Productivity Growth and Convergence Across China's Industrial Economy*

Gary H. Jefferson
Department of Economics
Brandeis University
Waltham, MA 02254
jefferson@brandeis.edu

Thomas G. Rawski
Department of Economics
University of Pittsburgh
Pittsburgh, PA
tgrawski@pitt.edu

Yifan Zhang
Department of Economics
Lingnan University
Hong Kong
yifan.zhang@ln.edu.hk

June 28, 2007
Draft: for review and comment only

Prepared for the *Journal of Chinese Economics and Business Studies*

*We acknowledge the support provided by the U.S. National Science Foundation (award # SES-0519902), the U.S. Department of Energy's Biological and Environmental Research Program (contract # DE-FG02-00ER63030), and Lingnan University Direct Research Grant (funding # DR07B4).

Abstract

Using a firm-level data set for 1998 and 2005 including all of China's "above designated size" enterprises that together account for more than 85 percent of China's industrial output, this paper investigates three issues. One key issue in China's industrial system is the extent to which growth has been driven by productivity change. A second issue is the relative productivity performance of enterprises of different ownership types, including a comparison of state-owned versus various forms of non-state ownership. The third issue is whether productivity across China's key regions – coast, northeast, central, and west – exhibits convergence or divergence. One key finding that cuts across all three issues is the exceptional contribution to productivity growth made by exiting and entering firms, much of which is associated with restructuring. During 1998-2005, the phenomenon of firm exit and entry contributes substantially to China's overall industrial productivity growth, to the relatively rapid growth of state industry productivity, and to substantial productivity catch-up with the coastal region by many of the interior provinces.

1. Introduction

Deng Xiaoping's 1992 tour of south China pushed China's reform to a new stage and ignited a remarkable spurt that, despite a brief slowdown following the Asian financial crisis of 1998, has delivered robust growth and rising living standards on a scale that parallels the steep economic ascent of Japan, South Korea, and Taiwan in the late twentieth century. In no sector has growth been more robust than in the industrial sector. Table 1 shows that China's industrial sector grew at an average annual real rate of 12.1 percent from 1992 to 2005. A central question concerning China's robust industrial performance is the extent to which it is driven by the growth of the labor force and high rates of investment versus growth in the productivity with which Chinese industry employs its labor and capital.

This paper has three objectives**.** The first is to estimate the rates of productivity growth for labor, for capital, and for a package of inputs that combines labor and capital during 1998 to 2005, the years spanned by our data set, which consists of more than 250,000 industrial enterprises that together account for more than 85 percent of China's total industrial value added in 2005.

In addition, we examine differences in levels and rates of productivity growth by ownership type. The firm-level data include both surviving firms that report in both 1998 and 2005 and firms that exit or enter the data set over this period. The arrival and departure of firms reflects enterprise births and deaths. It also reflects restructuring (*qiye gaizhi*) in which firms may be assigned new ID numbers following a major reorganization, which often includes changes in ownership (including full or partial privatization). In what follows, we use the terms "entry" and "exit" to describe all sources of changes in the makeup of our data: births, deaths, and restructuring. Our estimates of productivity differences between the balanced data set and the full sample that includes exits and entrants provide a perspective on the implications of restructuring for China's overall industrial performance.

Finally, we investigate the extent to which labor, capital, and multi-factor productivity differ across China's four key regions – its coastal provinces, provinces of the northeast, central provinces, and western provinces – and the extent to which these differences have grown or diminished over the past decade. China's internal technology diffusion and factor reallocation are important potential sources of growth of productivity and living standards. Evidence that productivity levels across regions are becoming more similar implies that markets, i.e. growing domestic and international trade, are creating a more uniform diffusion of technology and resources across China's industrial sector. Alternatively, evidence of divergence of productivity levels across regions indicates that technology and resources are not diffusing, at least not as rapidly as the leading provinces are developing. We find evidence of partial convergence.

This analysis is based on data for all industrial enterprises "above designated size" (i.e. *guimo yishang*), a category initiated in 1998 that includes all state-owned enterprises plus non-state enterprises that report annual sales of five million renminbi (Rmb) or more. Together these firms numbered over 128,000 in 1998 and nearly 260,000 industrial firms in 2005. The dataset includes all of China's nearly 25,000 firms that are formally designated as large or medium-size enterprises; while the balance of the firms consist of those that are formally designated as “small-scale” enterprises. The vast majority of the industrial enterprises that are not included are registered as individual household (i.e. *getihu*) enterprises.

The remainder of this paper is organized as follows. Section 2 reviews some of the more prominent literature that evaluates productivity growth in China and other East Asian economies. Section 3 describes some of the key features of the data used in this paper. Section 4 sets out the methodology we use for estimating multi-factor productivity, including controls for the business cycle and industry composition as well as for estimating differences in productivity levels and rates of growth across regions and ownership types. Section 5 describes the overall productivity performance of Chinese industry, as well as performance differences across ownership types. Section 6 focuses on regional productivity differences, while section 7 tests for convergence of productivity levels across China’s four key regions. Finally, Section 8 draws the main conclusions from our analysis.

2. Literature Review

Interest in the productivity performance of Asia’s rising economies – Hong Kong, Singapore, South Korea, and Taiwan – was spurred by Alwyn Young’s analysis (1995) of the respective roles of factor accumulation and productivity growth in the dramatic rise in the living standards of these economies. Contrary to general expectations, Young concluded that once the robust increase in factor inputs, including human capital, was accounted for, the growth of total factor productivity in these economies was comparable to those of the historical performance of the OECD and Latin American economies.

According to Young, while Hong Kong and Taiwan enjoyed rates of TFP growth in the range of 2-3 percent over the period from1966 to 1990, TFP in South Korea grew annually at about 1.7 percent, while that of Singapore was virtually zero. In Korea, Taiwan, and Singapore for which Young produced separate estimates of TFP growth for manufacturing, the estimates were 3.0 percent, 1.7 percent, and -1.0 percent respectively.

The initial estimates have been challenged on a number of fronts. One notable challenge was produced by Hsieh (1999), who uses the dual approach to growth accounting to show that TFP growth in each of the four Asian economies is considerably higher than the primal approach used by Young. Using factor prices, Hsieh's calculations show rates of TFP that exceed those reported by Young by as much as three percent, in the case of Singapore transforming Young's annual growth estimate of -0.68 percent into 2.39 percent.

Young's 2003 paper focuses exclusively on China. For our purposes, it is unfortunate that Young's analysis does not break out estimates of China's productivity performance for industry or manufacturing as he does for his 1995 study of the other four Asian economies. Instead, Young's estimates span the non-agricultural sector, including services and construction. Nonetheless, the spirit of the analysis is similar to that of his earlier study in which he assiduously deconstructs the data with particular emphasis on reworking price deflators for value added and the capital stock and adjusting for various characteristics of the labor force. The result is a substantial downward adjustment in estimates of productivity growth using the official statistics from 1978 to 1998. While the estimates using official data are 6.1 percent annual growth in output per worker, 5.0 percent in output per effective worker, 1.4 percent in output per unit of capital, and 3.0

percent for TFP growth, using his statistical revisions, Young reports estimates of 3.5, 2.6, 0.4, and 1.4 percent respectively. By focusing on the industrial sector, not including construction, and using data reported by individual firms, we are able to avoid some, but not all of the issues raised by Young. We discuss these in the next section.

Perkins and Rawski (2008) estimate total factor productivity growth for China's total economy and conclude that over the reform period 1978 to 2005, TFP rose at an average annual rate of 3.8 percent, accounting for nearly one-third of China's total GDP growth. Their analysis resembles Young's in that the output is measured in terms of value-added and the inputs exclude intermediates but include human capital as well as the usual factor inputs of labor and fixed capital. During 1995 to 2000 and 2000 to 2005, they estimate annual rates of TFP growth to be 3.2 and 3.1 percent respectively. Perkins and Rawski do not offer separate estimates of TFP growth by agriculture, industry, and services. It is likely, however, that such a disaggregation would show industrial productivity growing at a somewhat higher rate than the average of 3.1-3.2 percent, that is, higher than those reported by Young for manufacturing in Korea, Taiwan, Hong Kong, and Singapore.

Somewhat similar to Perkins and Rawski (2008), Zheng, Bigsten and Hu (2006) estimate rates of growth of TFP (labor and physical capital) for China's overall economy for the years 1978 to 2004. They assume a larger input share for capital, i.e. of 0.6, percent, which even without including human capital is larger than the estimates used by Perkins and Rawski. Zheng et al find that China's overall TFP grew at an average rate of 4.15 percent during 1978 to 1993 and 2.45 percent from 1993 to 2004. The difference between the estimates of Perkins-Rawski and Zheng et al may arise from the latter's use of a somewhat larger capital share and also by the exclusion of 2005, which was for China a year of above-average GDP growth. Like Perkins and Rawski, Zheng et al do not report separate estimates for industry.

In order to develop a first look at productivity growth in China's industrial sector during 1992-2005 and 1998-2005, the years for which we have micro-data, we construct Table 1 using aggregate measures of output and employment compiled by China's National Bureau of Statistics (2006). These statistics show the constant price measure of industrial growth averaging 12.1 percent over the period 1992 to 2005 with a marked slowdown from 14.2 percent during 1992-1998 to 10.4 percent during 1998-2005. Simultaneously, we see that industrial employment fell slightly over the whole period. After declining by 1.6 percent annually during 1992-1998, employment rose at an annual rate of one percent during 1998-2005. The slowing rates of industrial growth and the increase of the industrial labor force together yield a slowdown of industrial labor productivity growth over the 1998-2005 period. While overall industrial labor productivity grew at a rate of 12.4 percent, during the first six years it grew at a rate of 16.0 percent, slowing to 9.3 percent during 1998-2005.

A problem with these estimates based on macroeconomic data from NBS is the tendency for the NBS to underreport employment in industry. The explanation for this is that many workers who are classified as agricultural workers in fact spend all or a portion of their time in industry. These workers, who do not have residential permits that qualify them for urban residency, continue to be counted as rural agricultural workers. Hence, the numbers shown in Table 1 are likely to over-report both the level and the rate of growth of labor productivity for China's industrial sector.[1] The employment data are reported by each individual firm in the data set, so we do not need to worry about the over or underreporting of workers employed within the sector covered by our data.

3. The Data

This study is based on a firm-level dataset collected annually by China's National Bureau of Statistics (NBS). The study uses the data for 1998 and 2005. The NBS dataset covers all state-owned firms and all non-state firms with sales above Rmb 5 million. The data collected from this survey are used to compile the "Industry" section of the China Statistical Yearbook; the China Markets Yearbook compiles and reports the data for each four-digit industry.

In this NBS dataset, some firms report abnormally large or small values for certain variables. We surmise that these exaggerated values are often associated with misplaced digits, such as reporting units of a 1,000 rather than 10,000 (*wan*) or one million rather than 100,000,000 (*yi*). To correct for improbable values, we impose the following restrictions on the data: (i) restrict the values of employment (L) and the net value of fixed assets (K) to be positive, (ii) restrict the ratio of value added to sales to lie between 0 and 1; (iii) exclude those firms, which employ less than eight workers, since most of the improbable values are associated with smaller firms that usually do not have reliable accounting systems, and (iv) remove those firms in the upper and lower tails of the

[1] Brandt, Hsieh, and Zhu (2008) attempt to correct for this miscounting. Jefferson, Hu, and Su (2006) compare labor productivity levels across China's agricultural, industrial, and service sectors using both the original NBS employment data and the revised data prepared by Brandt et al.

productivity, i.e. we compute VA/L, VA/K, L/VA and K/VA and delete those firms that lie more than 4 standard deviations above the mean of each of these four variables.[2]

In our dataset, each firm is assigned a unique numerical ID. Firms that undergo restructuring, or participate in mergers or acquisition *may* receive a new numerical ID. For example, when several machine tool firms merged to form Shenyang Machine Tool Limited, the new entity was assigned an ID different from the codes previously assigned to the constituent firms. For this reason, the disappearance of a firm's ID from the database can arise from three causes: closure of the firm; a decline in sales that pushes the annual total below RMB 5 million; or a change in ID associated with some form of reorganization.[3] Similarly, the appearance of a new ID code in the database could reflect the birth of a new firm; expansion of an existing firm that pushes sales above the RMB 5 million cutoff; or some form of reorganization affecting one (or, as in the Shenyang case, several) firm(s). To deal with this problem, in addition to matching firm IDs, so as to track the surviving firms, we also match the firms by data that consist of a combination of consistent information including founding year, industry codes, geographic codes, zip codes, names of managers, addresses, and phone numbers.

Table 2 reports basic statistics for the NBS data set used in this study. The summary shows an approximate doubling from 1998 to 2005 in the number of firms covered by our dataset. While it is likely that most of the increase in the number of firms results from smaller firms crossing the RMB 5 million sales threshold,, the full sample of

---

[2] About 35,000 firms in 1998 and 10,000 firms in 2005 are removed from the sample as a result of the data cleaning procedure.

[3] Our analysis of the data indicates that firms that change their ownership classification and also change their SIC code, address, or size designation are more likely also to change their firm ID. Firms that change their ownership classification while leaving these other attributes unchanged are less likely to change their IDs.

data shows that average sales per firm during this period rose from RMB 42.255 million to 77.562 million. This substantial increase in size suggests that even as large numbers of small firms were becoming eligible for the annual survey, the average firm size was growing rapidly.

Table 2 also shows that while average firm sales and value added grew significantly during this period, the size of the average workforce declined; moreover, while the net value of the capital stock rose only slightly. As a result, we find substantial increases in labor productivity – nearly a doubling – and also in capital productivity, which increased by 75 percent over the seven-year period.[4]

The overall data, therefore, show significant improvements in labor and capital productivity within this critical population of industrial enterprises. We employ conventional regression methods to verify these initial results and also to identify the roles of changes in industry composition, ownership composition, and patterns of exit-entry in driving these productivity changes. Our regression analysis also investigates the extent to which productivity levels are converging across China's key regions.

4. The Research Method

We pool the data to estimate the following production function on which constant returns to scale (CRS) has been imposed.[5]

---

[4] Jefferson, Hu, and Su (2006) also show in their sample of China's large and medium-size industrial enterprises a substantial rise in capital productivity during 1998-2005 following a decline in capital productivity during 1995-1998.

[5] Constant returns to scale (CRS) is imposed by converting the Cobb-Douglas production function into intensive form, which requires that the two output elasticities for labor and capital sum to unity.

$$\ln(VA/L)_{it} = \alpha_0 + \alpha_k \ln(K/L)_{it} + \sum_k \beta_k IND_{ik} + \varepsilon_{it} \qquad (1)$$

In equation (1), α_k represents the weight that we assign to capital in constructing a measure of multi-factor productivity. Pursuant to the CRS restriction, the weight on labor, α_l, is simply defined as (1-α_k). In equation (1), $\sum_k \beta_k IND_{ik}$ is a set of dummy estimates for the k = 1,…,, 37 two-digit industries. Estimates of equation (1) are reported in Table 3.

In Table 3, we report five sets of estimates for α_k. Columns (1), (2), and (3) use the balanced sample of the data set; columns (4) and (5) use the full sample. Column (2) pools the data for 1998 and 2005 and incorporates a dummy for 2005 to allow for differences in capital's elasticity between the two years. Column (3) takes advantage of the balanced feature of the data to employ a fixed effects estimator that is intended to control for estimation bias associated with omitted variables that create fixed effects. Columns (4) and (5) employ the full sample;[6] like column (2), column (5) tests for the stability of the estimate of capital's elasticity between 1998 and 2005. Although in both columns (2) and (5), we find that the estimates of the elasticity for 2005 are significantly less than the 1998 estimates, however, the magnitudes of the differences are not large. The various estimates of α_k are all similar, falling in the range of 0.28 to 0.38. Because we are most concerned with possible endogeneity bias associated with fixed effects, we

[6] As a prior, we might anticipate that the estimate for capital's output elasticity for the full sample would be smaller for the full sample within which the firms are substantially less capital intensive than for the balanced sample. The smaller (larger) output elasticity for capital (labor) would tend to equalize the marginal products of capital and labor between the representative firm in the full sample as compared with that of the balanced sample. The difference in the estimates shown in columns (1) and (3) of Table 3 suggest that further analysis of different production technologies for surviving firms and exiting and entering firms may be useful.

select the estimate $\alpha_k = 0.381$ shown in column (3). Because the rate of growth of capital productivity, while consistently positive across various estimates, is significantly less than the growth of labor productivity, the choice of the largest estimate of α_k serves in the following analysis to yield conservative, lower bound estimates of the growth of multi-factor productivity.

We then use this estimate of α_k, i.e. 0.381, to construct measures of multi-factor productivity for each of the *i*th firms using the identity:

$$\ln MFP_{it} \equiv \alpha_k \ln(VA/K)_{it} + (1-\alpha_k)\ln(VA/L)_{it}, \qquad (2)$$

where t = 1998 and 2005.

With measures of labor productivity, capital productivity, and multi-factor productivity, we then estimate the following:

$$\ln \mathrm{Prod}_{ipt} = \beta_0 + \beta_{2005} + \beta_s \ln(\mathrm{GVIO/sales})_{it} + \sum_k \beta_k IND_{ik} + \sum_j \beta_j \mathrm{REGION}_{ij} + v_{it} \qquad (3)$$

where the left-side variable refers to either of three measures: ln(VA/L), ln(VA/K), and lnMFP, depending on whether p = 1, 2, or 3; β_0 represents the productivity level in 1998 and β_{2005} measures the 2005 productivity level. Also in equation (3), as in equation (1) k designates the industry, j = region (1,…, 4, i.e. regional groupings of China's 31 provincial-level regions[7]) and t = 1998 or 2005. The inclusion of these dummy variables, causes the interpretation of β_0 and β_{2005} to be altered, so that they are both to be interpreted as productivity levels in the textile industry in China's central region.

The variable $\ln(\text{GVIO/sales})_{it}$, where GVIO = gross value of industrial output, controls for business cycle effects on productivity. Ramey and West (1999) describe the well-known empirical regularity that inventories move pro-cyclically. Inventories tend to build up during expansion and draw down during contractions. Based on their review of the research on inventory behavior, Ramey and West explain that this empirical regularity can be explained by the behavior of the representative manufacturing firm. Cost shocks cause pro-cyclical movement, because interludes of low cost encourage firms to produce and build up inventory, and conversely for times of high cost. The second reason is that there are large costs of adjusting production and a strong accelerator motive. The accelerator motive links today's inventories to tomorrow's expected sales, perhaps resulting from concerns about stockouts. Since sales are positively serially correlated, this concern will tend to cause inventories to grow and shrink with sales and the cycle. As well, with strong costs of adjusting production, if a shock perturbs the inventory-sales relationship, return to equilibrium will be slow because firms will adjust production only very gradually (p. 867). This analysis of the pro-cyclical pattern of inventory accumulation causes the expected sign of estimates of β_s to be positive. The inclusion of this inventory adjustment variable is intended to correct for estimates of β_0 and β_{2005} in order to take into account the business cycle effects on productivity for those

[7] The coastal region includes Beijing, Fujian, Guangdong, Hainan, Hebei, Jiangsu, Shanghai, Shandong, Tianjin, Zhejiang; the northeast region includes Heilongjiang, Jilin, and Liaoning; the central provinces are Anhui, Guangxi, Henan, Hubei, Hunan, Inner Mongolia, Jiangxi, and Shanxi; the western provinces consist of Chongqing, Gansu, Guizhou, Ningxia, Qinghai, Shaanxi, Sichuan, Xinjiang, Tibet, and Yunnan.

years and to allow for a more accurate accounting of productivity growth between 1998 and 2005.

We also adjust the data for value-added and fixed assets to take account of inflation. We mapped the 37 two-digit industries in our data set into the 14 sectors for which the National Bureau of Statistics reports "Ex-Factory Price Index of Industrial Products by Sector" and used the NBS results to convert each firm's nominal 2005 value-added to 1998 prices.[8]

Using these indexes of ex-factory prices has the disadvantage of not fully aligning with value added, since the ex-factory price deflator incorporates changes in the price of intermediate inputs as well as value added. The ex-factory price deflator may over deflate value added in industries that consume large quantities of intermediate inputs with rapidly rising prices (for example, steel and petroleum processing). . However, a comparison of the general ex-factory price index and the implicit overall industrial GDP deflator shows that the difference between the two series is not large.[9] Finally, we deflate the capital stock for each firm using the following equation for the deflated net value of fixed assets: DNVFA(2005) = NVFA(2005)/deflator, DNVFA(1998) = NVFA(1998).

Comment [e1]: There is only one procedure to deflate both full sample and balanced sample.

Throughout we use ordinary least squares. To control for heteroskedasticity, we compute and report White heteroskedasticity- robust standard errors.

---

[8] A concordance is available from the authors.

[9] In fact, the implicit industrial GDP deflator tends to be marginally larger than the general ex-factory price index. One plausible explanation for this is that while the ex-factory index is based on the price of sales of industrial products by the manufacturing suppliers, the industrial GDP deflator is based on increases in the final prices of industrial goods, which may reflect an increase in markups associated with the distribution of industrial goods from the factory to the final users.

5. Overall performance

Table 4 reports estimates of equation (3) using both the full sample and the balanced sample to evaluate the overall productivity performance within China's industrial sector consisting of the "above designated-size" enterprises. The estimates in Table 4 do not include industry and region dummies. We first note that the estimates of the inventory adjustment coefficient, i.e., GVIO/sales are, as predicted, positive throughout. One curious aspect of these estimates, however, is the large magnitude of the estimates for the balanced sample in relation to the full sample. This disparity in estimates of the business cycle effect may reflect a tendency for low productivity firms to exit during business downturns, which in the full sample would moderate the measured downturn in productivity associated with the trough of the business cycle, thereby causing the correlation between low inventories and low productivity to be less robust.

A comparison of the two sets of estimates – the balanced sample and the full sample – shows that the level of multi-factor productivity in 1998 for the balanced sample is significantly higher than that of the full sample. One explanation for the higher productivity level for the balanced sample in 1998 is the relatively large scale of firms populating the balanced sample in that year. As shown in Table 2, in 1998, the average 1998 sales of the firm in the full sample was 42.2 million yuan as compared with 66.4 million yuan for the balanced data set.

By 2005, the productivity levels of the balanced and full samples become virtually identical (i.e. 2.575 for the balanced sample vs. 2.578 for the full sample). One explanation for the catch-up in productivity of the full sample relative to the balanced sample is the exclusion in the full sample of firms that exist in 1998 but not in 2005.

These exiting firms may be relatively low productivity firms whose exit leaves a pool of survivors in the full sample with productivity levels for 2005 that are relatively high. The second set of firms that appear in the full sample but not in the balanced data set are entering firms that report in 2005 but not in 1998. These entering firms may be more productive than the firms that survived for the 1998-2005 duration, again pushing up average productivity for the full sample.

Table 5 reports the multifactor productivity levels of exits, entrants and survivors by ownership type. The table shows that for most ownership types the average annual rate of growth of MFP computed for a firm that exits after 1998 and another that enters in or before 2005 exceeds the counterpart MFP growth rate for a surviving firm. Among the five ownership types, only the private firms show the increment in MFP for a surviving firm being greater than that for a 2005 entrant versus a 1998 exiting firm. For the state-owned enterprises, the disparity is striking, as the level of productivity of an entering firm in 2005 represents an annual rate of MFP growth of 18.37 percent in relation to the productivity level of the exiting firm in 1998. This contrasts with a rate of growth of but 8.33 percent for a surviving SOE.

A likely explanation for the high productivity of entrants relative to exiting firms is that the exiting firms may be low-productivity firms that are in need of restructuring. Restructuring, typically entails a change in formal ownership classification, industrial classification, or address, often resulting in the assignment of a new ID. When the restructuring leads to the exit of the firm subsequent to 1998 and its future reentry in 2005, with a new ID, the annual growth rate of MFP typically exceeds the MFP growth rates for the survivors that appear in both 1998 and 2005.[10] Again, with the exception of the private firms, the calculations in the last row of Table 5 show this to be true relative to the annual growth rates for the survivors.

6. Differences in regional productivity levels

Using the balanced sample, Table 6 replicates the estimates for Table 4 except that it includes dummies for China's four regions. Table 6 also includes a second set of estimates that controls for industry composition; these allow us to determine the extent to which differences in regional productivity can be accounted for by differences in industry mix.

In Table 6, for which the central region serves as the reference, the results without the industry dummies show that in 1998 the coastal provinces enjoyed a substantial labor, capital, and multi-factor productivity advantage over the other three regions. In 1998 the northeast region lagged somewhat behind the central provinces while the 10 western provinces exhibited the largest productivity lag.

The inclusion of the industry dummies does not significantly alter these results. The largest change that results from the inclusion of the industry dummies in the balanced sample is the decline in the coast's advantage in capital productivity relative to the other regions. Viewing Table 7, which shows the industry dummies that were included in the regression but not reported in the right-hand panel of Table 6, we surmise that the inclusion of the industry dummies controls for the high concentration of the textile and apparel industries in the coastal provinces. These are the two industries that,

[10] See Jefferson, Hu, and Su (forthcoming), who in their sample of large and medium-size industrial enterprises find that exiting firms exhibit productivity levels that are far below and entering firms exhibit levels that are generally above those of surviving firms.

close behind the leather products industry, exhibit the highest levels of capital productivity among the estimates shown in Table 7. In 2004, Shandong and Jiangsu accounted for 42.9 percent of the nation's yarn production, while in that same year, these two provinces and Zhejiang accounted for 38.9 percent of China's total apparel production.[11] At the other end of the capital productivity spectrum, the petroleum and gas extraction and electricity and gas distribution industries stand out among the industries with the lowest levels of capital productivity. With Heilongjiang being the largest supplier of crude oil, Sichuan and Shaanxi being the largest producers of natural gas, and Hubei, Sichuan, and the other provinces along the upper reaches of the Yangtze supplying hydroelectric power, the industry composition of the northeast, central and western provinces tends to depress their overall levels of capital productivity relative to the coast.[12] Conversely, because these capital intensive industries also tend to exhibit relatively high levels of labor productivity, while textile and apparel firms clustered in coastal regions have low output per worker, the interior regions also gain some advantage in labor productivity relative to the coast.

The estimates of the 2005 dummies in Table 6, column 1 show the central region enjoying the largest productivity growth thus enabling the central region to reduce its productivity gap with the coast from 33.8 percent in 1998 to 14.1 percent in 2005.[13] While the estimates show negligible MFP catch-up for the northeast, maintaining its lag with the center of approximately 40 percent, the estimates do show the west achieving a modest decline closing the gap with the coast from about 56 percent in 1998 to 46 percent

[11] NBS (2005), p. 514.
[12] NBS (2005), pp. 514-518.
[13] The 14.1% figue is the difference between the measure of the productivity gap in 1998 (i.e., 0. 338) and the 2005 coastal dummy (i.e. -0.197).

in 2005.[14] The inclusion of controls for industry composition has little effect on these changes in relative productivities from 1998 to 2005.

Table 8 employs the full sample to create a set of estimates that replicates the model in Table 6, which is based on the balanced sample alone. The differences are striking. A comparison of the 1998 estimates for Tables 6 and 8 shows that in the full sample the coast enjoys substantial productivity advantages, with the northeast provinces lagging behind both the coast and center and with the west lagging still further behind as well as trailing the northeast. However, as summarized in Table 9, for the full sample, the pattern of catch-up is notably different. Whereas in the balanced sample, the coast retains an advantage in MFP relative to the other provinces, in the full sample the center catches up to the coast. By achieving rates of MFP growth of 12.30 percent and 14.69 percent respectively, the northeast and west substantially close the gap with the coast, for which productivity grows at a still impressive, yet substantially slower, pace of 8.21 percent.

Thus, unlike the estimates shown in Table 6 that rely on the balanced data set, the estimates in Table 8 based on the full sample show a distinct tendency for all three regions to achieve a substantial measure of catch-up with the coast, including full catch-up for the center. If indeed, as suggested in the previous section, the relatively high growth of productivity in the full sample reflects the phenomenon of entry and exit, then the greater extent of catch-up of the center, northeast, and western regions in the full sample suggests a higher incidence of entry and exit in those regions relative to the coast. According to Table 10, which reports the proportion of total firms in each region in 1998

[14] These figures are computed as the differences between the coastal dummies for 1998 and 2005 and those for the regions in question for the same years.

that survive through 2005, the coast indeed reports the largest proportion of survivors, i.e. 36.2 percent, whereas the center reports the lowest proportion of survivors. Although the proportions of entrants between the coast and central regions are not so different, the coast exhibits the lowest proportion of exits, while the center reports the highest proportion of exits. One explanation for the relatively high proportion of survivors and low proportion of exits in the coastal region is that by 1998, many of the SOEs along the coast were already restructured, while in the other three regions, the incidence of restructuring which initially lagged behind the coast may have accelerated after 1998.

7. Is productivity converging across regions?

Table 9, which summarizes the results in Tables 6 and 8, shows a growth advantage for the non-coastal regions; this advantage is particularly striking for the full sample, which incorporates the large productivity growth associated with the exit-entry-restructuring phenomenon. We test whether this higher productivity growth outside the coast foreshadows convergence or simply reflects a temporary advantage associated with the relative backwardness of firms outside the coastal region. In order to test for convergence, we re-estimate the results shown in Table 6 while controlling for the initial productivity levels in 1998. This specification controls for the advantage of backwardness associated with low-productivity firms and regions. One drawback of using the firm-level data is that because tests of the convergence hypothesis require matching observations for the first and last years we can only implement the convergence test with firm observations using the balanced data set.

The results shown in Table 11 fail to reject convergence for MFP between the coast and central regions. The negative and robust estimates for the MFP growth dummies for the northwest and western regions indicate the absence of catch-up for these regions.

While estimates for multi-factor productivity show convergence between the center and the coast, we find an intriguing difference for labor and capital productivity. The results show the capital productivity of coastal firms enjoying a sustained advantage over their center counterparts. Yet, at the same time, labor productivity for the firms in the center region appears capable of exceeding the levels of the coastal firms. This pattern of labor productivity catch-up and persistent lag in capital productivity may reflect a difference in industry composition in which firms in the center are more concentrated in heavy industry and in natural resource extraction and processing industries that are more capital intensive with favorable implications for labor productivity. The estimates incorporating industry controls confirm this, as these estimates result in the elimination of any of the single factor advantages for either the coast or the center. However, inclusion of the industry dummies does not substantially alter the finding of a lack of convergence for the northeast and the west.

As mentioned, a shortcoming of the use of firm-level observations is that it precludes the possibility of implementing the convergence test for the full sample due to the inability to match a substantial number of observations for the initial and terminal years. We cannot remedy this problem using the firm-level observations, but we can aggregate the firm-level data for 1998 and 2005 to create a set of provincial and industry observations that are symmetric for both 1998 and 2005. We do this for each of the 31 provinces and the 37 industries whenever our underlying data set includes at least three or more firms for the relevant cell. The result is that we generate observations for 1,028 out of a potential 1,147 province-industry observations. The estimation results for the convergence equation using these data are shown in Table 12.

The results shown in Table 12 are not as dramatically different from those shown in Table 11 as we might expect given the very high rates of productivity growth associated with the exiting and entering firms that are concentrated outside of the coastal region, notably the concentration of restructuring SOEs in the west and northeast regions. The results in Table 12 confirm those shown in Table 11 regarding catch-up of the center region with the coast. The principal change shown in Table 12 relative to Table 11 is the finding of MFP and labor productivity catch-up by the northeast with the coast and center regions. The results, however, show a continuing lag of capital productivity for the northeast.

While this test of convergence does not control for industry structure, we may speculate that due to its concentration on heavy industry and natural resource extraction and processing industries – perhaps in the industries exhibiting an even greater concentration in the northeast than the center – labor productivity in the northeast is likely to catch-up or exceed that of the coast, whereas capital productivity is more likely to lag persistently. The results in Table 12 confirm the tendency for all forms of productivity in the west to lag behind those of the other regions, with the sole exception of capital productivity which exhibits a lag that is comparable to that of the northeast.

Given the substantial productivity growth disparities between the surviving non-state-owned firms that are concentrated in the coastal region and the SOEs and exiting and entering firms concentrated in the other regions, we might expect the provincial-industry data that incorporates the full sample to exhibit a greater pattern of across-the-board catch up. Indeed in 1998, while the proportion of SOEs in the coast declined to just 26.9 percent, the proportion in the west remained at 63.7 percent, well above any of the other three regions. This expectation seems particularly relevant for the western region, for which the balanced sample MFP growth exhibits an advantage of only 7.10 percent versus 6.41 percent for the coast. For the full sample, the disparity grows to 14.69 percent versus 8.21 percent favoring the west over the coast. The inability of this substantial growth disparity to propel catch-up on the part of China's western region underscores the west's relative backwardness and low productivity as of 1998. While the substantial advantages of backwardness associated with SOE catch-up and restructuring managed to generate high transitory rates of productivity growth, they were nonetheless unable to close the gap substantially. Indeed, this outcome is strongly suggested in Table 5, which shows that the entering SOEs continue to exhibit levels of labor productivity that lie somewhat below those of the other ownership types in 2005.

8. Conclusions

Much discussion of China's industrial performance focuses on productivity differences between the coast and interior regions. Using a panel of balanced data covering more than 250,000 "above-designated size" enterprises, we find that these productivity differentials persist between 1998 and 2005. Although we find evidence of partial catch-up, particularly for the central region, our convergence analysis indicates that much of the catch-up reflects the relative backwardness of industrial enterprises outside the coastal provinces. When we control for initial productivity levels, productivity growth in the non-coastal regions remains equivalent to or less than that of the coast, thereby denying the enterprises in central and western China the prospect of achieving productivity parity with coastal industry.

However, expanding our analysis to encompass all reporting enterprises, including firms that exit or enter during 1998-2005, significantly changes our results. Using these data, we find that with multi-factor productivity levels lagging in 1998 by 59, 69, and 75 percent for the west, northeast, and central provinces respectively, by 2005, the productivity of industry in China's central provinces substantially catches up with coastal productivity, while the productivity levels of the west and northeast respectively rise to 83 and 85 percent of that of the coast. The rates of MFP growth in the three non-coastal regions during 1998-2005 are all 50 percent or greater than that of coastal industry.

The principal explanation for this tendency for catching up with the coast is that productivity growth in the coast is largely driven by surviving firms that populate the balanced data set. Industry outside of the coast, by contrast, includes a comparatively low share of surviving firms and a high proportion of new or restructured firms whose productivity levels substantially exceed those of firms that disappear from our data, thus providing a substantial impetus to productivity growth. This exit-entry-restructuring phenomenon, which includes a substantial number of former state enterprises, accounts for the tendency toward greater productivity convergence that we find in the full population of China's industrial enterprises as compared with the balanced set of industrial enterprises. Our findings point to an industrial sector in which technology and efficiency have diffused extensively. Nonetheless, even accounting for the relatively high productivity contributions of exiting and entering firms outside the coastal region, the northeast shows a tendency for capital productivity to lag behind the coast. For the west, all measures of productivity persistently lag.

Table 1. Industrial Performance, Aggregate Data for 1992-2005

	Industrial GDP (billion yuan, 1992 constant price)	No. of employees in industry (million workers)	Period	Growth of industrial GDP	Growth of industrial labor	Growth of labor productivity
1992	1,028	102.2	1992-1998	14.2	-1.6	16.0
1998	2,284	92.9	1998-2005	10.4	1.0	9.3
2005	4,562	99.4	1992-2005	12.1	-0.2	12.4

Notes: These statistics cover manufacturing, mining, and utilities, but exclude construction.
Source: Calculated from China Statistical Yearbook, NBS (2006).

Table 2. Basic Statistics from the Firm-Level Dataset				
	Full Sample		Balanced Sample	
	1998	2005	1998	2005
No. of enterprises	128,363	259,873	41,783	41,783
Coast	77,211	178,277	27,973	27,973
Northeast	7,154	16,085	2,011	2,011
Central	30,439	43,800	7,412	7,412
West	13,648	21,711	4,387	4,387
Sales (s.d.)	42,255 (306,413)	77,562 (772,499)	66,397 (458,538)	155,481 (947,107)
Value added (s.d.)	12,631 (153,268)	21,933 (303,185)	20,383 (242,495)	44,351 (300,159)
Workers per firm (s.d.)	389 (2,009)	257 (1,120)	544 (3,074)	514 (2,260)
NVFA (s.d.)	25,873 (268,842)	26,723 (365,564)	42,983 (391,882)	57,334 (499,118)
VA/worker (s.d.)	43.61 (66.46)	85.81 (115.83)	47.87 (69.65)	82.25 (114.21)
VA/capital (s.d.)	2.68 (10.56)	4.71 (18.78)	1.99 (7.41)	2.87 (10.73)

Note: Data on average levels of sales, value-added, net value of fixed assets, and value-added per worker are measured in thousands of renminbi.

Table 3. Estimates of Capital's Factor Share					
	(1)	(2)	(3)	(4)	(5)
	Balanced sample with pooled estimates	Balanced sample with pooled estimates	Balanced sample with fixed effects	Full sample with pooled estimates	Full sample with pooled estimates
Constant	2.063*** (0.011)	1.998*** (0.015)	2.162*** (0.018)	2.145*** (0.005)	2.068*** (0.008)
2005 Dummy	0.456*** (0.007)	0.592*** (0.022)	n.a.	0.735*** (0.003)	0.848 (0.010)
ln(K/L)	0.345*** (0.003)	0.364*** (0.004)	0.381*** (0.005)	0.292*** (0.001)	0.316*** (0.002)
ln(K/L)*2005	n.a.	-0.037*** (0.006)	n.a.	n.a.	-0.034*** (0.003)
Industry dummies (textile = reference)	yes	yes	no	yes	yes
No. of obs.	83,566	83,566	83,566	388,236	388,236
Adj. R-square	0.199	0.200	0.159	0.216	0.217

Note: * denotes statistical significance at the 0.10 level. ** denotes statistical significance at the 0.05 level. *** denotes statistical significance at the 0.01 level.

Table 4. Estimates of productivity levels, 1998 and 2005						
	balanced sample			full sample		
	ln(MFP)	ln(VA/L)	ln(VA/K)	ln(MFP)	ln(VA/L)	ln(VA/K)
constant	2.126*** (0.012)	3.423*** (0.012)	0.020* (0.014)	1.860*** (0.005)	3.118*** (0.005)	-0.184*** (0.006)
2005	0.449*** (0.007)	0.528*** (0.007)	0.321*** (0.009)	0.718*** (0.004)	0.787*** (0.004)	0.607*** (0.005)
GVIO/Sales	0.191*** (0.011)	0.142*** (0.011)	0.271*** (0.013)	0.008** (0.004)	0.007* (0.004)	0.010** (0.004)
No. of obs.	83,550	83,550	83,50	388,158	388,158	388,158
R-square	0.054	0.058	0.024	0.098	0.103	0.041

Notes: 1. Industry dummies are not included. 2. Constant = log of 1998 productivity levels.
3. Numbers in parentheses are White heteroskedasticity- robust standard errors.
4. * denotes statistical significance at the 0.10 level. ** denotes statistical significance at the 0.05 level. *** denotes statistical significance at the 0.01 level.

Table 5. Multifactor Productivity by Ownership Type					
	SOEs	COEs	Private	Foreign	Others
Overall 1998	1.29	2.17	2.23	2.18	2.15
Overall 2005	2.38	2.69	2.66	2.53	2.72
Annual Growth (%)	15.63	7.44	6.14	4.89	8.16
Survivors Only					
Survivors 1998	1.49	2.15	2.14	2.21	2.17
Survivors 2005	2.07	2.60	2.61	2.53	2.53
Annual Growth (%)	8.33	6.43	6.70	4.53	5.16
Exiting and Entering Firms Only					
Exiters 1998	1.20	2.18	2.28	2.15	2.15
Entrants 2005	2.49	2.73	2.67	2.52	2.75
Annual Growth (%)	18.37	7.89	5.60	5.29	8.60

Table 6. Estimates of Productivity Levels – Pooled Estimates Using Balanced Sample						
	Without industry dummies			With industry dummies		
	ln(MFP)	ln(VA/L)	ln(VA/K)	ln(MFP)	ln(VA/L)	ln(VA/K)
Constant	1.919*** (0.016)	3.145*** (0.017)	-0.072*** (0.020)	1.782*** (0.020)	2.952*** (0.021)	-0.118*** (0.024)
Coast	0.338*** (0.013)	0.425*** (0.014)	0.197*** (0.017)	0.292*** (0.013)	0.456*** (0.014)	0.027* (0.016)
Northeast	-0.070*** (0.026)	-0.002 (0.028)	-0.181*** (0.033)	-0.091*** (0.025)	-0.015 (0.027)	-0.215*** (0.032)
West	-0.221*** (0.019)	-0.127*** (0.020)	-0.373*** (0.023)	-0.194*** (0.018)	-0.130*** (0.019)	-0.298*** (0.022)
Year 2005	0.601*** (0.018)	0.750*** (0.019)	0.359*** (0.022)	0.596*** (0.017)	0.744*** (0.018)	0.356*** (0.020)
2005*coast	-0.197*** (0.019)	-0.300*** (0.021)	-0.029 (0.024)	-0.193*** (0.019)	-0.300*** (0.020)	-0.018 (0.023)
2005*northeast	-0.195*** (0.038)	-0.185*** (0.042)	-0.212*** (0.048)	-0.190*** (0.037)	-0.185*** (0.040)	-0.198*** (0.045)
2005*west	-0.104*** (0.028)	-0.118*** (0.030)	-0.082** (0.035)	-0.103*** (0.027)	-0.120*** (0.028)	-0.075** (0.033)
GVIO/Sales	0.184*** (0.010)	0.134*** (0.011)	0.263*** (0.013)	0.163*** (0.010)	0.172*** (0.012)	0.148*** (0.012)
Industry dummies (textile = reference)	no	no	no	yes	yes	yes
No. of obs.	83,550	83,550	83,550	83,550	83,550	83,550
R-square	0.086	0.084	0.048	0.142	0.146	0.132

Notes: 1. Constant = log of 1998 productivity level for textile firms in the central region;
2. Numbers in parentheses are White heteroskedasticity- robust standard errors.
3. * denotes statistical significance at the 0.10 level. ** denotes statistical significance at the 0.05 level. *** denotes statistical significance at the 0.01 level.

Table 7. Industry Dummies for Table 6 (Textile is the Reference)			
	ln(VA/L)	ln(VA/K)	ln(MFP)
Mining and Washing of Coal	-0.15	0.10	-0.05
Extraction of Petroleum and Natural Gas	1.21	-0.51	0.56
Mining and Processing of Ferrous Metal Ores	0.35	0.35	0.35
Mining and Processing of Non-Ferrous Metal Ores	0.69	0.53	0.63
Mining and Processing of Nonmetal Ores	0.02	0.23	0.10
Mining of Other Ores	0.07	0.40	0.20
Processing of Food from Agricultural Products	0.66	0.16	0.47
Mfg. of Foods	0.30	-0.01	0.18
Mfg. of Beverages	0.55	-0.14	0.28
Mfg. of Tobacco	1.49	0.29	1.03
Mfg. of Apparel, Footwear, and Caps	-0.21	0.54	0.07
Mfg. of Leather, Fur, Feather and Related Products	-0.06	0.58	0.19
Processing of Timber, Mfg. of Wood, etc. Products	0.17	0.09	0.14
Mfg. of Furniture	0.10	0.10	0.09
Mfg. of Paper and Paper Products	0.32	0.03	0.21
Printing, Reproduction of Recording Media	0.00	-0.31	-0.12
Mfg. of Articles for Culture, Education and Sport	-0.26	0.45	0.01
Processing of Petroleum and Nuclear Fuel and Coking	0.90	0.15	0.62
Mfg. of Raw Chemical Mat’ls and Chem. Products	0.53	0.21	0.41
Mfg. of Medicines	0.59	0.02	0.37
Mfg. of Chemical Fibers	0.51	-0.29	0.20
Mfg. of Rubber	0.06	0.20	0.11
Mfg. of Plastics	0.30	0.07	0.22
Mfg. of Non-metallic Mineral Products	0.07	-0.15	-0.02
Smelting and Pressing of Ferrous Metals	0.62	0.19	0.46
Smelting and Pressing of Non-ferrous Metals	0.71	0.21	0.52
Mfg. of Metal Products	0.26	0.27	0.26
Mfg. of General Purpose Machinery	0.12	0.16	0.14
Mfg. of Special Purpose Machinery	0.09	0.07	0.08
Mfg. of Transport Equipment	0.20	0.03	0.14
Mfg. of Electrical Machinery and Equipment	0.32	0.29	0.31
Mfg. of Comm. Equip., Computers, and Electronic Equip.	0.29	0.11	0.22
Mfg. of Instruments and Mach. for Culture and Office Work	0.08	0.18	0.12
Mfg. of Artwork and Other Manufacturing	0.00	0.51	0.20
Production and Distrib. of Electric Power and Heat Power	0.53	-0.90	-0.02
Production and Distribution of Gas	0.16	-1.32	-0.40
Production and Distribution of Water	-0.44	-1.41	-0.81

Table 8. Estimates of Productivity Levels – Pooled Estimates Using Full Sample						
	w/o industry dummies			With industry dummies		
	ln(MFP)	ln(VA/L)	ln(VA/K)	ln(MFP)	ln(VA/L)	ln(VA/K)
Constant	1.723*** (0.008)	2.919*** (0.008)	-0.224*** (0.009)	1.557*** (0.009)	2.664*** (0.010)	-0.240*** (0.011)
Coast	0.308*** (0.008)	0.388*** (0.008)	0.176*** (0.010)	0.314*** (0.008)	0.465*** (0.008)	0.069*** (0.009)
Northeast	-0.138*** (0.016)	-0.120*** (0.016)	-0.167*** (0.019)	-0.142*** (0.015)	-0.118*** (0.016)	-0.181*** (0.019)
West	-0.364*** (0.011)	-0.257*** (0.012)	-0.539*** (0.014)	-0.331*** (0.011)	-0.259*** (0.012)	-0.449*** (0.014)
Year 2005	0.902*** (0.008)	1.055*** (0.009)	0.652*** (0.011)	0.873*** (0.008)	1.034*** (0.008)	0.613*** (0.010)
2005*Coast	-0.327*** (0.009)	-0.460*** (0.010)	-0.113*** (0.012)	-0.306*** (0.009)	-0.433*** (0.010)	-0.098*** (0.012)
2005*Northeast	-0.041** (0.019)	0.031* (0.019)	-0.157*** (0.024)	-0.043** (0.018)	0.024 (0.019)	-0.152*** (0.023)
2005*West	0.126*** (0.013)	0.083*** (0.015)	0.194*** (0.019)	0.106*** (0.014)	0.060*** (0.015)	0.179*** (0.018)
GVIO/Sales	0.008** (0.004)	0.007*** (0.004)	0.010*** (0.004)	0.008*** (0.004)	0.007*** (0.004)	0.008*** (0.003)
Industry dummies (textile = reference)	no	no	No	yes	yes	yes
No. of obs.	388,158	388,158	388,158	388,158	388,158	388,158
R-square	0.117	0.119	0.06	0.151	0.166	0.115

Notes: 1. Constant = log of 1998 productivity level for textile firms in the central region;
2. Numbers in parentheses are White heteroskedasticity- robust standard errors.
3. * denotes statistical significance at the 0.10 level. ** denotes statistical significance at the 0.05 level. *** denotes statistical significance at the 0.01 level.

Table 9. Summary of Productivity by Region										
	Balanced Sample					Full Sample				
Productivity Measure	Over-all	Coast	North-east	Center	West	Over-all	Coast	North-east	Center	West
Labor 1998	3.42	3.57	3.14	3.15	3.02	3.12	3.31	2.80	2.92	2.66
Labor 2005	3.95	4.02	3.71	3.90	3.65	3.91	3.90	3.89	3.97	3.80
Annual Growth (%)	7.54	6.43	8.07	10.71	9.03	11.24	8.50	15.51	15.07	16.26
Capital 1998	0.02	0.13	-0.25	-0.07	-0.45	-0.18	-0.05	-0.39	-0.22	-0.48
Capital 2005	0.34	0.46	-0.11	0.29	-0.17	0.42	0.49	0.10	0.43	0.37
Annual Growth (%)	4.59	4.71	2.10	5.13	3.96	8.67	7.70	7.07	9.31	12.09
MFP 1998	2.13	2.26	1.85	1.92	1.70	1.86	2.30	1.59	1.72	1.36
MFP 2005	2.58	2.66	2.26	2.52	2.20	2.58	2.87	2.45	2.63	2.39
Annual Growth (%)	6.41	5.77	5.80	8.59	7.10	10.26	8.21	12.30	12.89	14.69

Notes: 1. Industry or ownership dummies are not included; 2. Overall estimates are derived from Table 4; 3. regional estimates for the balanced sample are drawn from Table 6; 4. regional estimates for the full sample are drawn from Table 8.

Table 10. Proportion of Firm Types by Region					
	Number of firms		(% 1998)		(% 2005)
	1998	2005	Survivors	Exits	Entrants
Coast	77,211	178,277	36.2	63.8	84.3
Northeast	7,154	16,085	28.1	71.9	87.5
Central	30,439	43,800	24.4	75.6	83.1
West	13,648	21,711	32.1	67.9	79.8
Proportion of Ownership Types by Region (%), 1998					
	SOE	COE	Private	Foreign	Other
Coast	26.9	40.7	8.2	23.7	0.4
Northeast	50.4	30.4	7.2	11.9	0.1
Central	47.1	41.7	6.4	4.4	0.3
West	63.7	26.2	5.6	4.4	0.2

Table 11. Estimates of Productivity Convergence – Balanced Sample

	w/o industry dummies			With industry dummies		
	dln(MFP)	dln(VA/L)	dln(VA/K)	dln(MFP)	dln(VA/L)	dln(VA/K)
Constant	0.212*** (0.003)	0.311*** (0.003)	0.025*** (0.003)	0.204*** (0.004)	0.306*** (0.004)	0.012*** (0.004)
Coast	-0.002 (0.002)	-0.012*** (0.002)	0.010*** (0.002)	0.002 (0.002)	0.001 (0.002)	0.001 (0.002)
Northeast	-0.034*** (0.004)	-0.028*** (0.004)	-0.042*** (0.004)	-0.033*** (0.004)	-0.024*** (0.003)	-0.045*** (0.004)
West	-0.032*** (0.003)	-0.027*** (0.003)	-0.038*** (0.003)	-0.028*** (0.003)	-0.024*** (0.003)	-0.032*** (0.003)
lnVA/L(1998)	n.a.	-0.074*** (0.001)	n.a.	n.a.	-0.078*** (0.001)	n.a.
lnVA/K(1998)	n.a.	n.a.	-0.074*** (0.001)	n.a.	n.a.	-0.082*** (0.001)
lnMFP(1998)	-0.079*** (0.001)	n.a.	n.a.	-0.084*** (0.001)	n.a.	n.a.
GVIO/Sales	-0.011*** (0.001)	-0.018*** (0.001)	-0.002 (0.002)	-0.016*** (0.001)	-0.018*** (0.001)	-0.015*** (0.001)
Industry dummies (textile = reference)	no	no	No	yes	yes	yes
No. of obs.	41,780	41,780	41,780	41,780	41,780	41,780
R-square	0.241	0.242	0.228	0.276	0.280	0.272

Notes: 1. Constant = productivity growth rates for textile firms in the central region; 2. Numbers in parentheses are White heteroskedasticity- robust standard errors. 3. * denotes statistical significance at the 0.10 level. ** denotes statistical significance at the 0.05 level. *** denotes statistical significance at the 0.01 level.

Table 12. Province-Industry Estimation			
	dln(MFP)	dln(VA/L)	dln(VA/K)
Constant	0.322*** (0.015)	0.394*** (0.020)	0.129*** (0.015)
Coast	-0.001 (0.006)	-0.008 (0.008)	-0.001 (0.008)
Northeast	-0.010 (0.009)	0.005 (0.010)	-0.028*** (0.010)
West	-0.026*** (0.007)	-0.179** (0.008)	-0.029*** (0.009)
lnVA/L(1998)	n.a.	-0.076*** (0.005)	n.a.
lnVA/K(1998)	n.a.	n.a.	-0.070*** (0.006)
lnMFP(1998)	-0.089*** (0.005)	n.a.	n.a.
GVIO/Sales	0.004 (0.006)	-0.029*** (0.010)	0.052*** (0.016)
No. of obs.	1028	1028	1028
R-square	0.368	0.322	0.214
Notes: 1. Numbers in parentheses are White heteroskedasticity-robust standard errors. 2. * denotes statistical significance at the 0.10 level. ** denotes statistical significance at the 0.05 level. *** denotes statistical significance at the 0.01 level.			

References

Brandt, Loren, Chang-tai Hsieh, and Xiaodong Zhu (2008), "Growth and Structural Transformation in China, 1978-2004," in *China's Great Economic Transformation*, ed. Loren Brandt and Thomas G. Rawski. Cambridge and New York: Cambridge University Press.

Hsieh, Chang-Tai (1999), "Productivity Growth and Factor Prices in East Asia," *American Economic Review*," 89, 2:133-138.

Jefferson, Gary, and Su Jian (2006), "Privatization and Restructuring in China: Evidence from Shareholding Ownership, 1995-2001," *Journal of Comparative Economics*, 34, 1:146-166.

Jefferson, Gary, Albert G.Z. Hu, and Jian Su (2006), "China's Economic Growth: an Empirical Analysis of its Sources and Sustainability," *Brookings Papers on Economic Activity*, 2:2006:1-60.

National Bureau of Statistics (2005) *China Statistical Yearbook, 2005*, China Statistics Press, Beijing.

National Bureau of Statistics (2006) *China Statistical Yearbook, 2006*, China Statistics Press, Beijing.

Perkins, Dwight H., and Thomas G. Rawski (2008), "Forecasting China's Economic Growth to 2025," in Loren Brandt and Thomas G. Rawski, eds., *China's Great Economic Transformation.* Cambridge and New York: Cambridge University Press.

Ramey, Valerie A., and Kenneth D. West (1999), "Inventories," *Handbook of Macroeconomics* (volume 1B), North-Holland, Elsevier, Amsterdam.

Young, Alwyn (1995), "The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience," *Quarterly Journal of Economics*, 110, 3:641-680.

_____________ (2003), "Gold into Base Metals: Productivity Growth in the People's Republic of China during the Reform Period," *Journal of Political Economy*, 111, 6:1220-1261.

Zheng, Jinghai, Arne Bigsten, and Angang Hu (2006), "Can China's Growth be Sustained? A Productivity Perspective," manuscript, Department of Economics, School of Business, Economics and Law, Goteborg University, Sweden.