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Institutional Change and Productivity Growth in China's Manufacturing: The Microeconomics of Creative Restructuring

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Abstract

This paper investigates the firm-level dynamics of labour productivity in China's manufacturing sector over the period 1998-2007. Underlying the aggregate evidence of a dramatic growth of labour productivity, one observes a large, even if shrinking, intra-sectoral heterogeneity. A major process of both catching-up and dying out among the least efficient ones occurs. Furthermore, we explore the effect of the characteristics of firms according to the ownership and governance structure upon the productivity distributions, highlighting the importance of the transformation of domestic firms as drivers of technical learning. In essence the fast catching-up process entails more of a "creative restructuring" of domestic firms rather than sheer "creative destruction" and even less so an MNC-led drive.

JEL codes: O1, O3, O4

Keywords: Chinese industrial development, labour productivity distributions, catching-up, heterogeneity, corporate ownership

1. Introduction

This paper analyzes the productivity growth in manufacturing in China over the period 1998-2007, disentangling the contribution of the various types of organizational carriers, distinguished according to their institutional characteristics, related to ownership and governance structures (e.g., State-owned, foreign MNCs, private-owned etc.). Exploiting a unique firm-level database, we investigate the micro evidence on the dynamic of labour productivity distributions across and within groups underlying the revealed dramatic increase of China's productivity in manufacturing.

A first striking feature is the high degree of heterogeneity in production efficiency at all levels of sectoral disaggregation, well consistent with the literature on industrial dynamics. However, the support of the labour productivity distributions shrinks over time.

The degree of productivity dispersion among low-productivity firms diminishes, while that of high-productivity ones increases slightly, reflecting both catching-up by the former, and a forging-ahead some of the latter. Note that the dynamics in the support of productivity distributions and especially in the left tail is not just the sheer effect of market selection, but also the outcome of profound institutional changes within the corporate sector.

The contribution to productivity growth of various types of firms significantly changes over time. To analyze it, we compare labour productivity distributions and their dynamics across six ownership types. In general, foreign-invested enterprises enter with a relatively high productivity, but their contributions change relatively little thereafter. Conversely, all other types of firms display a pronounced change in both the mean and the support of the productivity distribution, showing learning and "catching-up", particularly during the period of the deepening of institutional reforms. The transformations of State-owned, "shareholding" (which we shall define in a while) and private enterprises significantly affect the decreasing dispersion of labour productivity especially among the less-efficient firms, but also contribute to the fattening of upper echelon. Moreover, a (small) group of "private enterprises" also contributes to catching-up to the technology-frontier as proxied by the upper tail of foreign-invested enterprises.

This article is organized as follows. Section 2 reviews some of the incumbent literature on China's industrial productivity. Section 3 briefly depicts the changing institutional context from 1978 to 2007. Section 4 introduces China's micro manufacturing dataset. Next, section 5 discusses the broad microeconomic picture underlying a striking productivity growth. Section 6 analyzes the micro-evidence on labour

productivity at sectional level in terms of levels and growth. Finally, section 7 investigates the properties of such distributions and their dynamics across different ownership categories. Section 8 concludes.

2. China's contemporary growth

China's GDP per capita increased from 524 in 1980 to 5239 dollars in 2007 (PPP constant price and exchange rate, 2005 dollars, source: The World Bank (1997)). Productivity growth in turn contributed a significant proportion to overall economic growth, as also reflected by several growth accounting exercises (Bosworth and Collins, 2008; Brandt and Zhu, 2010; Zheng et al., 2009).

With respect to the aggregate evidence, Young (2003) estimates that labour productivity growth has been 2.6% per year between 1978 and 1998, for the non-agriculture sector. For the manufacturing sector, Szirmai et al. (2005) and Wang and Szirmai (2008) estimate a growth of 2.3% between 1980 and 1990, and 15.9% per year during the period 1990-2002, witnessing a rapid and accelerating process of catch up.

Brandt et al. (2009) - on the grounds of longitudinal dataset somewhat similar to the one used below - finds an astonishing growth rate of total factor productivity of 7.7% yearly in manufacturing over the period 1998-2006.[1]

There are several policy and institutional drivers of the impressive productivity performance of Chinese manufacturing, many of which we can only telegraphically mention here. They include the reform of State-owned enterprises; industrial policies affecting investment, innovation, finance and trade; competition policies; and the expansion of private companies. (For a thorough discussion, comparative with India, see Dahlman, 2009.) The end-result of the foregoing policies and institutional changes yielded contributions to productivity growth which have been significantly different among different types of enterprises and across different periods. Such differences are also at the center of the analysis that follows.

In the early stage of reform, Goodhart and Xu (1996) show that township and village enterprises (TVEs) was the main engine of Chinese productivity growth during early 1990s although starting from very low levels. Jefferson and Rawski (1994) estimate that the annual growth rate of labour productivity of TVEs were the highest between 1980 and 1992, and conversely in the State sector it was the lowest. More precisely, the growth in the State sector was fluctuated between 3.8 to 6.3% during the period 1978-1992, peaking in the years 1984-1988, while the productivity of TVEs grew at 5.8% between 1980 and 1984, then

[1] Notwithstanding the limitation of such measure of productivity (for a more detailed discussion cf. Dosi and Grazzi, 2006).

increased to 14.4% (1984-1988) and to 17.7% (1988-1992).

In late 1990s, Deng et al. (2005) estimate annual labour productivity growth at 20.4% between 1995 and 2003, according to a firm-level dataset containing industrial large and medium enterprises, with a major contribution by the conversion of State-owned enterprises to "shareholding" ones (see below) (Jefferson and Su, 2006).

Wang and Szirmai (2008) decompose the overall labour productivity growth in terms of sectors and forms of ownership: interestingly, in the '80 changes in the sectoral composition of output (i.e. "structural change") bear an important contribution to aggregate industrial productivity growth, while, as we shall see, this is not any longer the case in the subsequent period, when restructuring is the main driving force. Together, shifts in the weights of ownership categories account a substantial part of productivity growth during the productivity boom in 1990s, and the expanding foreign-invested category (MNCs and joint-ventures) takes up most of the shift contribution.

A challenging issue regards the microeconomics of these whole processes.

There is an emerging tradition of analysis of the microeconomics behind aggregate means and dynamics. One important stylized fact concerns large and persistent heterogeneity in productivity among firms even within the same narrowly defined industries (see the evidence and reviews in Nelson, 1981; Dosi, 2007; Geroski, 1998; Foster et al., 1998; Geroski, 2002; Bartelsman and Doms, 2000; Ahn, 2001; Dosi and Nelson, 2010; Dosi et al., 2012).

The longitudinal data below will help indeed in highlighting the movements of sector-specific and organization-specific productivity distributions among firms.

However, before looking of the details of the data, it is useful to place the transformation of the Chinese industry against the background of at least equally profound institutional and policy changes.

3. The changing institutional context

Unlike the "big bang" transformation of the economy systems of Eastern Europe and the Soviet Union, China has adopted the "gradualist approach" of economic reform. Let us consider the reforms which occurred within China's industrial sector since 1978, made of three parallel trajectories, namely (i) reforms concerning State-owned enterprises (SOEs), (ii) the political economy of non-state sector and (iii) the "opening up" policy, and sub divided into three stages (Qian, 2000, 2002; Zou, 2008).

The first stage (1978-1992) featured the transfer of SOEs' power of control and governance without touching issues of property rights, the stated aim being "putting plan and market on equal footing" (Qian, 2000).

The main policy thrust during the period 1978-1984, was "decentralization of power and transfer of profits" attempting to re-shape corporate incentives, inspired by the successful implementation of "the household responsibility system" in rural area. Later reform policies, between 1985 and 1992, were aimed at the "separation of the government from enterprise management", operated mainly through the so-called "contract responsibility system". During 1980s, contract responsibility system delegated many effective control rights to managers, i.e., the rights to use assets and to distribute income, while maintained ultimate control rights for the Party and government, including the selection and dismissal of top managers, approval of large investment projects, and veto powers over the disposal of major assets (Qian, 1996). By the end of 1987, almost all medium and large SOEs adopted the "contract responsibility system". In the period SOE performance improved even if the fiscal revenue of government from them declined.[2] (Roughly equivalent to a fall in profitability.)

The emergence and expansion of non-SOE firms have been a crucial driving force of China's growth, starting with the outstanding performance of Township-Village Enterprises in rural areas during 1980s and early 1990s. Between 1978 and 1993, the State share of industrial output declined from 78% to 43% (Cao et al., 1999). In 1995, collectively-owned firms contributed 38% to industrial output, in which TVEs accounted for two thirds.

Prior to the opening up in 1978, there was little inward foreign investment due to a number of severe restrictions. With the 1979 "Law on Joint Ventures", foreign enterprise could form a joint venture with local Chinese firms (usually SOEs), subject to a minimum local content rule. Moreover, foreign-invested enterprises approvals were often contingent on technology transfer to domestic partners (Branstetter and Lardy, 2008). Meanwhile, four special economic zones (SEZs) were set up in 1980, in which foreign investments enjoyed preferential institutional conditions (i.e., preferential tax treatment, special benefits for export-processing and technologically advanced projects, lifted restriction on remittance of profit).[3] In mid 1980s, joint ventures mushroomed, especially in SEZs (Qian, 2000). Many foreign invested enterprises were restricted from participating in domestic markets and thus, engaged mainly in export business: in 1994,

[2]Either the agency costs are high because managers lack accountability or the political costs are high because the government causes political interference (Qian, 1996).

[3]Other areas were added later. By 1992, several regions were defined as "Costal Open Areas" all over China.

these firms accounted 37% of China's total exports (Zhang et al., 2003). Due to the gradual liberalization of FDI regime throughout China, FDI peaked in the early 1990s (Branstetter and Lardy, 2008). FDI increased from 4.4 billion US$ in 1991, to 11 billion US$ in 1992, and further to 28 billion US$ in 1993 when China became the second largest country to attract FDI, next to the U.S (Qian, 2000). Indeed, as we shall see, the period up to the early 1990s corresponded to distributions of labour productivities generally displaying an efficiency lead of foreign-invested firms. Here and throughout we treat MNCs and joint-ventures within the same broad FIE category as they nearly display the same distributions of productivities and dynamics thereof. Interestingly, joint-ventures in quite a few sectors display "best-performers" more efficient than "best-performers" of MNCs (evidence available by the author upon request).

In the second period (1993-2003) of institutional change, the focus of SOEs reform shifted to corporate governance, and the adjustment in their product portfolios.

The first strategy was to establish a "modern corporate system", involving the transformation of SOEs into modern enterprises with clear property rights, well defined responsibility and authority, separation of enterprises from the government, and professional internal management (Qian, 1996).

The second policy was meant to streamline SOEs output structure, highlighted by the slogan "retain the large while release the small". The central government defined five groups of sectors kept under the control of the State, i.e., national security sectors, natural monopolies, sectors providing public goods or services, strategic natural resources, and key enterprises in "pillar" and high-tech sectors.[4] Note, since most SOEs were in net loss until 1997, the transition of large and medium SOEs to some 'market discipline' involved deep and often socially painful reforms.[5]

The third strategy involved the "shareholding system" and the development of a "mixed ownership economy" within large SOEs. That meant transforming SOE in proper shareholder-owned firms possibly involving also private, domestic and foreign investors, yielding an ensemble of "shareholding firms" involving mixed ownership. In 1994, thousands of SOEs were selected to conduct such an experiment. Among them 540 (23%) were transformed into mixed shareholding enterprises; 909 (38.8%) turned into companies having the State as the only shareholder; the other did not implement corporate governance (Zou, 2008). In 1999, the shareholding system was promoted over all large and medium SOEs, with the State maintaining

[4]Government designated five "pillar" industries: machinery, electronics, petrochemicals, automobiles, and infrastructure construction (The World Bank, 1997).

[5]Through layoff workers, merger and reorganization, separation of social corporate-paid services, debt-to-equity swap and etc.: the goal was achieved roughly by year 2000.

ultimate control rights over the large/strategic SOEs.

A crucial property of the whole process has been the deep transformation but *not the destruction* of the technological capabilities embodied in incumbent SOEs (more on the transformation of SOEs in the 80's in Groves et al. (1994)).

Thereafter, in the period 1998-2002 "the State retreats and the private sector moves forward" has been the main strategy, which was designed according to the timetable of China's WTO accession. SOEs were withdrawn from so-called "competitive" sectors, while have been strengthened in "pillar" industries. Together a major employment shake out took place (Cao et al., 1999): the number of workers employed in State-owned manufacturing enterprises fell from 35 million in 1992 to 9.8 million in 2002, with most of the decline in late 1990s (NBS, 2003). The restructuring and consolidation of large and medium SOEs were mainly conducted by merger with domestic or foreign firms, conglomeration, and initial public offering on the stock market (Cao et al., 1999). Overall the background examples and inspiring objectives of these policies were the Japanese Keiretsu and the Korean Chaebol. Large State-controlled enterprises were and are mainly in resource-based, capital-intensive and high-tech industries, such as coal, steel, oil, petrochemicals, aluminum, shipbuilding, and industrial machinery which all qualify for government "preferential policies" (Brandt et al., 2008).

At the same time a significant process of privatization of small SOEs and COEs at the county level took place, involving between 50 and 70% of small SOEs, dependent on the provinces. In cities, privatization has occurred in two waves and peaked after 2000 (Garnaut et al., 2006). During the first wave, in mid-1990s, more than half of the firms were privatized in three forms, namely sale to a private domestic or foreign firm; transformation into a limited liability or joint stock company; and "stock cooperatives" which are essentially employee/manager ownership with some features of cooperatives (Cao et al., 1999). The second wave occurred around 1997, with management buyouts as the most frequent mode.

At the same time, a huge amount of private firms have entered the market, particularly into "competitive sectors", i.e., sectors outside the "pillar industries". The output share of domestic private enterprises increased from 3% in 1995 to 22% in 2004 (Wang, 2009).

Prior to WTO membership, during the negotiations in the 1990s, China has gradually liberalized trade and FDI regimes (Branstetter and Lardy, 2008). Huang (2003) highlights three patterns in FDI inflows into China and in the corresponding strategies of multinational corporations (MNCs). Early on, a significant portion of FDI inflow into China originated from small and medium enterprises typically

from China's neighboring regions, such as Hong Kong, Macao, and Taiwan, and operate relatively simple and labour-intensive production and assembly processes. Conversely, investments by large Western and Japanese MNCs constituted only a small portion of total FDI flows. Moreover, the former were the drivers of China's export-processing regime in the 1990s, yielding an increasing share of export in GDP from around 12% in 1990 to 20% in 2000. Second, joint-ventures typically involved foreign firms and SOEs and were explicitly aimed at the acquisition of advanced technologies. Third, the share of wholly foreign owned enterprise relative to equity joint ventures increases from mid-1990s, due to the gradual enforcement of the TRIM (Traded Related Investment Measures) linked with WTO accession.

Interestingly, foreign multinational and joint-ventures aim their production to China's domestic market. In 2002, within the ten industries with the highest share of FDI (accounting for around half of the output), two-thirds of their sales went to the domestic market (Brandt et al., 2008). Moreover, the composition of FDI has shifted from Hong Kong, Macao and Taiwan regions to Western countries and Japan ones. Simultaneously, MNCs investments increasingly favored what Pavitt (1984) call "scale-intensive sectors" (from automobiles to chemicals), "specialized suppliers" (such as machinery) and ICT.

In the third period (2004-) reform of the governance of SOEs went ahead, involving a higher liquidity of their shares and a greater separation between government and corporate management.

Possibly more interesting for the interpretation of the evidence that we shall present below, during this most recent period, in "pillar" industries, and especially the "scale-intensive" ones, State-owned firms and joint ventures kept a central role, notwithstanding some entering attempts by private domestic firms. And they indeed display a considerable dynamism in terms of technology acquisition and productivity growth. This is a dynamism which is shared across manufacturing by a good deal of private firms (especially in relative low tech industries). Indeed, as we shall see in detail below the period witness the strengthening of the role of domestic firms of all types in the process of catching-up.

4. Data

The raw dataset includes all industrial firms with sales above 5 million RMB covering period 1998-2007 (except 2004).[6]

[6]Industry is defined to include mining, manufacturing and public utilities, according to NBS. Five million RMB is approximately $US 600,000.

Out of that, we extracted manufacturing only firms,[7] and we cleansed the data in order to eliminate visible recording errors, yielding what we call "China Micro Manufacturing" (CMM).[8]

This work focuses on dynamics of labour productivity, measured as value added per employee, as such a proxy of efficiency in different sectors. In the analysis we shall use relative productivities (normalized with sectoral averages)

$$\pi_i(t) = \log \Pi_i(t) - < \log \Pi_i(t) > \tag{1}$$

$$\Pi_i = \frac{VA_i}{N_i}$$

with

$$< \log \Pi_i(t) > \equiv \frac{\sum_{i \in sector j} \log \Pi_i(t)}{n_j(t)}$$

$\Pi_i(t)$ labour productivity, $VA_i(t)$ real value added, $N_i(t)$ number of employees, of firm i at year t; $n_j(t)$ number of firms in sector j at year t.[9]

We further disaggregate firms by ownership and governance structures. According to firm's registration status, we distinguish firms into seven ownership categories: State-owned enterprises (SOEs); collective-owned enterprises (COEs), Hong Kong, Macao and Taiwan-invested enterprises (HMTs); foreign-invested enterprises (FIEs), including in turn 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 shown in Table 1, 23 registration categories have been aggregated into 7 larger ones, in line with Jefferson et al. (2003). Below, however, due to numerosity, we analyze only the first six categories.

Each firm is classified into a sector according to the 4-digit Chinese Industry Classification (CIC) system that resembles the old U.S. SIC system.[10]

[7] Manufacturing firms are those with Chinese Industrial Classification (CIC) code between 13 and 43.

[8] We drop firms with missing, zero or negative value-added; and also firms with a number of employees less than 8, since below that threshold they operate under another legal system (Brandt et al., 2009). NBS has modified its industrial classification after 2002, the dataset used in this paper has adjusted the industrial classification before 2003 into the new standard. Since CIC43 has emerged merely after 2002, we do not consider it here.

[9] Value-added is deflated by four-digit sectoral output deflators, from Brandt et al. (2009).

[10] In 2003, the classification system was revised to make room for further disaggregation for some sectors, while some other sectors were merged. To make the industry codes comparable across the entire period, we follow Brandt et al. (2009) which has constructed a harmonized classification. Our CMM dataset spans over 29 two-digit sectors, 161 three-digit sectors, and 424 four-digit sectors.

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

5. A striking productivity growth: the general picture

Table 2 shows the annual growth rate of labour productivity of incumbent firms during each time window in the CMM database, highlighting the dramatic growth of productivity in China's manufacturing. The overall productivity of incumbents grew at 9.98% during 1998-2007. All sectors display positive productivity growth rates, except petroleum refining, which had negative growth during the first 1998-2002 period.

Figure 1 offer three snapshots of the non-parametric kernel density distributions of labour productivity, together with the comparison with the corresponding ones from Italy and France, as a vivid illustration of the overall technology gaps with two higher income countries.

Start noting the different upper bounds of the three distributions as such an impressionistic proxy of different inter-country lags and leads (together of course with different sectoral compositions of output). Second, the width of the support of the distribution of China is much larger, revealing much greater technological asymmetries across Chinese firms. The dynamics of catching-up in China's manufacturing productivity is indeed associated with a) a right-ward movement of the mean of the distributions; b) a corresponding rightward movement of the support and c) as we shall analyze in more detail below, a shrinking

CIC	SECTOR	1998-2007	1998-2002	2002-2007
13	Food processing of agricultural products	11.25	8.55	13.46
14	Other foodstuff	8.87	5.73	11.22
15	Beverages	10.63	6.20	12.80
16	Tobacco	15.29	11.08	10.65
17	Textile	9.79	10.14	10.54
18	Garments, footwear etc.	7.84	4.84	10.57
19	Leather, fur, feather etc.	7.55	6.52	10.29
20	Processing of timber, manuf. of wood, bamboo etc.	11.87	7.61	14.43
21	Furniture	6.19	4.82	10.40
22	Paper and paper products	10.33	9.48	11.75
23	Printing, reproduction of recording media	8.92	7.54	8.17
24	Articles for culture, education and sports	8.39	7.06	10.03
25	Processing of petroleum, cokeries, nuclear fuel	3.77	-1.61	6.36
26	Raw chemical materials and chemical products	11.40	10.44	11.85
27	Pharmaceuticals	8.94	10.64	7.53
28	Chemical fibers	10.31	12.05	8.85
29	Rubber	8.80	7.01	9.39
30	Plastics	5.83	6.43	6.24
31	Non-metallic mineral products	12.76	9.86	14.71
32	Smelting and processing of ferrous metals	13.86	12.68	14.14
33	Smelting and processing of non-ferrous metals	12.45	13.73	12.64
34	Metal products	5.44	7.84	4.32
35	General purpose machinery	15.40	13.76	15.72
36	Special purpose machinery	16.23	13.09	15.13
37	Transport equipment	12.67	11.64	13.05
39	Electrical machinery and equipment	9.51	8.84	9.32
40	Communication equipments, computers etc.	5.64	8.37	3.30
41	Measuring instruments and machinery	9.62	9.46	9.57
42	Artwork and other	10.01	9.32	12.70
	Average	9.98	8.73	10.66

Table 2: Annual growth rate of labour productivity over 1998-2007, and sub periods 1998-2002 and 2002-2007 among "continuing" firms (i.e., keeping in the same 2 digit sector over the relevant period). Source: our elaboration on CMM.

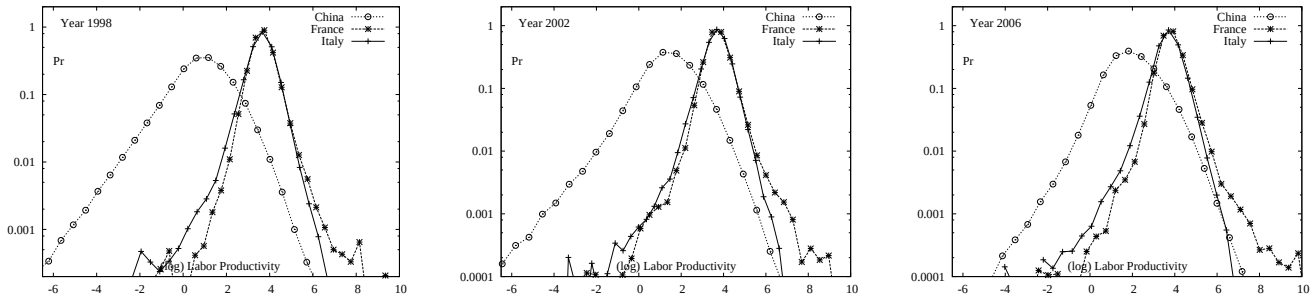

Figure 1: Empirical density of labour productivities, whole manufacturing of China, France and Italy, years 1998, 2002 and 2006, constant 2000 prices and exchange rates (IMF source). Source: our elaboration on CMM, INSEE (on France) and ISTAT-Micro 3 (on Italy).

of the support itself. Labour productivity distribution is asymmetric and left-skewed. The evolving pattern of the left-tail and that of the right-tail are different as well, as the magnitude of left-tail shift towards higher levels of productivity is very significant, compared with a relatively mild movement of right-tail. Such dynamics matches what in the old development literature was called a "reduction of the dualistic structure economy" composed by a shrinking traditional/relatively backward part of manufacturing and an expanding "modern" one, which however is only just beginning to push "frontier technologies" further.

Further, note the remarkable differences in productivity growth across sectors, as such circumstantial evidence of significant inter-sectoral differences in *absorptive capacities* (Cohen and Levinthal, 1989) of "frontier", generally foreign technologies, and corresponding differences in the average catching-up rates.

An important piece of evidence on *intra*-sectoral asymmetries in efficiency and their changes over time is top to bottom ratio of labour productivities. Table 3 displays the ratio of the 9th decile over the 2nd decile for each sector from 1998 to 2007. The ratios decrease in most of the sectors, indicating a reduction of productivity dispersion, plausibly due both to learning by laggard firms and selection (exit) of worse performers. Among the sectors the ratios are generally lower in "traditional" ones (CIC 17-24) and higher in relatively technology-intensive sectors (e.g., transport equipment, electrical machinery and communication equipment). The ratios drop more rapidly in the first part of the period under consideration which is also a period of retreat of State-owned enterprises from the so-called "competitive sectors". At the same time, the ratios in quite a few "heavy industries" such as petroleum refining, and non-ferrous metals sectors grows, hinting at some sort of persistent "dualism" within such industries (note that growing intra-sectoral asymmetries can and often even if not always do go hand-in-hand with high *average* growth rates).

CIC	SECTOR	1998	2002	2007
13	Food processing of agricultural products	15.62	11.35	10.02
14	Other Foodstuff	19.12	12.20	9.04
15	Beverages	14.89	11.82	9.06
16	Tobacco	17.05	22.95	26.44
17	Textile	8.61	7.01	6.07
18	Garments, footwear etc.	6.51	5.45	5.42
19	Leather, fur, feather etc.	7.80	7.17	6.80
20	Processing of timber, manuf. of wood, bamboo etc.	11.25	6.91	6.51
21	Furniture	9.29	7.15	6.93
22	Paper and paper products	7.44	6.16	6.27
23	Printing, reproduction of recording media	12.47	9.49	6.12
24	Articles for culture, education and sport activity	6.91	6.10	5.52
25	Processing of petroleum, cokeries, nuclear fuel	8.82	12.26	11.23
26	Raw chemical materials and chemical products	10.30	9.19	8.42
27	Pharmaceuticals	10.65	9.71	8.96
28	Chemical fibers	10.05	6.87	7.98
29	Rubber	6.56	7.49	7.42
30	Plastics	8.65	7.18	7.02
31	Non-metallic mineral products	8.32	7.91	8.23
32	Smelting and pressing of ferrous metals	9.57	8.58	8.40
33	Smelting and pressing of non-ferrous metals	9.70	8.43	12.72
34	Metal products	8.36	7.21	7.12
35	General purpose machinery	8.77	6.68	6.56
36	Special purpose machinery	12.24	9.59	7.25
37	Transport equipment	11.69	8.19	7.09
39	Electrical machinery and equipment	9.39	7.71	8.24
40	Communication equipment, computers etc.	13.52	11.08	8.36
41	Measuring instruments and machinery	12.38	9.00	8.70
42	Artwork and other	8.88	7.38	6.59

Table 3: Ratio of the average labour productivity of the second highest decile over the second lowest one. Source: our elaboration on CMM.

How much of the dynamics in overall productivity distribution is due to inter-sectoral relocation of production? Table 4 displays the time series of value-added shares of each 2-digit sector in overall manufacturing. It is remarkable that relatively little structural change has occurred over the period under investigation. So for example, the shares of transport equipment, electrical machinery and equipment, and communication equipment, computers etc. are amongst the highest from the start of the period under consideration, and their total contribution just increases from 20.7% in 1998 to 22.5% in 2007. A sign indeed that China achieves quite early a "modern" industrial structure. Interestingly, this evidence seems to contradict Kuznets's view of increasing productivity due to structural change, i.e., movements from low-productivity sectors to high-productivity ones also within manufacturing. On the contrary, our evidence suggests that, unlike the '80s (cf. Wang and Szirmai, 2008), the movement of the overall manufacturing means is mainly due to sector specific dynamics.

Of course, the relative stability of sectoral shares at 2-digit sectoral level, does not rule out much more turbulence at finer levels of disaggregation within 2-digit sector: indeed, there is a lot micro structure change. However, the evidence marks a difference with other episodes of industrialization and catching-up, in that China appears to be from the period of our observation already quite mature in terms of broad manufacturing structure. For example, when South Korea had the same real per capita income that China had in 1998, which was 1973 (Maddison's historical statistics www.ggdc.net/maddison/oriindex.htm), it had a share of around 22% of textile and clothing over total manufacturing (World Development Indicators database), compared to a 1998 Chinese share of 12%.

In the literature a quite common claim is that export and productivity growth go together (possibly with causality running in both directions). China does indeed display a dramatic rise in the share of export in total manufacturing output and, as we have seen, a dramatic growth in productivity. However the latter is not associated with an increased frequency of exporting firms over the total; on the contrary, after a mild surge, the former's share in manufacturing value added significantly falls (see Figure 2).

In fact, the final share in 2007 (48%) is lower than that at the beginning in 1998 (51%). Figure 3 shows the labour productivity distributions of exporters and non-exporters for the years 1998 and 2007, in some selected sectors (chemical, electrical machinery and communication equipment) which well illustrate a more general pattern. Note that in 1998 exporters have higher level of productivity and their support of distribution is narrower than that of non-exporters. However, a significant catch-up of non-exporters takes place, so that in 2007, exporters and non-exporters have similar productivity distributions and similar

CIC	SECTOR	1998	2002	2007
13	Food processing of agricultural products	4.74	4.50	4.96
14	Other Foodstuff	2.07	1.99	1.99
15	Beverages	3.51	2.69	2.01
16	Tobacco	5.70	5.13	3.11
17	Textile	6.39	5.81	5.23
18	Garments, footwear etc.	3.02	2.76	2.41
19	Leather, fur, feather etc.	1.78	1.76	1.58
20	Processing of timber, manuf. of wood, bamboo etc.	0.82	0.86	1.16
21	Furniture	0.50	0.53	0.69
22	Paper and paper products	2.11	2.17	1.86
23	Printing, reproduction of recording media	1.21	1.11	0.74
24	Articles for culture, education and sports	0.92	0.77	0.60
25	Processing of petroleum, cokeries, nuclear fuel	3.56	3.79	3.52
26	Raw chemical materials and chemical products	7.18	6.96	7.78
27	Pharmaceuticals	2.95	3.29	2.45
28	Chemical fibers	1.19	0.91	0.86
29	Rubber	1.33	1.12	1.02
30	Plastics	2.35	2.47	2.28
31	Non-metallic mineral products	6.03	5.20	5.18
32	Smelting and pressing of ferrous metals	6.47	6.92	9.52
33	Smelting and pressing of non-ferrous metals	2.08	2.24	4.58
34	Metal products	2.98	2.86	3.21
35	General purpose machinery	4.75	4.51	5.46
36	Special purpose machinery	3.33	3.09	3.25
37	Transport equipment	7.41	8.54	7.54
39	Electrical machinery and equipment	5.94	6.12	6.47
40	Communication equipment, computers etc.	7.39	9.64	8.44
41	Measuring instruments and machinery	1.25	1.23	1.24
42	Artwork and other	1.05	0.99	0.86
	Total	100	100	100

Table 4: Contribution of each 2 digit sector to the total value added of manufacturing (percentages). Source: our elaboration on CMM.

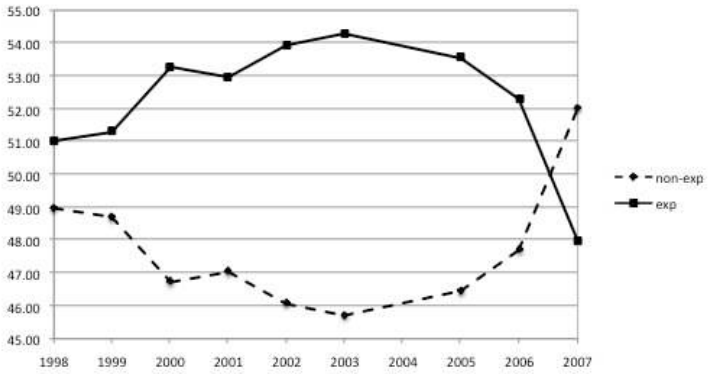

Figure 2: Annual percentage contribution of exporters and non-exporters to value added of manufacturing. Source: our elaboration on CMM.

widths of support.

6. The dynamics of labour productivity distributions

Let us now focus on the detailed properties of productivity distributions and their dynamics.

The non-parametric kernel densities above provide a general appreciation of the evolutionary patterns of labour productivity distributions. In order to account in more detail for such distributions and their dynamics, we resort to a family of theoretical distributions, Asymmetric Exponential Power (AEP) ones (Bottazzi and Secchi, 2011),[11] which enables to properly account for the asymmetries and leptokurtosis of the distributions themselves.

[11] As from Bottazzi and Secchi (2011) the AEP distribution is characterized by 5 parameters, two positive shape parameters b_l and b_r, describing the tail behavior in the upper and lower tail, respectively, two positive scale parameters a_l and a_r, measuring the width of left and right tail, respectively, and one mode parameter m. AEP density is

$$f_{AEP}(x;\mathbf{p}) = \frac{1}{C}\, e^{-\left(\frac{1}{b_l}\left|\frac{x-m}{a_l}\right|^{b_l}\theta(m-x)+\frac{1}{b_r}\left|\frac{x-m}{a_r}\right|^{b_r}\theta(x-m)\right)} \tag{2}$$

where $\mathbf{p} = (b_l, b_r, a_l, a_r, m)$, $\theta(x)$ is the Heaviside theta function and where the normalization constant reads $C = a_l A_0(b_l) + a_r A_0(b_r)$ with

$$A_k(x) = x^{\frac{k+1}{x}-1}\Gamma\left(\frac{k+1}{x}\right) \tag{3}$$

The AEP reduces to the Exponential Power distribution (Subbotin, 1923) when $a_l = a_r$ and $b_l = b_r$. Notice that the smaller the b's, the fatter the tails. For $b = 2$ the distribution approximates a log-normal and for $b = 1$ a Laplace (exponential) distribution.

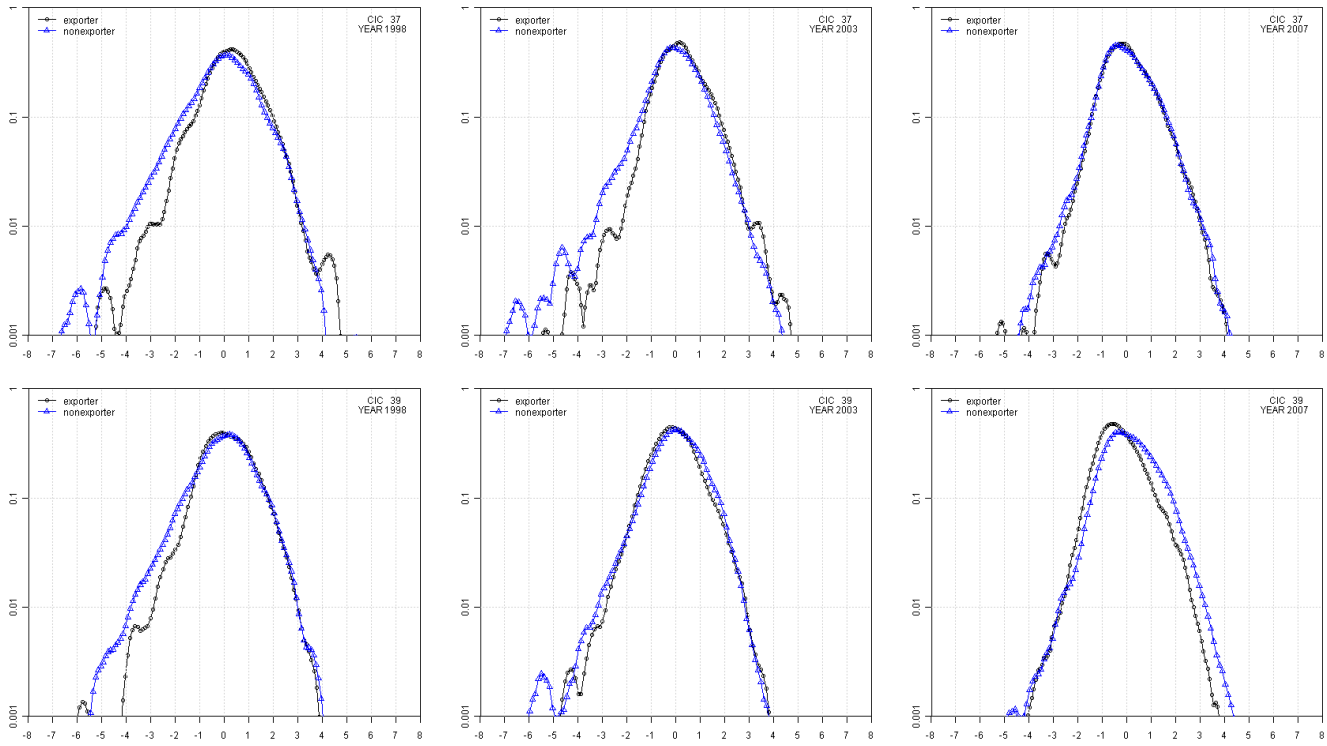

Figure 3: Empirical density of (log) labour productivity of exporters and non-exporters of transport equipment (CIC 37) and electrical machinery and equipment (CIC 39) sectors in selected years (1998, 2003 and 2007). Source: our elaboration on CMM.

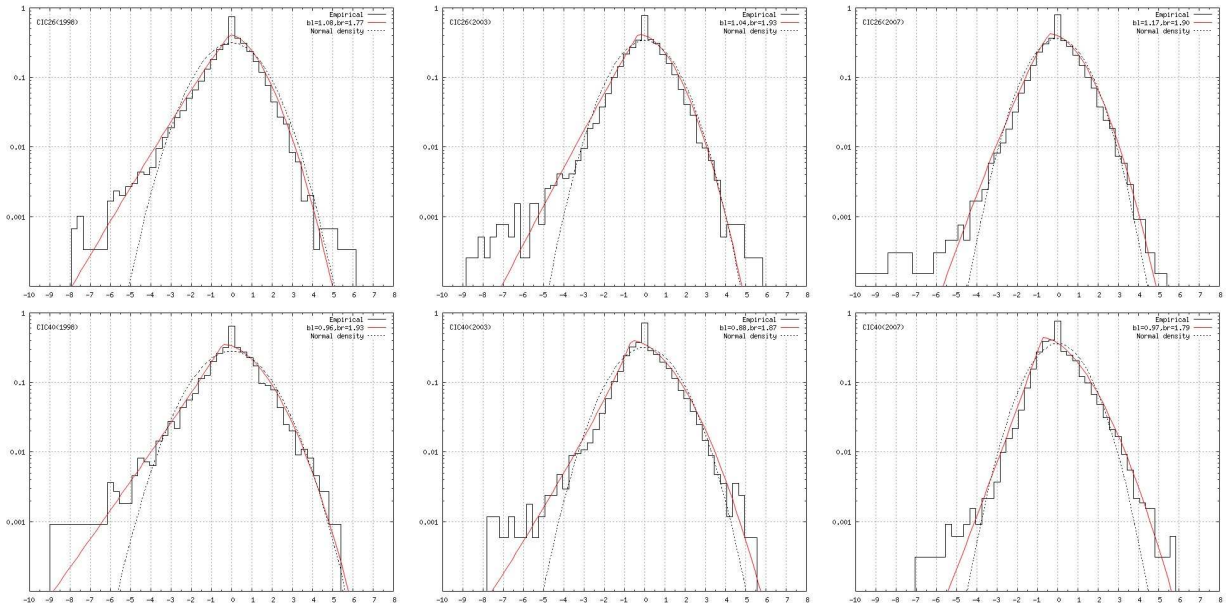

Figure 4: Empirical density of normalized (log) labour productivity for chemical (CIC26), the first row, and communication equipment, computers etc. (CIC40), the second row, together with the AEP fit (solid smooth curve) and Normal fit (dotted curve) for year 1998, 2003 and 2007 respectively. (Probabilities on the y-axis on log scale.) Source: our elaboration on CMM.

6.1. High intra-sectoral heterogeneity

Let us study the behavior of normalized (log) labour productivity at 2 digit sectoral level. Figure 4 displays the binned probability density, AEP fitted distribution[12] and the Normal fit of normalized (log) labour productivity for selected sectors in years 1998, 2003 and 2007. Over all sectors, AEP distributions show a remarkable goodness of fit to the empirical densities, which significantly deviate from (log-) Normal distributions, and more so is on the low-productivity side.

First, the width of the support of both empirical distribution and AEP fit is much larger than that of the Normal fit with a good deal of the deviation due to the wide support of less-efficient firms.

Second, distributions are leptokurtic, with a very fat left tail. Figure 4 presents some sectoral examples while Table 5 and 6 provide the MLE estimates of the AEP parameters.

Scale parameters a_l and a_r capturing the left and right width of the support of AEP distributions are shown in Table 5. In contrast with the properties of Italian data in Dosi et al. (2012),[13] for the majority

[12]The five parameters are estimated by maximum likelihood method (MLE) following Bottazzi and Secchi (2011).

[13]which finds a quite high stability of a_l and a_r over time.

	a_l			a_r		
CIC	1998	2002	2007	1998	2002	2007
13	1.24	1.04	0.88	1.39	1.29	1.35
14	1.59	1.11	0.74	1.04	1.28	1.34
15	1.38	1.13	0.75	1.00	1.11	1.35
16	1.39	1.14	0.40	1.31	1.90	3.50
17	0.91	0.75	0.52	1.07	1.08	1.20
18	0.70	0.61	0.49	1.06	0.92	1.03
19	0.79	0.63	0.40	1.13	1.21	1.29
20	1.09	0.74	0.54	1.16	1.11	1.26
21	1.07	0.80	0.45	0.91	1.06	1.43
22	0.98	0.73	0.56	0.82	0.98	1.20
23	1.13	1.06	0.53	1.22	0.97	1.12
24	0.68	0.66	0.54	1.21	1.03	0.96
25	0.84	0.74	0.81	1.26	1.65	1.47
26	1.03	0.87	0.76	1.11	1.23	1.23
27	1.01	0.96	0.80	1.14	1.17	1.31
28	1.11	0.80	0.63	0.93	0.96	1.49
29	0.75	0.79	0.57	1.08	1.10	1.34
30	0.89	0.73	0.48	1.13	1.14	1.38
31	0.79	0.74	0.66	1.22	1.24	1.35
32	0.95	0.92	0.84	1.14	1.07	1.13
33	0.86	0.85	0.62	1.42	1.13	1.94
34	0.85	0.68	0.46	1.15	1.22	1.39
35	0.96	0.75	0.48	1.02	1.01	1.30
36	1.13	1.00	0.54	1.16	1.05	1.37
37	1.08	0.83	0.50	1.12	1.07	1.34
39	0.90	0.73	0.53	1.25	1.27	1.46
40	0.98	0.81	0.54	1.50	1.41	1.41
41	1.03	0.78	0.48	1.25	1.31	1.66
42	0.90	0.78	0.49	1.13	1.00	1.16

Table 5: Estimated a_l and a_r parameters for the distribution of labour productivities, 2 digit CIC sectors. Source: our elaboration on CMM.

of sectors, a_l monotonically decreases over time, indicating a shrinking process of the left-tail. This offers another circumstantial piece of evidence that labour productivities of less efficient firms tend to converge over time toward the mean. On the contrary, for the majority of sectors, their a_r increases over time, indicating that the labour productivities of more-efficient firms gradually diverge. Overall the support of sectoral labour productivity distributions shrinks over time for most sectors, except a few capital-and scale-intensive industries such as chemical fibers, rubber, non-metallic mineral products and non-ferrous metals (CIC 25, 28, 29, 31 and 33).

Shape parameters b_l and b_r of AEP distributions are shown in Table 6, the values of b_l are all around 1, confirming the striking fat-tail property on the left-side distributions, while the values of b_r are not too far from 2, hinting at a near log-normality of the upper tail. Moreover, the dynamic patterns of b_l and b_r

	b_l			b_r		
CIC	1998	2002	2007	1998	2002	2007
13	1.18	1.02	1.27	2.47	2.36	2.41
14	1.45	1.09	1.20	1.74	2.19	2.22
15	1.32	1.09	1.09	1.61	1.77	2.24
16	1.56	1.25	0.67	2.30	2.75	6.85
17	1.05	0.99	0.99	1.77	1.88	2.10
18	0.86	0.93	0.96	1.75	1.61	1.68
19	0.90	0.85	0.89	1.80	1.83	1.71
20	1.02	0.94	1.07	2.03	2.00	2.16
21	1.23	0.89	0.79	1.50	1.97	2.28
22	1.15	0.97	0.91	1.44	1.82	2.09
23	1.31	1.19	0.95	1.94	1.68	1.73
24	0.79	1.03	1.08	2.01	1.84	1.58
25	1.09	0.95	1.07	2.21	2.31	2.10
26	1.08	1.04	1.17	1.77	1.98	1.90
27	1.22	1.10	1.36	1.68	1.98	2.39
28	1.19	0.99	1.07	1.74	1.53	2.89
29	0.85	0.92	1.12	2.00	2.01	2.27
30	1.03	0.94	0.94	1.95	1.95	2.16
31	0.96	1.01	1.08	2.05	2.14	2.22
32	1.02	1.03	1.29	1.78	1.84	1.85
33	0.85	1.10	0.97	2.37	1.85	2.78
34	0.94	0.84	0.92	1.83	1.96	2.10
35	1.04	0.92	0.88	1.69	1.68	2.07
36	1.17	1.02	0.86	1.88	1.75	2.11
37	1.09	0.95	0.85	1.66	1.61	1.95
39	1.03	0.91	0.96	2.11	2.23	2.12
40	0.96	0.92	0.97	1.93	1.75	1.79
41	0.93	0.83	0.75	1.87	1.83	2.37
42	1.21	1.14	1.11	1.79	1.59	1.67

Table 6: Estimated b_l and b_r parameters for the distribution of labour productivities, 2 digit CIC sectors. Source: our elaboration on CMM.

are different across sectors. In quite a few sectors, including general purpose machinery, special purpose machinery, transport equipment and electrical machinery and equipment (CIC 17, 35, 36, 37, 39), the values of b_l tend to decrease over time, hence the fatness of the tails increases.

6.2. Growth rates of labour productivity

Let us look next at the properties of growth rates. Figure 5 displays the empirical distribution and Exponential Power fit of growth rates of labour productivity of selected sectors for periods 1998-2002 and 2003-2007: they are all fat-tailed and symmetric. Such long term "lumpiness" of productivity growth events clearly militates against any notion of productivity growth resulting from of a smooth process made by small independent improvements. Rather, it appears characterized by relatively frequent "big" idiosyncratic

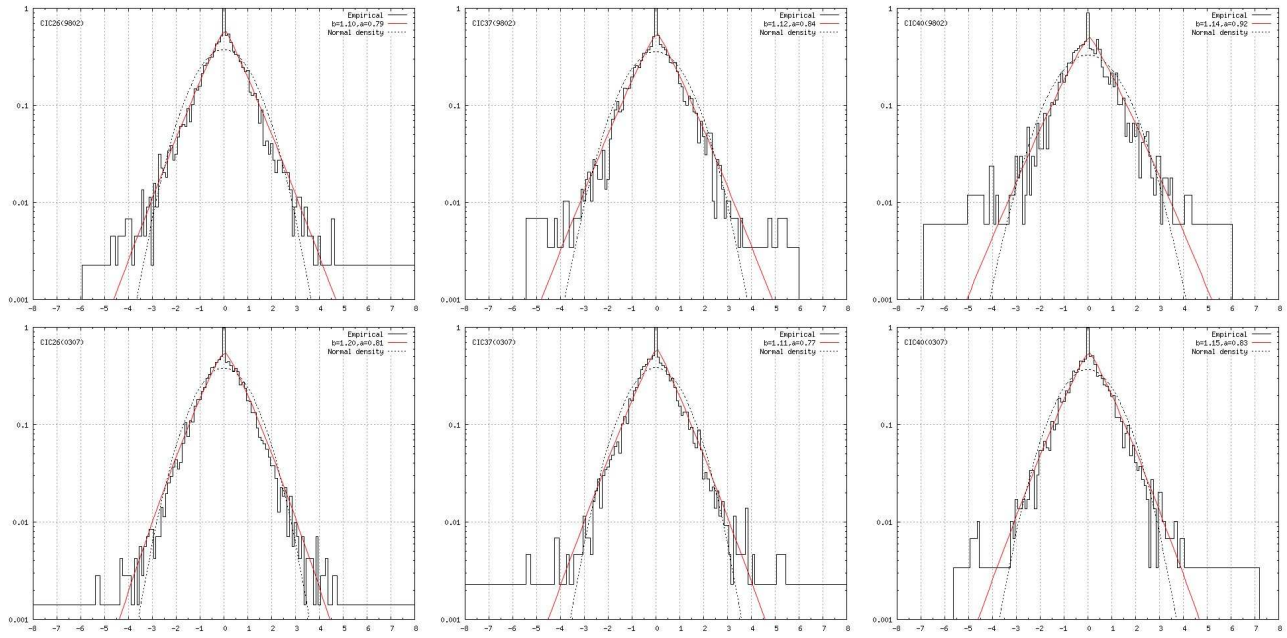

Figure 5: Empirical density of growth rates of normalized (log) labour productivity over four years interval, for chemical (CIC 26), transport equipment (CIC 37), and communication equipment, computers and etc. (CIC 40), with Exponential Power and Normal fits. The first row, 1998-2002; second row, 2003-2007. Source: our elaboration on CMM.

shocks (Dosi et al., 2012; Dosi, 2007), plausibly of technological but also strategic and institutional nature.

7. The comparative evidence across ownership and governance forms

Distributions and their dynamics are deeply affected by the organizational types of the micro entities. Let us consider them.

Start by noticing that over the period under consideration the Chinese industry underwent deep changes in its ownership and governance patterns. Figure 6 illustrates the fall of *fully* publicly owned firms. The share of SOEs and collective-owned enterprises drops from 66% in 1998 to around 7% in 2007 in terms of number of firms, and from 60% to 14% in terms of value added. On the contrary, one observes a surge of shareholding firms, as such a "capitalist" transformation of SOEs, and of private enterprises. Shareholding firms increased from 7% in 1998 to 17.3% in 2007 in terms of numbers, and from 11% to 26.8% in terms of value added. Together, the share of domestic private enterprises has increased dramatically from 7.4% in 1998 to 54% in 2007 in terms of numbers and less dramatically from 3.2% to 26% as measured by value

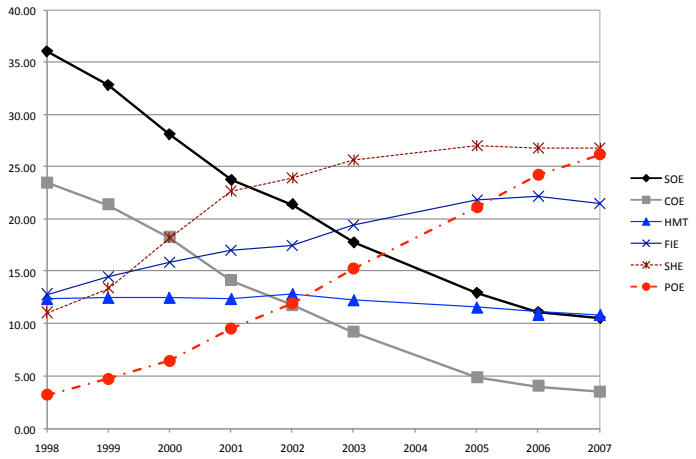

Figure 6: Annual percentage shares of ownership categories to total value added. Source: our elaboration on CMM.

added.

The relative importance of public and private (domestic and foreign) forms of ownership however differ a lot across sectors. The "core" industries continue to be dominated by SOEs and/or by State-controlled shareholding enterprises even after privatization process. For instance, in 2007, the value-added share of SOEs and shareholding firms was 67% for petroleum sector; 64% in non-ferrous metals; 54% in ferrous metals. In transport equipment, the value added share of SOEs and shareholdings was 35%, while that of FIEs was 42%.[14] The activities dominated by privately-owned companies are quite diverse, but mainly concentrated in "competitive sectors" as defined by the government policies, such as food product, textile, non-metallic minerals products, metal products. High and medium-high tech sectors (as classified by OECD taxonomy, while the caveat that in China, most of these sectors also contain a quite large labour-intensive export-processing part), such as communication equipment, computers and etc., measuring instrument display a persistently high share of foreign-invested enterprises over the whole period, but also a significant presence of shareholding firms (including, often in the upper end of the industries).

Over the period, a good deal of the changes in the shares of different types of firms is due to a fast transformation in the forms of corporate governance of incumbents. Table 7 present, by governance type, the percentage of firms which maintain their institutional characteristics ("keep"), enter ("entry"), exit, move-in the type ("S-in") and move to other types ("S-out"). The percentage share of exiting firms is

[14]In transport equipment sector, FIEs are mainly joint ventures between foreign MNCs and the State and, in most cases, the Chinese side is the controlling shareholder.

	Percentage of firms in initial year				Percentage of firms in final year			
OWNERSHIP	Keep	Exit	S-out	Total	Keep	Entry	S-in	Total
1998 - 2002								
SOE	31.94	60.23	7.83	100 (38121)	63.77	34.38	1.86	100 (19095)
COE	29.05	58.17	12.79	100 (52099)	45.04	51.07	3.89	100 (33599)
HMT	51.34	42.37	6.29	100 (14410)	40.37	53.19	6.43	100 (18324)
FOE	54.66	35.23	10.11	100 (9700)	38.20	56.12	5.67	100 (13878)
SHE	38.10	48.91	12.99	100 (9447)	14.75	64.76	20.49	100 (24393)
POE	34.66	58.86	6.48	100 (10078)	7.52	81.99	10.49	100 (46441)
ODE	23.50	52.87	23.63	100 (1655)	30.27	45.60	24.12	100 (1285)
Total	35.05	54.77	10.19	100 (135510)	30.25	60.96	8.79	100 (157015)
2002 - 2007								
SOE	25.23	64.58	10.20	100 (14936)	59.66	33.61	6.73	100 (6316)
COE	24.82	49.94	25.24	100 (28784)	45.40	48.01	6.60	100 (15739)
HMT	55.96	32.37	11.67	100 (20457)	36.99	57.01	6.01	100 (30951)
FOE	64.18	26.88	8.94	100 (16673)	31.58	60.40	8.03	100 (33890)
SHE	41.91	37.06	21.03	100 (28516)	22.56	62.75	14.69	100 (52969)
POE	49.53	42.02	8.45	100 (64331)	19.31	74.41	6.29	100 (165027)
ODE	13.28	52.23	34.49	100 (1235)	11.43	65.37	23.21	100 (1435)
Total	44.04	41.94	14.02	100 (174932)	25.15	66.84	8.01	100 (306327)

Table 7: Dynamics of ownership distribution for 1998-2002 and 2002-2007: shares of ownership-keeping firms ("Keep"), exits ("Exit"), ownership-switching-out in percentage of firms in the initial year ("S-out") and shares of ownership-keeping firms ("Keep"), entrants ("Entry") and ownership-switching-in firms ("S-in") in the ending year. Number of firms in brackets. Source: our elaboration on CMM.

the highest in publicly (both State and collective) owned enterprises in both periods. "Shareholding" and "domestic private" categories have highest share of entrants and they are also the main destinations of firms undertaking restructuring.

Figure 7 displays the trend in labour productivity by corporate type. Foreign-invested firms (MNCs and joint ventures), not too surprisingly, keep the highest productivity levels, but, interestingly, display also the weaker growth rate. Conversely, Chinese firms, of all types - private, State-owned and mixed ownership - all growth faster in impressive catching-up processes.

Moreover, among Chinese firms those which restructure (especially among the SOE) display the highest dynamics: see Table 8 covering the ten largest sectors.

7.1. Micro evidence

The foregoing evidence regards, the means of productivities by governance/ownership types. Let us now zoom-in onto the whole distributions.

Figure 8 displays the kernel density plots in selected sectors and their evolutionary patterns by corporate

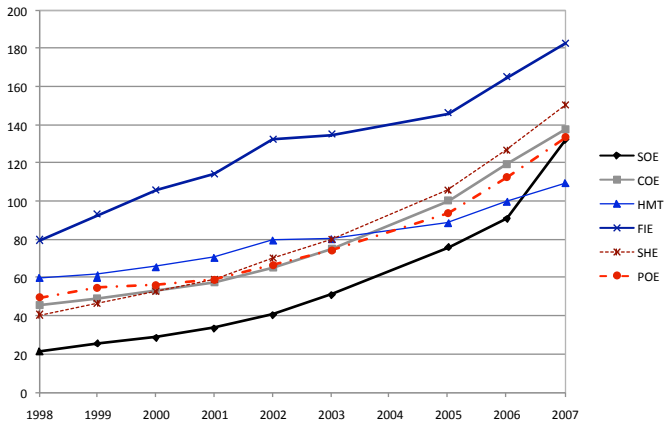

Figure 7: Average value added per employee by corporate categories (at 1998 constant price; 1000 yuan=1). Source: our elaboration on CMM.

	SOE		COE		HMT		FIE		SHE		POE	
CIC	Keep	Switch	Keep	Switch	Keep	Switch	Keep	Switch	Keep	Switch	Keep	Switch
	1998-2002											
13	4.95	14.54	8.65	11.14	10.14	10.13	9.08	5.66	8.09	10.48	8.18	9.55
17	8.75	12.69	10.02	11.93	6.42	16.33	4.64	9.38	8.56	14.28	12.75	13.24
26	8.55	15.17	8.68	10.86	6.60	7.15	12.73	6.51	13.71	8.41	11.85	8.70
31	8.25	13.42	8.82	10.26	8.38	10.31	9.66	7.03	8.67	11.52	12.45	11.79
32	15.91	22.76	8.70	14.53	7.67	0.56	6.97	27.71	9.19	8.72	13.35	14.70
33	16.39	20.07	10.30	11.68	16.53	27.44	3.66	25.04	14.23	15.83	12.47	13.07
35	12.27	19.93	12.56	12.55	10.16	7.75	15.73	14.15	12.81	15.65	10.37	9.00
37	11.87	20.50	8.72	9.48	3.46	10.58	13.54	7.76	15.65	13.42	12.17	10.28
39	9.33	9.84	7.19	7.56	6.79	9.50	9.37	7.68	7.67	10.07	16.54	13.39
40	11.54	12.35	7.93	7.11	6.24	5.05	7.87	6.23	8.77	18.20	7.47	-6.04
	2002-2007											
13	12.56	16.23	12.41	12.91	4.91	9.24	7.88	11.99	10.38	13.20	16.10	16.77
17	8.48	13.23	9.53	11.16	4.89	7.55	6.84	8.26	9.48	12.89	12.05	11.30
26	14.03	16.66	8.91	11.42	6.12	5.89	7.57	11.55	11.94	12.85	13.26	11.25
31	12.44	13.77	13.97	15.65	5.84	8.64	7.59	10.42	11.80	15.42	16.54	16.70
32	13.70	21.02	12.34	10.56	1.66	14.42	3.13	18.88	17.00	18.84	13.11	12.77
33	11.89	15.07	11.61	11.58	12.05	14.54	10.18	16.98	10.82	7.06	12.35	15.36
35	14.47	22.62	13.17	16.04	8.54	10.51	10.35	13.08	16.20	15.77	15.34	14.37
37	16.26	18.35	11.67	14.57	6.52	10.71	7.03	2.86	11.84	12.44	14.19	11.53
39	6.78	16.23	8.41	11.47	3.55	5.77	6.16	4.81	8.84	12.32	10.20	13.97
40	-0.40	8.27	-0.46	11.13	1.48	4.57	2.05	1.76	1.31	7.98	6.53	6.76

Table 8: Average growth rates of labour productivity, largest ten sectors, firms keeping their ownership and switching-types. Source: our elaboration on CMM.

types.[15] In addition to the different levels of labour productivity, notice that the empirical distribution of SOE is significantly different from that of the others, in terms of wider support, fatter left-tail, underling a catching-up process but with an increasing dual structure, with a small group of SOEs lagging behind.

Overall, the empirical densities of six ownership types converge over time.

In order to disentangle statistically the importance of the six types, we construct a panel containing the MLE estimators of five parameters of AEP fits of annual labour productivity distribution by sectors and by ownership.[16] A two-way ANOVA with repeated yearly measures is employed to test the effects of ownership, time and their interaction, in a model such as

$$Y_{ijk} = \mu_{...} + \rho_{i(j)} + \alpha_j + \beta_k + (\alpha\beta)_{jk} + \epsilon_{ijk} \tag{4}$$

with Y_{ijk} the estimated AEP parameters a_l, a_r, b_l, b_r and m respectively; α_j ownership effect, $j \in \{1, ..., 6\}$;[17] β_k year effect, $k \in \{1998, ..., 2007\}$; $(\alpha\beta)_{jk}$ interaction effect of ownership and year; $\rho_{i(j)}$ sector effects, $i \in \{1, ..., 25\}$; ϵ_{ijk} residual.

Ownership effect turns out indeed to be highly significant for all five parameters.

The difference across distributions conditional on ownership and their evolving patterns are detected adopting *post hoc* Tukey simultaneous pairwise comparison techniques. The average values of AEP parameters over sectors and years for each ownership category are shown in Table 9.[18] In particular, corporate types exert a statistically significant influence on the value of a_l, with SOEs having the largest and domestic private the smallest ones. Conversely, foreign-invested firms display the largest contribution to the upper-tail (a_r) and both domestic private firms and SOEs the smallest one.

Moreover, the estimates, available on request from the author, show a significant time effect on the left tail of state-owned, shareholding and private Chinese firms: yet another piece of evidence on the dynamism of domestic firms of all types.

[15] We only display four ownership types on each figure, neglecting COE and HMT.

[16] This panel includes 1350 observations obtained by 6 ownerships × 25 CICs × 9 years. CIC 16, 25, 28 and 42 are excluded, due to the low number of observations. Likewise, the category "other domestic enterprises" is disregarded.

[17] 1 to 6 indicate SOEs, COEs, HMTs, FIEs, SHEs and POEs.

[18] The *post hoc* Tukey pairwise comparison of mean differences of six ownership-groups is not shown here.

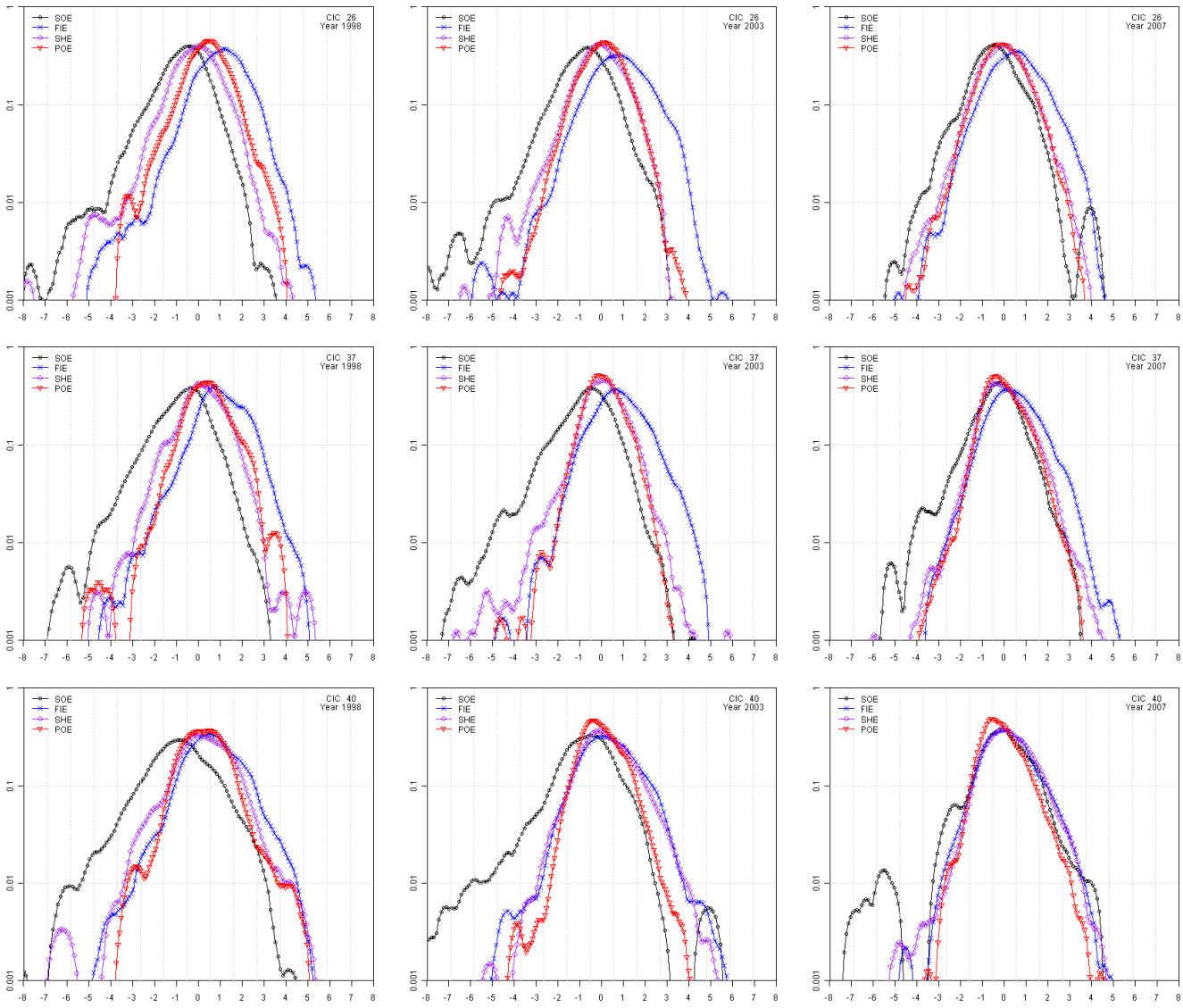

Figure 8: Empirical density of normalized (log) labour productivity of four ownership categories (SOEs, foreign-invested, shareholding and private enterprises) for chemical (CIC 26), transport equipment (CIC 37) and communication equipment, computers and etc. (CIC 40), for year 1998, 2003 and 2007. Source: our elaboration on CMM.

Order	a_l	Ownership	a_r	Ownership	b_l	Ownership	b_r	Ownership
Smallest	0.62	Private	1.06	SOE	1.04	Shareholding	1.84	SOE
	0.71	Collective	1.11	Private	1.05	Collective	1.98	Private
	0.74	HMT-invested	1.15	Shareholding	1.10	Private	2.00	Shareholding
	0.75	Shareholding	1.17	Collective	1.12	HMT-invested	2.00	Collective
	0.81	Foreign-invested	1.20	HMT-invested	1.12	SOE	2.06	HMT-invested
Largest	1.21	SOE	1.34	Foreign-invested	1.16	Foreign-invested	2.24	Foreign-invested

Table 9: Average value of parameters of AEP fits for each ownership category. Source: *post hoc* Tukey Pairwise comparison of ownership effects.

8. Conclusion

In this work, we investigated the microeconomic patterns underling the impressive growth of labour productivity in Chinese manufacturing over the most recent decade for which data are available.

The evidence suggests that the major driver of such dynamic rests in a fast catching-up by Chinese firms of different governance and ownership structures.

The dispersion in productivities, still extremely high in the late 90s, significantly shrinks due to exit, but also more importantly, organizational change involving deep transformations in governance and together technological learning.

In all that, firms which initially were State-owned play a very important role. Most of them modify their structure gaining the shape management-run "capitalist" firms. And many of them (the "shareholding" ones) become State-private joint ventures. Together, newly born private domestic firms gain importance even if mostly in industries characterized by relatively low technological sophistication. Interestingly, aggregate manufacturing productivity growth does not appear to be influenced by "structural change" at the macroscopic level of 2-digit industries: China seem to have achieved quite early a "mature" composition of industrial sectors.

Finally, our evidence suggests that foreign MNCs and joint ventures do often display initial above average productivities, but they are also the group of firms with a relatively low rate of productivity growth.

Indeed, the overall picture suggests a fast process of restructuring and learning rooted in the deep transformation of domestic (often ex-State owned) enterprises. Indeed the story underlying the impressive catching up of Chinese manufacturing is much more one of "creative restructuring" and accumulation of absorptive capabilities by domestic firms, rather than sheer "creative destruction" and even less so an

MNC-led drive.

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