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INDUSTRIAL ORGANIZATION∗

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I. INTRODUCTION AND OVERVIEW:

China’s industries have achieved remarkable development since the start of reform in 1978. We will briefly sketch both the quantitative and institutional dimensions of recent growth. Our main objective, however, is to examine what we see as the central achievement of Chinese industry: the emergence of mechanisms for extending industrial capability, which we measure by the capacity to sell into overseas markets, to a growing array of products and sectors. This objective, which only a few economies – among them Taiwan, South Korea, Israel, India, and Brazil – have attained during the decades since the end of World War II, ensures that China’s recent boom represents a permanent shift rather than a temporary respite from the long history of poverty.

At the start of reform, Chinese industry had already attained substantial size – its factories employed more workers than the combined total of all other third-world nations – and considerable capabilities – as attested by China’s mastery of nuclear weapons and satellite technology. Yet visits to Chinese factories revealed a vast array of obsolete and dysfunctional products: vans and transformers that failed to keep out rainwater, sewing machines that leaked oil onto the fabric, power tillers that sat rusting outside a factory that continued to churn out fresh batches of unwanted inventory, and so on. Similar difficulties arose elsewhere in the socialist world.

China’s reforms, now well into their third decade, have remade Chinese industry along many dimensions. The considerable divergence between China and transition economies of provides clear insight into the forces driving economic change.

After 25 years of reform, China’s wide performance advantage over the transition economies of the former Soviet Union demonstrates the central role of entry and competition in motivating enterprise owners, executives, managers, technicians, and workers to expand capabilities and improve performance. China’s experience shows that whatever their benefits, neither privatization of enterprise ownership nor extensive deregulation, full price flexibility, rule of law and other widely recommended institutional changes must precede a broad-gauged advance of manufacturing capabilities.

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Although competition provides a universal spur to industrial firms, the process of upgrading differs systematically across sectors, which vary according to

-- the effectiveness of sunk costs in expanding capabilities (low in cotton textiles, moderate in steel and home appliances, high in semiconductors and aircraft)

-- the extent to which expanded capabilities translate into increased market share (low in flow meters with multiple niches populated by numerous specialist firms; high in passenger aircraft, where buyers only consider top-quality products) (Sutton 2000).

The importance of industry-specific characteristics in shaping the development process leads us to anticipate that the evolution of Chinese markets will generally follow patterns established in other nations. Globalization, which multiplies the impact of international market forces on Chinese producers, accentuates this tendency. At the same time, China’s large size, unusual history, and unique institutional arrangements also shape market structures. This combination of forces results in outcomes that partly conform to international commonalities, but also reflect special features of China’s economy.

China’s industrial development is a vast subject that no single essay can encompass. We focus on two central issues. What are the consequences of China’s substantial, though incomplete shift from plan to market? How far has China advanced toward creating a modern, technologically advanced manufacturing sector? In addressing these questions, we emphasize a subset of industries: automobiles, beer, cement, garments, home appliances, machine tools and steel.

We preface our study with an historical sketch of industrial development under reform and a brief discussion of the extent to which market forces shape the evolution of industrial structures in China’s transitional economy.

II. HISTORICAL SKETCH OF REFORM

Incentives. The gradual shift from plan to market revived and expanded the scope for profit-driven business behavior. Enterprise financial outcomes gradually emerged as central determinants of career opportunities and material welfare for employees and managers alike. These changes advanced gradually and remain incomplete. Well into the first reform decade, the scope for independent business strategies remained so slight that Komiya likened Chinese enterprise directors to plant supervisors in Japanese multi-plant firms (Jefferson and Rawski 2002; Komiya 1987; Organisation for Economic Co-operation and Development. 2002). Even today, scope for independent managerial action in specific areas, notably investment decisions and transactions involving the sale or exchange of tangible assets and other property rights, remains limited, especially among large state-run firms (Jefferson and Rawski 2002; Organisation for Economic Co-operation and Development. 2002).
Growth. Aggregate performance measures are subject to considerable ambiguity: standard figures are widely believed to overstate output growth; both the definition of industrial output and the range of firms covered have changed over time; standard measures for capital are compiled without reference to shifts in the price level; labor figures are not consistent with the output totals and, prior to 1998, include large numbers of personnel who received wages but performed no regular duties.

Despite these difficulties, broad trends are beyond dispute. Output volume, output per worker, quality, variety, and exports all grew dramatically, with an extraordinary influx of direct foreign investment providing a major contribution in the last three areas. Figures 1 and 2 compare China’s achievements during the long 25-year boom from 1978 with other Asian growth spurts: Japan from 1955-1980; Taiwan from 1960-1985; and Korea from 1965-1990. Figure 6 focuses on the growth of secondary-sector value-added; Figure 2 examines changes in the global trade share of the four economies.

With output rising swiftly, employment in manufacturing and in industry (the latter including mining and utilities) increased only until the mid-1990s. Figure 3 shows that employment in urban industry rose to a 1993 peak, and then declined. Reported employment in rural (or TVE) industry increased until 1996, then dropped sharply before recovering somewhat in the late 1990s (Rawski 2003). Figure 4 summarizes employment changes between 1993 and 2002 for a balanced panel of over 30,000 firms; grouped into 4-digit sectors. Results show that employment declined in over three-fourths of 527 sectors. This combination of rapid output growth and substantial reductions in employment coveys a picture of restructuring rather than unbridled growth.

China’s stock of industrial fixed assets leaped ahead with extraordinary speed and also with considerable waste – Chinese economists regularly lament the prevalence of “wasteful and duplicative” investments (Rawski 2002). As a result, output per unit of capital has tended to decline.

Controversy over the direction of change in multi-factor productivity, especially for state-owned firms [e.g. Jefferson et al; W.T. Woo et al xxx] has perhaps obscured the larger picture, which includes the following:

- Despite truly enormous increases in market opportunity and information, technology, managerial knowledge, quality of equipment, and many other beneficial factors, growth of multi-factor productivity appears modest at best.
- However modest, performance improvements, especially in the initially dominant state sector, made vital contributions to the initial success of China’s reform efforts [as emphasized by G. Jefferson xxx]
- The surprisingly small payoff to a seemingly potent combination of deregulation, improved factor quality, and unprecedented openness points to the presence of costly institutional barriers to improved performance. This in
turn suggests that China’s remarkable growth conceals considerable untapped potential.

**Enterprise demographics.** Reform led to rapid acceleration of entry. In 1980, the number of industrial enterprises was below 1 million.\(^1\) China’s 1995 industrial census enumerated 7.34 million enterprises, including 5.69 million private-sector establishments (Dì 3 ci quan guo gong ye pu cha ban gong shi (China) 1996). The reported total reached 7.93 million firms in 1999 (Yearbook 2000).\(^2\) The growing diversity of enterprise types eroded the counter-productive uniformity typical of socialist systems. Despite obstacles arising from excessive regulation and official micromanagement, increasing numbers of firms found themselves positioned to respond to profitable opportunities, for example by jumping into new industries or new markets.\(^3\)

Exit of weak firms and redundant resources from unprofitable occupations has expanded dramatically – most visibly with the sacking of perhaps 60 million (mainly industrial) workers - but remains limited by official concern about social and political consequences of bankruptcies, layoffs and firm closures. Despite the survival of many “zombie” firms, bankruptcy and closure have become genuine possibilities, especially for small firms and for export-oriented producers. Thus the EU’s imposition of anti-dumping duties in 2001 pushed “half of Chinese energy-saving lamp enterprises” into bankruptcy, with the total number of firms plunging “from 4,000 to around 2,000” during 2001, and then dropping to “around 1,400” in 2002 (Yan 2004).

Mergers and acquisitions, long hobbled by official restrictions, have grown rapidly from a tiny base (Jefferson and Rawski 2002) and have recently developed substantial scale and momentum, with giant multinationals like Anheuser-Busch, Ssangyung, and General Motors participating as both buyers and sellers. Although data remain spotty and inconsistent, rapid growth continues: one source shows both the number and value of M&A transactions doubling between 2002 and 2003 (Center 2004). One source places the total value of such transactions as US$35 billion in 2003 and $23 billion in the first half of 2004 (Chang 2004). Accelerated merger activity is widely anticipated in steel, motor vehicles, and other sectors (Yu 2004b; Yu 2004d).

**Competition.** China is no exception to the tendency of entry to intensify competition. The trappings of business rivalry: strategic pricing, advertising, sales effort, brand formation (along with theft of intellectual property rights, fraud, and other less attractive facets of market systems) have come increasingly to the fore. Although various forms of

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\(^1\) (China. Gong ye jiao tong tong ji si. 2000)@16 shows 377.3 thousand firms at and above the township level, to which we should add 558.7 thousand operating at the brigade (shengchan dui) level – see (Office 1986), p. 12.

\(^2\) Subsequent figures exclude firms with sales under RMB5 million, and are therefore not comparable with earlier totals.

\(^3\) In the 1990s, Beijing-based Capital Iron & Steel entered banking, transport, and aquaculture, among others. Recent entrants into China’s booming automotive sector include domestic producers of motorcycles, batteries, chemicals, and beverages.
market segmentation persist, changes in both policy and infrastructure, including the 
growing acceptance of private business, ongoing deregulation, China’s entry into the 
World Trade Organization, and the impact of improved transport and communication on 
transaction costs, all tend to undercut entry restrictions and expand the ambit of market 
forces – a subject further explored in the discussion of volatility below.

Specialization, Division of Labor, Supply Chains.  As in other socialist systems, 
Chinese firms sought to insulate themselves from unreliable suppliers by pursuing 
extensive vertical integration (Berliner 1957; Granick 1967; Rawski 1979; Wang and 
Chen 1991). The transition from plan to market and the associated shift from a 
shortage economy to new patterns in which suppliers found it necessary to woo clients 
created new opportunities for specialization. The growth of export industries necessitated 
the creation of intricate supply chains, reinforcing tendencies already visible during the 
early 1980s, when several segments of the home appliance industry recorded substantial 
increases in the ratio of intermediate purchases to output value. Similar changes follow 
in the manufacture of motorcycles, cars and trucks, machine tools, and various items of 
general machinery. Yifan Zhang uses aggregate and micro-level data to document and 
analyze a considerable expansion of specialization within China’s industrial sector during 
the reform period (Zhang 2004).

Institutional framework of the business system. China’s transition, initially hesitant, 
but increasingly purposeful following the 1992 Communist Party decision to create a 
“socialist market economy with Chinese characteristics,” has brought a torrent of 
reforms: markets for products, resources, intermediates, technology, shares, bonds, 
commodities, and corporate ownership; laws on competition, bankruptcy, contracts, and 
corporate structures, along with a growing array of judicial institutions; elements of a 
market regulatory regime; credit ratings; business associations; new modes of corporate 
governance; efforts to align accounting systems with standard international practice; 
massive privatization first of rural, and now of urban industry; and much more. Every 
day brings news of fresh reform designed to expand and strengthen the foundations of 
China’s emergent market economy. Each day also brings fresh illustrations of gaps and 
shortcomings that often reflect the surprisingly persistent legacy of China’s quarter-
century of socialism.

III. IMPORTACE OF MARKET FORCES IN CHINA’S INDUSTRIAL 
ECONOMY

Our analysis of Chinese industrial development builds on the notion that under reform, 
strong firms that raise quality and variety, improve service, and control cost can and do 
gain market share at the expense of weaker rivals. This view runs counter to recent 
studies that extending the view of China as a “cellular economy” with limited 
interregional links first articulated by Audrey Donnithorne during the 1970s (Boyreau-
Debray and Wei 2003; Donnithorne 1972; Kumar 1994; Poncet 2002; Poncet 2003;

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4 (Wang and Chen 1991); also Otsuka, Liu and xxx (machine tools); also Rawski file 
\io\dol\draft1.072503.
Young 2000). These authors buttress their perspective with evidence of limited domestic trade expansion, absence of regional specialization, and small cross-provincial flows of both commodities and capital.

The basic tenet of the cellular economy perspective is that some combination of official protection and weak physical or institutional infrastructure effectively reserves local and regional markets for “home” producers. Favored incumbents sheltering behind strong entry barriers are partially or wholly immune from the competitive pressures that underpin our vision of Chinese market development. As a result, we see a fundamental clash between the cellular economy approach and our perception of typical Chinese markets for industrial products.

In our view, cellular economy authors are misled by excessive aggregation and inadequate data. Rather than attempting to refute their analysis on a case-by-case basis, we attempt to undermine a key implication of their analysis: that incumbent firms are substantially immune from external competition.

We plan to test this hypothesis by studying market share volatility for the 500 largest manufacturing firms by sales value for China, Japan, and the United States between 1993 and 2002. If, as we anticipate, market share volatility, adjusted for changes in output structure, turns out to be larger for China than for Japan, we will conclude that, despite well-documented instances of internal trade barriers, China’s markets for industrial goods are sufficiently open to allow capable firms to expand market share at the expense of weak rivals.

Pending the completion of the volatility research, we offer a preliminary analysis based solely on Chinese firm-level data for 1993 and 2002. In many industries, foreign firms and foreign-linked joint ventures, which now number in the tens of thousands, as well as some domestic companies, have implemented equipment, process, and product innovations that surpass prior norms by large margins. For example, an (unsystematic) sample of members in an association of compressor producers shows output per worker averaging RMB13,800 (median for 23 firms is RMB17,800) in 2000. In the same year, output per worker at Nanjing Ingersoll, which also makes compressors, was RMB110,400 (Machinery 2002) [see /io/division of labor/tongyong.082603].

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5 Evidence contradicting the cellular economy view abounds. Travelers along China’s expanding highway network can observe trucks streaming across wide-open provincial borders. China’s press is filled with accounts of cross-regional competition: for example: “Unilever is eyeing China’s small and medium-sized cities and rural areas to expand its business. . . . More and more enterprises have joined the household chemicals market in the large cities, making it increasingly severe. . . . Chinese national enterprises in this sector are facing great challenges from foreign companies and joint ventures…”(Jiang 2004) p. 10. Endless reports of “price wars” show producers of appliances, automobiles, and other products struggling to expand market share: for example (Yu 2004a) and (Yu 2004c), which cites a researcher’s view that auto producers “will take all kinds of measures to boost sales” so that “further vehicle price wars will be ‘inevitable’.” See also studies by (Bai et al. 2004; Park and Du 2003; Qi 2004; Zhang and Tan 2004).

6 Shaomin Li of Old Dominion University will join us as a co-author for this project.
If, as the cellular economy view implies, such differences have little impact on the operations of incumbent firms outside the specific areas served by the innovators, the dispersion of productivity within specific industries should increase. Our view, by contrast, anticipates that increases in productivity in specific 4-digit industries, proxied by sales per worker, will pressure rivals to attempt their own productivity gains or leave the industry, resulting in the exact opposite: a reduction in the dispersion of productivity.

We evaluate these conflicting expectations with data for approximately 270,000 Chinese industrial firms in 1993 and 180,000 firms in 2002. In each of 500+ four-digit industries, we calculate the coefficient of variation for sales per worker across all firms in 1993 and again in 2002 (where the array of firms is not necessarily identical). Our test statistic is the ratio of these coefficients of variation,

\[ R = \frac{CV_{2002}}{CV_{1993}} \]

We expect the test statistic R to fall within the range (0,1). The cellular economy perspective points toward values greater than unity. Results summarized in Figure 5 clearly fit our expectations. With observations for 535 4-digit industries, the mean and median are 0.907 and 0.776. One-half of all observations fall below 0.78, 70.9% fall below unity, and 78.6% of R-values are less than 1.10.\(^7\)

These results provide strong support for the view that, notwithstanding the incomplete nature of China’s reforms and the well-documented presence of officially directed market segmentation, both individual firms and whole industries typically experience strong influence from fundamental pressures common to all market systems. This perspective, which remains subject to further verification, informs what follows.

**IV. ANALYTIC FRAMEWORK**

**A. Introduction**

How have Chinese market structures evolved? Starting from the late 1970s, liberalization and market expansion arising from the gradual demise of planning\(^8\), the relaxation of control over international trade and investment,\(^9\) and improvements in

\(^7\) See file /cc/io/volatility/yifan091004/c_variation_full_sample.092604. Splitting the data into sub-samples for coastal and interior provinces yields no major change: for the coastal regions, the mean and median values of R are 0.884 and 0.759; for interior regions, the mean and median are 1.060 and 0.896 respectively. See files cv_coast… and cv_noncoast… All these results include a small number of observations for mining and utilities (should focus on manufacturing alone).

\(^8\) Possible documentation: falling share of planned products in industrial output; or rising share of planned/administered prices.

\(^9\) Possible documentation: rising ratio of imports to GDP (or of manufactured imports to industrial output); growth of DFI.
transport and communication stimulated entry into formerly closed markets, intensified competition, and deepened market integration.

With market rivalries sharpening and official agencies embarking on a gradual, but accelerating process of reducing subsidies to weak firms, Chinese companies face a steady escalation of financial pressures. The dispersion of outcomes – not just wages, but also investment opportunities, housing, and medical and pension benefits – is increasingly aligned with enterprise financial results. This presages the decline and eventual disappearance of weak firms and the dismissal of redundant workers. Although ongoing subsidies for incumbents, imperfect exit mechanisms, and the veneer of prosperity arising from rapid growth slow the process of downward mobility, the basic consequence of economic reform – the idea that participants’ economic future depends on financial outcome of market activity – has gradually come to the fore.

Two main themes are explored in what follows. The first of these relates to the shift towards a market economy that has occurred over the past two decades. Up to the early ‘90s, it was widely argued that the shift was limited by geographical segmentation of markets, by political interference, and by the behaviour of state-owned enterprises. A blow-by-blow listing of barriers to the operation of markets might suggest many impediments of this kind; and yet the cumulative quantitative impact of such barriers would be difficult to assess. In what follows, we take an indirect approach, by looking at the way market structure has evolved in a range of industries of different kinds over the past twenty years. Different industries have different characteristics which affect their mode of evolution in market economies, and by looking across a range of industries of different types we can see whether patterns of development characteristic of market economies have been observed. Clearly, there are two very different situations involved here, since some industries have been long-established, while others have essentially grown up from scratch over the twenty-year period. We begin, in the next section with a brief sketch of the different types of industry to be considered; and we then look at the ‘new’ industries before turning to the adjustment paths followed by the ‘old’ industries.

The second theme relates to the question ‘how far has China come?’ How close has its ‘industrial capability’ moved towards that of advanced industrial economies? Before addressing these issues, it is worth pausing to ask what is meant here by ‘capability’.

**B. Some preliminary remarks**

A firm’s capability can be defined, for our present purposes, in two steps:

(a) The firm’s (‘revealed’) capability relates to the range of products which it currently produces; specifically, for each (narrowly defined) product line, it refers to (i) the unit variable cost of production expressed as the number of units of materials, and labour input, required per unit of output product, and (ii) a measure or index of ‘perceived’ quality defined in terms of buyers’ willingness-to-pay for a unit of the firm’s

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10 Can refer to Naughton (Mod China 1992?); Jefferson & Rawski; or simply to big increases in numbers of firms.
product, as against rival firms’ products. (It is worth noting that this index of ‘perceived quality’ can be raised not only by improving the physical attributes of the product, via R&D or otherwise, but also through improvement in reputation, brand image, and so on).

(b) Underlying the firm’s revealed capability is the firm’s ‘underlying capability’, which consists of the set of elements of ‘know-how’ held collectively by the group of individuals comprising the firm. The importance of this deeper notion of capability lies in the fact that some of these elements of ‘know-how’ will be useful in producing products not currently made by the firm\textsuperscript{11} – and this will enhance the firm’s ability to take advantage of new opportunities over time, as shifts occur in the underlying pattern of technology and demand which it faces.

A generic property of the class of models considered here is that competition between firms will generate some ‘threshold’ level of capability below which no firm can survive (in the sense of achieving any positive level of sales revenue at equilibrium). Thus there is a range, or ‘window’, of capability levels at any time, between the current ‘top’ level attained by any firm and this threshold – and any potential entrant must attain a capability that puts it into this window.\textsuperscript{12}

It will be useful to begin with a few general remarks about some relevant industry characteristics. Two key characteristics that affect the different patterns of evolution of different industries are as follows:

(i) the first factor, labelled $1/\beta$ in Figure 6 below, relates to the process of capability building within the firms. Specifically, $\beta$ represents the elasticity of the function specifying the level of fixed outlays required to achieve a given level of perceived quality or a given level of productivity (Sutton 1998) Chapter 3). If, for example, an increase in R&D spending leads to a substantial rise in product quality (‘product innovation’), or a substantial fall in the unit cost of production (‘process innovation’), then $1/\beta$ will be high. In this (narrow) sense, $1/\beta$ measures the ‘effectiveness of R&D’. More generally, the firm may build up its capability using a variety of methods; what is common to all these methods is that they are costly – in all cases, the firm incurs some fixed and sunk cost in equipping individuals with new elements of ‘know-how’, whether these relate to product design, production routines, or other devices that enhance productivity or perceived product quality. Now if we are dealing with a standard commodity product, produced using equipment available for sale on the market, which can be operated effectively by low-skill workers, then the firm’s opportunities for raising its level of capability relative to its rivals may be limited so that $1/\beta$ is low. On the other hand, if the firm can develop, or imitate, new and better routines in its

\textsuperscript{11} An early formulation of this idea appears in (Rawski 1975)

\textsuperscript{12} China’s pre-reform system, with its weak competition, segmented markets, low incomes, excess demand, and product prices set to allow mediocre firms to cover costs, ensured that most suppliers faced low thresholds and wide sales windows. Customers willingly accepted a wide range of products – including goods with “small defects.” In the 1990s, for example, urban residents moving into new housing immediately replaced the (defective) electrical switches supplied by construction firms.
production process, by way of training programs or otherwise, then $1/\beta$ will be correspondingly higher. As we move up vertically in Figure 6, we move from commodity-type industries where the relevant technology is largely ‘embodied’ in capital equipment bought in from outside, towards industries in which increasing efforts are devoted to the building up of in-house expertise and know-how.

(ii) The second factor of interest, labelled $\sigma$ in Figure 6, relates to the relationship between different (firms’) products. These relationships arise both on the demand side (‘substitutability’) and on the supply side (‘scope economies’). What $\sigma$ measures is the extent to which a firm that devotes additional effort to capability building can capture market share from its rivals. The value of $\sigma$ can be affected, for example, by the cost of transport: in the cement industry, price differences across two different geographical regions may have only a modest impact on the pattern of market shares, in that they may induce switches of consumers only in some intermediate areas more or less equivalent from the rival plants; if this is the case, then $\sigma$ is low. If, on the other hand, transport costs are low, then small price differences may induce larger shifts in market shares, and $\sigma$ will be correspondingly higher. More generally, if buyers are insensitive to any differences between the product varieties offered by different producers, so that small price differences have a big impact on market shares, then $\sigma$ is high.

A second form of linkage arises on the supply side: this linkage operates at the level of the underlying elements of know-how required in the production of rival products (‘economies of scope’). Here, if a firm deepens its expertise in the production of one product line, this expertise can place it at an advantage on introducing a second product line, or – if it is already active in the production of that second line – in enhancing its previous level of productivity or quality in that second line. At the opposite extreme, we might imagine the market to include a set of different product types, each based on an entirely different form of technology to the others. A firm investing heavily in its capability may take market share only from those rivals selling the same type of product to its own offering but will not take share from producers in other segments or (‘sub-markets’). (For a practical illustration of this type of market, see the discussion of the flow meter industry in (Sutton 1998), chapter 5). This again constitutes the kind of linkage that is measured by $\sigma$, viz. and increase in a firm’s spending on capability building is effective in allowing it to capture a larger share of the market as a whole.

Figure 6 shows the pattern of outcomes associated with different combinations of $1/\beta$ and $\sigma$; for the underlying analytical arguments, and empirical evidence supporting this summary picture, see (Sutton 1998), chapters 3-4. What the figure indicates is as follows: when the effectiveness of capability building is low, then its will be possible to sustain an increasingly fragmented market structure as the size of the market increases. It is important to note that this outcome does not necessarily emerge, however the

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13 China’s Haier Group, which used its expertise and reputation in refrigerators as a springboard to enter markets for air conditioners and televisions, provides an apt Chinese illustration.
underlying economic mechanisms permit a wide range of market structures to be supported.\textsuperscript{14}

Now as we move up the vertical axis in Figure 6, two alternative patterns emerge, according as $\sigma$ is low or high. When $\sigma$ is low, we can once again sustain a fragmented market structure, but now the levels of effort devoted to capability building by firms will be intense, and R&D to sales ratio will be high. But as we move across the diagram to the top right hand corner (high $1/\beta$, high $\sigma$), concentration must necessarily be high, independently of the size of the market. The key economic mechanism at work here is an ‘escalation effect’: as the market grows, the familiar tendency for new entry to occur, leading to a rise in the number of producers and a fall in concentration, does not operate. Instead, the enhanced profits available to a firm that commands a given share of the larger market induces increased investments in capability building by market leaders. Instead of having more firms, we have an unchanged number of firms, each supporting a correspondingly greater level of R&D spending (or, more generally, spending on ‘capability building’).

It may be useful to note where various industries lie on this Figure; this can be done by reference to measurable ‘industry characteristics’ following (Sutton 1998); see Figure 7.

A comparison of Figures 6 and 7 allows us to make some preliminary observations as to the way in which market liberalization should be expected to affect the pattern of capability building, and the evolution of concentration, in different Chinese industries.

First, however, a general remark is in order. As noted earlier, the economic mechanisms we are concerned with here operate merely to place a lower limit of the level of market concentration; if, as was the case in Eastern Europe, the pre-liberalization regime favoured the creation and maintenance of highly concentrated industries in which a handful of large state-owned enterprises dominated, then the move to a free market environment is consistent with a fall in concentration. In the Chinese context, however, the most common starting point featured low concentration because dispersal of manufacturing formed part of China’s military strategy and because Chinese economic planners generally ratified the efforts of individual provinces to build “full sets” of industries.\textsuperscript{15} Rapid development of rural industry after 1978 accentuated the tendency for market concentration in Chinese industries to fall below the levels typical of similar industries in large market economies.

\textsuperscript{14}To illustrate this point, consider the case of a large number of cement plants arranged along the coastline from north to south. A fragmented market structure might involve each plant being owned by a different firm; if however, every second plant is acquired by a single firm, so that each competes only with the same independent local rivals as before, the (price) equilibrium in the market is unaffected, and the new form of market structure is viable and stable, just as was the old ‘fragmented’ structure.

\textsuperscript{15}Printing equipment, a new industry in the 1950s, had spread to 21 provinces by 1980 (Board 1983), p. 89. Li Chengrui, a prominent Chinese economist, commented in 1975 that China’s regions “all want to speed up production in their own area” and therefore “argue for large state investments in their own provinces” for every sector (American Rural Small-Scale Industry Delegation. 1977), p. 276.
The impact of liberalization involves three important mechanisms (see (Sutton 2000):

I As domestic firms come into closer competition with domestically based rivals, or with imports, prices fall, and the least capable firms may no longer be viable.\textsuperscript{16}

The result is a mixture of exit, and consolidation (aimed at restoring margins), leading concentration to rise. This mechanism operates across all industries, but is relatively weak when $\sigma$ is low, as in cement.

II As we move up and across Figure 6, towards the top right corner (high $\sigma$, high $1/\beta$), a second mechanism plays an increasingly important role: this involves an escalation of efforts by surviving firms in respect of capability building, leading to higher levels of R&D spending and increased market concentration. This plays a central role in industries such as ‘Domestic Electrical Appliances’, on which we focus in the next section.\textsuperscript{17} \textsuperscript{18}

III The third mechanism relates to volatility of market shares. As competition intensifies, the market share gap between more capable firms in each market, and their less capable rivals, widens. Moreover, a firm’s current (‘revealed’) capability is not always mirrored in its underlying (‘dynamic’) capability, i.e. its ability to adjust to shocks in its environment. It follows that shifts in the ranking of firms in the market are likely to occur; at its most extreme, this may lead to the displacement of old market leaders by new entrants. Again, this mechanism plays a central role in what follows.

3. The New Industries

\textsuperscript{16} In China, Rising incomes and export expansion tended to raise the lower threshold of sales windows, thus multiplying pressures on low capability firms

\textsuperscript{17} Mechanisms I and II can be described as follows: as more firms enter the ‘window’, the lower threshold rises. Moreover, the incentives for firms to raise their investments in ‘capability building’ also rise: so that the top of the window (defined by the highest capability attained by any firm) also rises. In other words, the process of entry pushes up the window. While these remarks relate to a single (‘closed’) economy, the same idea carries over to a multi-country setting: as a new country joins the global market, its firms ‘enter the window’, and the window itself shifts upwards – rendering some hitherto viable firms elsewhere non-viable. It is worth noting, finally, that having low wage rates in the ‘entrant’ country reduces the relevant threshold of capability that its firms must attain, but this effect can only partially offset shortenings in quality: even if wage rates become arbitrarily low, the fact that manufacturing firms need some bought-in inputs fixes a lower bound to their marginal costs of production – an this in turn implies that once quality falls below a certain threshold, the firm cannot achieve any positive sales at equilibrium.

\textsuperscript{18} How wide, then, is the window? It turns out that it depends not only on the two parameters introduced in Figure 6, but also on (a) the nature (‘toughness’) of price competition in the market, and (b) the range of buyers’ ‘willingness to pay’ for quality. In particular, if there are some customers who are indifferent to quality, and are concerned only with price, then an arbitrarily large fringe of low-cost, low-quality firms may be viable ((Sutton 1991), Chapter 3 for an example).
From about 1978 onwards, a series of new industries developed in the area of consumer durables. At that time, only one model of fridge was produced in China, and annual output was only 29,000 units. By 1990, annual output had increased to 4.6 million, and this figure doubled over the next six years, while a wide variety of models became available. Washing machines followed a similar trend, with annual output climbing from 4,000 units in 1978 to 6.6 million in 1990, and 10.7 million by 1996. Annual production of colour televisions stood at 3,800 units in 1978; by 1990, this had exceeded 10 million units. By 1999, sales of colour TVs drew equal with sales of Black and White TVs at about 15 million sets per year, and by 1998, production of colour TVs exceeded 35 million units per year. Table 1 summarizes physical output trends for these products.

The classic pattern of evolution of firm numbers and of market concentration under free competition in markets of this kind has been described in a series of papers by Steve Klepper and his several co-authors; see also (Sutton 1998).

The first phase of the process involves ‘excess entry’ as a wide range of firms enter the market – an effect usually attributed to their holding different prior beliefs as to their relative chances of long-term survival. Thereafter, the ‘escalation’ mechanism introduced in the preceding section kicks in: as competition intensifies, some firms advance more quickly than rivals in building their capabilities, lending to rising concentration (Sutton 1998) Chapter 3), so that a ‘shakeout’ occurs which sharply reduces the number of active firms, and so the level of concentration rises.

In the Chinese context, two factors operated which might, in principle, have modified or offset this mechanism. First, government tried to control the evolution of the market, as noted by (Jiang 2001), p.168), but since its view favoured a move towards a structure with a modest number of relatively capable firms (Marukawa, 2001 p. 74), its influence was working in direction in which the market was evolving naturally. Second, the surge in demand in the 1980s and early ‘90s could have been partly met by imports, thus stilling the growth of domestic production but strict import controls were imposed from 1985 and the share of imports remained small (Marukawa 2001), p. 61).

The pattern that emerged in all three industries conformed closely to that described by Klepper et al. for the U.S. While full data is lacking, a sketch of the basic patterns can be assembled from the data cited in (Marukawa 2001) and (Jiang 2001), together with information obtained via company interviews. As Figure 8 shows, the number of firms in each industry rose to very high levels during the latter half of the 1980s, but by the late 1990s, a severe shakeout had occurred. The number of washing machine producers exceeded 180 in 1983; by 1995, only some 30 brands were visible in the market. In fridges, there were over 200 firms active in 1988; this had fallen to about 30 in 1995 (Jiang 2001).

In colour TVs, 87 firms were active in 1990; seven years later, this had fallen to 15. These shakeouts were accompanied by a rise in concentration. Again, figures are available only for occasional years, but the pattern is clear. In washing machines, the

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19 See for example, (Klepper and Graddy 1990).
four firm concentration ratio rose from 21% in 1982 to 72% in 1996. In fridges, it rose from 29% in 1988 to 37% in 1994. In colour TVs, it rose from 43% in 1993 to 68% by 1998. Table 1 includes additional data on concentration.

These changes were marked by considerable turbulence in the pattern of market shares, as is evident from a brief review of developments in the color television sector. This industry is a big success story. Figure 9 shows a classic “product cycle” pattern – initial imports followed by both a steep rise in exports and an equally abrupt decline in the ratio of imported components to export sales, that has rocketed Chinese producers into a leading position among global exporters of televisions.

The road to success, however, is long and costly. Figures 10-A and 10-B use provincial data to plot the annual capacity of color TV assembly factories imported during 1978-85 (horizontal axis) against annual production of color sets in 1990 (Figure 10-A) and in 2000 (Figure 10-B). The figures for 1990 suggest a costly disaster. No province can produce an output that even approaches the capacity of plants imported before 1985 (not to mention subsequent imports). Ten years later, the story is much different. Now several regions, led by Guangdong (home of TCL and Konka) and Sichuan (home of Changhong, the new industry leader) have experienced a “takeoff” into successful mass production and large-scale export.

Figure 10-B identifies losers – regions like Beijing that never attained the production level associated with facilities imported before 1985. In 2004, a Ministry of Commerce researcher summarized this outcome: “many money-losing [sic] or uncompetitive TV makers still exist. . . although some real market players have emerged” (Wang and Dai 2004). Others question the strength of the industry’s current leaders, who “lack their own core technologies, and compete by making products for overseas brand labels using ruinous price competition to gain market share” (Li 2003).

With firms struggling to master new technologies and to stabilize their finances amid fierce competition, rapid shifts in market shares are commonplace. The industry’s largest producer in 1993 was the Nanjing-based Panda company, with a market share of 11%. Over the next three years, Panda’s position was rapidly eroded by the rise of Sichuan-based Changhong, which had ranked fourth in 1993 with a market share of 4%. The decline of Panda in the TV market was sharp; its failure to assess the challenge posed by Changhong led to its being slow to respond to a series of price cuts offered by its rival from ’94 onwards. Initially, executives at Panda failed to appreciate that Changhong’s productivity had advanced to the point where the price cuts it offered were sustainable in the long term. As Changhong’s sales rose, Panda’s declined, and by 1996, Changhong held a market share of 21% while Panda’s had halved to 5%.

Changhong is in danger of suffering a similar fate. During the late ‘90s, Changhong faced strong competition from TCL, which rose from third position in 1996 to overtake Changhong as market leader by 2003. Now both TCL and Konka, another strong challenger, are invading Changhong’s home base and threatening to undercut its former market dominance across leading market share across China’s western region.
The evolution of these ‘new’ industries, then, clearly follows the type of patterns familiar from Western economies. But what of the older established industries?

4. Adjusting: The Established Industries

Cement. The pressures to adjust in a market environment vary sharply across industries. For the cement industry, even in a free market environment the high level of transport costs segments markets geographically, and the intensity of price competition and the extent of cross-hauling across different regions remains low (Figure 6). For Chinese cement makers, adjustment has posed relatively few problems.

The natural tendency for the market to be segmented at the local or regional level has been accentuated by policy decisions and regulations. In Beijing, for example, the BBMG Company is the only large producer. Operating all three large-scale plants in the city area, it supplies one-third of demand, the remainder being supplied by forty small ‘township companies’ and by cross-hauling from firms in neighboring Hebei province. Environmental concerns have led the authorities to bar further plant building or expansion in the city area, in spite of the rapid increase in demand over the past decade. BBMG operates profitably in this setting, and it has focussed its strategy on diversification into other areas of the building industry. It has several foreign joint venture partners, in areas ranging from ceramics to chipboard.

A contrasting case is that of the Sunnsy Company in Jinan city (Shandong). A long established producer, and the largest in its region, it ran at a loss for a decade during the 1980s. The firm launched a ‘turnaround’ strategy in 1990 [DETAILS TO BE ADDED xxx]

Clothing and textiles. The clothing and textiles sector has also experienced a relatively smooth adjustment process over the past decade. Some firms have been partially privatised, and some operate as fully private ventures, but the turning point for all the firms visited in the course of this study came with the relaxation of the controls that freed their export business from reliance on state trading companies, and permitted them to develop direct relationships with foreign buyers, and especially with foreign brands and retail chains.

The Lanyan Company is China’s largest exporter of denim fabrics, and currently the world’s eleventh largest producer with 1% of global output. Privatised since 2003, the company experienced a major turn-around in 1999 when it was allowed to bypass official intermediaries; its employment level, which had been static for a decade, rose from 4000 to 7400 over the next four years, while its output doubled over the same period.

The Chenfeng company, located in Jintan, Jiangsu, is China’s largest silk producer [must check notes xxx]. The firm was privatised in 2003, after obtaining the right to export

\[20\] Management share a 50% stake, while the remaining shares were taken up by employees.
directly in 1994. Over the ensuing decade, its output rose ten-fold, as it embarked on a series of expansions, integrating backwards into the ownership of silkworm farms. This latter move is seen by the company as being crucial to the efforts it undertook during the 1994-98 period to raise productive efficiency and quality. The firm’s manager identifies plan-era institutions as having contributed to the company’s quality record - a theme that recurs below.

At the other extreme of the clothing industry, the Nanjing-based Hoare (Ever Glory) Apparel firm, a private company founded in 1993, built its business from the outset on direct links to foreign buyers. It established its first major relationship by way of repeated visits to the Shanghai sourcing office of the multinational retailer C & A. Since then, it has built links to a small number of large foreign customers. It has developed close relations with its own suppliers, interacting on a continuing basis with these firms in order to develop good working relations – a strategy more familiar from the auto industry than among clothing firms. It adopts a deliberate strategy of seeking customers in the most demanding market (Japan), with a view to learning to meet high quality standards, and carrying over the practices developed in doing this to all areas of its business. While Ever Glory remains small by the standards of China’s remaining state-owned enterprises in clothing, it now has 6,600 employees, (some of whom are based in its plants in Vietnam and Cambodia; see below), and its mode of operation closely matches the pattern of operation of leading global firms in its industry.

Steel. In the steel industry, capability building plays a central role (Figure 6). China’s steel industry remains fragmented, with some 2000 firms currently active; half of the country’s total tonnage is produced by firms with an annual output below 3 million tons. Yet the changing economic environment has, over the past decade, forced a quickening pace of capability building among the industry’s leading firms. As one executive at Jinan Steel explained: “every firm has shifted its basic focus to quality control. . . there’s been no letup in emphasis on quality from the 1970s/80s until today.”

Beijing-based Shougang Corporation is the industry’s fourth largest producer, with annual output of 8 million tons. A long-established producer of wire rods, plate and section (profile) steel, it faced modest excess demand for its products at the beginning of the 1990s, at a time when government restrictions limited its freedom to expand its capacity. Shougang installed a plant purchased second hand from Belgium in 1985, and initially confined its output to basic grade products. The lack of a price premium for high quality products, and the persistence of excess demand for ordinary products left the firm with no incentive to upgrade its offerings. Another possible reason for limited effort to

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21 By changing the feeding arrangements at farm level, for example, longer fibres were produced, leading to fewer breaks in the threads at the production stage.

22 Including training facilities at the Suzhou Silk Institute and facilities in Wuxi and Shandong as well as the silk industry association and a national research agency that helped develop cocoons yielding long fibers. (Field notes 11 August 2004).

23 Interview at Jinan Steel Group Company, 4 August 2004.
upgrade quality was that Shougang benefited from unusually favorable financial arrangements that resulted in steeply rising retained earnings. Shougang used these funds to develop a wide array of non-steel businesses, but with little success: 2003 figures show the steel business accounting for 54% of the firm’s assets, 56% of sales, and 96% of profits.  

From 1993 onwards, however, Shougang faced tougher competition. This new market environment pushed the company to switch its product mix in wire rod towards higher value-added lines. By upgrading the production process, the company began to produce both hardened rods (for use in car tires and as cables for suspension bridges) and moderate or soft steel rod (suitable for drawing into thin rods).

This pattern of events was repeated in the firm’s other areas of steel production over the course of the 1990s. In section (or profile) steel (used for vehicle shafts and bearings) which had formerly been produced in an arc furnace, the firm introduced improvements in composition control to allow these lines to be produced from their converters. It halted production for eight months on its plate rolling mill to allow for a major upgrade, in collaboration with one of its long-term equipment suppliers (SMD Denmark).

Shougang’s reliance on its equipment suppliers as a channel of capability building is a normal practice in the steel industry. A similar pattern occurred during the 1990s at Jiangsu Shagang Group Co. Ltd., China’s thirteenth largest producer. Its upgrading projects during the past decade have involved collaborations with equipment suppliers from Switzerland (Concast, in continuous casting), the United States (Morgan, for wire rod rolling), and Germany (Siemens, for control systems). A particularly deep and continuing involvement began with the installation by Fuchs (Germany) of Shagang’s first electric arc furnace in 1993-95. A continuous relationship evolved between the two firms, leading to the installation of two more EAFs, the latest being in 2003.

Over the past decade, the relationship between the two firms has been typical of a standard pattern of mutually advantageous interactions between equipment suppliers and buyers. When, for example, Shagang’s engineers decided to attempt a modification of the process which would allow them to introduce molten iron into the EAF during the course of operation in an energy efficient way (i.e. without inducing a drop in temperature), they consulted Fuchs, and engineers from the two firms worked together on the project. This led to design modifications on the EAF which were not only of immediate benefit to Jiangsu, but also of long term benefit to Fuchs.

While such collaborations with equipment suppliers play a vital role in capability building in the industry, a second channel – of similar importance – involves international joint ventures. One of the most successful joint ventures in the industry involves Shagang’s link with Posco (Korea) in stainless steel. The partnership was initiated by

24 Interview at Shougang Corporation, 2 August 2004.

25 This was the sixth EAF installed worldwide by Fuchs, and its first in China. It has now installed a total of 11.
Posco, who wanted to establish a presence in China, and approached a trading company under the (former) Ministry of Metallurgy, which suggested Shagang as a potential partner. Ownership is 80% Posco and 20% Shagang, giving Posco a strong incentive to develop the business; investment over the eight-year period has totalled one billion US dollars, most of which was associated with the construction of an entire rolling mill and production line. At the time of installation, Posco had 30 personnel on site; this has now fallen to about 18 at any time, out of a total plant employment of almost seven hundred. This joint venture has allowed Shagang to broaden its capabilities in a significant way, by establishing itself as one of the only three producers of stainless steel in China.\textsuperscript{26}

Whilst neither Shougang nor Shagang has any private ownership,\textsuperscript{27} some degree of privatisation has occurred elsewhere in the industry. The Jinan Iron and Steel group, for example, China’s eighth largest producer, is 22% privately owned following a stock market flotation in 2003 [maybe 2004?xxx]. The company is notable for diversification into steel related businesses (fireproof materials, mechanical machinery, metallurgical engineering, and transportation services). The firm’s subsidiaries in these areas had sales revenue of RMB4.56 billion in 2003 (almost one-third of total 2003 sales), more than double the figure for the preceding year.

The current state of the steel industry remains one of ‘high volume, moderate quality’, yet the rate of progress on quality enhancement by the industry’s leading firms is changing this picture. Export performance is only one indicator of success (see below); an equally informative measure of capability is the industry’s success in exporting its know-how. Shougang, for example, was already building wire bar rolling mills in South East Asia in the early ‘90s; it built a blast furnace in India in ’97-’98, a blast furnace and converter in Zimbabwe in 1998, and recently completed a wide plate rolling mill in Vietnam. Most interestingly, perhaps, it sold an automation system for blast furnace operations which it had developed in-house to United Steel of the US in the early 1990s.

China’s steel sector is currently enjoying a massive boom that includes remarkable increases in production, investment and profits. However underlying conditions point to a future shakeout that could be as dramatic as in the appliance sector. Technical upgrading is both risky and expensive. As noted above, Shougang experienced lengthy shutdowns in connection with equipment refurbishment. Shagang imported China’s first continuous casting line in 1989 (second-hand equipment from U.K.), but took two years to move the new equipment into production. Shagang officials report that many firms followed their lead, but with mixed results: success at a firm in nearby Jiangyin (Jiangsu), failure at a Fujian enterprise that installed new equipment but never managed to increase output.

With demand and profits at a cyclical peak, roaring cash flow conceals potential weaknesses. Even after strenuous reform efforts, traditional industry leaders like

\textsuperscript{26} The others are the Bao Steel group (China’s number one producer), and Taiyuan.

\textsuperscript{27} Shougang is a state-controlled corporation. Shagang executives described their firm as “minying” (i.e. not in the state sector) but also “collective” (indicating some degree of local government control).
Shougang stand at risk of being undercut by newcomers. After cutting its work force in half, Shougang now produces 8 million tons of steel annually and employs 130,000 personnel, many no doubt in non-steel operations. Output is effectively capped at 8 million tons because of the Beijing municipal government’s determination to improve the capital’s air quality. Shagang, by contrast, has raised its output from 450,000 tons (1993 capacity) to 5.6 million tons of steel products (2003 output). Completion of current expansion projects will raise annual capacity to 12 million tons at the end of 2004, when the company expects to employ a total of 10,000 workers. If these plans are successfully implemented, Shagang will produce 50 percent more steel than Beijing-based Shougang, much of it at a higher quality level, with one-thirteenth the work force (although many of the Beijing firm’s staff work in non-steel businesses). Shagang requires just under 300 kwh of power to manufacture one ton of steel in its electric arc furnaces, nearly 100 kwh less than the current national average of 380-400 kwh.

Similar gaps probably exist between some of the industry’s traditional leaders and aggressive steelmakers, including some private firms, in places like Tangshan (Hebei), which is now capable of producing more than 15 million tons per year (Wang and Zhang 2002).

Since 1990, the most dynamic newer firms have recorded large advances in market share and value-added per worker. With the notable exception of Shanghai-based Baosteel, the large steel complexes developed during the plan era have not kept pace. The big centers at Anshan, Wuhan, Baotou, Chongqing, and Beijing (Shougang) report below average increases in value-added per worker as well as considerable declines in market share since 1990. Current discussions of prospective merger activity focus on possible acquisitions by traditional leaders like Wuhan and also Shanghai Baosteel (Yu 2004d). Subsequent developments could easily include big structural changes that topple familiar industry leaders from long-standing leadership positions.

Machine tools.28 While the steel makers have been able to adjust in a slow and steady fashion, the industries in the mid-ground in Figure 6 have found adjustment to be more demanding. Two contrasting cases illustrate the nature of the processes involved: the machine-tool industry, and the beer industry.

China’s machine-tools industry produced, up to the mid-1990s, only ‘conventional’ machine tools, as opposed to the computer-controlled (‘CNC’) machine tools that dominate sales in advanced industrial economies. During the 1990s, however, Chinese users of machine tools began to switch towards CNC machines. The domestic machine tool producers varied in their response to this changing pattern of demand: the initial pace of change was slow, and this induced a major surge in imports, with 60% of CNC machine tools being imported in the late 1990s.

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28 Material in this section comes primarily from visits to machine tool companies in Dalian (August 12) and Shenyang (August 13, 2004).
Some domestic producers responded very effectively however, forging links with foreign partners and research centres to develop their own lines of CNC lathes. The Dalian Group, among China’s largest integrated producer of machine tools, built up a business in the production of CNC lathes during the late 1990s. It now has a joint venture with Index (Germany), to produce more sophisticated machines (‘turning centers’). Components are produced by the Dalian Company, and assembly is carried out in the joint-venture plant. The joint venture began in 2001 and shipped its first machines a year later. The head of the joint venture comes from the German partner, who also supplies three senior engineer/managers, while Dalian seconded eight of its technical personnel to the Index Company in Germany for eight months training. Dalian also has a joint venture in producing cutting tools with Fuji Tools (Japan), and in 2004, it established a new joint venture with the OKK Company (Japan) to produce machining centers. In a further effort to expand its network of technical cooperation, the Dalian firm has also acquired a U.S. machine manufacturer.

Despite these energetic efforts, it is not clear that Dalian’s main production facilities have established a firm foundation in the new core area of CNC lathes. Dalian’s best-selling CNC lathe model, the CKA6136, a single spindle, 2-axis device, sells for approximately RMB90,000 with (imported, superior quality) Fanuc controls, and RMB15,000 less, or roughly RMB75,000 with less sophisticated controls of domestic manufacture. Shenyang Machine Tool Group, currently China’s largest producer of CNC lathes, is another long-time industry stalwart that, like Dalian, has endured intense financial pressure while struggling to catch up with the rapid shift of market demand toward computer-enhanced equipment. The “typical” price of its CNC products is in the range of RMB1 million and the lowest price approximately RMB100,000. Another firm in Baoji (Shaanxi) exports CNC lathes at a unit price of approximately US$40,000 (over RMB300,000 at the official exchange rate). This raises the possibility that Dalian’s sales of CNC models depend on substantial price discounting.

The Shenyang firm produces approximately 30,000 units annually, nearly all lathes, of which about 3,000 are CNC products. The CNC machines generate 40-50 percent of annual sales revenue. Inability to meet the rising demand for CNC lathes caused Shenyang’s annual sales revenue to plunge from RMB1 billion (1993) to RMB500-700 million during 1994-97, years when domestic demand for machine tools expanded rapidly. This crisis sparked intense efforts to upgrade the firm’s product mix. Like Dalian, the Shenyang firm has explored multiple avenues to improve its technical capacity and product quality.

By 2003, four Chinese firms had built up substantial capabilities in design and manufacture of CNC machines, and the import share had fallen to 40%; and for China’s leading machine tool makers, the fraction of their output volume accounted for by CNC machines stood at around 10%, as compared with a share of sales of CNC machines in the Chinese market of just under a quarter.

The machine-tool makers were cushioned financially by their long established business in conventional machine tools, which still account for over 90% of sales volume and almost
half of sales revenue among the industry’s leading firms. This has allowed the firms time to adjust, albeit slowly, to changing patterns of demand.

**Beer.** The beer industry offers a point of contrast. Beer represents an industry in which market forces appear to have supplanted public sector administrators as the chief determinant of industry output, growth, distribution, investment, and development strategy. Local producers find themselves swept up in a tidal wave of competition, often orchestrated by distant firms, including overseas multinationals, over which their local sponsors and erstwhile protectors have virtually no influence. Competitive pressures have defeated not only local Chinese firms, but also savvy international players, several of whom have sold out to Chinese rivals (Qi 2001?). The importance of market dynamics unleashes forces that have determined the evolution of structure in the beer industry in major market economies, where we see an interplay between the quest for scale economies in production, and the establishment of advertising-based national brands (on the U.S. and Japan, see (Sutton 1991), Chapter 14). The tendency to concentration engendered by this process can, however, be offset by regulatory restrictions that constrain the firms’ relations with wholesale and retail operators, and these restrictions vary widely across countries ((Sutton 1991), Chapter 14, discusses these issues in the European context.

In China, the beer market was traditionally divided among a very large number of local and regional firms, with only a single nationally recognised brand (Tsingtao). The changing economic environment of the industry has, over the past few years, led to a series of moves by firms that appear to be setting the scene for an escalation of brand advertising that will, in all likelihood, mirror the evolution of concentration in the U.S. market (for the evolution of structure in the U.S., see (Sutton 1991)).

With incomes rising following the onset of reform, China’s beer market entered into a phase of massive expansion. Production figures (Table 2) show that beer output increased from 700,000 tons (1981) to 22.3 million tons (2000). The growth rate has declined: physical output grew by 123% during 1985/90, by 127% during 1990/95, and by 42% during 1995/2000. Annual output grew by 20 percent or more in 10 of 12 years between 1981 and 1994; production has achieved double-digit growth only once since then. The reason for declining growth is evident: per capita consumption jumped from 6.1 liters (1994) to 17.6 liters (2000) and is moving toward the global average of 23 liters per year.

This stunning growth attracted great interest among the international beer majors, who jumped into the China market with gusto. Their initial efforts focused on production and marketing of high-priced premium brands. However, this strategy failed, leading several overseas firms to abandon their China ventures, at least temporarily. A second round of initiatives by foreign firms, now aimed at purchasing partial or controlling interests in Chinese breweries and then consolidating their operation while maintaining local brand identities, has achieved much better results. Table 3 lists some of these ventures.

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In the meantime, China’s domestic market leaders have worked furiously to expand market share and consolidate control, leading to a blizzard of mergers and buyouts. Tsingtao, China’s largest brewery, has led the charge. Backed by tax rebates, low-interest loans, and official encouragement, the Shandong-based firm has acquired “more than 40 breweries... since 1997” and forming an alliance with U.S. beer giant Anheuser-Busch, which, according to one executive, will “strengthen our status in the capital market” and, “more importantly... sharpen our expertise in business administration and market analysis.”

The acquisition binge included numerous mergers with firms beyond Tsingtao’s home base in Shandong: new plants include breweries in Xian (Shaanxi province) and Yangzhou (Jiangsu). Tsingtao has also built a new plant in Shenzhen (Guangdong). These mergers make Tsingtao into a national (rather than regional) market power. Cross-provincial mergers, formerly rare, have become more common in recent years. The underlying difficulties are reflected in a 1996 report that management “expects Beijing to push provincial governments to facilitate Tsingtao’s purchase of factories in their region.”

Other domestic firms have rushed to expand via mergers and acquisitions: Gansu-based Yellow River Group tripled its capacity in 1997 by acquiring a brewery in Xian. Beijing-based Yanjing Beer Co., Ltd. “has successively merged and purchased with a holding status Jiangxi Yanjing Beer Co., Ltd, Hunan Yanjing Beer Co., Ltd, Yanjing Beer(Hengyang) Co., Ltd, Yanjing Beer(Ganzhou)Co., Ltd, Yanjing Beer (Xiangfan) Co., Ltd, Yanjing Beer(Laizhou) Co., Ltd, Yanjing beer (Shandong Wuming) Co., Ltd, Yanjing Beer (Shandong Qufu) Co., Ltd, Yanjing Beer (Baotou Snowdeer) Co., Ltd, Yanjing Beer (Chifeng) Co., Ltd, Yanjing Beer (Chengde Sihai) Co., Ltd in the province Jiangxi, Hunan, Hubei, Shandong, Inner Mongolia and Hebei.” Firms ranked below the top 20, such as Shenyang-based Xuehua and Jilin-based Yintai (???) are described as enterprises engaged in “large-scale M&A and taking the joint venture route.”

The result is rapid concentration of ownership and control. China had 800 independent brewers in 1995/96, a figure that has already fallen to 500. Meanwhile, the top three brewers now account for 30% of industry sales, while the next three have a combined share of only 10% or so. While advertising levels were modest in the 1990s, the leading firms are now moving towards more expensive TV advertising campaigns, and it seems likely that concentration will rise further as the top three consolidate their positions.

31 (Wang 2002; Wei 1997; Yatsko 1996; Zhou 2002)
32 (Wei 1997; Yatsko 1996)
33 (Yatsko 1996)
34 (Wonacott 1997)
36 (Tao 2000), p. 133.
Table 4 provides another view of this process: the between 1994 and 2000, the output share of large breweries (200,000 annual tons and up) shot up from 5 to 42 percent, while beer from small facilities (under 50,000 tons per year) dropped from 58 to 23 percent of national output. Sichuan illustrates the predicament of small breweries and the dominance of large producers (Tao 2000). Only two local firms produced over 100,000 tons in 1997. With provincial output rising by 21.5% in 1998, the largest firm, Lanjian, broke the 200,000-ton barrier in 1998 and increased production to 467,000 tons in 2000. Lanjian stands out as the province’s only strong and viable brewery. Average production for Sichuan’s remaining 18 breweries was less than 50,000 tons in 1998. Small firms producing under 10,000 tons “basically belong to the ranks of loss-makers.” Nationwide, 37% of breweries lost money in 1997. In 1998, the proportion of loss-makers jumped to “nearly half” nationally and reached 60% in Sichuan.

With regional, national, and international giants flexing their economic muscle in China’s beer markets, small firms face growing difficulty. They lack distinctive products and unusual packaging (97% of Sichuan beer comes in standard bottles). For most small firms, joining forces with a powerful business group typically offers the only hope of survival. Thus Sichuan’s #2 firm, the former Mianyang Yatai Brewery, was acquired by the Hong Kong-based Huarun group, which plans to expand production capacity to 500,000 tons.

5. How far has China come?

There are two ways of assessing the current level of industrial capability. The first is to benchmark performance against the standards of the advanced industrial economies. The second is to examine ‘revealed performance’ by looking at the product mix of Chinese exports.

On the first front, it is of interest to look in some detail at the auto-components sector, which represents an extreme case in which the incentives to adjust are very high, and the institutional setting facilitates the rapid transfer of know-how. The leading international car makers have, over the past generation, developed and codified their own working practices in a way that has become remarkably uniform across different countries. In parallel with this, they have built up a close relationship with their immediate (i.e. ‘first tier’) component suppliers. To become a supplier, a firm needs to achieve very high standards of quality and productivity, and liberalisation typically leads to the rapid shakeout of all but the most capable suppliers. On the other hand, there are highly effective channels for transferring international best practice. First, car makers work directly with suppliers, or using a two-way flow of engineering personnel, in order to transfer good practice. Second, suppliers have access to international consulting firms who specialise in the transfer of the appropriate production know-how. The result of this is that once the main international car makers become active, the speed of advance in capability among first tier suppliers is extremely rapid.

In China’s case, the new wave of car makers arrived in the 1990s, and they faced a government-imposed requirement to source some 70% of their components locally (a point to which we return below). The auto-makers’ arrival induced the arrival of many
international first-tier producers who formed joint ventures with Chinese suppliers, and the industry’s evolution during the 1990s led to a mix of international and domestic Chinese suppliers in the industry’s top tier.

A measure of the effectiveness of the transfer of capability in this context is shown in Figure 4 (follows Figure 10-A below), where we look at the standard measure of supplier quality (parts per million found defective by the car-maker); international best practice currently demands that defect rates for the general run of parts lie below 100 ppm – and Figure 4 (follows Figure 10A) indicates that new generation auto-makers in China already enjoy a first tier supplier base that meets these standards.

As we move down the supply chain, however, incentives become weaker. Figure 5 (follows Figures 10-A and 4 below) shows the profile of a typical first tier supplier of steering gear. Here, the defect rates experienced by this firm are very high (and are measured as a percentage, rather than ‘parts per million’). First tier suppliers are typically mid-size firms, and they are reluctant to invest in training their own suppliers; moreover, they are more willing than are the car makers to tolerate a higher level of product defects in return for a lower price from their own (‘second tier’) suppliers. The result is a much slower rate of capability building – a pattern seen also in the U.S., Japan and Europe, though in the Chinese case the gap between first and second tier suppliers is particularly wide.

A second, indirect approach to evaluating overall industrial development focuses on international commodity flows. We have used trade data to illustrate the rapid emergence of specific export sectors, including televisions and air conditioners. We hope to conclude this paper with a broader analysis based on trade statistics. Peter Schott has examined Chinese exports to the United States in great detail. He reports two major findings. First, Chinese goods have expanded more rapidly across the entire product spectrum of United States imports than exports from other nations. Second, unit values of Chinese goods outpaced exports from other low-income nations in the speed with which they have risen toward the levels attained by U.S. imports from OECD nations.

These results appear to exaggerate the extent and rapidity of Chinese industrial upgrading. If Chinese factories provide labor-intensive assembly and packaging to components imported from abroad, then ship finished products to the United States, the resulting “Chinese exports” of computers etc. may occupy “high technology” product space and command high prices even though the actual contribution of Chinese factors of production consists primarily or entirely of the simplest operations. In addition, the important and very recent contribution of information processing technology to the creation of global supply chains distorts comparisons between current Chinese experience and (even very recent) historical developments in, say Korea.

Despite these concerns, we hope to extend Schott’s promising approach in two directions. We intend to work with China’s entire trade flows rather than looking only at U.S.-China trade. One possibility is to study the behavior of net exports, a tactic that could limit
possible exaggerations arising from the large import component in many Chinese export goods.

A second possibility involves studying the R&D intensity of Chinese exports over time using the “Annual Line of Business Report 1977” (typescript, Harvard University Baker Library call number 9163120), which provides ratios for “Company Financed R&D to Sales” and also “Total R&D to Sales” for United States 4-digit industries. This approach could, for example, investigate the dispersion of China’s exports of manufactures in 1980, 1990, and 2000 across commodity space indexed by R&D intensity compiled from this source.

6. Current Trends

The early nineties were marked by a wave of foreign entrants to the Chinese market, many of them attracted by the low wage levels that offered a low cost location for basic manufacturing operations. Over the past decade, however, a switch has occurred to a different pattern which marks a crucial intermediate phase of the development process. This phase is marked by a rise in the capabilities of domestic firms across a wide range of industries and a concomitant rise in real wages, which has occurred primarily in the eastern provinces. The balance of attraction for foreign firms locating in China has tilted away from a wage-cost argument towards one based on access to a huge domestic market. This process has been marked by a series of trends at the industry level:

(i) Labour-intensive commodity-type industries such as clothing are already beginning to react to the rise in domestic wage levels by seeking out low-cost areas in China’s interior regions and elsewhere in Asia. We noted above that the Ever Glory clothing company already operates plants in Vietnam and Cambodia, in anticipation of possible shifts in the balance of its production as wages in China’s coastal provinces rise further.

(ii) China remains an attractive location for labour-intensive industries in fields such as electronics. Shinco, which boasts the world’s largest capacity to produce of DVD players, is located in Changzhou (Jiangsu). Its products are sold by a series of leading Japanese and other foreign brands. On the other hand, Haier, China’s leading producers of fridges, has 22 plants in foreign countries, including Pakistan and the U.S. and has recently opened a plant in Italy. In contrast to the offshore branches of the Ever Glory clothing firm, Haier’s new plant will have far higher wage costs than the domestic parent plant, but this cost is seen as worth bearing in order to establish a European presence – only by being based in Europe does the company see itself building up a successful brand in the European market. Haier has already established itself successfully in the German market; following a long-standing joint venture with a leading German fridge maker, it launched its own first product on the German market in 2000.

Could add wage data, which rise steeply but apparently exclude wages of migrant workers, which seem to have remained flat over the past decade (WSJ reports from Guangdong; Jintan Silk notes from Jiangsu).
1991. Wholesalers were initially reluctant to stock its brand, but by first setting a low price, and – crucially – having its product tested by a well-established local testing agency, the firm has acquired a satisfactory brand image, and has gained access to retail distribution channels. Exports now account for one-third of this firm’s production; export sales revenue has doubled in each year for the past four years, and reached one billion U.S. dollars in 2003.

(iii) Opening plants in high-cost countries is a costly way to establish a presence. Most firms adopt the easier route of establishing a marketing outlet in key export destinations. For some industries, this implies a breaking-away from state-controlled trading companies. As we noted earlier, clothing producers saw their exports take off dramatically when they began to establish direct links with final customers. Rising real wages induce a shift to capital-intensive techniques, a tendency reinforced by low interest rates and weak enforcement of repayment obligations on the part of China’s big state-run banks, which offer cheap funds to favored state-sector borrowers. A litmus test of this trend is provided by the machine-tool industry. Here, higher wage rates make it worthwhile to move from conventional machine tools to CNC (computer controlled) machines of the kind that dominate the market in advanced industrial economies. As we noted earlier, four of China’s leading producers have built up substantial capabilities in this area.

(iv) As China’s manufacturing firms seek to establish their own brands in international markets, some have followed a classic route, in offering a finely differentiated variant of a standard product in order to build up a foothold via a niche market. One of the country’s leading producers of air-conditioners, for example, has developed a unit that is particularly robust to sand and dust, which it markets successfully to Saudi Arabia.

All of these events are indicative of the kind of trends we expect to see as industrial capabilities approach world-class norms across a range of manufacturing industries. In addition, the knowledge gained from efforts to upgrade capabilities and expand markets in diverse industries like steel, beer, electronics, garments, machine tools, and motor vehicles will surely spill over into sectors like construction equipment, ship-building, aircraft and biotechnology in which Chinese firms aspire to build globally competitive manufacturing capabilities.

Yet, there remain features of some industries which suggest continuing institutional rigidities. Three areas stand out. One is the perennial problem of managing China’s shrinking, but still massive, state enterprise sector.

Another is the continuing survival of a huge fringe of small, inefficient local producers in steel, cement, and many other industries. In cement, small local firms may survive because of their access to local limestone supplies. In steel, they are protected by local
government patronage. In both cases, they often survive by paying much lower wages than the industry’s leading firms. The continuing survival of these smaller firms would be adversely affected by, for example, the imposition of environmental controls, a move advocated by some of the larger firms.

Finally, there is the large gap between the product mix, productivity, technology, and management sophistication of firms in coastal and interior regions.

Each of these issues will continue to impose substantial costs and to create major policy problems. At the same time, these areas present opportunities as well as costs. In each area, further reform has the potential to raise the productivity of resources currently trapped in wasteful and inefficient activities. But unlike the start of the reform period, there are now thousands of Chinese citizens with direct personal knowledge and experience of the official policies, production and organizational technologies, marketing strategies, shop-floor skills, management techniques, computer programs, business networks and other devices that can contribute to the revival of weak companies, redeployment of idle assets, opening of new markets, development of improved products and other productivity-enhancing measures. This new opportunity to draw on the skill and experience of Chinese citizens surely raises the chances of beneficial outcomes for future rounds of reform.

7. Special features affecting China’s past and future development

A. Compared to Japan and Korea, China has opened its industrial sector very substantially both to commodity imports and to direct investment by foreign firms. As a result, we expect less of a dual structure in China in the following sense. If $y_i$ represents the ratio of local productivity in sector $i$ to US productivity in the same sector, then duality arises if the set of sector coefficients $[y_i]$ is widely dispersed. In Japan, we find $y >> 1$ for “good” industries like autos and steel and also $y << 1$ for heavily protected “bad” industries like food processing. In China, we can expect that limited protection will lead to a gradual reduction in the dispersion of $[y_i]$.

B. China enjoys a special position as the BIG PRIZE luring international business entry. China’s governments, both central and local, make intelligent use of China’s special attraction to encourage foreign participation and to accelerate the inflow of foreign technology and expertise. For example:

- forcing foreign firms into joint ventures (if Guatemala made such demands, foreign firms would invest elsewhere)
- pressuring foreign firms to “bring technology with you” when investing or entering market
- pressuring foreign firms to establish research operations in China

A colleague informs us of American executives who use the term “PR & D” to describe certain China-based research operations. While some multinationals establish Chinese research facilities aimed toward public relations rather than innovation, many see China as an increasingly vital link in their global research plans.
pushing for expanded domestic content

Note stages of foreign investment activity:

- foreign firms establish domestic manufacturing operations mainly to take advantage of China’s low labor cost – a large but declining proportion of FDI activity especially prominent up to the early 1990s

More recently,

- foreign firms enter China market with ambition to serve domestic demand – increasingly prominent
- enter China to create manufacturing base for export and/or to participate in multinational production networks

also

- late 1990s, shift of FDI organization from joint ventures to wholly-owned foreign firms – shift results from i) regulatory liberalization; ii) international firms have learned enough to strike out on their own.

- Interviews suggest that joint ventures may work better when foreigners gain control (1-2 episodes -- Dalian? Shinco?). There may be research supporting this point.

C. FORTUITOUS TIMING

China benefited enormously from a historical accident. During the 1970s, labor-intensive export industries in Taiwan and Hong Kong that had gained major footholds in rich-country markets began to run out of economic space due to increased costs for labor and land. Ethnic Chinese entrepreneurs with wealth, experience, and knowledge of production, management, finance, and marketing, were scouting for new, low-cost production venues when China fortuitously decided to allow what its leaders viewed as a small experiment in opening hitherto closed national doors to foreign trade and investment activity.

The result, totally unexpected on the Chinese side (as testified by no less than Deng Xiaoping), was a surge of FDI into, and export out of newly flourishing labor-intensive industries based along China’s southeast coast. The surge began in China’s new “special economic zones” and spread to surrounding areas, linking up with newly dynamic “township and village” (TVE) enterprises. This export boom shattered China’s long-standing foreign exchange constraint – a revolutionary shift in development circumstances.

TVE dynamism was itself partly accidental. TVEs, the legacy of the disastrous Great Leap Forward of 1958-60, remained largely bottled up in their home districts prior to reform – they had little access to outside supplies or outside markets (American Rural
Small-Scale Industry Delegation. 1977). The farm boom following de-collectivization and partial deregulation of agriculture in the late 1970s produced big increases in the supply of labor and materials and in demand for products of TVE industry. But the biggest break for TVE expansion came from early urban reforms, which created new flexibility in buying and selling industrial inputs and outputs in the urban sector. These urban reforms gave ambitious TVEs new opportunities to increase the quantity and quality of their products (by buying inputs, including technical consulting, from urban sources) and to increase sales (by breaking into formerly closed urban markets). The result: a big boom for clever and ambitious TVE firms, especially along the coast and in the environs of big cities.

This outcome reflected an ideal marriage between China’s production resources – cheap land and cheap semi-skilled labor – and the complementary resources and skills of Asian (especially Taiwanese and Hong Kong) entrepreneurs, who possessed an abundance of the exact knowledge and resources that Chinese officials and managers lacked. The HK/Taiwan people had developed networks for selling and financing the shipment of garments, toys, etc. etc. to markets like USA and Japan. They knew how to navigate the formidable complexities of US trade and immigration regulations – all the things about which the long-isolated Chinese knew nothing.

D. Even after nearly 3 decades of reform, the institutional structure supporting China’s manufacturing sector remains defective when compared to textbook ideals or to the current reality of major market economies (think of law, finance, corporate governance, information…). Nonetheless, the institutions of Chinese planning included many features that give China’s manufacturers a distinct advantage over typical firms on other developing nations in terms of capability-building. Consider the following:

- China entered reform with a large stock of technical schools that feed specialized graduates into every substantial sector of manufacturing.

- China entered reform with a well-developed system for assembling, compiling, publishing, and disseminating technical information. This includes libraries, trade associations, publishing houses, trade journals.

- China entered reform with a massive array of specialized research institutions covering every major sector of science and technology.

- There is also a well-developed mechanism to facilitate sharing of information within specific industries – professional associations, trade associations, annual meetings and conventions etc.

The result: even if the quality of information, training etc. provided by these institutions under the plan system may have been incomplete, obsolete etc., the existence of these structures, organizations, and networks contributes substantially to capability-building
efforts on the part of Chinese firms. Our interviews produced repeated evidence of such benefits.

References (incomplete)


Beijing: Zhongguo tongji chubanshe.
Zhongguo tongji chubanshe.
Figure 1
Asian Growth Spurts: Growth of Secondary-Sector Value-added Over 25 Years
Figure 2
Asian Trade Spurts: Evolution of Share of World Trade Over 25 Years

Index of Share of World Trade, Initial Year of Spurt = 100

China
Taiwan
Korea
Japan
Figure 3
China: Maximal Industry Employment: Urban + TVE

Source: updateF03\table4aR.120803
Figure 4
Ratio: Employment in 2002 to Employment in 1993
527 Sectoral Observations for Balanced Panel of 30,331 Firms

![Bar chart and line graph showing frequency and cumulative percentage]

- Frequency bar chart for different employment ratios.
- Line graph showing cumulative percentage.

Legend:
- Frequency
- Cumulative %
Figure 5
Distribution of Ratio R for 535 Four Digit Industries, R<1
Indicates Reduced Dispersion of Productivity
R>1 Fits Cellular Economy Approach

Frequency Intervals for Ratio R

<table>
<thead>
<tr>
<th>Frequency Interval</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>0-0.8</td>
<td>200</td>
</tr>
<tr>
<td>0.8-1</td>
<td>150</td>
</tr>
<tr>
<td>1-1.2</td>
<td>100</td>
</tr>
<tr>
<td>1.2-2</td>
<td>50</td>
</tr>
</tbody>
</table>

Cumulative %:

<table>
<thead>
<tr>
<th>Frequency Interval</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-0.8</td>
<td>20%</td>
</tr>
<tr>
<td>0.8-1</td>
<td>80%</td>
</tr>
<tr>
<td>1-1.2</td>
<td>100%</td>
</tr>
<tr>
<td>1.2-2</td>
<td>120%</td>
</tr>
</tbody>
</table>
Linkages Across Submarkets

\[ \sigma \]

1/\( \beta \)
Effectiveness of Capability Building

- **Low Concentration**
  - Low R&D intensity
- **High Concentration**
  - High R&D intensity
- **Low concentration**
  - Low R&D intensity

Figure 6: Industry Characteristics
Figure 7: Industry Characteristics: Example

Linkages Across Submarkets

1/β
Effectiveness of Capability Building

σ

Beer
Automobiles
CNC Lathes
Auto Components
Domestic Electrical Appliances
Steel
Cement
Clothing
Figure 8: The New Industries
Figure 9
China's Trade in TVs and Components
1992-2003 (US$ million - left scale) and percent

Read percent from right scale

Legend:
- Total Exports (US$mn)
- Net Exports (US$mn)
- Imported parts as % of TV exports


Millions $US

Y Tool: 0 20 40 60 80 100 120 140 160 180

Figure 10-A.
China: Investment and Production of Color Televisions By Province 1: 1978-1990

Annual Output in 1990 (1000 sets)

Capacity of Production Lines Imported in 1978-1985 (1000 sets)

\[ y = 0.1116x - 11.553 \]

\[ R^2 = 0.7573 \]
Figure 10-B
China: Investment and Production of Color Televisions by Province 2: 1978-2000 omitting Guangdong

Color TV Output in 2000 (1000s)

Annual Capacity of Production Lines Imported 1978-1985 (1000s)
Figure 4: Component Suppliers to Multi-National Car Makers

Figure 5: Component Suppliers to Steering Gear Firms
Table 1
Chinese Production of Home Electric Appliances
(Million units)

<table>
<thead>
<tr>
<th>Year</th>
<th>Color Refrigerators</th>
<th>Washing Machines</th>
<th>Air Conditioners</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>0.004</td>
<td>0.03</td>
<td>0.0004</td>
</tr>
<tr>
<td>1985</td>
<td>4.35</td>
<td>1.45</td>
<td>8.87</td>
</tr>
<tr>
<td>1990</td>
<td>10.33</td>
<td>4.63</td>
<td>6.63</td>
</tr>
<tr>
<td>1995</td>
<td>20.57</td>
<td>9.18</td>
<td>9.48</td>
</tr>
<tr>
<td>2000</td>
<td>39.36</td>
<td>12.79</td>
<td>14.43</td>
</tr>
<tr>
<td>2003</td>
<td>65.41</td>
<td>22.43</td>
<td>19.43</td>
</tr>
</tbody>
</table>

Eight-firm Concentration Ratios CR8

<table>
<thead>
<tr>
<th>Year</th>
<th>CR8</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>54.1</td>
</tr>
<tr>
<td>2002</td>
<td>47.7</td>
</tr>
</tbody>
</table>


File: /io/sectors/appliance/appliance_output.110204

Concentration ratios
TV data are for the entire sector (not just color TV makers)
TV 2002: \pdata\Ent Data 2002 Sector Complete\Television 4171.110204
TV 2000: \pdata\Ent Data 2000 Sector Complete\Television 4171.110204
Table 2. Beer Production and Consumption in China (1981-2001)

<table>
<thead>
<tr>
<th>Year</th>
<th>Production (million tons)</th>
<th>Growth Rate (%)</th>
<th>Consumption Per Capita (liters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>0.91</td>
<td></td>
<td>0.7</td>
</tr>
<tr>
<td>1982</td>
<td>1.17</td>
<td>28.6</td>
<td>0.9</td>
</tr>
<tr>
<td>1983</td>
<td>1.63</td>
<td>39.3</td>
<td>1.1</td>
</tr>
<tr>
<td>1984</td>
<td>2.24</td>
<td>37.4</td>
<td>1.3</td>
</tr>
<tr>
<td>1985</td>
<td>3.10</td>
<td>38.4</td>
<td>1.7</td>
</tr>
<tr>
<td>1986</td>
<td>4.13</td>
<td>33.2</td>
<td>2.2</td>
</tr>
<tr>
<td>1987</td>
<td>5.40</td>
<td>30.8</td>
<td>3.7</td>
</tr>
<tr>
<td>1988</td>
<td>6.62</td>
<td>22.6</td>
<td>5.0</td>
</tr>
<tr>
<td>1989</td>
<td>6.50</td>
<td>-1.8</td>
<td>5.5</td>
</tr>
<tr>
<td>1990</td>
<td>6.92</td>
<td>6.5</td>
<td>5.4</td>
</tr>
<tr>
<td>1991</td>
<td>8.38</td>
<td>21.1</td>
<td>7.0</td>
</tr>
<tr>
<td>1992</td>
<td>10.20</td>
<td>21.7</td>
<td>7.4</td>
</tr>
<tr>
<td>1993</td>
<td>12.25</td>
<td>20.1</td>
<td>8.5</td>
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<td>1994</td>
<td>14.23</td>
<td>16.2</td>
<td>9.4</td>
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<tr>
<td>1995</td>
<td>15.46</td>
<td>8.6</td>
<td>11.5</td>
</tr>
<tr>
<td>1996</td>
<td>16.31</td>
<td>5.5</td>
<td>12.5</td>
</tr>
<tr>
<td>1997</td>
<td>18.76</td>
<td>15.0</td>
<td>14.1</td>
</tr>
<tr>
<td>1998</td>
<td>19.87</td>
<td>5.9</td>
<td>15.9</td>
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<tr>
<td>1999</td>
<td>20.98</td>
<td>5.6</td>
<td>16.7</td>
</tr>
<tr>
<td>2000</td>
<td>22.31</td>
<td>6.3</td>
<td>17.6</td>
</tr>
<tr>
<td>2001</td>
<td>22.89</td>
<td>2.6</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3: Some Recent Acquisitions in the Beer Industry

<table>
<thead>
<tr>
<th>Foreign Stakeholder</th>
<th>Chinese Brewer</th>
<th>Stake</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAB (South Africa)</td>
<td>Huaren</td>
<td>50%</td>
</tr>
<tr>
<td>Anheuser Busch (U.S.)</td>
<td>Harbin</td>
<td>99.6%</td>
</tr>
<tr>
<td>Interbrew (Belgium)</td>
<td>Zhujiang</td>
<td>24%</td>
</tr>
<tr>
<td>Scottish and Newcastle (U.K.)</td>
<td>Chongqin</td>
<td>20%</td>
</tr>
<tr>
<td>Carlsberg (Denmark)</td>
<td>Kuming</td>
<td>100%</td>
</tr>
<tr>
<td>Carlsberg</td>
<td>Zhejiang</td>
<td>70%</td>
</tr>
<tr>
<td>Heineken</td>
<td>Kingsway (Shenzen)</td>
<td>~20%</td>
</tr>
<tr>
<td>Asahi (Japan)</td>
<td>Beijing Beer Co. (and four others)</td>
<td>?</td>
</tr>
</tbody>
</table>

### Table 4: The Scale of Beer Producers in China (1994-2000)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Firms</td>
<td>655</td>
<td>656</td>
<td>589</td>
<td>550</td>
<td>495</td>
<td>474</td>
<td>495</td>
</tr>
<tr>
<td>Average Size (1000 tons)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above 200,000 tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>3</td>
<td>7</td>
<td>8</td>
<td>13</td>
<td>18</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>Share (%)</td>
<td>5.4</td>
<td>12.1</td>
<td>14.5</td>
<td>21.4</td>
<td>31.3</td>
<td>35.2</td>
<td>41.8</td>
</tr>
<tr>
<td>100,000 — 200,000 tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>21</td>
<td>23</td>
<td>28</td>
<td>28</td>
<td>26</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>Share (%)</td>
<td>19.9</td>
<td>18.6</td>
<td>21.8</td>
<td>20.9</td>
<td>17.1</td>
<td>17.1</td>
<td>16.7</td>
</tr>
<tr>
<td>50,000 — 100,000 tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Number</td>
<td>36</td>
<td>44</td>
<td>47</td>
<td>57</td>
<td>60</td>
<td>62</td>
<td>60</td>
</tr>
<tr>
<td>Share (%)</td>
<td>16.6</td>
<td>19.1</td>
<td>18.2</td>
<td>20.1</td>
<td>21.2</td>
<td>21.1</td>
<td>18.9</td>
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<tr>
<td>Below 50,000 tons</td>
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<tr>
<td>Number</td>
<td>595</td>
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<td>206</td>
<td>452</td>
<td>391</td>
<td>368</td>
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<tr>
<td>Share (%)</td>
<td>58.1</td>
<td>50.2</td>
<td>45.5</td>
<td>37.6</td>
<td>30.4</td>
<td>26.6</td>
<td>22.6</td>
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