

Market Reforms, Technological Capabilities and the Performance of Small Enterprises in China

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ABSTRACT. This paper shows that the domestic and foreign trade liberalization of the Chinese economy since the late 1970s has led to much dynamism among small and medium firms. Such firms have grown at a rapid pace and have increased their share of value added in the Chinese economy. At the same time, they have recorded gains in total factor productivity. However, after two decades of decontrol, the potential for further growth among small and medium industries is limited unless further liberalization is undertaken and government policies pertaining to the allocation of credit, levy of taxes, and grants of research and other subsidies are applied in a more even-handed fashion.

Introduction

During the past 20 years, China has maintained a high economic growth rate that has attracted worldwide attention. Small enterprises have contributed the lion's share to this achievement. In 1995, small enterprises accounted for 62.5 percent of China's total industrial output and 73.6 percent of its industrial employment. While most large- and medium-size enterprises are still owned by the state, China's small enterprises are overwhelmingly private. In 1995, 78.5 percent of all the small enterprises were private, and their share of the national industrial output amounted to 36.1 percent. This feature has made small enterprises the most vibrant element in the national economy.

The causes for the success of China's small

enterprises are several. First, the success has been made possible by general economic reforms that have released China's economic energy and are gradually accelerating it to its full throttle. Second, the success has been stimulated by the huge market for basic consumer goods that was not targeted by the planned economy before the reforms took place. Third, the newly established small enterprises are agile in responding to market signals, emerging and vanishing constantly, avoiding the fate of the state firms that are plagued by redundant employees and nonperforming capital. Last, rural communities and local governments have played a significant role in helping the development of small enterprises at the township and village level.

However, China's small enterprises have also raised incomes. While it is widely acknowledged that small enterprises, especially those in the countryside, the so-called township and village enterprises (TVEs) have played an important role in creating employment, fulfilling market needs, and increasing competition, some scholars and government agencies have noted that they are wasting precious resources because of their technical incompetence. For example, a report issued by the State Council in 1990 stated: "Compared with large and medium enterprises, their (small enterprises') technology is backward, their consumption of materials and energy is high, and their product quality is low. . . . They compete with large and medium enterprises for materials, energy, capital, and markets, making large and medium enterprises not able to fully utilize their production and technical potentials. From a social point of view, this trend of "smallization" and diversification will inevitably aggravate the inefficiency in industrial production." (Industrial

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Census Office of the State Council and Institute of Economic State Planning Commission, 1990). Other people blame small enterprises for the sluggish growth of large enterprises and the technology intensive sectors, and call the flow of capital to small enterprises the “adverse allocation” of resources (Yin, 1997). While these criticisms are warranted to the extent that small enterprises are technically less efficient than larger enterprises, they fail to reconcile the obvious conflict between small enterprises’ fast growth and their technical incompetence. While an in-depth analysis is beyond the scope of this paper, we do contend that these criticisms miss the point by overlooking small enterprises’ superior allocation efficiency that is made possible by their nimble responses to market signals. Their success suggests that gains from their allocative efficiency may outweigh their losses from technical inefficiency. Nevertheless, the problem raised by these criticisms constitutes a good starting point for our analysis.

In this paper we first present measures of the technical efficiency gap between small and larger enterprises in industry and study its historical trend. Then, based on several recent studies, we discuss the abilities, patterns, and unique characteristics of China’s small enterprises in industry in acquiring technical capacities.

The paper is organized as follows. In Section 1 we review the development of small enterprises in China. In Section 2 we present measures of the gap between small and larger enterprises. In Sections 3 and 4 we study the pattern and sources of technology acquisition by small firms and discuss the factors that have impeded their technical advancement. Section 5 reviews business challenges facing China’s small enterprises in the future.

1. Recent evolution

China’s industrial scale classification convention is different from international standards. International criteria for scale classification are mainly based on a firm’s number of employees, capital, and sales volume. For example, in Canada, “small business” is defined as a firm with fewer than 50 employees (fewer than 100 employees in the manufacturing sector), or less than \$5 million of

sales volume. “Medium-sized business” is a firm with an employment size between 50 (100 for manufacturing sector) and 500 employees, or sales volume between \$5 million and \$20 million. In China, however, a rather complicated classification system is adopted. Roughly speaking, there are two kinds of classification methods.

The first method is based on output capacity and is applied to industries with a limited number of products. For example, in the iron and steel industry, a “small enterprise” is defined as an enterprise with annual production capacity of fewer than 100,000 tons, “medium enterprise” is between 100,000 and 600,000 tons, and “large enterprise” is over 600,000 tons. In the electricity sector, “small” is defined as an annual production capability of fewer than 50,000 kilowatts, “medium” is between 50,000 and 300,000 kilowatts, and “large” is over 300,000 kilowatts. The second method is based on the original value of fixed capital and is applied to firms with diversified products. Still, it differs in different sectors. In general machinery manufacturing sectors, for instance, an enterprise with fewer than 15 million Yuan of original value of fixed capital is a “small enterprise,” 15–50 million Yuan is “medium,” and 50 million and more is “large.” In instrument-making industries, however, those with fewer than 10 million Yuan of original value of fixed assets is defined as “small enterprise,” 10 million to 30 million Yuan is “medium,” and 30 million Yuan and over is “large.” According to the Third National Industrial Census conducted in 1995, the average numbers of employees in large, medium, and small enterprises were 3,755, 893, and 15, respectively. Therefore, compared with other countries, China’s large and medium enterprises employ far more employees.

Contribution of small enterprises to China’s national industrial economy

Small enterprises have been playing an important role in China’s national industrial economy and have achieved rapid growth since the introduction of broad market-oriented economic reforms in the late 1970s. Small enterprises have been the major engine behind China’s industrial economic growth. The total number of small enterprises in industry had increased from 344,000 in 1978 to 7,963,000

in 1996. In terms of comparable statistics, in the period from 1985 to 1995, the number of small enterprises in industry increased by 2.164 million, accounting for 99.33 percent of all the newly established enterprises in that period. The output value of small enterprises increased by 4,429.5 billion Yuan, accounting for 62.31 percent of the total new output created; employees in small enterprises increased by 32.87 million, consisting of 66.12 percent of all the new jobs created in that period. In 1995, the number of small firms was 7.32 million, accounting for 99.7 percent of the national total; the number of employees of small firms was 108 million, making up 73.6 percent of the whole industrial labor force. In terms of output, 5,139 billion Yuan were created by small enterprises, accounting for 62.5 percent of the gross national industrial output (Table I and Table II).

Small enterprises are the backbone of China's economic growth and the major contributor to newly created employment. Meanwhile, they are the major source for the revenues of county and smaller administration units. Before the mid-

1980s, they were invested and managed by administrative units at various levels. For instance, state-owned small enterprises were basically set up by municipal or county governments; collective enterprises were mostly held by TVEs, usually with vaguely defined property rights, a property to which many authors have attributed the success of the TVEs (e.g., Weitzman and Xu, 1997; Chang and Wang, 1997). Public ownership still takes a rather important role, with the number of state or collectively owned small firms being about one-fifth of the total, and their output being near two-thirds of the total. However, other types of ownership have flourished in the last 10 years. Table III presents breakdown statistics for different kinds of ownership in 1995. Specifically, the number of firms in the private sector accounted for 78.5 percent of the total number, and their output accounted for 36.1 percent of total output. The disproportion of the number of output of the firms in the private sector shows that their average size was much smaller than that of the public firms. After the Fifteenth Congress of the Chinese Communist Party held in late 1997, many small public firms have been sold to private owners or transformed into joint shareholding. Although no statistics have come out, it is likely that the share of public small firms has dropped dramatically in the last year.

Causes of the growth of China's small enterprises in industry

The success of China's small enterprises, especially the TVEs, has attracted the attention of the international academic community. Several factors

TABLE I
The share of small enterprises in China's industrial economy: 1980-96 (in percent)

Year	Number of firms	Output value	Employment
1980	98.93	56.82	n.a.
1985	99.85	57.70	76.51
1995	99.69	62.45	73.59
1996	99.70	65.59	n.a.

Sources: China Industrial Statistical Yearbook, various years.

TABLE II
Scale distribution of China's industry: 1995

Categories	Number of firms		Output value		Employment	
	Amount (thousand)	Share (%)	Amount (billion yuan)	Share (%)	Amount (million persons)	Share (%)
Total	7,341.5	100	8,229.7	100	147.4	100
Large firms	6.4	0.09	2,182.8	26.52	24.1	16.35
Medium firms	16.6	0.23	907.8	11.03	14.8	10.06
Small firms	7,318.5	99.69	5,139.1	62.45	108.5	73.59

Sources: State Bureau of Statistics, 1996.

TABLE III
Ownership structure of China's small firms in industry: 1995

Ownership	Number of firms		Output value	
	Amount (thousand)	Share (%)	Amount (billion Yuan)	Share (%)
Total	7,318.5	100	5,139.1	100
State	102.3	1.4	675.1	13.1
Collective	1,470.9	20.1	2,377.7	46.3
Individual ^a	5,403.6	73.8	963.3	18.7
Private ^b	287.5	3.9	233.9	4.6
Foreign and joint venture ^c	43.2	0.6	674.7	13.1
Other	10.9	0.2	214.4	4.2

^a Individual firm is defined as a privately owned firm with no more than eight hired employees.

^b Private firm is defined as a privately owned firm with more than eight hired employees.

^c Include firms solely owned by foreign, Hong Kong, Taiwan, or Macao capital, and their joint venture with Chinese partners.

Sources: Author calculation based on the Third National Industrial Census.

have been identified as having contributed to their fast growth.

First, the fast growth of the small firms in China was made possible by the reforms carried out in both rural and urban areas. The rural reforms have re-established the family farming system and raised the prices of agricultural products. The enhanced productivity provided critical initial capital for the establishment of numerous small firms in the rural areas. The urban and industrial reforms have gradually released resources to the market, so small firms that were not covered by plans could get access to needed materials (Lin and Yao, 1998).

Second, a large market for labor-intensive consumer goods was left un-addressed prior to the 1980s as a result of the heavy industry-oriented development strategy pursued by China (Lin, Cai and Li, 1994). This gave small enterprises a perfect opportunity to fill the gap. In the 1980s, small firms produced 80–90 percent of the output in textile, garment, leather, furniture, and plastic products. Those industries led the growth in the country in that period. At the end of the 1980s, demand for durable consumer goods picked up. Although China's industrial structure has continued to become lighter, the growth has mainly happened in durable consumer goods such as television sets and refrigerators. Some small firms have successfully taken this opportunity and developed into large firms that produce national brand products.

Third, small firms grew outside the planning economy and have developed a strong ability to respond to market signals. One of their sources of advantage is their link with labor intensive industries (Lin and Yao, 1998). China is a country with low capital endowment and abundant labor. This is especially true for its rural areas. Therefore, engaging in labor intensive industries is cost effective. This is why a heavy presence of small enterprises in labor-intensive industries such as textiles and garments has been observed. In addition, small enterprises' share in China's export is also remarkable. By 1996, the export share of township and village firms reached 48 percent of the total export. Among the remaining 53 percent, small enterprises in the cities also accounted for a large share. The nimbleness of Chinese small firms is also shown by their response to the changes of relative factor prices. As labor became more expensive, small firms began to increase their capital stocks relative to their workforce. For example, per worker capital stock of small enterprises (at or above township level) increased by 5.44 times from 1980 to 1995.

Fourth, small enterprises at the township and village level received much needed assistance from local governments and communities in their early stage of development. Coming out of the planning era, it was difficult for individuals to set up private firms in the 1980s. In addition, China is still a society beholden to administrative hierarchy. In this social and economic setting, local

governments possess advantages over individuals in accessing critical resources such as land, bank loans, and raw materials. Therefore, the support of local governments is found by some studies to be a key factor in TVE development (e.g., Jin and Qian, 1998).

2. Technical efficiency considerations

There are several ways to measure a firm's technical efficiency. Among them, total factor productivity (TFP) is a comprehensive and popular measurement. Tidrick (1986) studied the TFP of China's state enterprises in the period of 1953–83. Jefferson, Rawski, and Zheng (1992) compared the growth and efficiency of state and collective firms. Several Chinese scholars have also done similar work (e.g., Shi, Qin, and Chen, 1985; Shi and Qin, 1987; Li, Zheng and Gong, 1993). Several studies have directly compared the TFP of different types of firms. Jefferson, Rawski, and Zheng (1990) compared the TFP of state, collective, and private enterprises based on an estimation of a production function with three inputs, that is, labor, capital, and middle inputs (Table IVa). According to their study, the TFP of Chinese firms kept increasing in the 1980s. Before 1984, the growth rate of state firms was larger than that of collective firms, but the trend was reversed after 1984. Wu (1992) studied the TFP gap between state firms and rural enterprises (mostly small ones) in the 1980s. He showed that the TFP of rural firms was only 39.1 percent of that of state firms in 1980, but picked up through the 1980s and reached 58.8 percent of the TFP of the state firms. Guo (1998) did similar work by estimating a production function with only labor and capital as input but extended the comparison into the 1990s. While finding similar trends in the 1980s, they also found that collective and other types of firms maintained a higher TFP growth rate than state firms did in the 1990s (Table IVb). Bao (1992) and Shen (1996) studied the TFP of the TVEs in Jiangsu province. Bao (1992), by estimating a growth function, showed that TFP growth contributed 44.5 percent to the output growth of the TVEs in the province when the elasticity's of capital and labor were set to 0.4 and 0.6. Shen (1996), on the other hand, obtained the elasticity's by estimating a translog production

function and found that technical progress contributed 43 percent to the output growth of the TVEs in the province in 1979–93. The results of these studies, however, are sensitive to the deflators used in the calculation, especially that for output (Zhang, 1993).

By using a sample of 14,760 firms surveyed by the Third National Industrial Census, Yao (1998) estimated the TFP gaps between different firm sizes and different types of ownership. He adopted the stochastic frontier model to estimate the production functions of 12 major industries. The production function was of Cobb-Douglas type and had only labor and capital as inputs. A TFP index was obtained based on the estimation of the production function, and a multivariate regression analysis was carried out to determine the TFP gaps. His results showed that when compared with large firms, medium and small firms were 20 percent and 49 percent less technically efficient, respectively. However, collective and private firms were 22 percent and 57 percent more efficient than state firms, respectively. These results are robust to the changes of variables included in the regression analysis. It is interesting to find that the state firms, most of which are large, were far less efficient than collective and private firms, most of which are small. This finding indicated that the efficiency gap between state firms and collective and private firms was very significant and that the size advantage of state firms was overridden by the lack of a proper incentive structure.

To show the historical change, we estimate the TFP growth of Chinese firms by scale during 1981–95. It is impossible to get firm level data for this long period. Therefore, we use aggregate data for our calculation. The output we use is the total amount of value-added created by each category of firms. This enables us to exclude from our analysis intermediate inputs whose data are hard to obtain, and only include labor and fixed capital. Labor is the total number of employees at the end of each year, and capital is the net value of fixed capital. All financial data are deflated to the 1980 constant prices. Output is deflated by the overall industrial price index; fixed capital is deflated by the heavy industrial price index. In the calculation, constant return to scale is imposed to the technology. The shares of capital and labor are set to 0.4 and 0.6. These are actual figures calculated

TABLE IVa
TFP growth by ownership in industry (in percent)

	Annual growth rate					Contribution to output growth			
	Output	Capital	Labor	Intermediate use	TFP	Capital	Labor	Intermediate use	TFP
State owned enterprises									
1980–87	8.44	6.74	3.27	6.62	2.14	18.2	3.9	52.5	25.4
1980–84	7	4.5	2.97	5.77	1.81	14.7	4.3	55.1	25.9
1984–87	10.38	9.8	3.68	7.7	2.57	21.4	3.7	50.1	24.8
Collective enterprises									
1980–87	17.68	13.58	5.36	14.51	4.62	11.8	4.1	57.9	26.2
1980–84	15.06	10.09	5.68	12.49	3.88	12	5.1	57.1	25.8
1984–87	21.11	18.39	4.94	16.67	5.83	11.8	3.3	57.3	27.6

Source: Jefferson, Rawski and Zheng (1990).

TABLE IVb
TFP growth by ownership in industry (in percent)

	Annual growth rate				Contribution to output growth		
	Output	Capital	Labor	TFP	Capital	Labor	TFP
1981–85							
State-owned	8.1	7.7	3.5	2.9	38	25.9	36.1
Collective	17.5	17.5	9	5.1	40	30.9	29.1
Others	26.6	29.3	12.9	7.1	44.1	29.1	26.8
Total	10.3	9.2	5.6	3.3	35.7	32.6	31.7
1986–1990							
State-owned	5.1	10.3	2.6	−0.6	80.8	30.6	−11.4
Collective	9	13.3	2.8	2	59.1	18.7	22.2
Others	35.9	39.9	25.9	4.4	44.5	43.3	12.2
Total	6.9	11.3	3	0.6	65.5	26.1	8.1
1991–95							
State-owned	4.4	10.7	0.2	0	97.3	27.7	0
Collective	13.4	11.1	−0.2	9.1	33.1	−0.9	67.8
Others	55	57.2	41	7.5	41.6	44.7	13.7
Total	12.2	14.9	2.1	5	48.9	10.3	40.8

Source: Guo (1998).

based on the 1995 input-output table. Other figures such as the one with the above weights reversed and those in between have also been tried, but the relative order of firms with different sizes is not changed substantially.

We have conducted two sets of calculation. One is the TFP growth and contribution of TFP to value-added growth in the periods of 1981–85 and of 1986–95, the other is the level of TFP index in 1985 and 1995. The first set is based on the

standard growth equation, and the second set creates an output-input index by the formula $TFP = Y/L^{0.6}K^{0.4}$. The results are presented in Tables Va and Vb, respectively. The estimates of the contribution of TFP to the output growth are close to but lower than what reported in the World Bank (1997) report, *China 2020*, that puts TFP's contribution to GDP at 43 percent. The TFP gaps between small and large firms are smaller than what obtained by Yao (1998). As the differences

TABLE Va
TFP growth rate by scale in industry: 1981–95

	Value-added	Annual growth rate			Contribution (percent)		
		Capital	Labor	TFP	Capital	Labor	TFP
1981–85							
All firms	9.73	7.92	5.60	3.40	31.90	33.87	34.23
Large and medium	7.61	6.39	3.00	3.25	33.59	23.65	42.76
Small	13.39	10.97	7.07	4.76	32.77	31.68	35.55
1986–95							
All firms	9.43	11.90	2.56	3.13	50.50	16.27	33.23
Large	12.54	14.20	6.91	2.71	45.31	33.07	21.62
Medium	6.66	9.28	4.20	0.43	55.74	37.87	6.39
Small	7.48	10.17	0.52	3.10	54.41	4.14	41.45

Note: Include only firms at levels of village and above.

Sources: Author calculation based on the data from the Second and Third National Industrial Census and China Industrial Statistical Yearbook (1992).

TABLE Vb
TFP level index by scale in industry: 1985 and 1995

	1985	1995
All	0.53	0.72
Large	0.74	0.95
Medium	0.59	0.62
Small	0.46	0.62
Large	1.00	1.00
Medium	0.80	0.65
Small	0.62	0.65

Note: Include only firms at levels of village and above.

Sources: Same as in Table Va.

between our calculation and Yao's approach are substantial, it is hard to assess the comparability between the two results.

As shown in Table Va, the contribution of TFP to value-added growth was smaller in small firms than in larger firms in the period of 1981–85. In the period of 1986–95, however, TFP contribution was much higher in small firms than in larger firms. In addition, small firms' TFP had a higher growth rate than larger firms' in both the periods of 1981–85 and of 1986–95 although the gap was quite narrow in the latter period. As a result, the TFP gap between small and large firms, as shown by small firms' TFP as percentage of large firms', had not been narrowed dramatically from 1985 to 1995 (Table Vb).

Another interesting result revealed by our calculation is that the contribution of labor to output growth decreased considerably from 1981 to 1995. This was especially true for small firms. In fact, in the period of 1986–95, their employment growth rate was merely 0.52 percent annually. This shows that the capacity of small firms, TVEs in particular, to absorb employment decreased dramatically in the last decade. In other words, small enterprises became much more capital-intensive than they were 20 years ago. As an example, the net value of fixed capital per-employment in small firms was increased by 36 percent in the five years (during 1981–85), while the same indicator was 92 percent during 1986–90 and 146 percent during 1991–96.

To summarize, both our calculation and calculations done by others have shown a considerable gap between smaller and larger firms' technical efficiency. Nevertheless, this fact does not warrant the criticism accusing small firms for wasting resources and hurting China's overall industrial development. As we will see in the next section, small firms are more efficient in using the technology they currently possess. This means that their inferior technical efficiency is brought about mainly by the lack of adequate technology and not by the lack of efficient use of technology. Therefore, attention should be paid to finding the impediments to their obtaining necessary technologies.

3. Factors affecting technology acquisition

In the last section we showed that China's small enterprises have been catching up to larger enterprises quickly in their technical capacities, although a gap still remains. In this section, based on several existing studies, we will analyze the factors that affect small enterprises' incentives to acquire production and management technology.

In 1989 and 1990, the Ministry of Sciences and Technologies conducted a survey of 105 enterprises with more than one million output per year in Yichang, Hubei province, to study the factors affecting the firms' technical advances and innovations (MST study). During 1991–93, a group of researchers in Tsinghua University conducted six rounds of surveys on 1,051 firms to study their technical innovations (Tsinghua study). In 1994–95, the Development Research Center and the State Statistical Bureau, both under the State Council, studied technical innovations at the enterprise level in Fujian and Gansu provinces (DRC and SSB study). In 1995, the Development Research Center conduct a comprehensive study on the functions of research institutions and governments in promoting technical progresses in six major industries (DRC study). The analysis below draws heavily on these studies.

Resources and incentives for technical innovations

In China, human and financial resources for technical innovations are concentrated in large and

medium state enterprises. However, the incentive structure in these state firms hinders efficient innovations and their dissemination. In contrast, small firms lack the resources for adopting new technology although they are flexible in responding to market signals and thus could be more efficient in the application of technologies. Therefore, there is a mismatch between innovation resources and the capacities to use them efficiently.

Several studies verified the existence of this mismatch. The MST study (Jia, 1994) showed that in the 1980s when plans still maintained a dominant role in the economy, an enterprise's access to plans on supplies and sales was clearly correlated with its size, ownership, and administrative affiliation (Table VI). Large firms, state firms, and firms with higher administrative affiliation were more closely tied to the plan, so they were more likely to get planned resources. Many large and medium firms did not use up the funds allocated for technical innovations, indicating that they lacked the incentives to engaging in such activities. In contrast, small enterprises were more willing to adopt new technology because they faced pressures from two sides: From inside, their equipment were out of date; from outside, the market competition was intense. The surveys conducted by the Tsinghua study showed that 84.7 percent of the TVEs surveyed expressed willingness to adopt pertinent new technology if they had enough funds (Fu and Deng, 1994).

There are several reasons why small firms are more efficient in using the technology they possess. First, most of the small firms grew

TABLE VI
Access to planned resources by type of firm in industry in the 1980s

	By scale			By ownership		By affiliation			
	Large	Medium	Small	State	Collective	Central	Municipal	County	Township
Planned production	26.3	21.9	17.2	24.2	10.6	14.8	21.6	0	0
Planned material supply	58.5	19.6	21.4	21.0	24.5	54.0	21.0	17.9	0
Investment:									
Allocated by plan	22.2	5.6	3.7	6.9	2.1	31.5	3.1	6.7	7.5
Bank loans	46.2	48.3	50.6	51.5	47.9	24.6	53.0	27.7	45.0
By firm itself	31.5	46.2	42.2	41.6	43.6	43.9	41.6	65.7	47.5
Sales through the plan	18.6	3.6	12.8	9.0	11.2	8.3	10.5	0	0

Sources: Jia, Ma and Tang (1994).

outside the plan, having very limited access to financial capital, materials, and technicians provided by the plan, so they are more sensitive to market discipline. Second, most of the small firms are TVEs that are owned by local townships and villages, so they can use community resources (such as land and buildings) to save costs. In addition, they have more autonomy to act according to market signals. Last, because their ownership is shared by a small group living locally, small enterprises are more closely monitored and have a harder budget constraint than state firms (Hong and Yuan, 1997).

Entering the 1990s, the situation has changed tremendously. The DRC and SSB study showed, that thanks to the reforms carried out in the 1980s, market demands and competition became the major impetuses for all kinds of firms to engage in technical innovations. Government planning played a limited role in promoting technical innovations at the enterprise level. However, state-owned large and medium firms still relied more on government to provide key information and technology than small firms did. In addition, since the extent of the reforms was unevenly distributed among different regions, the role of the government was also different. For example, the function of the government in Gansu province, a province that is slow in catching up with the average of the country in adopting reform initiatives, was much more important than in Guangdong province and Shanghai that lead the country in reforms (Fan, 1997).

Patterns of technical progress

The patterns of technical progress are quite different among firms with different sizes. These differences arise as a consequence of different incentive structures, market competition, and financial constraints faced by different firms. First, large firms generally spend more on technical innovations than small firms do because they have more financial resources and skilled manpower to do that (see our description in Section 1). For example, the Tsinghua study showed that on average innovation expenditures of firms in China's manufacturing sector were 0.5 percent of their total sales; the ratios for large, medium, and small firms, however, were quite different, being

0.78 percent, 0.34 percent and 0.37 percent, respectively. The MST study also revealed a similar pattern, with the ratios for the three groups of firms being 2.08 percent 1.30 percent, and 1.15 percent, respectively.

Second, although small firms spend less on innovations, they tend to spend more on acquiring existing new technologies and concentrate on using those technologies more efficiently. In addition, new technology is usually bought in the form of new and advanced equipment. For instance, the DRC and SSB study showed that among the objects of expenditures on technical progress, new equipment accounted for 68 percent; the rest, in descending order, were R&D, buying external techniques, new product testing, and advertisement of new products. The MST study divided technological expenditures into two categories: R&D and other expenditures. The latter was in turn broken into four subcategories: purchases of external technology, application of new technology, acquirement of new production capacities, and innovative sales. A surprising result was that small firms spent a larger portion of technological expenditures on R&D than large firms. Among other expenditures, smaller firms spent a smaller proportion of money in acquiring new production capacities than larger firms, although acquiring new production capacities accounted for the largest chunk for all the firms with different scales. For the other three subcategories, small firms spent a higher proportion than large firms (Table VII). This shows two things. First, most of the spending by large firms was used to increase their production capacities. Second, small firms were more concerned than large firms about how to absorb new technology and transform the technology into marketable products. The DRC and SSB study also supported this conclusion.

Third, small firms put more emphasis on obtaining suitable technology while large firms are more concerned about how advanced the technology is. In terms of ownership type, the percentage of new equipment decreased in the order of foreign and joint ventures, state and collective joint ventures, collective firms, and state firms. However, the new equipment in small firms were mostly domestically made and less advanced. In contrast, large firms had much more internationally advanced equipment.

TABLE VII
Distribution of technical spending by firm size (in percent)

Size of firm	Acquiring technology	Application of technology	New production capacity	Sales of new products
All firms	18.4	12.9	56.4	12.3
Large	10.0	3.4	76.6	10.0
Medium	13.6	15.2	66.8	4.4
Small	23.4	8.8	53.2	14.6

Note: Spending includes only the category of "Other" as defined in Jia et al. (1994).

Sources: Jia et al. (1994).

Fourth, small firms have a higher success rate than large firms in transforming new technology into new products. Table VIII, adopted from Jefferson et al. (1993), shows that the percentage of the value of new products in total output value was highest for TVEs and lowest for state firms. The MST study showed similar trend for firms in Yichang city (Table IX). Small firms introduced more new products and had higher commercial success rates than large firms, collective firms performed better than state firms, and firms belonging to low administrative units performed better than those belonging to higher administrative units.

Complementary to the above two studies, the Tsinghua study showed that small firms tended to use technology to improve their overall profitability while large firms tended to use technology to improve the efficiency of productive inputs such as labor and materials. When asked which aspects had been improved by adopting new technology, large firms' answers were concentrated in savings of labor and materials and improvement of product quality whereas small firms' answers were concentrated in improvements of labor productivity, variety of products, and profitability. These differences are consistent with the observation that

TABLE VIII
Share of new product value in total output by ownership (in percent)

Year	All firms	State-owned		Urban	
		Large and medium	Small	Collective	TVE
1985	10.2	9.2		9.4	15.5
1989	26.9	19.8	37.3	26.4	38.8
1985–89	14.0	10.0		15.0	22.0

Sources: Jefferson et al. (1993).

TABLE IX
New products of firms in Yichang: 1985–89 (in percent)

	By scale			By ownership		By affiliation			
	Large	Medium	Small	State	Collective	Central	Municipal	County	Township
New products ^a	58	64	59	62	60	61	60	63	83
Success rate ^b	74	80	83	81	82	78	81	97	75
New product value in total in 1989	37	26	29	25	35	35	25	25	65

^a The percentage of the number of new products in total number of products.

^b The percentage of new products that were commercially successful.

Sources: Jia et al. (1994).

large firms have made more technical innovations but do not have better performance than small firms.

4. Sources of new technology

China's small enterprises obtain new technology from several sources. Because they do not have adequate capacities to conduct their own innovations, they are more likely to buy technologies from outside sources than large firms are. For instance, the DRC and SSB study showed that the proportion of purchased technologies increased as firm size was reduced. In addition, the MST study showed that smaller firms tended to more rely on domestic technology than larger firms did. Table X shows the percentages of firms in Yichang city buying domestic and foreign technology by size, ownership, and affiliation. Obviously, larger firms, state firms, and firms belonging to city and central governments were much more likely to buy technologies from abroad than their respective peers. In particular, firms at the county and township level hardly bought any technologies from abroad.

The most important channel for small enterprises to obtain technology is to cooperate with an outside source. This can take several forms: acting as a supplier for a large firm, cooperating with a research institute or a university, forming a joint venture with a foreign firm, and cooperating with other small firms. Cooperation with large firms secures the market for a small firm's products and enables it to specialize. Cooperation with research institutes and universities enables small firms to quickly get access to new technology, new products, and necessary training. Cooperation with a foreign firm not only provides a small firm with much needed capital, but also brings new pro-

duction and management technologies and enlarges its market. Last, cooperation with other small firms also enables a small firm to specialize, making it much easier to improve its core products. In addition, specialization among local small enterprises improves the local industrial structure and reduces excessive local competition. Yan and Zhang (1995) and He et al. (1996) showed that when compared with firms of the same size, firms engaged in outside cooperation had more standardized products, higher labor productivity, more qualified labor force, and more investment in technical innovations than those not engaged in outside cooperation (Table XI). In addition, these firms are keener to use "appropriate" technologies. For example, the percentage of equipment made in the 1980s in these firms was 69 percent, 2 percent lower than in firms without outside cooperation; but their percentage of equipment made in the 1970s was 27 percent, 8 percent higher than the other group of firms. However, there was less old equipment in these firms, too. Their percentage of equipment made in the 1950s was 4 percent, 6 percent lower than in the other group of firms.

Human capital is the most important factor that determines a firm's technical efficiency. The majority of small firms, TVEs in particular, rely on hiring or contracting with urban technicians and experienced workers to improve their human capital. In the 1970s when TVEs just started, these firms relied on young urban technicians who were previously sent out to the countryside to be "re-educated" by peasants. Entering the 1980s, these young technicians returned to the cities, and TVEs began to turn to contracting with retired urban technicians and experienced workers, or hiring experts from research institutes and universities as consultants. Almost every TVE in the Yangtze

TABLE X
Percentage of firms buying domestic or foreign technologies in Yichang: 1985–89 (in percent)

	By scale			By ownership		By affiliation			
	Large	Medium	Small	State	Collective	Central	Municipal	County	Township
Domestic technologies	40.0	45	43.3	44.3	42.4	57.1	44.1	16.7	50.0
Foreign technologies	40.0	22.5	3.3	15.7	3.0	14.3	13.3	0	0

Sources: Jia, Ma and Tang (1994).

TABLE XI
Comparison between firms with and without outside cooperation: 1990

	Cooperating firms (A)	Other Firms (B)	A/B
Number of Workers	228	211	1.08
With high school or above education (percent)	25.9	24.5	1.06
Technicians (percent)	4.6	3.1	1.48
Trained workers	8.0	4.5	1.77
Contracted outside technical and management personnel	4.9	2.2	2.25
Innovation spending (thou. Yuan)	127.5	16.2	7.87
Standardized products (percent)	50.5	31.3	1.61
Equipment made in 1980s (percent)	69.0	71.0	0.97
Pre-tax profit per worker (thou. Yuan)	2.83	2.6	1.06

Sources: Yan and Zhang (1995).

River delta hired retired workers from Shanghai in their early stage of development. These workers brought information and expertise to the firms and have contributed tremendously to the early development of the TVEs in that area.

The Chinese government is keen in improving the technical capacities of small firms, especially the TVEs. Although the coastal areas are flourishing with numerous small firms, the inland areas are falling behind. On the other hand, many research institutes and universities have redundant researchers who do not have enough funding to conduct research. Because of this, the central government initiated the "Star Plan" in the mid-1980s. The Star Plan aims at improving the technical capacities of small firms, especially those of the TVEs. As a result, 80 percent of the technical developments covered by the plan are designated for TVEs. Every Star Plan project is assigned a research institute to provide technical support. The government provides favorable treatment to Star Plan projects in the areas of technology imports, equipment purchases, and human resource training. Financial institutions also have preferential terms toward Star Plan projects.

The major accomplishments designated for the Star Plan are to (1) establish a group of model TVEs with adequate technology, (2) develop production equipment that is suitable for TVEs, and (3) train key technicians and management personnel for TVEs. Because of the good coordination between various levels of the government, TVEs, research institutes, and banks, Star Plan projects have been quite successful. For instance, in the Seventh Five-Year Plan period (1986–1990),

88.6 percent of the Star Plan projects supported by the central and provincial governments were completed in two years and recovered their investments also in two years (He et al., 1996). In 1997, the Ministry of Sciences and Technologies conducted a survey on the 108 Star Plan projects financed by the World Bank in the period of 1991–97. It showed that among all the surveyed projects 18.03 percent developed new manufacturing methods for existing products, 62.3 percent developed new products that did not exist countrywide or province-wide, and 80.64 percent reached the level of advanced technology (Cao and Zhao, 1998). However, as the Star Plan is managed by the government and requires intensive resource input, its coverage is still quite low. Take Jiangsu province as an example. During 1986–90, Jiangsu implemented an average of 230 Star Plan projects each year. Excluding the projects implemented in agriculture and the county-and-above level enterprises, the remaining projects only covered 0.1 percent of the total number of enterprises at the township and village level, and only accounted for 1.18 percent of the total number of new projects in each year (He et al., 1996).

Last, FDI has become a major source for small enterprises to obtain foreign technologies. During 1986–95, the share of FDI (including capital from Hong Kong, Macao, and Taiwan) in China's industrial growth was 18.26 percent. Entering the 1990s, FDI has become the most important source of technological imports in monetary terms (Wang, 1997). FDI not only brings new production and management technology to the joint ventures, but

also provides spill-over benefits to other firms. Yao (1998) estimated that a 1 percent increase of the number of foreign (not including Hong Kong, Macao, and Taiwan) solely owned or joint venture firms in an industry, the technical efficiency of each firm in that industry will increase by 1.1 percent. In terms of scale, most FDI goes to establish small firms, and small FDI (including Hong Kong, Macao, and Taiwan) firms accounted for 95.95 percent of the total number of FDI firms. However, the presence of FDI in China's industry is still limited. For instance, small FDI firms only accounted for 6.5 percent of the total number of small firms, 9.76 percent of the total number of firms at the township and village level, 13.14 percent of the total output of all small firms, and 28.08 percent of the output of firms at the township and village level.

5. Business challenges facing small firms

Although China's small firms have made remarkable technical progress, the efficiency gap of nearly 50 percent indicates that small firms still have a long way to go to catch up with the large firms. In this section, we will analyze the major impediments that have hindered small firms' technical advance.

Several studies show that the lack of financial resources is an important impediment. The Tsinghua study showed that the lack of funds, qualified personnel, and information were the three most important impediments among its sample firms (Gao, 1997). The MST study also showed that the lack of financial resources was a serious obstacle to technical innovations at the firm level.

Lack access to the formal financial market is a problem for small firms in many countries. The problem is even worse in China. For example, the output of TVEs now accounts for half of the national total industry, but they get less than 10 percent of formal loans each year. Except for some projects with limited coverage (e.g., the Star Plan), China does not have any specific policies geared toward small firms. Under this circumstance, small firms have to resort to informal and in many cases underground financial institutions to get loans. High interest rates and questionable activities of these informal institutions have caused serious

problems in some parts of the country, and prompted the central government to launch a nationwide campaign to curb illegal financial activities. However, the campaign has gone beyond just eliminating underground financial organizations and has closed numerous semi-formal credit associations in the rural areas and several regional stock exchanges that were managed by local governments and designated for small firms to issue stocks. The recent reforms have also created new pressures on small firms. Because banks are now required to bear their own risks in their lending activities, they have become more cautious in issuing loans. This hurts small firms more than large firms because small firms are perceived to be more risky. The recent privatization programs also hurt small firms to some extent. Local governments are no longer allowed to guarantee bank loans for any enterprises, so TVEs no longer have the convenience they had before. In addition, banks regard a default by a private firm as more serious than a default by a state firm (Wang, 1998). Therefore, getting formal bank loans is becoming harder for small firms. The Chinese government has realized the problems. Recently, the central bank asked each commercial bank to set up a department specialized in issuing loans to small firms.

Another impediment to small firms is the lack of information intermediaries, or marketing and research firms. In a survey of 207 foreign firms that had business in China, Wang and Shi (1997) found that information intermediaries played an insignificant role in providing these businesses with information. The most important channels for these firms to obtain information in China were business visits, personal and business contacts, exhibitions, and contacts with other foreign firms. The intermediaries such as market research and forecasting firms that are widely consulted in developed countries were not mentioned in their answers. Right now, there are only several market research firms whose services are confined to large cities such as Beijing and Shanghai. Most of other cities do not even have such firms, not to mention the vast countryside where most of the small firms are. There are national and local semi-official industrial associations whose function is supposed to offer information to their members. However, this function is not carried out seriously. Even if

it is, the high membership fees charged by the associations put off the willingness of small firms to join. In this aspect, large firms have certain advantages over small firms because they can conduct their own R&D while the latter do not have that capacity.

In addition, small enterprises themselves do not have adequate personnel to conduct technical innovation, or even to implement existing technology. Because of this shortcoming, the technology small firms adopt is simple and easily imitated by others. A common observation is that TVEs in one locality all produce the same product, indicating there is strong externality with a technical innovation. On the one hand, this externality is conducive to economic development at the local level; on the other hand, it discourages firms from introducing new products or new production practices. This has much to do with China's imperfect legal system. Although there are laws providing protection for patents and intellectual property rights, the implementation of these laws is weak.

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