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MORE COSTLY OR MORE PRODUCTIVE? MEASURING CHANGES IN COMPETITIVENESS IN MANUFACTURING ACROSS REGIONS IN CHINA

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Using a newly constructed industry-by-region dataset based on China's two censuses, this paper examines the trend of average labor compensation (ALC), labor productivity (ALP) and unit labor cost (ULC) in 28 manufacturing industries across 29 provinces in China for 1995 and 2004. Findings show that at the aggregate level, ALP growth was generally faster than that of ALC and hence resulted in a significant decline in ULC for all regions in China. Furthermore, less developed regions exhibited stronger productivity growth relative to labor cost increase than more developed regions, thus leading to a convergence in ULC levels across provinces and regions over this period. Comparing individual industries, we observe a substantial variation in growth rates and convergence trends across regions. Logit regression analysis confirms that labor-intensive industries are more likely to converge in ALP, ALC and ULC, whereas capital/skill-intensive industries tended to diverge. This finding is further confirmed by estimating a convergence regression, which suggests that misallocation of resources due to market imperfections or institutional barriers is likely to be the main factor behind the divergence of ULC.

1. Introduction

Low wage has been contributing significantly to China's strong competitiveness in labor-intensive manufacturing that has made China "the world factory" since the mid-1990s. However, wages are due to rise along with income growth. Hence one may argue that China's cost advantage will soon erode if the average wage rate in manufacturing industries continues to rise. However, rising wage is only one part of the picture. One cannot sensibly look at competitiveness without

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examining changes in labor productivity which is missing in the current discussion. In the long run, the key to any country's sustainable growth lies in the rise of labor productivity that is attributable to both capital deepening (capital–labor ratio) and total factor productivity improvement. China can still maintain its competitive edge if its productivity growth is able to outpace the rising wages.

On the other hand, one should not ignore that China is a large country with complicated geographical layout and different levels of development across regions. Regional differences in industrial capacity, infrastructure, state influence (through state enterprises) and accessibility to foreign direct investment and international business imply differences in the level and dynamism of productivity and factor costs across regions. China can still maintain its competitiveness if further reforms can facilitate resource reallocation and hence regional specialization in response to changes in productivity and labor cost. The literature on income inequality convincingly shows us that China's regional income inequality has been rising considerably since the mid-1980s when China's industrial reform began.[1] Surprisingly, so far there have been few studies on regional inequality from the production perspective examining two underlying important components of income change, i.e. labor productivity and compensation. After all, the reallocation of resources across space is not directly driven by gaps in average household income but by differentials in factor costs and regional competitive advantage in general. This could be largely due to the lack of data at industry level and regional level, though national aggregate data on output, employment and labor compensation are also subject to criticism. Ceglowski and Golub (2007) may be two of the pioneers who attempt to estimate annual unit labor cost in Chinese manufacturing for the period 1980–2002. They show that Chinese unit labor cost in manufacturing was very low relative to a wide range of countries including the U.S., EU, Japan, Mexico, Korea and most newly industrializing countries. However, their investigation is limited to aggregate manufacturing and does not reach the industry and province level.

Unit labor cost (ULC) analysis provides a useful measure of competitiveness that takes into account both the change of labor productivity (ALP) in real terms and the nominal change of average labor compensation (ALC). In this study we follow the standard approach of unit labor cost (ULC) to measure changes in ALP and ALC by industry and by province, and hence their impacts on changes in ULC. We exploit the available information from two major industrial censuses, China's *Third Industrial Census* for 1995 (the 1995 Census hereafter) and the *First Economic Census* for 2004 (the 2004 Census hereafter) to examine changes in the levels and growth rates of labor compensation (including wage, welfare and all other non-wage payments to labor) and productivity by industry and by location. This exercise covers 29 provinces and 28 manufacturing industries in China.

Our findings show that manufacturing production in China indeed became more costly in terms of labor compensation over the period 1995–2004, ranging from 2 to 4 times in most industries and provinces. However, it became even more productive at the same time. The change in the latter easily overrode the former

[1]For a recent overview, see the special issue of *The Review of Income and Wealth* on "Inequality and Poverty in China" in March 2007, including contributions by Wan (2007), Wan *et al.* (2007) and Tsui (2007). Also refer to Riskin *et al.* (2001), for a comprehensive study on income inequality in China.

because the growth of labor productivity across industries and provinces ranged between 4 and 10 times. This resulted in a substantial decline in unit labor cost across the board, ranging from 20 to 80 percent during this period. We also find that the regional inequality, measured by coefficient of variation, fell significantly for ULC and its two components (ALP and ALC) at least at the aggregate manufacturing level. This implies that even though there may still be sizeable differences in labor productivity and compensation levels among regions, they are now much better aligned than a decade ago, suggesting a significant convergence of regions in labor productivity and compensation and thus ULC.

Turning to industry level, we find that while there was an overall decline in ULC for all provinces due to the faster increase in ALP relative to ALC, not all industries exhibit the convergence trend across regions as observed at the aggregate manufacturing level. We therefore apply a logit regression analysis to investigate whether industries with certain characteristics have a higher probability to converge in ALP, ALC and ULC than those without these characteristics. The results show that labor-intensive industries are more likely to converge while capital and skill-intensive industries tend to increase inequality in ULC. We carry on our investigation further by estimating an extended form of convergence regression as used in the growth literature. We find that highly skill-intensive industries, such as machinery and transportation equipment, experienced a significant decline in ULC only in locations that were characterized by high skill level of the labor force. This sheds important light on the existing institutional problems that have resulted in misallocation of resources in China.

This paper proceeds as follows. Section 2 presents the methodology for unit labor cost analysis. Section 3 discusses the problems in data construction. Section 4 examines the trends and convergence patterns in ULC and its two components, labor productivity and compensation, between 1995 and 2004. Section 5 analyzes the "causes" of convergence using a logit regression model. Section 6 further substantiates the Logit results by carrying out a convergence analysis to identify the factors that may have affected the decline of ULC. Section 7 concludes this study.

2. Methodology

The ULC analysis is based on a simple decomposition of labor share in gross value added into output and compensation per worker. The idea is to examine if productivity increase can keep pace with the rise of labor cost. As a standard practice, for a meaningful measure of competitiveness in business, the productivity is measured in real terms while the cost of labor is in nominal terms.

This idea can be expressed in simple equations. Let Y be denoted as gross value added, C be total labor compensation (wage and all non-wage earnings) and L be the total number of workers (standardized, who receive the total labor compensation), output per worker or labor productivity (ALP) and average compensation per worker (ALC) be denoted as $\mathrm{ALP} = \frac{Y}{L}$ and $\mathrm{ALC} = \frac{C}{L}$, respectively. Therefore, ALP and ALC can be linked logically through the decomposition of total labor compensation as the share of gross value added at any given time as below:

$$(1) \qquad \frac{C_t}{Y_t} = \frac{C_t}{L_t} \cdot \frac{L_t}{Y_t} = \frac{C_t}{L_t} \bigg/ \frac{Y_t}{L_t} = \frac{\text{ALC}_t}{\text{ALP}_t}$$

Equation (1) is expressed in nominal terms. Following the discussion above, ULC is defined as *nominal* compensation per worker adjusted by *real* labor productivity, which can be shown below after a modification of equation (1):

$$(2) \qquad \text{ULC}_t = \frac{C_t^{P_t}}{Y_t^{P_0}} = \frac{C_t^{P_t}}{L_t} \cdot \frac{L_t}{Y_t^{P_0}} = \frac{C_t^{P_t}}{L_t} \bigg/ \frac{Y_t^{P_0}}{L_t} = \frac{\text{ALC}_t^{P_t}}{\text{ALP}_t^{P_0}}$$

where superscripts P_t and P_0 indicate current and constant (base-year) prices, respectively.

Clearly, changes in ULC can be affected by changes in ALC or/and ALP. Examination of these indicators can be conducted at aggregate level, either industry or location aggregation, and disaggregate level of economic activities, i.e. industry or industry group in individual regions or provinces. The following two equations define industry-wide ULC as an aggregation of all locations and provincial (regional) ULC as an aggregation of all industries:

$$(3) \qquad \text{ULC}_{j,t} = \frac{\text{ALC}_{j,t}}{\text{ALP}_{j,t}} = \frac{\sum_{i=1}^{m} C_{ij,t}^{P_t}}{\sum_{i=1}^{m} L_{ij,t}} \bigg/ \frac{\sum_{i=1}^{m} Y_{ij,t}^{P_0}}{\sum_{i=1}^{m} L_{ij,t}}, \quad (i = 1, 2, \ldots, m;\ j = 1, 2, \ldots, n, i \neq j)$$

which expresses aggregated ULC for all industries (i's) at each location or province j, and

$$(4) \qquad \text{ULC}_{i,t} = \frac{\text{ALC}_{i,t}}{\text{ALP}_{i,t}} = \frac{\sum_{j=1}^{n} C_{ij,t}^{P_t}}{\sum_{j=1}^{n} L_{ij,t}} \bigg/ \frac{\sum_{j=1}^{n} Y_{ij,t}^{P_0}}{\sum_{j=1}^{n} L_{ij,t}}, \quad (i = 1, 2, \ldots, m;\ j = 1, 2, \ldots, n, i \neq j)$$

which expresses aggregated ULC for industry i across all provinces (j's). It is needless to show that the measured ULC changes over time are the results of changes in the weight of individual industries in a location and/or changes in the weight of individual provinces in an industry for Y, L and C.

3. Data Construction

For such a measurement based exercise, a primary question will be how the key variables Y, L and C are measured and constructed. Firstly, official statistics on the real growth of value added (GDP) may be exaggerated, as argued by researchers such as Maddison (1998), Rawski (1993, 2001), Ren (1997), Woo (1998) and Wu (2002) and empirically supported by Wu (2002, 2007). The problem is highly relevant to our measure of gross value added in this study because if Y is overestimated, other things being equal, ALP will be exaggerated and hence ULC will be underestimated. Secondly, official statistics on labor compensation could be understated because payment in kind may not be fully counted and state enterprises have strong incentives to hide labor compensation under other cost items (this may to some extent offset the exaggeration in output) (see also Banister (2007) for detailed measurement problems in labor compensation). If this is the case and the misreporting of labor cost as other costs cannot fully offset the exaggeration of output, holding others unchanged, both ALC and ULC will be underestimated. Lastly, a proper measure of labor input is important for an accurate productivity assessment. However, there are no official data on hours worked and no information that allows a standardization of numbers employed. If one assumes that the work intensity of an average worker increased over the study period as a result of deepening marketization, ALP will be exaggerated and then ULC will again be underestimated, *ceteris paribus*.

In this study we cannot address these potential problems as suggested in the literature mainly because there is insufficient information for adjustment at regional level. We assume that the error margins caused by these problems are the same across industries and regions, and therefore will not significantly affect the ULC dynamics among industries and regions in relative terms.

The best information available with industry and province details required by this study can only be found in the 1995 and 2004 censuses (NICO, 1996, 1997; NBS, 2006). Our main data work focuses on the construction of a coherent dataset for the two censuses. Unfortunately, in some cases even the census reports do not provide industry-by-province data. Therefore, we have to rely on indirect information in the annual official report of industrial statistics. In what follows we provide details on how our data are constructed.

Coverage and Classification

The Chinese industrial statistics only provide detailed data for enterprises included in the official statistical reporting system. As far as our study period is concerned, prior to 1998 such enterprises are those "independent accounting units at or above township level." This definition was used in the 1995 Census. In 1998 the coverage changed to all state-owned enterprises plus non-state enterprises at or above the "designated size" defined as a minimum of 5 million yuan (about 600,000 U.S. dollars in 1998) annual sales. The impact of the coverage change was two sided. On the one hand, enterprises below the township level but with 5 million yuan or more annual sales were now included; on the other hand, enterprises above the township level with less than 5 million yuan annual sales were excluded.

It is not possible to make a precise assessment of the effect of the change. However, according to a calculation by Holz and Lin (2001) the enterprises under the old coverage (at or above the township level) covered roughly 60 percent of gross value of output in 1997, whereas the enterprises under the new system (at or above "designated size") covered about 57 percent of gross value of output in 1998 (p. 314). We feel it is reasonable to assume that the enterprises under the two definitions are compatible. It is also worthwhile to note that the non-state enterprises in both cases include all foreign firms and major private firms. This coverage is justified by our theme of competitiveness in Chinese manufacturing in international perspective.

The 28 manufacturing industries classified in this study follow the 2002 Chinese Standard of Industrial Classification and conform to the two-digit level industries in the International Standard of Industrial Classification (ISIC). The 2002 CSIC (Chinese Standard of Industrial Classification) was adopted in the 2004 Census. Data from the 1995 Census are adjusted accordingly. We also group the 28 industries into eight groups in order to examine the performance of industries with similar technologies.[2] The classification and grouping are reported in Appendix Table A1.

Appendix Table A1 also provides a list of 29 Chinese provinces. In the 2004 Census Chongqing was reported as a separated provincial-level city from Sichuan. Note that to be consistent with the 1995 Census we have added Chongqing back to Sichuan. It should also be noted that due to odd data problems we have excluded Tibet from all analyses in this paper.

Industry-by-Province Employment

The 2004 Census reports 80.8 million employees in China's established legal manufacturing enterprises, of which 56.67 million or 70 percent were from the enterprises at or above the designated size (NBS, *The First Economic Census*, Volume II, table 1-A-1 and table 1-A-2). In comparison, the 1995 Census reports 108.84 million in total, of which 85.01 million or 78 percent were at or above the township level (Wu and Yue, 2009). The 2004 Census provides industry-by-province employment data, but the 1995 Census only reports employment by industry at the national level. We estimate industry-by-province employment data for 1995 based on data from the *China Industry Economic Statistical Yearbook* published by the Department of Industrial and Transportation Statistics (DITS, 1995). Specifically, we use the regional shares in each industry for 1994 (the best available) to decompose the aggregate employment by industry into data by province for each industry.

Industry-by-Province Gross Value Added and Labor Compensation

We discuss the two variables (Y and C) together in this sub-section because they have similar problems that can be tackled by the same approach. Before we proceed further, we should notify that compared with the 1995 Census, the 2004 Census has much more information that allows crosschecks. However, problems found in these checks cannot be easily confirmed by the 1995 Census because of non-existence of the same level of details in the latter. We assume that the problems did not exist in the 1995 Census.[3]

Unlike the 1995 Census, the 2004 Census does not provide estimates of gross value added and labor compensation in the published or reported tables (hereafter

[2]We exclude "manufacture of artwork and other manufacturing" (29) and "recycling and disposal of waste" (30) in the 2004 Census because of no matching industries in the 1995 Census.

[3]For example, in the 1995 Census labor compensation only includes total wage bill and the welfare fund. We then assume that the other categories (such as insurance, pension, housing subsidy, etc) of labor compensation were virtually non-existent in 1995.

reported tables).[4] However, an extended table (hereafter *full* table) provided by the National Bureau of Statistics (NBS) contains census-based estimates for gross value added and labor compensation. Yet, the estimates are only available by industry at the national level, not available in the industry-by-province form. Using the factor income items in the reported tables by industry at the national level, we firstly calculate labor compensation and then follow the income approach to estimate "gross value added" (in fact, it should be terms as "gross income"). Compared with the NBS estimates in the full table, our direct estimates based on the reported income items are somewhat smaller, suggesting that we may underestimate industry-by-province gross value added and labor compensation if using the data in the reported tables. A closer examination reveals that our underestimation may be partially due to unreported components in labor compensation, such as "endowment and medicare insurance" and "housing subsidy," as suggested in Banister (2007), but we do not exactly know what is missing in our income approach calculation. NBS does not provide information on the details of their estimation. However, we feel justified to adjust the 2004 industry-by-province data using the differences between the *reported* and *full* tables as found in the exercise.

Since both the reported and full (extended) tables are from the same census, we can reasonably assume that the ratio of provincial share to national total for each industry calculated from the reported tables should be the same or very close to that calculated in the full tables. Therefore, we use the following equation to obtain the full gross value added and labor compensation:

$$Y_{ij}^{F} = Y_{ij}^{R}\left(\sum\nolimits_{j=1}^{n} Y_{ij}^{F} \Big/ \sum\nolimits_{j=1}^{n} Y_{ij}^{R}\right) \tag{5}$$

The so-derived industry-by-province gross value added data are in nominal terms and need to be deflated. There are no matching industry-by-province deflators. The available Producer Price Index (PPI) data published by NBS refer to 12 industry groups. We can match 20 of our industries to these PPIs and estimate PPIs for the remaining eight industries using output weights.

4. Changes in ALC, ALP and ULC between 1995 and 2004

Applying the ULC methodology as presented in Section 2 to the constructed data as explained in Section 3, we can obtain all the three measures, namely, average labor compensation (ALC), labor productivity (ALP) and unit labor cost (ULC).[5] Secondary measures and analyses in this section and in the rest of the paper are based on these primary measures.

Trends of ULC as a Result of Changes in ALC and ALP

Panels A and B in Figure 1 present ULC as a result of changes in ALC (on y-axis) and ALP (on x-axis) across provinces and industries, respectively. It indi-

[4]See NBS, *The First Economic Census*, Volume II, table 1-B-13, for total manufacturing at/above the designated size by province, and table 1-B-14 to 1-B-41 for manufacturing at/above designated size, cross-classified by industry and by province.

[5]The data are available on request.

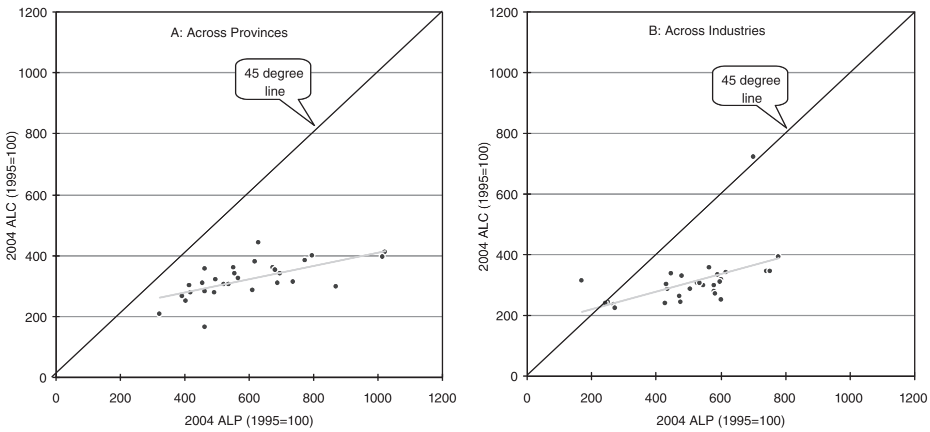

Figure 1. Change in ULC as the Results of Changes in ALC and ALP, across Provinces and among Industries

Source: Authors' calculations. See Section 3 for details.

cates that if an increase in ALC is compensated by the same rise in ALP, graphically the relevant data points will meet on the 45-degree line. The regression line in the figure does not imply causality but an empirical observation. Figure 1 shows that firstly, in both observations the growth of ALP substantially outpaced the growth of ALC, leading to a significant decline in ULC (in most cases well below the 45-degree line); and secondly, in both panels we can see that the magnitude of the correlation between ALC and ALP is fairly small (a flat regression line), suggesting that faster labor productivity growth was not associated by faster increase in labor compensation (though the correlation is statistically significant).

To present more general pictures across industries and provinces we further classify the 28 industries into eight industry groups: food & allied products; textiles & clothing; wood & paper; chemicals; metal products; machinery; transport equipment; and electronics. We classify the 29 provinces into six larger regions: Bohai, southeast, northeast, central, southwest and northwest (see Appendix Table A1). Table 1 shows a matrix of the changes in average labor compensation, productivity and unit labor cost by industry group cross-classified by each region between 1995 and 2004 (1995 = 100). It is clear from the *last row* of each panel and the *last column* that either for the national total or for the manufacturing total ALP outpaced ALC, hence resulting in a significant drop in ULC (less than 100). It shows that for the national manufacturing as a whole, while ALC increased by 205 percent over this period, ALP rose by 436 percent, leading to a significant decline of 43 percent in ULC.

It is interesting to look at the performance of individual groups. At the national level, on the one hand, transport equipment industry experienced the fastest ALC increase, followed by food products and electronics; on the other hand, transport equipment also had fastest ALP increase, followed by machinery and electronics. However, to examine ULC change, what matters is the relative change of ALP to ALC. In Table 1, all the three best ALP performers demon-

TABLE 1

Change in ALC, ALP and ULC between 1995 and 2004 by Industry Group and by Region (1995 = 100)

	Bohai	Southeast	Northeast	Central	Southwest	Northwest	National
				Panel A: ALC Index			
Food & allied products	285.4	317.8	459.3	343.7	353.5	370.7	334.4
Textiles & clothing	238.2	219.7	331.5	241.7	234.6	250.1	255.4
Wood & paper	283.0	232.6	342.6	309.0	263.7	392.2	298.6
Chemicals	274.5	263.5	384.1	296.4	284.3	317.4	298.0
Metal products	361.0	254.1	393.6	335.1	269.9	325.5	313.2
Machinery	297.8	240.4	364.4	299.8	375.1	341.1	304.7
Transport equipment	314.3	297.2	386.6	391.0	308.6	386.1	346.5
Electronics	371.7	257.1	478.9	379.4	434.0	276.2	321.9
Total manufacturing	*302.5*	*249.8*	*397.9*	*320.0*	*315.6*	*337.3*	305.0
				Panel B: ALP Index			
Food & allied products	412.1	626.2	799.2	509.1	488.5	727.0	531.3
Textiles & clothing	375.7	279.6	678.5	315.8	642.2	410.5	364.3
Wood & paper	486.3	348.1	658.3	557.7	595.2	739.6	499.0
Chemicals	361.7	406.7	584.0	364.9	598.8	440.5	444.9
Metal products	507.0	428.5	835.7	593.2	536.7	605.6	549.0
Machinery	598.8	462.2	818.3	524.9	796.4	755.6	624.1
Transport equipment	617.9	598.7	866.6	748.0	761.3	911.2	743.2
Electronics	662.9	470.2	749.7	1,032.1	760.9	513.4	609.1
Total manufacturing	*439.3*	*394.9*	*747.3*	*504.6*	*622.9*	*634.2*	535.9
				Panel C: ULC Index			
Food & allied products	69.3	50.7	57.5	67.5	72.4	51.0	62.9
Textiles & clothing	63.4	78.6	48.9	76.5	36.5	60.9	70.1
Wood & paper	58.2	66.8	52.0	55.4	44.3	53.0	59.8
Chemicals	75.9	64.8	65.8	81.2	47.5	72.0	67.0
Metal products	71.2	59.3	47.1	56.5	50.3	53.8	57.1
Machinery	49.7	52.0	44.5	57.1	47.1	45.1	48.8
Transport equipment	50.9	49.6	44.6	52.3	40.5	42.4	46.6
Electronics	56.1	54.7	63.9	36.8	57.0	53.8	52.9
Total manufacturing	*68.9*	*63.3*	*53.2*	*63.4*	*50.7*	*53.2*	56.9

Source: Authors' calculations. See Section 2 for the methodology and Table A1 for classification of industry and regional groups.

strated the most decline in ULC since their increases in ALP significantly surpassed their increases in ALC, of which ALP in transport equipment was more than twice its ALC. Regional disparities are also distinct. For example, in general textiles & clothing underwent the slowest growth in both ALC and ALP. Among regions, although the northeast suffered the highest ALC rise (by 231.5 = 331.5 – 100 percent), it enjoyed the highest ALP increase (by 578.5 = 678.5 – 100 percent). The southeast had the slowest ALC increase (by 119.7 = 219.7 – 100 percent), yet it also had the slowest growth in ALP (by 179.6 = 279.6 – 100 percent). With regard to the change in ULC, textiles & clothing in the southwest underwent the greatest drop, by 63.5 percent (= 100 – 36.5), whereas it had the smallest drop (21.4) in the southeast (= 100 – 78.6). More industry-by-region details show that electronics in the northeast and the southwest, food in the northeast and northwest, and transport equipment in the central, northeast and northwest went through the highest ALC rise during this period. The best ALP performers were food and wood & paper industries in the northeast and northwest, metal and machinery in the northeast, transport equipment in the northwest, and electronics in the central. As a conclusion, industries by region with cost advantage (by ULC) are food in the southeast and northwest, wood & paper, chemicals and transport equipment in the southwest, metals in the northeast, machinery in the northeast and northwest, and electronics in the central region.

One may reasonably argue that the trends in ALP, ALC and ULC as shown in Table 1 might have followed a traditional convergence trend. Typically, labor compensation in low cost regions and industries would catch up with others and productivity growth in high-productivity industries and regions would slow down, hence resulting in rising and converging unit labor costs across the board. It is then of a great interest to examine if industries and regions that were characterized by low productivity *levels* initially grew faster than others, if this was also true in average labor compensation, and what would be the impact on the trends of unit labor cost. In what follows, we use descriptive index measures as well as analytical techniques (see Sections 5 and 6) to carry out such an investigation.

In Table 2, we measure the "initial position" of the cross-classified individual industries and regions in 1995 with the national total as the benchmark (national = 100). In 1995, manufacturing in the southeast paid about 30 percent more ALC than the national average, followed by the southwest and Bohai regions which were very close to the national level. By contrast, the central and northeast were lowest in ALC. Both Bohai and the southeast also enjoyed the highest ALP with the southeast more than 30 percent higher than the national level. Not surprisingly, productivity in both the northeast and northwest was more than 30 percent below the national average. Yet, for both we have observed the fastest growth in productivity! Together with the data presented in Table 1, a clear convergence picture seems to have emerged.

Convergence in ALC, ALP and ULC

To have a better understanding of the degree of convergence that has taken place across regions, we further look at the dispersion of the comparative levels of ALP, ALC and ULC across provinces and regions in 1995 and 2004. In Table 3 we show the coefficients of variation (CV), expressed as the ratio of the standard deviation to the mean for each variable, for major industry groups across 29 provinces. To show changes in CV in larger areas, which may be of interest in less detailed regional pictures, we also include six regions and three even larger areas of the country (see Appendix Table A1). Note that throughout this study, CV is used as a standard measure of between-group disparities.

As shown in Table 3, in general ULC became less dispersed over this period. It is not surprising to see the CV measures based on a broader category of locations (regions and areas) to be less dispersed than those by a narrower definition of locations (i.e. provinces). Besides, the CVs measured based on six regions decline more rapidly than the CVs based on 29 provinces. From 1995 to 2004, the decline in the former for manufacturing as whole was about 57 percent in ALC, 65 percent in ALP and 59 percent in ULC, while the decline in the latter was about 25 percent, 23 percent and 14 percent, respectively. When focusing on industry groups over the

TABLE 2
The "Initial Position" in 1995 by Industry Group and by Region (national = 100)

	Bohai	Southeast	Northeast	Central	Southwest	Northwest	National
				Panel A: ALC Index			
Food & allied products	98	135	71	82	113	79	100
Textiles & clothing	90	130	61	75	81	80	100
Wood & paper	103	139	65	77	108	67	100
Chemicals	104	128	84	76	94	88	100
Metal products	88	127	92	87	104	95	100
Machinery	96	136	79	79	84	84	100
Transport equipment	101	133	91	83	100	78	100
Electronics	113	123	59	69	65	92	100
Total manufacturing	*96*	*129*	*81*	*80*	*96*	*87*	100
				Panel B: ALP Index			
Food & allied products	93	106	45	99	178	54	100
Textiles & clothing	99	141	33	77	38	62	100
Wood & paper	123	143	53	84	83	58	100
Chemicals	127	131	85	75	66	69	100
Metal products	110	138	76	86	80	88	100
Machinery	110	152	60	81	66	56	100
Transport equipment	110	167	89	72	75	45	100
Electronics	153	124	50	47	54	74	100
Total manufacturing	*112*	*132*	*67*	*82*	*91*	*69*	100
				Panel C: ULC Index			
Food & allied products	105	127	158	83	63	145	100
Textiles & clothing	91	92	182	97	210	129	100
Wood & paper	84	98	122	92	130	116	100
Chemicals	82	97	98	102	144	127	100
Metal products	80	92	121	101	130	108	100
Machinery	88	89	131	97	128	149	100
Transport equipment	92	79	102	114	134	172	100
Electronics	74	99	117	149	120	124	100
Total manufacturing	*85*	*98*	*120*	*98*	*106*	*125*	100

Source: As Table 1.

same period, the decline was not across the board and differed substantially. If based on the CV measured across 29 provinces, those that experienced significant decline (above –20 percent) in the variation of ALC include textiles & clothing, wood & paper, metals, and machinery; in the case of ALP only include food, and in the case of ULC include chemicals and transport equipment. By contrast, chemicals and electronics in ALP and textiles in ULC underwent significant increase in variation by 23, 35 and 87 percent, respectively. To better understand the provinces in similar geographical/resource endowment conditions without sacrificing too much provincial detail, one may focus on the cross 6-region CVs instead of 29-province or three-area CVs, which will be used in the rest of the paper.

The increasing aligning of ALC, ALP and ULC can essentially be ascribed to market forces, suggesting that factor mobility became freer because of less institutional barriers along with deepened reforms. However, at more detailed industry level (rather than eight industry groups reported in Table 3), the convergence trend

TABLE 3

Coefficient of Variation by Industry Group and by Province/Region/Area

	ALC			ALP			ULC		
	29 Provinces	6 Regions	3 Areas	29 Provinces	6 Regions	3 Areas	29 Provinces	6 Regions	3 Areas
Coefficient of Variation in 1995									
Food & allied products	0.391	0.251	0.200	1.176	0.493	0.387	0.341	0.321	0.337
Textiles & clothing	0.392	0.271	0.297	0.524	0.539	0.521	0.499	0.386	0.330
Wood & paper	0.403	0.310	0.321	0.390	0.394	0.367	0.239	0.172	0.061
Chemicals	0.329	0.192	0.228	0.397	0.320	0.323	0.484	0.209	0.105
Metal products	0.306	0.150	0.152	0.440	0.243	0.242	0.255	0.174	0.103
Machinery	0.332	0.237	0.262	0.454	0.426	0.440	0.313	0.227	0.184
Transport equipment	0.326	0.199	0.160	0.700	0.452	0.395	0.595	0.290	0.302
Electronics	0.374	0.310	0.316	0.869	0.532	0.553	0.594	0.221	0.257
Total manufacturing	*0.299*	*0.192*	*0.214*	*0.438*	*0.276*	*0.244*	*0.207*	*0.142*	*0.028*
Coefficient of Variation in 2004									
Food & allied products	0.406	0.191	0.111	0.682	0.321	0.244	0.281	0.184	0.129
Textiles & clothing	0.256	0.176	0.224	0.476	0.266	0.342	0.935	0.136	0.148
Wood & paper	0.254	0.138	0.162	0.317	0.177	0.098	0.242	0.126	0.067
Chemicals	0.277	0.138	0.140	0.488	0.269	0.184	0.241	0.144	0.047
Metal products	0.233	0.089	0.064	0.419	0.130	0.146	0.220	0.063	0.128
Machinery	0.249	0.107	0.131	0.399	0.207	0.249	0.254	0.151	0.143
Transport equipment	0.296	0.105	0.124	0.750	0.312	0.295	0.405	0.227	0.179
Electronics	0.368	0.203	0.134	1.175	0.451	0.283	0.557	0.202	0.242
Total manufacturing	*0.223*	*0.082*	*0.090*	*0.340*	*0.097*	*0.074*	*0.177*	*0.058*	*0.018*

Source: As Table 1.

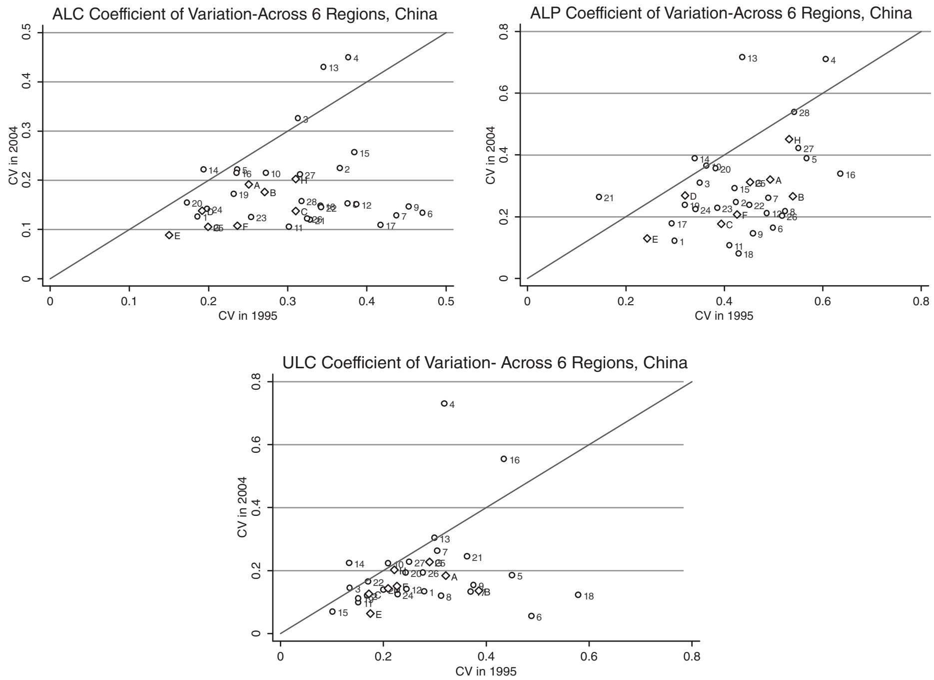

Figure 2. Coefficients of Variation for ALC, ALP and ULC

Notes: Codes in the above figures indicate 28 industries. Please refer to their names in Appendix Table A1. For other notations: A, food & allied products; B, textiles & clothing; C, wood & paper; D, chemicals; E, metal products; F, machinery; G, transport equipment; H, electronics.

The CV of ULC for instruments & stationery machine tools is not shown due to a very large value in 2004, 1.964 vs 0.262 in 1995 (see text for discussion).

Source: As for Table 1.

is no longer unanimous. There appear to be some industries either undergoing significant divergence or little convergence during the same period. This can be clearly depicted in Figure 2.

In Figure 2, industries that experienced either divergence or little convergence are positioned above, on or close to the 45-degree line. It is worth a tedious list of these industries. In the ALC Panel, we can see that such industries include *petroleum* (13), *tobacco* (4), *basic chemicals* (14), *beverages* (3), textiles (5), chemical fibers (16) and ferrous metals (20). In the ALP Panel, they are *non-ferrous metals* (21), *petroleum* (13), *tobacco* (4), *basic chemicals* (14), *paper* (10), instruments (28), ferrous metals (20) and beverages (3). In the ULC Panel, they are *instruments* (28) (not shown in Figure 2 due to the large value in 2004), *tobacco* (4), *basic chemicals* (14), *chemical fibers* (16), *beverages* (3), *paper* (10), *petroleum* (13), metals products (22) and electronics (27). Note that all the above lists are ranked by the ratio of 2004 CV to 1995 CV of individual industries. The italicized industries are well above the 45-degree line, indicating they underwent significant divergence across regions. The remainder of the industries are either very close to or on the 45-degree line, suggesting that they had little convergence across regions.

Most of the industries in the "divergence club" have strong central planning heritage and are still under state monopoly or tight control for national strategic purposes (petroleum, basic chemicals, chemical fibers, and non-ferrous metals) and tax purposes (tobacco). Those industries with little convergence (instruments, electronics) seem to be more capital/skill-intensive than others. However, it is difficult to quickly jump to a conclusion. In fact, industries in the "convergence club" can be divided into two categories with one including almost all labor intensive manufacturers and one including the rest capital/skill-intensive industries. Therefore, more sophisticated techniques are required for a closer investigation into the likely factors behind the observed convergence or divergence.

5. "Causes" of the Convergence–Divergence Dichotomy at Industry Level

To investigate what factors caused some industries to converge and others to diverge across regions, we proceeded as follows. First we looked for variables that are expected to have a significant effect on the convergence trend within an industry. From the available data, we constructed the following variables:

(1) "State share," defined as the share of state capital and collective capital among total capital held in each industry (the 2004 Census table 1-A-2 and "Regional Volume" of the 1995 Census). It is a proxy for state controls aiming to implement and carry out state industrial policies or satisfy national interests, thus it may obstruct factor mobility. We expect this factor has a negative impact on regional convergence.

(2) "Firm size," defined as gross value added divided by the number of firms in million nominal yuan in each industry (the 2004 Census table 1-A-2 and "Comprehension and Industry Volume" of the 1995 Census, pp. 46–197). It is a proxy for capital intensity of an industry. Since a larger firm may indicate higher capital intensity that requires more fixed investment and more industry-specific technology, it benefits more from conglomeration and hence is more likely to increase regional disparity.

(3) "Labor intensity," measured as total labor compensation as the percentage of gross value added in each industry, i.e. industry ULC (see the previous discussion of methodology). Its effect on convergence is just opposite to "firm size," i.e. increase in "labor intensity" will lead to regional convergence. It is used as an alternative variable to "firm size," though a negative sign is expected.

(4) "Openness," defined as the value of export as the percentage of gross value added in each industry (the 2004 Census table 1-A-2 and "Comprehensive and Industry Volume" of the 1995 Census, pp. 46–197). It is used as a proxy for a more integrated domestic market or less barriers to factor mobility. We expect that increase in openness in an industry will increase the probability to converge across regions.

To systematically analyze the effect of the above industry characteristics on convergence and divergence while controlling for the initial level of CV, we applied a logistic regression (logit) analysis which reveals the "probability" that an industry with a given characteristic will converge or diverge. For this purpose we converted the ratio of the CV for each industry i in 2004 over 1995 into a binary variable, taking the value of 1 if the CV ratio is less than 1, indicating convergence, and 0 otherwise, indicating divergence. If we take ULC as an example and denote $p_i = prob\left(CV^{04}_{i,ULC} / CV^{95}_{i,ULC} < 1\right)$, the estimating logit regression takes the following form:

$$\text{logit}\left(\frac{p_i}{1-p_i}\right) = \alpha_0 + \alpha_1 CV^{95}_{i,ULC} + \alpha_2 X_i + \varepsilon_i \tag{6}$$

with $CV^{95}_{i,ULC}$ representing the level of the coefficient of variation of industry *i* in 1995, and *X* representing one of the categorical variables for an industry (state ownership, firm size, labor intensity or openness). The estimated coefficients from the logit regression are parameters in the above model. As our interest is to know how much the change in the independent variable affects the probability of convergence, i.e. $\partial P_i / \partial X_i$, the following manipulation is employed:

$$\hat{p}_i = \frac{e^{\alpha_0 + \alpha_1 CV^{95}_{i,ULC} + \alpha_2 X_i}}{1 + e^{\alpha_0 + \alpha_1 CV^{95}_{i,ULC} + \alpha_2 X_i}} \tag{7}$$

$$\frac{\partial \hat{p}_i}{\partial X_i} = \frac{e^{\alpha_0 + \alpha_1 CV^{95}_{i,ULC} + \alpha_2 X_i}}{\left(1 + e^{\alpha_0 + \alpha_1 CV^{95}_{i,ULC} + \alpha_2 X_i}\right)^2} \alpha_2. \tag{8}$$

The marginal effect on probability is evaluated at the sample mean for a continuous independent variable and against the reference category for a categorical variable. In Table 4, only the marginal effects on probability are listed.

We first estimated the regression with all of the 28 observations, with each observation being the six-region CV ratio for a particular industry *i*. Due to the small sample size (28 industry observations), we should not use more than two variables for each regression. We also carried out diagnostic tests for ULC to identify influential observations (outliers). The influential points are determined by their deviation from other normal observations in the graph, and only those that significantly affect regression results are dropped.[6]

The results are summarized in Table 4 (Panels A to D). As our interest is to know how much the change in the independent variable affects the probability of convergence, i.e. $\partial P_i / \partial X_i$, for each dependent variable we report the estimated marginal effect for the 1995 CV ratio and the characteristic variable. The marginal effect on probability is evaluated at the sample mean for a continuous independent variable and against the reference category for a categorical variable. For state share we have only one set of observations, whereas for the other variables we have both 1995 and 2004 independent characteristic variables. Analogous to R^2 in OLS,

[6]The influential observations are detected by the following diagnostic tests: the standardized Pearson residual which measures the relative deviations between the observed and fitted values, the deviance residual which measures the disagreement between the maxima of the observed and the fitted log likelihood functions; the hat diagonal which measures the leverage of an observation, the chi-square fit statistic which identifies observations with substantial impact on chi-square, the deviance statistic which identifies observations with substantial impact on deviance, and dbeta which provides summary information of influence on parameter estimates of each individual observation.

TABLE 4

Results of Logistic Regression (dependent variable: CV ratios between six regions)

	ALC	ALP	ULC	ULC Excluding Influential Obs.		ALC	ALP	ULC	ULC Excluding Influential Obs.
Panel A: State Size					**Panel C: Labor Intensity**				
CV 1995	–0.240	0.827	0.437	1.095	CV 1995	0.149	0.807*	0.386	0.662
State share 2004	–0.968	–0.789**	–0.991	–0.874*	Labor intensity 1995	0.707**	1.167***	1.882**	1.035**
Pseudo R^2	0.289	0.418	0.132	0.211	Pseudo R^2	0.525	0.366	0.230	0.450
Lstat	89.29%	85.71%	75.00%	77.78%	Lstat	92.86%	85.71%	82.14%	88.46%
					CV 95	–0.082	0.297	0.207	0.132
					Labor intensity 2004	0.765**	1.383**	2.472**	2.396**
					Pseudo R^2	0.522	0.395	0.196	0.360
					Lstat	89.29%	85.71%	82.14%	85.19%
Panel B: Firm Scale					**Panel D: Openness**				
CV 1995	0.352	2.164*	1.444	1.818	CV 1995	–0.007	0.098	–0.205	–0.037
Firm scale 1995	–0.020	–0.026*	–0.045*	–0.061**	Openness 1995	0.016*	0.123*	0.395*	0.067**
Pseudo R^2	0.281	0.472	0.241	0.407	Pseudo R^2	0.480	0.292	0.190	0.431
Lstat	89.29%	89.29%	78.57%	84.62%	Lstat	92.86%	75.00%	85.71%	88.89%
CV 1995	0.551	2.872*	0.822	1.380	CV 1995	0.000	0.006	–0.041	–0.000
Firm scale 2004	–0.010*	–0.009*	–0.007	–0.001	Openness 2004	0.000*	0.007*	0.226	0.001**
Pseudo R^2	0.343	0.453	0.165	0.267	Pseudo R^2	0.561	0.379	0.113	0.575
Lstat	89.29%	89.29%	78.57%	84.62%	Lstat	96.43%	82.14%	75.00%	88.89%

Notes: ALC means the logit regression is run using the CV of ALC, i.e. the dependent variable is the ALC CV ratio between six regions, and CV 1995 indicates ALC CV 1995. Same notation for ALP and ULC. ULC excluding influential obs. means that the influential observations are excluded from the logit regression.

*Significant at 10% level, **5% level, ***1% level.

Source: Authors' estimation based on the 1995 and 2004 Census.

a pseudo R^2 is reported, which provides a quick way to describe or compare the fitness of the model. However, as it lacks the straightforward explained-variance interpretation of true R^2 in OLS regression, another statistic, Lstat, is used to show the corrected classified rate, i.e. the percentage of the convergence/divergence that can be correctly predicted by the specified model.

The results show that our hypotheses are well supported, though not all of the effects are statistically significant and in some cases the magnitudes are small. Firstly, high "state share" tends to reduce the convergence probability for all three variables (ALC, ALP and ULC). Specifically, a 1 percent point increase (decrease) in state share significantly reduces (increases) the convergence probability for ALP and ULC (after excluding the influential points) by less than 1 percent. As our hypothesis suggests, the rigidity of government policy and state interests indeed reduces the possibility for the convergence or market integration in China. Although we have no data in this study to test for the "state share" effect in the current economy, our conjecture is that it still plays a significant role in obstructing the convergence.

Secondly, increase in "firm size" (average size) also tends to reduce the convergence probability for all three variables (though insignificant for ALC using 1995 data and insignificant for ULC using 2004 data, but correct sign), that is, a one million increase (decrease) in firm size decreases (raises) the convergence probability by about 0.03 to 0.06 percentage points using the 1995 Census data. However, when using the 2004 Census data, the effect is significantly reduced, with ALP and ALC being marginally significant at only –0.01 percentage points. This implies that compared with the "state share" effect, the "firm size" effect was less important, and along with the deepening economic reform, it is no longer an important obstruct to market integration across regions in China.

Thirdly, we find that changes in "labor intensity" (the inverse of capital intensity) significantly affect the convergence using either the 1995 Census or the 2004 Census data, regardless of whether we exclude the influential points (in this case, chemical fibers and instruments) for ULC or not. Specifically, at the sample mean, a 1 percentage point increase (decrease) in "labor intensity" raises (reduces) the convergence probability for ULC by about 1.0 to 1.9 percentage points using the 1995 data and by 2.5 percentage points using the 2004 data. The results for ALC and ALP are also supportive though not as strong in magnitude. More importantly, in all cases the "labor intensity" effect increased over the period 1995 and 2004 and ALP tends to be more significant than ALC and ULC. This suggests that the growth of labor-intensive industries and the improvement in labor productivity in these industries in particular play an increasingly important role in the convergence.

Lastly, we find that an increase in the degree of "openness" also plays an important role in reducing the possibility of divergence and promoting integration of the domestic market. All variables present the correct sign, especially for ULC after adjustment for "outliers" (influential points removed). However, the role of "openness" declined significantly over this period. This may indicate that the effect of "openness" on regional convergence is nearly exhausted after 30 years of market-oriented reform and 10 years of the World Trade Organization. Nonetheless, one can be sure that any reverse policy to reduce "openness" will be very likely to reverse the trend of convergence and hence harm market integration in China.

6. Test for the Unit Labor Cost Convergence

The above logit regression results suggest, though implicitly, that capital and skill intensive industries are more likely to diverge. It is necessary to examine more closely whether these industries would benefit by locating in the provinces characterized by higher skill levels. For this purpose, we use a full industry by province panel and estimate an extended form of the beta-convergence regression (Barro and Sala-i-Martin, 1995, p. 385), commonly used in the economic growth literature in cross-country analysis, to investigate the provincial skill-level effect on the declining rate of ULC for different industries after controlling for the initial level of ULC.

In what follows, we focus on the effect of the change of ULC because ULC meaningfully measures competitiveness, though the same exercise can also be applied to ALP and ALC. Among various characteristics of a province, we focus on skill level. Skill intensity has been used to measure and categorize industries and localities for examining whether an economy upgrades its skill level through both physical and human capital investment alongside its income growth, an approach that is sensible for studying the emerging economies such as China and India (see Kochhar *et al.*, 2006) because they are rapidly upgrading from a nation that is characterized by low labor cost and low skill level to a country that is moving up the industrial value chain and improving the quality of labor as well as productivity.

The following models are specified to test for the effect of "skill intensity" across provinces upon ULC convergence:

$$Y_{ij} = \alpha_0 + \alpha_1 Z_{ij} + \boldsymbol{\beta\phi}_i X_j + \boldsymbol{\phi}_i + \alpha_2 X_j + \varepsilon_{ij} \tag{9}$$

$$Y_{ij} = \alpha_0 + \alpha_1 Z_{ij} + \boldsymbol{\beta\phi}_i X_j + \boldsymbol{\phi}_i + \boldsymbol{\theta}_j + \varepsilon_{ij} \tag{10}$$

where, Y_{ij} is the growth rate (difference of logs) in industry i and province j for ULC, Z_{ij} is the log of the initial value of ULC, $\boldsymbol{\phi}_i$ and $\boldsymbol{\theta}_j$ are vectors of industry and province dummy variables, respectively, capturing the industry and province fixed effects, and X_j is a province-specific characteristic variable that measures provincial skill intensity. Note that X_j does not capture the rest of province-related features. Hence, the provincial dummy $\boldsymbol{\theta}_j$ introduced in equation (10) is to control the provincial fixed effect as well as to compare with equation (9).

Our measure of provincial skill intensity is a provincial industrial structure-modified version of the skill intensity categorization by Kochhar *et al.* (2006, table 3, pp. 987–91) who follow the approach developed in Alleyne and Subramanian (2001). In Kochhar *et al.*, the share of remuneration of the highly skilled and skilled workers (in contrast to unskilled and informal workers as categorized in Alleyne and Subramanian) in total values is used as a proxy for the skill intensity of an industry (p. 990). Eventually, skill intensity is a categorical variable and two definitions are used to test for robustness, with one that classifies the upper half of the industries ranked by skill intensity as "high" and the lower half as "low," and the other that classifies the top one third in the skill ranking as "high" and the rest as "low." We quantify "high" as 1 and "low" as 0, and refer the first definition to

"Measure 1" and the second to "Measure 2." In the current study, both measures are further modified by the industrial structure of a province, i.e. adjusted by individual industrial weights in total manufacturing output of a province.[7] They are used alternatively in each model as X_j, independently or/and interactively.

The interactive term ($\beta\phi_i X_j$) in equations (9) and (10) is actually a slope dummy vector examining whether the province-specific skill intensity effect (X_j) on the growth of ULC (Y_{ij}) changes when interacted with specific industries (ϕ_i). However, the magnitude as well as the statistical significance of the β coefficients will depend on the reference industry (used in setting up the industry dummy ϕ_i) and hence inevitably be affected by the choice of the reference industry. To solve this problem the estimated β coefficients have to be normalized. This normalization first calculates each industry's share in the national gross value added for manufacturing. The estimated β coefficients are then weighted by the industrial share. Next, the *sum* of the so-weighted β coefficients, which is a national industry average, is used as a new reference that is "neutral" or minimizes the industry-specific effect. The *normalized* β coefficients are finally estimated as *deviations* from this "neutral reference." This approach is akin to the calculation of the industry wage premium in the labor economics literature (see Haisken-DeNew and Schmidt, 1997). In Table 5, the standard errors of the normalized coefficients are given, *not* the standard errors directly obtained from the OLS regression.

Results reported in Table 5 are based on our two alternative measures on skill intensity of provinces, "Measure 1" and "Measure 2." Furthermore, the first row in Table 5 shows the coefficients of the initial ULC (Z_{ij}), α_1, which appeared in both equations (9) and (10); the second row gives the coefficient of the provincial skill intensity (X_j), α_2, which appeared only in equation (9); and the main part of the table reports the coefficient of the slope dummy, β, for all 28 industries. Note that the industry code used from "Ind01" to "Ind28" exactly follows the industry order listed in Appendix Table A1.

Firstly, the significantly negative effects of the initial ULC across the board indicate a strong "catch-up" trend over this period that reduced regional disparity in ULC. This conforms to our observed spatial convergence trend at a more aggregate manufacturing level (Table 3).[8] Secondly, the results for provincial skill intensity are statistically insignificant on *average*, which should not be a surprise and just be what we expected—provincial skill level does not have a significant effect on the declining rate of ULC. This is because continuous reforms in the

[7]In our empirical analysis, three shares are used, namely, gross value added of 2004, gross value added of 1995 and the average gross value added share of 1995 and 2004. The results are not sensitive to the change of shares. For concision, only the results using the gross value added of 2004 share are reported. In the adjustment to "Measure 1" and "Measure 2," the provincial skill intensity is a continuous variable derived by weighing the binary industrial skill intensity by its share in total manufacturing output of a province. As "high" skill intensity industries take the value of one while "low" skill intensity industries are 0, "low" skill intensity industries are hence dropped (0 multiply by its share) in constructing the variable of provincial skill intensity.

[8]To further verify the convergence trend, we estimate the regression below using provincial observations for manufacturing as a whole and find a significantly negative coefficient of the initial level. We also restrict 29 provinces to those with gross value added share more than 1 percent in the convergence regression below, and the significant negative coefficient signing convergence trend remains.

$$\ln ULC_j^t - \ln ULC_j^{t-1} = \alpha_0 + \alpha_1 \ln ULC_j^{t-1} + \varepsilon_j.$$

TABLE 5

THE EFFECTS OF PROVINCIAL CHARACTERISTICS ON INDIVIDUAL INDUSTRIES IN CONVERGENCE MODELS

	Skill Level—Measure 1				Skill Level—Measure 2			
	Equation 9		Equation 10		Equation 9		Equation 10	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Z_{ij} (α_1)	−0.760***	(0.050)	−0.822***	(0.060)	−0.755***	(0.049)	−0.821***	(0.059)
X_j (α_2)	−0.231	(0.346)			0.495	(0.546)		
Ind01_φX (β)	0.174	(0.345)	0.242	(0.366)	0.149	(0.352)	0.197	(0.375)
Ind02_φX (β)	0.025	(0.367)	0.033	(0.406)	0.483	(0.366)	0.470	(0.395)
Ind03_φX (β)	0.317	(0.339)	0.292	(0.410)	0.387	(0.305)	0.353	(0.360)
Ind04_φX (β)	0.132	(0.658)	0.251	(0.680)	0.779	(0.780)	0.870	(0.747)
Ind05_φX (β)	0.496	(0.384)	0.444	(0.346)	0.482	(0.337)	0.428	(0.289)
Ind06_φX (β)	0.419*	(0.216)	0.380*	(0.194)	0.506*	(0.273)	0.461*	(0.238)
Ind07_φX (β)	0.782*	(0.406)	0.757*	(0.388)	1.273***	(0.450)	1.242***	(0.444)
Ind08_φX (β)	−0.009	(0.267)	−0.041	(0.185)	0.077	(0.330)	0.062	(0.231)
Ind09_φX (β)	−0.692	(0.473)	−0.748*	(0.421)	−0.103	(0.451)	−0.167	(0.399)
Ind10_φX (β)	0.526	(0.377)	0.545	(0.354)	0.478	(0.446)	0.482	(0.453)
Ind11_φX (β)	0.308	(0.370)	0.318	(0.339)	0.121	(0.327)	0.097	(0.352)
Ind12_φX (β)	−0.523	(0.471)	−0.508	(0.398)	−0.383	(0.465)	−0.295	(0.394)
Ind13_φX (β)	−0.380	(0.554)	−0.476	(0.489)	−0.307	(0.646)	−0.460	(0.650)
Ind14_φX (β)	−0.143	(0.434)	−0.165	(0.442)	−0.777	(0.565)	−0.810	(0.552)
Ind15_φX (β)	0.085	(0.287)	0.092	(0.273)	−0.168	(0.365)	−0.216	(0.357)
Ind16_φX (β)	0.690	(0.646)	0.719	(0.611)	−0.353	(0.948)	−0.201	(0.940)
Ind17_φX (β)	−0.486	(0.484)	−0.462	(0.515)	−0.511	(0.439)	−0.414	(0.501)
Ind18_φX (β)	−0.571	(0.361)	−0.530*	(0.305)	0.436	(0.565)	0.416	(0.514)
Ind19_φX (β)	−0.147	(0.246)	−0.130	(0.202)	0.027	(0.273)	0.029	(0.220)
Ind20_φX (β)	−0.190	(0.536)	−0.227	(0.509)	0.346	(0.502)	0.305	(0.454)
Ind21_φX (β)	0.858**	(0.391)	0.858**	(0.380)	0.764**	(0.380)	0.752**	(0.354)
Ind22_φX (β)	−0.457	(0.289)	−0.444*	(0.239)	−0.443	(0.478)	−0.450	(0.424)
Ind23_φX (β)	−0.730***	(0.268)	−0.737***	(0.222)	−0.585**	(0.292)	−0.591**	(0.283)
Ind24_φX (β)	−0.640*	(0.349)	−0.634**	(0.322)	−0.456	(0.345)	−0.462	(0.287)
Ind25_φX (β)	−0.686*	(0.352)	−0.745**	(0.334)	−1.044**	(0.491)	−1.156**	(0.457)
Ind26_φX (β)	−0.275	(0.336)	−0.274	(0.299)	−0.073	(0.433)	−0.091	(0.417)
Ind27_φX (β)	0.595	(0.660)	0.476	(0.645)	1.330	(1.066)	1.183	(1.062)
Ind28_φX (β)	−0.133	(0.415)	−0.184	(0.417)	0.626	(0.647)	0.522	(0.583)
Observations	812		812		812		812	
R^2	0.64		0.68		0.64		0.69	

Notes: Standard errors are in parentheses.
*Significant at 10% level, **5% level, ***1% level.
Source: Authors' estimation using the 1995 and 2004 Census data. See equations (9) and (10) for specifications.

past 30 years, and China's WTO entry in 2001 in particular, have substantially improved factor mobility and market integration. Existing institutional problems that functioned as barriers to further marketization could be picked up by the interactive terms with industry-by-province specifics as in the discussion below.

After controlling for the initial level of ULC, the results show that in general (though not all are statistically significant), by interacting with labor-intensive or "consumer goods" industries, provincial skill intensity tends to slow down the decline of provincial ULCs (shown with a positive sign), whereas if interacting with capital-intensive or "producer goods," industries' provincial skill intensity tends to enhance the decline of provincial ULCs (shown with a negative sign); this satisfies our expectation.[9] Specifically, we find 5–8 industries that are statistically significant when interacting with the provincial skill intensity variable, depending on the model specification and the measures of provincial skill intensity. Among these are both low-skill industries (e.g. apparel and leather products) and high-skill industries (e.g. ordinary machinery, special purpose equipment, and transport equipment). These industry-level findings lend a further support to our conjecture. Since labor-intensive industries have less capital and skill requirement, "relocating" them according to provincial skill intensity (note that our measures highlight "high" skill intensity) may impede market integration of these industries, hence being unfavorable to the decline of ULC. However, "relocating" capital intensive industries to where there are favorable conditions will enhance the decline of ULC. This implies that government policies or state interventions that cause misallocation of resources, i.e. locating capital intensive industries in locations where there is no comparative advantage in skill resources, will halt the ULC decline in those industries.

7. Concluding Remarks

This, which is perhaps the first ever industry-level comprehensive investigation in the trend of China's labor compensation, labor productivity and unit labor cost over the period 1995–2004—a period that underwent more in-depth market oriented reform and wider openings to the international economy through foreign trade and direct investment, has revealed that manufacturing in China has indeed become increasingly costly in terms of labor compensation, yet become even much more productive at the same time. Consequently, such changes in cost and productivity have resulted in a clear trend of declining unit labor cost in Chinese manufacturing. Such a ULC declining trend is well accompanied by a cross-region convergence in ULC, suggesting that what have been observed is spreading out geographically across China. If this trend persists, it will lead China to a smooth upgrading of her industries while maintaining her competitiveness in the international market. However, we do find evidence suggesting that there are still existing obstacles to factor mobility and market integration, especially in capital and skill intensive industries, which is likely a counterforce to what we have observed and certainly calls for further institutional reforms.

[9]Here factor intensity is loosely used. "Labor intensive" industries refer to industries from Code 01 to Code 12 and "capital intensive" industries refer to the rest. The former is also referred to "consumer goods" whereas the later to "capital goods."

Our findings have some important implications. Firstly, the rapid convergence in unit labor cost signals an alignment of compensation and productivity across provinces that have been eradicating inefficient activities in industries and regions. The key is the rapid growth of labor-intensive manufacturing. We believe that if this continues, China's regional income disparities would be improved. On the policy side, it suggests that policies aiming to improve regional disparities by using state investment or through state promotion for capital-intensive industrial development are unlikely to be effective.

Secondly, capital and skill-intensive industries are more likely to show a divergent trend. As such industries have been becoming more important in the process of upgrading and modernizing the manufacturing sector, one question has arisen: what are the driving forces behind the divergent trend in ALP, ALC and ULC in these industries?

Standard neoclassical trade theory would predict that in due time market reforms may bring about an equalization of compensation and productivity levels at industry level across regions. However, another strand of theory would predict that greater regional specialization will attract even more highly paid resources and cause further divergence rather than convergence at industry level, and perhaps even at the aggregate level. This is because such industries may be benefiting from typical concentration forces that trigger spillovers (through access to capital, education, and specialized services, etc). The increasing importance of these industries over time may negatively affect the convergence trends at the labor intensive end of the spectrum of industries (Krugman, 1991; Fujita *et al.*, 1999).

However, our conjecture gives more emphasis on the institutional effect. To us the observed divergence in some of the highly skill-intensive industries is likely attributed mainly to various market imperfections and state interventions in which the government used preferential policies to encourage the establishment of capital intensive industries for national strategic considerations or state interests. This will cause misallocation of resources and inefficiencies, resulting in a rise in unit labor cost because it restricts the growth of productivity relative to wages in regions where such industries are located. This is supported by the findings in our convergence regression exercise. Specifically, it suggests that after controlling for the initial level, skill-intensive industries such as ordinary machinery, special purpose equipment and transport equipment show a faster decline in unit labor cost by locating in the right locations (provinces with proper resources or skill attributes).

Lastly, but most importantly, the growth of productivity is the key to maintaining competitiveness despite an inevitable increase in the cost of labor along with income growth. However, this is not easy for transition economies. In theory, we understand that resources should be used with the right technology, in the right business, at the right locations, and their owners should be properly rewarded. In reality, one important policy implication that could be drawn from China's experience is that institutional reforms to remove barriers to resource mobility, market competition and integration (so that the price signals are not distorted), as well as the state support to infrastructural development are the needed "helping hand" from the governments in transition economies.

Appendix

TABLE A1

Industries and Provinces Covered and Their Groupings

Industry	Industry Code	Industry Group	Province	Location Code	Region Code	Area Code
Food processing	01	Food & allied products	Beijing	01	Bohai	Coastal
Food manufacturing	02	Food & allied products	Tianjin	02	Bohai	Coastal
Beverages	03	Food & allied products	Hebei	03	Bohai	Coastal
Tobacco	04	Food & allied products	Shanxi	04	Northwest	Central
Textiles	05	Textile & clothing	Inner Mongolia	05	Northwest	Central
Apparel	06	Textile & clothing	Liaoning	06	Northeast	Coastal
Leather & related products	07	Textile & clothing	Jilin	07	Northeast	Central
Timber & bamboo products	08	Wood & paper	Heilongjiang	08	Northeast	Central
Furniture manufacturing	09	Wood & paper	Shanghai	09	Southeast	Coastal
Paper & products	10	Wood & paper	Jiangsu	10	Southeast	Coastal
Printing & recording	11	Wood & paper	Zhejiang	11	Southeast	Coastal
Cultural, educational, sports	12	Wood & paper	Anhui	12	Central	Central
Petroleum & coking	13	Chemicals	Fujian	13	Southeast	Coastal
Basic chemicals	14	Chemicals	Jiangxi	14	Central	Central
Medical & pharma. products	15	Chemicals	Shandong	15	Bohai	Coastal
Chemical fibers	16	Chemicals	Henan	16	Central	Central
Rubber products	17	Chemicals	Hubei	17	Central	Central
Plastic products	18	Chemicals	Hunan	18	Central	Central
Non-metal mineral products	19	Metal products	Guangdong	19	Southeast	Coastal
Ferrous metals	20	Metal products	Guangxi	20	Southwest	Coastal
Nonferrous metals	21	Metal products	Hainan	21	Southwest	Coastal
Metal products	22	Metal products	Sichuan	22	Southwest	Western
Ordinary machinery	23	Machinery	Guizhou	23	Southwest	Western
Special purpose equipment	24	Machinery	Yunnan	24	Southwest	Western
Transport equipment	25	Transport equipment	Shannxi	25	Northwest	Western
Electric equipment	26	Machinery	Gansu	26	Northwest	Western
Electronics & tele equipment	27	Electronics	Qinghai	27	Northwest	Western
Instruments	28	Electronics	Ningxia	28	Northwest	Western
			Xinjiang	29	Northwest	Western
Total manufacturing		*Total manufacturing*	*National total*		*National total*	*National total*

Notes: To be consistent with the 1995 Census, Chongqing is added back to Sichuan in 2004 Census. Tibet is excluded from the analysis as it accounts for less than 1% of overall manufacturing value added in China. We also exclude "manufacture of artwork and other manufacturing" (29) and "recycling and disposal of waste" (30) in the 2004 Census because of no matching industries in the 1995 Census.

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