 4- digit respectively.[13] The median of S^2 is around 20%, that is higher than the explanatory power of labour productivity.

It is well known that the ownership and governance structure of firms is much relevant to account for the different growth patterns of firms, and this is particularly true for the case of China (Guariglia et al., 2011). To study how different ownership structures affect the magnitudes of the explanatory power of

[12] As an robustness check, this property also holds at more disaggregated level, 4-digit sectoral level. Mean and median statistics are shown in Table 2.

[13] The productivity measure is a Törnqvist index number, which does not require the estimation of any parameters.

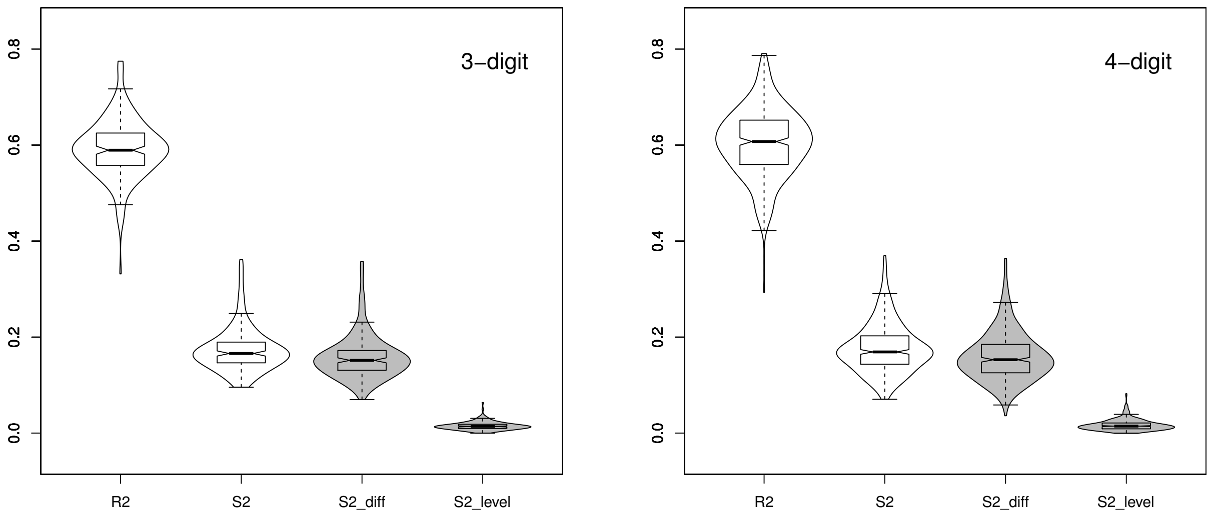

Figure 3: Productivity - Growth relationship at 3-digit and 4-digit sectoral level respectively. Distributions of R^2, S^2, S^2_Δ and S^2_a. The shaded violins refer to S^2_Δ and S^2_a, which are derived from the decomposition of S^2. Notes: Distributions, median values and interquartile ranges have been calculated according to the values reported in Table A.4 for 3-digit sectors.

productivity we replicate the exercise above after splitting firms within the same 3-digit sector according to the seven ownership types. Table 3 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, on the contrary, State-owned enterprises have significantly lower S^2, based on ANOVA and post hoc Tukey pairwise comparisons. That is, the selective power of market competition based on firms' relative efficiency is comparatively stronger in private and mixed ownership types, but is weaker among SOEs. Finally, we also investigate whether different "regimes" of technological learning, as captured by the well known Pavitt taxonomy (Pavitt, 1984), entails differences in the strength of the productivity-growth relation. Results do not support such hypothesis and are not shown here.

3.1. Productivity levels and productivity changes

Due to the statistical regularities of the coefficients of the current and lagged productivities, 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., forthcoming). In order to test for such

		Explanatory power of productivity to growth					
		(Mean)			(Median)		
Ownership	Number of sectors	S^2-mean (%)	$S^2_{\Delta\pi_{i,t}}$	$S^2_{\bar{\pi}_{i,t}}$	S^2-median (%)	$S^2_{\Delta\pi_{i,t}}$	$S^2_{\bar{\pi}_{i,t}}$
State-owned	108	14.37	11.88	2.50	13.64	11.10	2.12
Collective-owned	123	17.46	15.13	2.33	16.36	14.39	2.05
HMT-invested	104	14.48	13.11	1.38	13.88	12.41	1.05
Foreign-invested	113	15.47	14.30	1.17	14.44	13.39	0.92
Shareholding	119	18.73	17.02	1.71	17.98	16.33	1.53
Private-owned	143	21.47	20.05	1.41	21.16	19.81	1.18
Total	710	17.26	15.52	1.74	16.70	14.75	1.37

Table 3: Productivity - Growth relationship. Mean and median S^2 and decomposition of S^2 ($S^2_{\Delta\pi_{i,t}}$ and $S^2_{\bar{\pi}_{i,t}}$) 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.

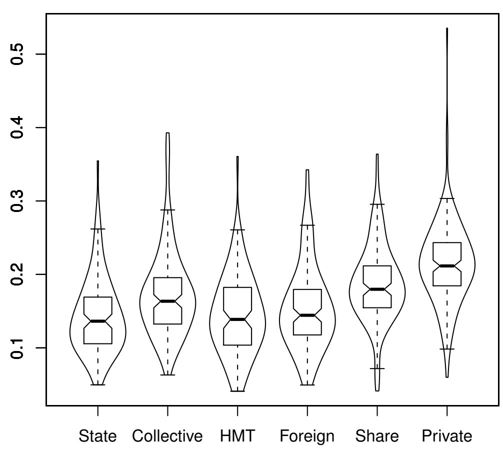

Figure 4: Productivity - Growth relationship. Distributions of S^2 of six important ownership types. Notes: Distributions, median values and interquartile ranges are shown in the violin plot.

hypothesis 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.[14] 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.4. 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 explained to a greater extent by productivity *changes* rather than relative productivity *levels* across firms.

4. Profitability and investment

The results from the previous section highlight a few relevant regularities. First, productivity is positively related to firm growth, and the strength of the relation is further reinforced when one is able to disentangle the effects due to average firm productivity from the firm fixed effect. Second, ownership type also matters: the selective power of market competition based on firms' relative efficiency is stronger for private and mixed ownership types. Third, the largest share of the productivity-growth relation is explained by *changes* in productivity rather than by productivity *levels*.

We next investigate the extent to which firms' profitability is directly related to growth. Figure 5 shows the relationship between profitability and growth by means of a simple kernel regression. Notice that the kernel fit is flatter than in Figure 1, suggesting that the direct relation between profitability and growth is weaker than what found for productivity. Such conjecture is confirmed by more rigorous parametric analysis. To allow for comparability of results we employ the same model of equation (1). The coefficients

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

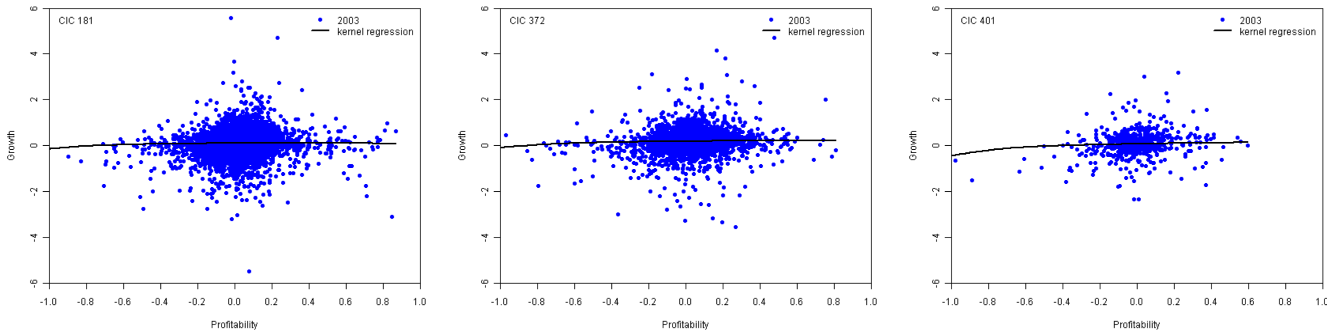

Figure 5: Profitability - Growth relationship in selected 3-digit sectors (textile clothing, automobiles and communication equipment) - kernel regression of 2003. Source: our elaboration on CMM.

of current and lagged profitabilities are statistically significant for the majority of 3-digit sectors, as shown in Figure 6 and Table A.5. However, no strong statistical regularities concerning the signs and values of the coefficients emerges. Moreover, Table A.6 report the values of R^2 and S^2. The median 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 7. Therefore, firm's unobserved idiosyncratic characteristics explain most of the variance of growth in profitability-growth relationship.

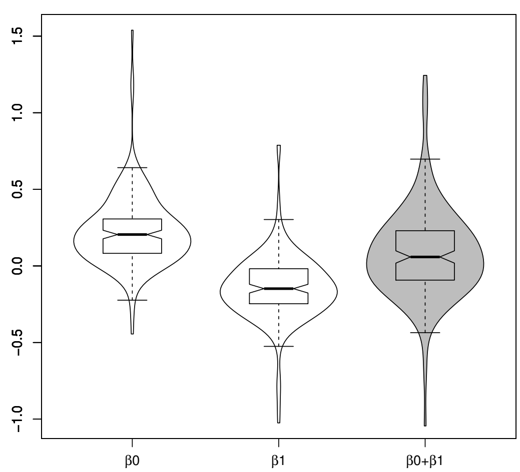

Figure 6: Profitability - Growth relationship. Distribution of parameters β_0, β_1 and $\beta_0 + \beta_1$ of the baseline model. Notes: Distributions, median values and interquartile ranges have been calculated according to the values reported in Table A.5.

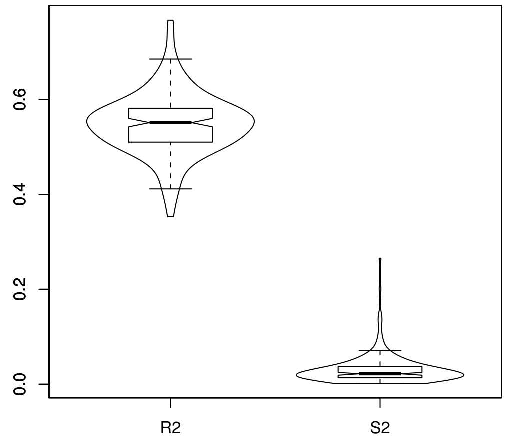

Figure 7: Profitability - Growth relationship. Distribution of R^2 and S^2. Notes: Distributions, median values and interquartile ranges have been calculated according to the values reported in Table A.6.

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 8. 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.[15]

Profitability appears to explain a modest 5% or less of the variance of growth rates of sales, which is much smaller when compared to the 17% of the explanatory power of productivity. Hence we investigate

[15]However, the overall magnitudes of S^2 are very small, we cannot say much difference between them.

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.

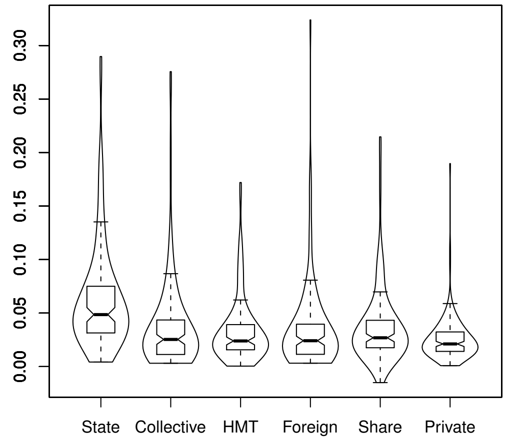

Figure 8: Profitability - Growth relationship. Distributions of S^2 of six important ownership types. Notes: Distributions, median values and interquartile ranges are shown in the violin plot.

whether the missing link between profitability and growth could instead occur through the *indirect* channel of investment in tangible assets, which in turn would spur firm growth.

To our knowledge there does not exist to date a thorough investigation of statistical properties of investment rates in China employing firm level data. Hence we start by looking at the statistical properties of capital adjustment patterns for Chinese firms.

Figure 9 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 displayed an investment rate of 50% or more. This patterns are also much stable over time, in 2007, 60% of firms reported an investment rate of 10% or lower; 15% of firms display an investment rate of 50% or more. Inactivity (zero investment) also occurs quite often: about 33.7% of the investment observations are zeros.

In Figure 10 we look at how, within any one firm, firms decide to allocate investment over time. If we were to observe that, on average, 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. The opposite would be true if we were to observe spikes in such firm level patterns, as they would suggest that firms tend to concentrate investments in few periods. For each firm, we rank the investment shares for the period 1998-2007 and then we compute the average (median) for each rank over all the firms in the balanced panel.

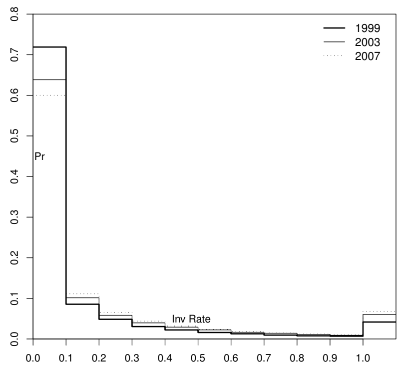

Figure 9: Histogram of investment rates in 1999, 2003 and 2007. Source: our elaboration on CMM.

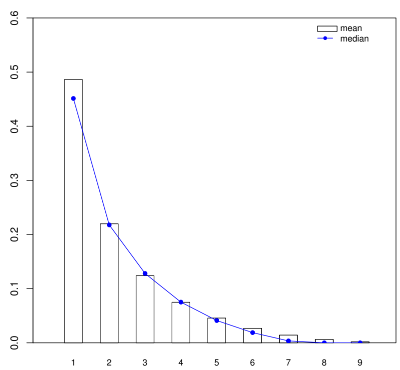

Figure 10: Average and median investment shares by rank (over firms in balanced panel - exist during 1998 - 2007). Source: our elaboration on CMM.

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. This confirms previous result on the dynamics of firms investments, see, among the others, Doms and Dunne (1998).

As standard in the literature on investment, we focus on abnormal event of capital adjustment, the so called investment spikes (see among the others Power, 1998; Nilsen et al., 2009), because only very large investments episodes are accompanied by the expansion of production capacity and/or innovation, which

[16] Investment is deflated by price index.

	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 5: Descriptive 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 6: Distribution of firms and investment spikes by size class. Source: our elaboration on CMM.

can in turn spur firm growth. As a result, only investment rate above a certain threshold will be classified as spikes. There exist some criteria that guide the choice among different spike measures. As put forth in Nilsen et al. (2009) the investment must be large both respect to the history of the firm and to the cross section of the industry. Further, it has to be a rare event, and the definition of the spike must be able to account for a relevant share of total industry investment. Nilsen et al. (2009) also hint at the necessity to account for the relationship that might exist between the investment rate and the capital stock.[17]

In this work, we employ a non parametric methodology that, in order to identify firm level spikes, resort to the kernel estimate of the relation between investment and capital stock (Grazzi et al., forthcoming). Details are reported in the Appendix B. Descriptive statistics for kernel method are reported in Table 5. 18% of observations are classified as spikes and they account for 68% of total investment. Table 6 shows how firms and investment spikes are distributed across size classes.

[17] According to NBSC, the 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.

4.1. Profitability and investment spike

Conditional on firm's past investment behavior and on average investment behavior over the sample, what is the role of current and past profitabilities in shaping the capital adjustment patterns? The baseline model for estimating the relationship between profitability and investment employs an autoregressive-distributed lag of length m,

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

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 correlated firm effect, b_t are year dummies, c_j are 2-digit sector dummies, and $\epsilon_{i,t}$ 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

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

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., 1999; Grazzi et al., forthcoming; 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 7. The results of random effect logistic regression are reported in column (v), that controls for firm's heterogeneity.[19] The

[18] After some experimentation and after comparing the AIC and BIC criteria of the models, we decide to include three lags of profitability.

[19] The results of logistic regression in column (vi) are very similar to column (iv). Robustness checks of the model are also reported in Table 7, column (i) through (iii). We exclude current profitability due to the endogeneity problem. The sum of the coefficients of profitabilities does not change significantly.

coefficients of current and lagged profitabilities are jointly significant, indicating that investment spikes are sensitive to profitability. This finding in turn signals that internal and external sources of finance are not perfectly substitutable. The sum of the marginal effects of contemporaneous and lagged profitabilities is 0.074, meaning that one percent increase profitabilites will induce 7.4% 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 spikes on the probability of having current investment spike decreases with time. Also the ownership structure of firms matters for the probability to undertake relevant investment projects. 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. This also confirms the long-standing literature of soft-budget constraints on the investment of China's state-owned enterprises (see also Guariglia et al., 2011).

5. Investment spike and firm growth

Investments in equipment embodying the latest technology drive productivity growth and hence, firm growth. In this respect, investments represent a further channel for the efficiency-driven competitive selection process. On the other hand, it might also happen that very large investment episodes are associated with the disruption of consolidated production processes and existing organizational routines, thus having a negative effect on productivity or sales growth, due to a long (and steep) learning curve. In particular, the recent empirical evidence (see for instance Power, 1998) has shown that the occurrence of negative effects following a spike is not a rare event, especially in the first years following the large investment episode.

To assess the effect of investment spike on firm performance we estimate the following model:

$$X_{i,t} = \beta_0 Dt0_{i,t} + \beta_2 Dt1_{i,t} + \beta_3 Dt2_{i,t} + \gamma_1 DBefore_{i,t} + \gamma_2 DLeast_i + b_t + c_j + u_i + \epsilon_{i,t} \tag{8}$$

where $X_{i,t}$ is one of the performance variables (productivity level/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

	Dependent Variable: Investment Spike											
	(i) Random Effect Logit		(ii) Random Effect Logit		(iii) Random Effect Logit		(iv) Random Effect Logit		(v) Random Effect Logit		(vi) Logit	
	Coef	Marginal Effects	Coef	Marginal Effects	Coef	Marginal Effects	Coef	Marginal Effects	Coef	Marginal Effects	Coef	Marginal Effects
P_t							0.359***	0.040***	0.274***	0.030***	0.273**	0.030**
							(0.120)	(0.013)	(0.100)	(0.011)	(0.127)	(0.014)
P_{t-1}	0.778***	0.070***	0.696***	0.063***	0.604***	0.054***	0.325**	0.036**	0.286**	0.031**	0.282**	0.031**
	(0.072)	(0.007)	(0.080)	(0.007)	(0.072)	(0.006)	(0.132)	(0.015)	(0.117)	(0.013)	(0.120)	(0.013)
P_{t-2}			0.182**	0.016**	0.066	0.006	-0.025	-0.003	-0.058	-0.006	-0.058	-0.006
			(0.077)	(0.007)	(0.072)	(0.006)	(0.088)	(0.010)	(0.088)	(0.009)	(0.068)	(0.008)
P_{t-3}					0.405***	0.036***	0.229***	0.025***	0.176**	0.019**	0.171**	0.019**
					(0.080)	(0.007)	(0.066)	(0.007)	(0.081)	(0.009)	(0.076)	(0.008)
Sum	0.778	0.070	0.878	0.079	1.075	0.096	0.888	0.098	0.678	0.074	0.668	0.074
Duration 1							0.877***	0.121***	0.800***	0.106***	0.822***	0.112***
							(0.025)	(0.005)	(0.030)	(0.005)	(0.026)	(0.004)
Duration 2							0.650***	0.085***	0.584***	0.074***	0.577***	0.074***
							(0.030)	(0.004)	(0.027)	(0.004)	(0.027)	(0.004)
Duration 3							0.401***	0.050***	0.345***	0.041***	0.342***	0.042***
							(0.033)	(0.005)	(0.030)	(0.004)	(0.030)	(0.004)
Collective									0.489***	0.058***	0.484***	0.059***
									(0.039)	(0.005)	(0.036)	(0.005)
HMT									0.480***	0.059***	0.475***	0.059***
									(0.045)	(0.006)	(0.041)	(0.006)
Foreign									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									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	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs	94622		94622		94622		94622		94622		94622	
Number of Groups	55647		55647		55647		55647		55647			
Brier Score							0.1150		0.1142		0.1142	
Pseudo R^2							0.0175		0.0257		0.0318	

Table 7: 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%).

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.

Table 8 reports the estimates of the effects of investment spikes on productivity level. The positive coefficients (see columns (ii) and (vii)) of the dummy variable $DLeast$ reveal that the group of investing firms display higher productivity levels than their counterparts.[20] In model (ii), the overall contemporaneous effect of spikes on productivity level is ($Dt0 + DLeast$) (0.427), and the effects of the latest past investment on productivity are $Dt1 + DLeast$, $Dt2 + DLeast$ and $DBefore + DLeast$ (0.400, 0.369 and 0.294). Thus, contemporaneous investments are associated with higher productivity levels: investments in tangible assets are able to deploy their effect on productivity since their very adoption. Notice, finally, that the positive effect of investment spikes on productivity levels decreases with the time elapsed from last investment spike.

Table 9 displays the estimates of the effects of investment spikes on productivity growth. As shown in columns (ii) and (vii), the positive coefficients on the dummy variable $DLeast$ indicate that investing firms have higher productivity growth rates than non-investing group. In column (ii), firms' contemporaneous investment spikes are associated with higher productivity growth rates, but this effect is mild (0.059) when compared to the effect on productivity level, further such mild positive effect vanishes over time. Notice that the effects of investment spikes on productivity growth are similar in magnitude amongst State-owned, HMT-invested and foreign-invested enterprises. And the other ownership types display stronger effects.

Table 10 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 column(ii)) and drops significantly afterwards. Rather interestingly, the strength of investment - sales growth is the lowest amongst State-owned enterprises.

[20] All the other models in Table 8 provide robustness checks.

	Dependent variable: Level of productivity						
				DLeast=1			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
	RE	RE	FE	RE	FE	RE	RE
Dt0	0.251***	0.053***	0.086***	0.052***	0.062***	0.228***	0.055***
	(0.006)	(0.008)	(0.009)	(0.008)	(0.009)	(0.006)	(0.008)
Dt1	0.236***	0.026***	0.076***	0.024***	0.049***	0.213***	0.029***
	(0.006)	(0.009)	(0.010)	(0.009)	(0.010)	(0.006)	(0.009)
Dt2	0.216***	-0.005	0.067***	-0.008	0.035***	0.192***	-0.001
	(0.006)	(0.009)	(0.010)	(0.009)	(0.011)	(0.006)	(0.009)
DBefore	0.158***	-0.080***	0.037***	-0.084***	-0.009	0.140***	-0.067***
	(0.007)	(0.010)	(0.011)	(0.010)	(0.012)	(0.006)	(0.010)
DLeast		0.374***					0.321***
		(0.010)					(0.010)
Collective-owned						0.568***	0.549***
						(0.013)	(0.013)
HMT-invested						0.708***	0.689***
						(0.013)	(0.013)
Foreign-invested						0.894***	0.871***
						(0.014)	(0.014)
Shareholding						0.589***	0.566***
						(0.013)	(0.012)
Private-owned						0.689***	0.661***
						(0.012)	(0.012)
Others						0.566***	0.549***
						(0.030)	(0.030)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of obs	279357	279357	279357	177428	177428	279357	279357
Number of firms	110052	110052	110052	65076	65076	110052	110052
R^2 - overall	0.1260	0.1299	0.0450	0.1102	0.0364	0.1775	0.1805
R^2			0.843		0.8274		

Table 8: Effect of Investment on level 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%).

	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 9: 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%).

	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 10: 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%).

6. Final remarks

This paper contributes to the literature on the market selection mechanism in an emerging market by exploring the extent to which firm growth rates are shaped by a) relative productivity levels and productivity variations, b) profitability-related variables, respectively.

We find that, *first*, in both mechanisms, firms' fixed unobserved heterogeneity plays a prominent role in explaining the different patterns of firms growth.

Second, we have shown that productivity also greatly contributes to firm growth, however it is the *growth* of productivity to account for a substantial portion (17%) of overall variance of firm growth rates, while firm's relative productivity level does not seem to contribute much. This finding is coherent with a situation in which different submarkets are aggregated in the same industrial sector. Firms located in different submarkets do not compete over the same products, thus, their different levels of efficiency do not matter in explaining their different growth rates. What matters, on the contrary, is the shock to the level of productivity.

Quite interestingly, our results show that the productivity-growth link is stronger for the most dynamic firms of the Chinese economy, which are domestic private-owned enterprises and state-private joint ventures (shareholding enterprises). However, the underlying reasons for the dynamism of these two types of firms might differ substantially. China's domestic private-owned firms are relatively more frequent in low-tech sectors (eg. textile, food manufacturing, etc.) and thus are exposed to severe market competition. Hence, their incentives for setting lower prices are rather obvious. On the contrary, most of shareholding enterprises are located in high-tech and capital-intensive industries (eg. oil refining, smelting, etc.) hence they tend to enjoy a higher degree of freedom in setting prices.

Third, the direct contribution of profitability-related variables to growth is rather small and it is around 2%. In the second part of the paper we have tested for the possibility that the profitability to growth relation gets mediated through investments in tangible assets. In this respect we find that firm's contemporaneous and lagged profitabilities display a 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 financial constraints and financial market imperfection, which appears to be much more severe for China's domestic privately-owned firms than state-owned enterprises. In other words, the growth opportunity of the most dynamic category of Chinese firms appears to have been constrained by limited access to external finance. Contemporaneous investment spikes have a positive and significant effect on firms' productivity, both in levels and growth rates, whether the effect on sales growth is even bigger. Taken together these results provide evidence in support of the mediating role of investment for firm growth.

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A. Table Appendix

	Original Dataset		Firms with missing, zero, or negative values, manufacturing firms only					
Year	Total	Manuf. (CIC 13-42)	Output	Value Added	Sales	Original Value of Fixed Assets	Cost of Labour	Employment (< 8)
1998	165097	148664	5431	12239	5406	4555	11041	4237
1999	162010	146078	6111	10931	6115	4881	10562	5390
2000	162879	147249	5533	9342	5732	4615	9477	4708
2001	171187	155665	4216	7020	4492	3412	8905	3468
2002	181494	165801	4014	7877	4120	3163	8971	3194
2003	196154	181013	2672	5383	2654	2473	6674	2126
2005	271747	250975	1965	6212	1721	1501	5392	1884
2006	301873	278667	2044	5626	2138	2021	7261	2637
2007	336678	312304	1144	4928	1520	1768	10433	1790

Table A.1: Number of observations of the original dataset, number of observations with missing, zero or negative values for each variable, manufacturing firms only (CIC 13- 42).

Table A.2: 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.3: 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	.

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Table A.3 –continued from previous page

CIC	SECTOR	β_0	Sdt.err	star	β_1	Sdt.err	star
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	***
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	***

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Table A.3 −continued from previous page

CIC	SECTOR	β_0	Sdt.err	star	β_1	Sdt.err	star
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	***
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	***

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Table A.3 −continued from previous page

CIC	SECTOR	β_0	Sdt.err	star	β_1	Sdt.err	star
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.4: Productivity - Growth relationship: R^2, S^2 of fixed effects (FE) model and correlated random effects (CRE) model and decomposition of S^2 of CRE model

CIC	SECTOR	R^2	S^2_{FE}	S^2_{CRE}	$S^2_{\Delta\pi_{i,t}}$	$S^2_{\bar{\pi}_{i,t}}$
131	Corn milling	0.53	0.11	0.15	0.13	0.01
132	Feed	0.58	0.08	0.15	0.14	0.02
133	Vegetable oil	0.57	0.15	0.17	0.16	0.01
134	Sugar	0.54	0.10	0.12	0.11	0.00
135	Slaughtering and meat	0.54	0.11	0.16	0.15	0.01
136	Aquatic products	0.56	0.11	0.15	0.14	0.01
137	Vegetables, fruit and nuts	0.64	0.10	0.17	0.16	0.00
139	Other agricultural and subsidiary food	0.61	0.18	0.23	0.22	0.01
141	Starch and starch products	0.59	0.10	0.15	0.13	0.02
142	Candies, chocolates and candied fruit	0.64	0.08	0.15	0.14	0.01
143	Convenience food	0.67	0.12	0.19	0.17	0.02
144	Liquid milk and dairy products	0.58	0.09	0.17	0.16	0.02
145	Canning	0.54	0.06	0.11	0.11	0.00
146	Condiments and fermentation products	0.57	0.12	0.15	0.13	0.02
149	Other food	0.59	0.10	0.16	0.15	0.01
151	Neutral spirits	0.67	0.25	0.35	0.35	0.00

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Table A.4 –continued from previous page

CIC	SECTOR	R^2	S^2_{FE}	S^2_{CRE}	$S^2_{\Delta\pi_{i,t}}$	$S^2_{\pi_{i,t}}$
152	Alcohols	0.55	0.15	0.19	0.17	0.02
153	Soft drinks	0.60	0.14	0.20	0.19	0.01
154	Purified tea	0.55	0.14	0.15	0.12	0.02
161	Tobacco redrying	0.45	0.10	0.10	0.09	0.02
162	Tobacco manufacture	0.50	0.26	0.23	0.19	0.04
169	Other tobacco products	0.33	0.08	0.13	0.10	0.03
171	Dyeing and finishing of cotton and chemical fiber textile	0.61	0.11	0.19	0.18	0.00
172	Dyeing and finishing of wool textile	0.52	0.13	0.17	0.15	0.01
173	Bast fibre	0.58	0.12	0.14	0.14	0.00
174	Silk textile and finishing	0.58	0.14	0.14	0.12	0.02
175	Textile finished products	0.62	0.10	0.15	0.13	0.02
176	Knitgoods, knitworks and their products	0.58	0.12	0.15	0.13	0.01
181	Textile clothing	0.53	0.11	0.14	0.14	0.01
182	Textile fabric shoes	0.61	0.09	0.13	0.11	0.02
183	Hats	0.53	0.14	0.18	0.16	0.01
191	Leather tanning and processing	0.63	0.12	0.17	0.16	0.01
192	Leather products	0.59	0.12	0.16	0.15	0.01
193	Fur tanning and products processing	0.60	0.23	0.26	0.23	0.02
194	Feather processing and products manufacturing	0.56	0.16	0.18	0.17	0.01
201	Sawn timber and wood clip processing	0.66	0.10	0.15	0.13	0.02
202	Hard board	0.68	0.17	0.27	0.26	0.01
203	Wooden products	0.60	0.11	0.18	0.17	0.01
204	Bamboo, rattan, palm and grass products	0.62	0.13	0.19	0.18	0.01
211	Wood furniture	0.63	0.11	0.17	0.15	0.01
212	Bamboo and rattan furniture	0.77	0.23	0.29	0.28	0.00
213	Metal furniture	0.65	0.10	0.17	0.16	0.01
214	Plastic furniture	0.76	0.33	0.31	0.25	0.06
219	Other furniture	0.63	0.12	0.17	0.16	0.01
221	Paper pulp	0.62	0.23	0.28	0.27	0.01
222	Paper making	0.53	0.15	0.18	0.17	0.01
223	Paper products	0.59	0.11	0.18	0.17	0.01
231	Printing	0.55	0.10	0.14	0.12	0.02
232	Binding and other printing services	0.56	0.16	0.20	0.15	0.05
233	Copy of records media	0.54	0.08	0.13	0.12	0.01
241	Stationery commodities	0.58	0.11	0.12	0.11	0.01
242	Sporting goods	0.59	0.15	0.18	0.16	0.01
243	Musical instruments	0.56	0.09	0.23	0.20	0.03
244	Toys	0.52	0.14	0.16	0.16	0.00
245	Recreation facilities and entertainment products	0.69	0.04	0.12	0.10	0.01
251	Refined petroleum products	0.63	0.10	0.17	0.16	0.01
252	Coke	0.67	0.20	0.22	0.22	0.00
253	Nuclear fuel	0.63	0.22	0.25	0.23	0.02
261	Basic chemical raw materials	0.60	0.14	0.20	0.19	0.01
262	Fertilizer	0.51	0.11	0.15	0.13	0.02
263	Pesticide	0.46	0.09	0.13	0.12	0.01
264	Coatings, inks, paints and other similar products	0.53	0.10	0.14	0.12	0.02
265	Synthetic materials	0.66	0.08	0.16	0.15	0.01
266	Special chemical products	0.65	0.14	0.22	0.21	0.01
267	Daily chemical products	0.60	0.10	0.17	0.16	0.01
271	Original drug of chemicals	0.58	0.13	0.18	0.17	0.01
272	The preparation of chemicals	0.55	0.11	0.18	0.16	0.01
273	Decoction pieces of Chinese medicine	0.48	0.10	0.12	0.12	0.01
275	Veterinary drugs	0.65	0.18	0.23	0.22	0.01
276	Biological and biochemical products	0.60	0.13	0.17	0.17	0.01

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Table A.4 –continued from previous page

CIC	SECTOR	R^2	S^2_{FE}	S^2_{CRE}	$S^2_{\Delta\pi_{i,t}}$	$S^2_{\pi_{i,t}}$
277	Sanitation materials and medical supplies	0.72	0.10	0.25	0.22	0.03
281	Cellulose and cellulose	0.63	0.12	0.17	0.16	0.01
282	Synthetic fiber	0.61	0.14	0.16	0.14	0.02
291	Tire	0.59	0.07	0.12	0.11	0.01
292	Rubber plates, tubes and belts	0.56	0.12	0.18	0.16	0.02
293	Rubber parts	0.59	0.10	0.15	0.13	0.02
294	Reclaimed rubber	0.66	0.29	0.36	0.36	0.00
295	Daily and medical rubber products	0.60	0.12	0.13	0.12	0.01
296	Gumboots and rubber shoes	0.57	0.07	0.14	0.10	0.03
299	Other rubber products	0.70	0.14	0.16	0.15	0.01
301	Plastics film	0.59	0.09	0.16	0.12	0.03
302	Plastic plates, tubes and profiles	0.65	0.12	0.20	0.19	0.01
303	Plastic wire, rope and knitting	0.60	0.14	0.18	0.16	0.02
304	Foam	0.60	0.10	0.16	0.14	0.02
306	Plastic packing cases and containers	0.64	0.10	0.17	0.15	0.02
307	Plastic parts	0.56	0.09	0.12	0.11	0.01
308	Daily plastic manufacture	0.60	0.11	0.15	0.13	0.02
309	Other plastic products	0.61	0.08	0.14	0.13	0.01
311	Cement, limestone and gypsum	0.48	0.16	0.19	0.18	0.01
312	Cement and gypsum products	0.58	0.14	0.19	0.19	0.01
313	Brick, stone and other building materials	0.56	0.12	0.17	0.16	0.01
314	Glass and glass products	0.58	0.16	0.20	0.19	0.01
315	Ceramic products	0.58	0.16	0.21	0.18	0.02
316	Refractory products	0.54	0.14	0.18	0.17	0.02
319	Graphite and other non-metallic mineral products	0.55	0.12	0.16	0.15	0.01
321	Iron-making	0.67	0.20	0.27	0.27	0.01
322	Steel-making	0.66	0.18	0.21	0.20	0.01
323	Steel calendering	0.61	0.11	0.17	0.15	0.01
324	Ferroalloy smelting	0.59	0.13	0.18	0.18	0.00
331	Common non-ferrous metal smelting	0.65	0.15	0.22	0.22	0.00
332	Nobel metal smelting	0.69	0.20	0.34	0.33	0.01
333	Smelting of rare earth metal in singularity	0.77	0.08	0.31	0.30	0.01
334	Non-ferrous metal alloy	0.61	0.11	0.12	0.11	0.01
335	Non-ferrous metal calendering	0.67	0.11	0.19	0.19	0.01
341	Structural metal products	0.63	0.10	0.15	0.14	0.01
342	Metal tools	0.58	0.13	0.18	0.16	0.02
343	Containers and metal packaging containers	0.59	0.11	0.15	0.14	0.01
344	Metal wire and rope and their products	0.59	0.11	0.18	0.16	0.02
345	Metal products used in construction and security	0.62	0.11	0.16	0.14	0.02
346	Treatment and heat treatment processing	0.54	0.10	0.14	0.13	0.01
347	Ceramic products	0.62	0.08	0.10	0.09	0.01
348	Stainless steel and similar daily metal products	0.63	0.13	0.18	0.16	0.01
351	Boilers and prime movers	0.52	0.12	0.15	0.12	0.02
352	Metal processing machinery	0.59	0.11	0.17	0.15	0.01
353	Lifting and transport equipments	0.55	0.08	0.12	0.10	0.02
354	Pumps, valves, compressors and other similar machinery	0.58	0.12	0.17	0.16	0.02
355	Bearing, gears and transmission & drive components	0.61	0.17	0.22	0.18	0.03
356	Ovens, furnaces and electric furnaces	0.63	0.22	0.21	0.18	0.03
357	Universal equipments like fans, weighing instruments and packing equipments	0.60	0.11	0.15	0.13	0.02
358	General parts manufacture and mechanical	0.63	0.11	0.15	0.14	0.01
359	Metal casting and forging processing	0.64	0.13	0.21	0.20	0.01
361	Special equipments in mining, metallurgy and construction	0.60	0.11	0.16	0.14	0.02
362	Chemical, timber and non-metallic processing equipments	0.60	0.16	0.18	0.17	0.01
363	Special equipments in food, beverages, tobacco and feed production	0.50	0.15	0.19	0.16	0.03

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Table A.4 –continued from previous page

CIC	SECTOR	R^2	S^2_{FE}	S^2_{CRE}	$S^2_{\Delta\pi_{i,t}}$	$S^2_{\pi_{i,t}}$
364	Special equipments in printing, pharmacy and daily chemical	0.55	0.13	0.18	0.17	0.01
365	Special equipments in textile, clothing and leather industries	0.57	0.13	0.17	0.14	0.03
366	Special equipments in electronic industry and electrical machinery	0.61	0.07	0.15	0.13	0.01
367	Special equipments in agriculture, forestry, animal husbandry and fishery	0.52	0.14	0.16	0.13	0.02
368	Medical equipments and appliances	0.58	0.12	0.15	0.14	0.01
369	Environmental, social public security and other special equipments	0.59	0.10	0.13	0.12	0.01
371	Rail transportation equipments	0.53	0.13	0.16	0.14	0.03
372	Automobiles	0.55	0.13	0.17	0.15	0.02
373	Autobikes	0.58	0.14	0.20	0.19	0.01
374	Bicycles	0.58	0.07	0.11	0.09	0.01
375	Ships and floating device	0.58	0.11	0.13	0.12	0.02
376	Aerospace vehicles	0.60	0.10	0.21	0.20	0.02
379	Transport equipments and other transport facilities	0.70	0.17	0.23	0.22	0.01
391	Motors	0.61	0.15	0.19	0.17	0.02
392	Power transmission & distribution and control equipments	0.56	0.13	0.16	0.15	0.01
393	Wires, cables, optical cables and electrical equipments	0.54	0.13	0.16	0.15	0.01
394	Batteries	0.62	0.12	0.17	0.16	0.01
395	Household electrical	0.57	0.11	0.18	0.16	0.02
396	Non-electrical household appliances	0.65	0.11	0.15	0.13	0.01
397	Lighting equipments	0.54	0.10	0.14	0.12	0.02
399	Other electrical machinery and equipments	0.69	0.16	0.17	0.17	0.01
401	Communications equipment	0.52	0.11	0.12	0.11	0.01
402	Radar and matching equipment	0.59	0.06	0.10	0.07	0.03
403	Broadcasting and TV equipment	0.66	0.10	0.22	0.20	0.02
404	Electronic computer	0.57	0.14	0.16	0.16	0.00
405	Electronic parts	0.59	0.08	0.16	0.15	0.01
406	Electronic components	0.61	0.11	0.15	0.14	0.01
407	Home audio-visual equipment	0.56	0.11	0.14	0.13	0.01
409	Other electronic equipment	0.61	0.08	0.12	0.11	0.01
411	Common instruments and meters	0.59	0.15	0.17	0.15	0.02
412	Special instruments and meters	0.61	0.19	0.21	0.18	0.03
413	Watches and clocks	0.44	0.09	0.11	0.10	0.01
414	Optical instruments and glasses	0.45	0.08	0.10	0.10	0.00
415	Cultural and office machinery	0.61	0.08	0.17	0.15	0.02
419	Other instruments and meters	0.76	0.10	0.16	0.14	0.02
421	Arts and crafts	0.54	0.09	0.14	0.12	0.02
422	Daily miscellaneous articles	0.60	0.09	0.16	0.14	0.02

Table A.5: 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	***

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Table A.5 –continued from previous page

CIC	SECTOR	β_0	Sdt.err	star	β_1	Sdt.err	star
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	.
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	***

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Table A.5 −continued from previous page

CIC	SECTOR	β_0	Sdt.err	star	β_1	Sdt.err	star
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	.
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	.

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Table A.5 −continued from previous page

CIC	SECTOR	β_0	Sdt.err	star	β_1	Sdt.err	star
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	*
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.6: 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

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Table A.6 −continued from previous page

CIC	SECTOR	R^2	S^2
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
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

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Table A.6 –continued from previous page

CIC	SECTOR	R^2	S^2
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
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

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Table A.6 –continued from previous page

CIC	SECTOR	R^2	S^2
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
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. (forthcoming). 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.[21]

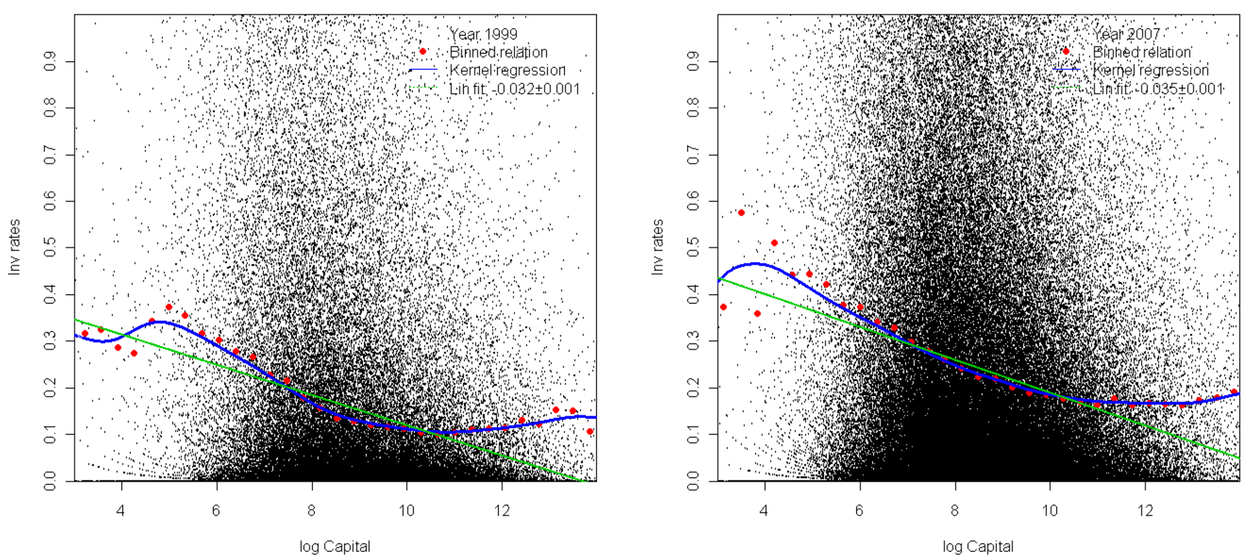

Figure B.1: Kernel regression (blue curve), binned relation (50 equal spaced bin; red dots) and OLS regression (green line) of investment rates (black dots) on log(capital) in 1999 and 2007. Source: our elaboration on CMM.

[21] 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.

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