Labor Compensation, Productivity and Unit Labor Cost in Chinese Provinces[1]

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Abstract

This paper shows comparisons of relative levels of productivity, labor compensation and unit labor cost by manufacturing industry and province in China. The study is based on a 3-dimensional panel (benchmark years 1995 and 2004, 28 industries and 30 provinces) which makes use of data from the *First Economic Census* for 2004, covering enterprises of designated size and above (well over 50% of total manufacturing employment in China), and *China's Third Industrial Census* for 1995, covering enterprises at township level and above.

The paper first provides a descriptive analysis of the distribution of productivity, unit labor cost and productivity in manufacturing. It shows that the faster growth in productivity relative to labor compensation at the aggregate level has led unit labor cost to decline significantly for all provinces. It also finds that there has been a strong convergence in labor compensation, productivity, and unit labor cost across provinces and regions (after merging the provinces to our preferred group of seven regions). This convergence trend may be contrasted with the continuous increase in per capita income inequality observed in the literature.

However, we signal a substantial variation in convergence trends between industries across provinces and regions. Applying a logit analysis we find that industries that are characterized by a relatively low level of labor usage, expressed as labor compensation in total value added, but high skill levels tend to show a greater "probability" for showing divergence across provinces. We argue that a shift in manufacturing production towards more capital and skill intensive industries increases the likelihood that diverging trends may begin to dominate and reverse the trend towards one of greater inequality between provinces and regions in the future.

1. Introduction and Summary

The literature on China's regional economy in recent years has been dominated by the emphasis on the increased inequality between provinces. Indeed the literature convincingly shows that the inequality in inter-regional income disparity has increased considerably since the mid-1980s.[2] Surprisingly, so far there has been relatively little research on the provincial inequality of some of the underlying components of income, including productivity and compensation. One reason for this is undoubtedly a lack of adequate statistical series at province level to obtain consistent measures of output, employment and compensation.

However, it would be of great interest to see how the unequal distribution of income, which is directly related to living standards, reduction in poverty, etc., is related to the inequality in supply side measures like compensation and productivity. After all the migration of resources across space is not only driven by income differentials but also by differences in compensation, productivity and competitive forces in general.

In this paper we exploit the information from two major industrial censuses, China's *Third Industrial Census* for 1995 and the *First Economic Census* for 2004 to take a comprehensive look at the regional distribution of manufacturing output, labor compensation and employment, covering 30 provinces and 28 industries. Indeed the censuses are the only source from which this information can be obtained in a consistent way. The downside of using the two censuses, however, is that we cannot directly obtain a time series so that we need to assess the consistency of the two censuses carefully. Below we argue that our measures for "enterprises of designated size and above" for 2004 and for "enterprises at township level and above" for 1995 are sufficiently compatible to make an adequate comparison for those two years.

In contrast to the literature on income inequality, we find that there has been a strong decline in inequality in terms of average labor compensation (ALC), labor productivity (ALP) and unit labor cost (ULC). While average labor compensation increased between 2 and 4 times in most provinces, the coefficient of variation of compensation levels dropped to a very low level of only 0.22 by 2004. Between seven major regions it even

[2] For a recent overview, see the special issue of *The Review of Income and Wealth* on "Inequality and Poverty in China" (March 2007), including contributions by Wan (2007), Wan, Lu Chen (2007) and Tsui (2007).

dropped to less than 0.08. Growth differentials have been bigger in labor productivity, roughly between a 4 and 10 times increase between 1995 and 2004, but even here the provincial inequality fell to a coefficient of variation of 0.34, and regional inequality declined to a coefficient of variation of 0.10.

It is particularly interesting to look also at the development of unit labor cost, which is the ratio of compensation to productivity. It turned out that unit labor cost fell dramatically in all provinces by between 20 and 80 per cent between 1995 and 2004. Moreover the coefficient of variation declined to less than 0.18 among provinces and to 0.05 across the seven major regions. The latter implies that even though there may still be sizeable differences in productivity and compensation levels, these are now much better aligned than a decade ago. This suggests that institutional reforms have been doing much to eradicate inefficient activity at the wrong places. Indeed the literature has now clearly evidenced the huge wipe-out of inefficient state-owned enterprise across the country.[3]

When turning to the industry detail by province (or region), we find that there is still substantial variation. While we find that, overall, unit labor cost have declined almost everywhere due to faster increases in productivity relative to compensation, not all industries exhibit the convergence trend between provinces and regions as described at the aggregate level. At a regional level up to ten out of 29 industries have exhibited divergence rather than convergence for ALP (nine industries), ALC (six industries) and ULC (ten industries).

We therefore apply a logit analysis to find out what industry characteristics might have caused the “probability” for an industry to show increased inequality across regions. We find that more capital intensive industries are more likely to show a rise in inequality on all our three variables. We also find that industries that are characterized by relatively high skills are likely to show more inequality on unit labor cost, even though this was not confirmed for labor compensation and labor productivity separately. Other characteristics like state share, openness to foreign competition and average firm size had no impact on the likelihood for an industry to converge or diverge, at least without controlling for characteristics other than the original 1995 level.

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[3] See, for example, Dougerthy and McGuckin (2002) who show that government decentralization – “federalism” – has played an important role in improving the performance of collective, state-owned and mixed public/private ownership firms. This result is strongly confirmatory of much of the recent theoretical work on transition economies that posits a key role for government in the efficient operation of markets.

On the basis of this analysis we conclude that labor intensive industries have contributed most to the decline in inequality in China. Hence with the increased sophistication of manufacturing production towards more capital and skill intensive industries there is an increased likelihood that diverging trends may begin to dominate and therefore further contribute to the inequality trend in income observed elsewhere.

The paper proceeds as follows. In section 2 we discuss the database that has been developed for this study and the issues concerning the asserted consistency of the figures for the two benchmark years. In section 3 we provide a descriptive analysis of the main trends in ALC, ALP and ULC between 1995 and 2004. In section 4 we focus on the inequality issue, looking at the degree of convergence across regions. In section 5 we provide a logit analysis to identify the factors which may be impacting the probability of industries to converge or divergence. Section 5 concludes.

2. Methodology and data sources

Our analysis is based on the study of three variables, average labor compensation (ALC), labor productivity (ALP) and unit labor cost (ULC). Average labor compensation and labor productivity are obtained as a ratio of total labor compensation (LC) to the number of employees (E) and the ratio of gross value added (GVA) to the number of employees (E) respectively. ULC may be defined as the ratio of total labor compensation (LC) to gross value added (GVA) or average labor compensation (ALC) to labor productivity (ALP). Hence for a given year, the level of ALC, ALP and ULC for each individual industry *i* and each province *j* can be expressed as follows :[4]

$$ALC_{ij} = LC_{ij} / E_{ij}, \quad ALP_{ij} = GVA_{ij} / E_{ij} \quad \text{and} \quad ULC_{ij} = ALC_{ij} / ALP_{ij} \text{ [5]} \qquad \text{(1a, 1b, 1c)}$$

Aggregation for each industry *i* across provinces *j* is as follows:

$$ALC_i = \sum_j^n LC_{ij} / \sum_j^n E_{ij}, \; ALP_i = \sum_j^n GVA_{ij} / \sum_j^n E_{ij} \text{ and } ULC_i = ALC_i / ALP_i \qquad \text{(2a, 2b, 2c)}$$

[4] Provided that there is only one estimate of employment for each cell, there is by definition no difference between the ratio of total labor compensation to value added and the ratio of average labor compensation to labor productivity.

[5] ULC can also be written and understood as $ULC_{ij} = LC_{ij}/GVA_{ij}$. We also use this concept further on in this paper (section 5).

Aggregation for each province *j* across industries *i* is as follows:

$$ALC_j = \sum_i^m LC_{ij} / \sum_i^m E_{ij}\ ,\ ALP_j = \sum_i^m GVA_{ij} / \sum_i^m E_{ij} \text{ and } ULC_j = ALC_j / ALP_j \quad (3a, 3b, 3c)$$

The estimates above are derived for two benchmark years, for which the underlying information on total labor compensation, value added and numbers of employees can be obtained from one and the same source for each year, namely China's *Third Industrial Census* for 1995 and the *First Economic Census* for 2004. Both the sources and the main manipulations carried out are briefly discussed below. The appendix presents the basic information on ALP, ALC and ULC for 28 industries at all-nation level (see Appendix Table A.1).[6]

First Economic Census 2004

The *First Economic Census of China* was conducted by the National Bureau of Statistics in 2005 with reference to calendar year 2004.[7] The focus of the census was the non-agricultural and comparatively modern sectors of the economy, in particular industry and services. Using the average numbers of employees in 2004 from the Economic Census, there were 80.8 million employees in China's established legal manufacturing enterprises, of whom 56.67 million were in the "manufacturing enterprises of designated size and above". Enterprises of designated size and above are defined as all state-owned enterprises plus non-state-owned enterprises that had sales of 5 million yuan (about 600,000 US dollars) or more. The remaining 24.13 million were in manufacturing enterprises below designated size. Moreover the census includes another 23.8 million employees which were self-employed or in household manufacturing firms.

For 2004, we focus exclusively on the group of 56.67 million employees in enterprises of designated size and above, covering well over 50% of total manufacturing employment in China. There are several reasons for focusing on the larger plants only, including the difficulties to estimate output and labor compensation for the other two groups. Moreover, there is no information available on a province by industry basis for enterprises other than those at designated size or above. Finally, from the perspective of competitiveness, the interest in the manufacturing firms of designated size and above (beyond 600,000 US$ sales revenue) only seems justified.

[6] The industry level detail at provincial level will be made available for research purposes in due time.
[7] The reference time for the Economic Census was December 31st of 2004, and the flow data covered the whole year of 2004 (China NBS, 2005).

Even for enterprises at designated size and above there were no estimates of GVA and LC that could be directly obtained from the census. We therefore derived GVA at the aggregate level by summing up the following categories:[8]

- wage
- welfare payment
- total profit
- tax paid plus supplementary levies
- current year depreciation
- minus enterprise income tax;

After obtaining from the National Bureau of Statistics an extended table we were able to check this "income-based" estimate with a reported estimate of GVA that was obtained according to the production approach, i.e. total output minus intermediate inputs.

For labor compensation the census only published wages and welfare payments. Again we required more detailed information from the extended NBS table, so that labor compensation includes:[9]

- wages
- welfare payments
- labor and furlough insurance
- endowment and medicare insurance
- housing subsidy

Surprisingly, the sum of these labor compensation components together with the total profit, tax paid plus supplementary levies, current year depreciation minus the enterprise income tax, still did not add to the reported GVA from the extended table. Indeed it might be that the labor compensation component is therefore still somewhat understated – an issue that we discuss in more detail below.

Even though the *First Economic Census* publishes a separate volume on provincial estimates[10], including the detailed estimates on employment by industry and province, substantial manipulations to the data were necessary in order to estimate gross value

[8] NBS, *First Economic Census, Volume II*, Table 1-A-2 for manufacturing designated size and above by industry.
[9] See a companion study on manufacturing employment and compensation by Banister (2007) for more details.
[10] NBS, *First Economic Census*, *Volume II*, Table 1-B-13 for manufacturing designated size and above by province, and Table 1-B-14 to 1-B-41 for manufacturing designated size and above, industry by province.

added and labor compensation by industry and province. Using the industry-level relationships between the published and extended tables from NBS described above at the national level, we obtained GVA and LC for 28 industries and 30 provinces.[11]

Third National Industrial Census 1995

The *1995 Third National Industrial Census* consists of three volumes (by industry, region and ownership-type), plus a summary volume. It differs greatly from the 2004 Census in many aspects. The most notable problem is that there has been a change in the definition of the industrial accounting unit. Up to 1998 the major subset of industries for which the industrial statistics provided extensive information was "national independent accounting industrial enterprises at and above township level". Since 1998 this has been replaced by ''all industrial state-owned enterprises (SOEs) with independent accounting system and all industrial non-SOEs with independent accounting system and annual sales revenue in excess of 5 million yuan" (the designated size and above unit). According to Holz and Lin (2001) this change implied that non-SOEs with independent accounting system at or above township level but with sales revenue of no more than 5 million yuan are now excluded from the detailed industrial statistics. On the other hand, village-level enterprises that meet the two requirements are now included (p. 304, footnote 2). Even though it is not possible to make a precise assessment of the difference, it appears that "township level and above" firms covered roughly 60% of gross value of output in 1997, whereas "designated size and above" firms covered 57% of gross value of output in 1998 (Holz and Lin, p. 314, figure 2), which is a sufficiently small difference to assume that these two categories of firms are reasonably comparable.

While the Third National Industrial Census provides complete data on GVA and LC (at least for wages and the welfare fund)[12], the data on employment by industry and province are essentially missing from the census. This information had to be obtained from the *China Industrial Economic Statistical Yearbook* (CIESY) for 1994, from which we used the industry shares by province to apply to province employment in the census.

Time series of productivity and unit labor cost

[11] In fact the 2004 census has 29 industry by province tables. However, the 1995 census discussed below has 28 industries that can be matched but does not include "Manufacture of Artwork and Other Manufacturing" (29) and "Recycling and Disposal of Waste" (30). These two sectors are therefore excluded from our analysis.

[12] We assume that the other categories of labor compensation were virtually non-existent in 1995.

In addition to the two individual benchmark years, we also computed changes in ALP, ALC and ULC from 1995 to 2004. Here it is important to note that the time series for output and labor productivity need to be adjusted for price changes between 1995 and 2004. While we have no information on price indices for individual provinces, we used producer price indices (PPIs) by industry at the national level from the CEIC Database, assuming that price development by industry did not differ between provinces.

Hence gross value added and labor productivity in 2004 in prices of 1995 may be expressed as:

$$GVA_{ij}^{04(95)} = GVA_{ij}^{04} / \frac{PPI_i^{04}}{PPI_i^{95}}, \text{ and } ALP_{ij}^{04(95)} = GVA_{ij}^{04(95)} / E_{ij} \qquad \text{(4a, 4b)}$$

It is noted that for the calculation of the change in unit labor cost, only the denominator (ALP) is deflated, while the numerator (ALC) is expressed in nominal terms. This is usual practice in competitiveness studies, as the unit labor cost measure is supposed to measure the nominal cost per unit of real output.[13]

To compute producer prices we could only apply 12 industry-specific indices for the nation as a whole which we allocated to the individual 28 industries by province. Appendix Table A.1 provides the ALP and ULC estimates for 2004 in both current and 1995 prices.

Are we understating the growth of labor compensation?

Because of the two different sources used for 1995 and 2004 we have to carefully assess their consistency. As indicated above, we believe that the accounting units ("township level and above" and "designated size and above") match reasonably well albeit not perfectly. At face value we have no reason to expect any systematic bias in our results from this. Also we are less concerned about the consistency of the measures of output in both censuses, as the recording by accounting unit leaves little room for statistical manipulations.

[13] See, for example, Bureau of Labor Statistics, http://www.bls.gov/lpc/. Naturally, if one would be primarily interested in workers' wealth created per unit of output produced, it would be appropriate to also adjust the wage sum by a cost of living index.

However, as mentioned above the statistical sources used for this study do not provide a full coverage of the manufacturing sector in China and we can therefore not be certain that the conclusions from this study on enterprises at designated size and above also apply to the manufacturing sector as a whole. A rough comparison of the figures on GVA and LC from the two censuses with those published in the Input-Output Tables for 1995 and 2002, with a national accounts extrapolation to 2004, suggests that our estimated change in labor compensation for enterprises at designated size and above was much slower than for the manufacturing sector as a whole, while output growth was faster.[14] The obvious concern therefore is of course that we may be understating the trend in labor compensation relative gross value added and therefore exaggerating the decline in unit labor cost.

In this regard we wish to make a few observations:

- as firms at designated size and above represent relatively large enterprises, we are missing the smaller enterprises which usually are more labor intensive, hence explaining the larger gap in terms of labor compensation compared to the gap in gross value added
- due to the liberalization of the economy, output and employment outside the “designated size and above” category has probably increased faster. For example, according to a forthcoming research publication of The Conference Board, net employment creation in private companies have grown very fast at 9 per cent per year. Many of these companies are start-ups which will not have immediately hit the 5 million yuan revenue level.

While more research is needed, we assume that the rapid decline in unit labor cost is on the whole realistic for the category of “established” firms at designated size and above, on which we are focusing in this study. But the trend is probably somewhat faster than what one would observe for the aggregate manufacturing sector including enterprises below designated size.

3. Descriptive results

[14] Roughly, the coverage of the census-based gross value added for enterprises at designated size and above relative to aggregate manufacturing has increased from around 60 per cent in 1995 to 89 per cent in 2004. In contrast, total labor compensation according to the census relative to the I/O tables has fallen from 63 per cent in 1995 to 52 per cent in 2004.

Figures 1 and 2 are a reflection of our main results which are shown separately along each of the two dimensions (province and industry) in our study. In figure 1 we look at the change in average labor compensation and labor productivity (on the left y-axis) and the decline in unit labor cost (on the right y-axis) for aggregate manufacturing by province between 1995 and 2004. In figure 2 we observe the same variables by manufacturing industry for the whole nation.

The figures show a rapid decline in unit labor cost across the board, both by province as well as by industry. Figure 1 shows that, on average, ULC declined by about 40 per cent between 1995 and 2004. Some provinces show substantially larger declines, but – with the exception of Shanghai – these are all relatively underdeveloped provinces outside the coastal area. While labor compensation grows at a relative comparable rate of 2 to 4 times between 1995 and 2004, labor productivity growth differentials were much bigger (between 4 and 10 times). However, with a few exceptions, the provinces with the fastest decline in unit labor cost are also typically the ones with the most rapid growth in productivity (between 6 and 8 times). Hence on the whole, productivity accounted for more of the variation in unit labor cost between provinces than labor compensation.

Compared to the variation across provinces, figure 2 shows somewhat less variation in ALC, ALP and ULC across industries in particular for ULC (with the exception of petroleum products). On the whole, productivity growth and ULC declines appear fastest in several capital intensive industries, including electric equipment and transportation equipment. In contrast, labor intensive industries, such as sport products, leather and garments, showed the slowest increases in productivity and the least declines in ULC.

The biggest added value of our work, however, is in the development of a full industry by province panel. In terms of presentation of the results, we combined the 28 industries into eight main industry groups: Food Products; Textile & Clothing; Wood & Paper; Chemicals; Metal Products; Machinery; Transport equipment; and Electronics. Appendix Table A.2 shows how industries were allocated to industry groups. We also grouped the 30 provinces into seven regions which include: Bohai (Beijing and provinces around it), Southeast (including Shanghai and Guangdong), Northeast (represent the traditional industrial region of China), Central, Southwest, Northwest and Tibet (see section 4 and Appendix Table A.2 for a further explanation).

Table 1 shows a matrix of the change in ALC, ALP and ULC by industry group and each of the seven regions between 1995 and 2004. It shows that the labor compensation increases were highest in the electronics industry group in the Southwest and Northeast regions, and lowest across some industry groups in Tibet. Labor productivity increased fastest in all industry groups in the Northeast region and also in Tibet.[15] In contrast productivity growth was slower in the richer provinces in Bohai and the Southeast. Finally, again with the exception of Tibet, ULC declined most rapidly in the Northeast, Southwest and Northwest regions, and less in the booming regions such as Bohai, the Southeast and the Central region.[16]

Although the picture is not entirely consistent, there is good reason to argue that the trends in ALP, ALC and ULC are at least in part related to traditional convergence trends, with regions that are characterized by low productivity *levels* growing faster in terms of productivity and showing bigger unit labor cost declines than high productivity level regions. This is also clear from Table 2 which – for the first year in our analysis, 1995 – shows relatively low levels of compensation and productivity in the Northeast, Central and Northwest regions, whereas the Bohai and Southeast region showed relatively higher levels.[17]

These convergence trends in average labor compensation, labor productivity and unit labor cost may be contrasted with the diverging trends in terms of per capita income. For example, Wan (2007) summarizes the literature on inequality trends in the personal income distribution, stressing the important role of the rural-urban income gap. Personal income inequality also appears to translate into increased income inequality across provinces. For example, the coefficient of variation of the per capita regional product across provinces has increased from 0.63 in 1995 to 0.76 in 2004.[18] Hence we need a better understanding of the reasons for the convergence trends in manufacturing compensation, labor productivity and unit labor cost, which is the main topic of the remainder of this paper.

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[15] It should be stressed that the industrial sector in Tibet as a whole is small and relatively underdeveloped.
[16] The results for electronics in the Southwest are strange, which is related to the very high negative profit that is reported for the electronics industry in Sichuan (incl. Chongqing). Negative profits occur more often in the database, but it rarely happens that these offset the positive components that contribute to income-based value added, as is the case here.
[17] The Southwest takes a somewhat intermediate position. This is mainly due to the relatively high productivity level of the Yunnan province which is due to the tobacco processing, accounting for more than 50% of the total GVA. Also in the Hainan province, productivity came out relatively high (at least in 2004) due to the high productivity level in transportation industry
[18] NBS, Statistical Yearbook 2005, Table 3-11, Statistical Yearbook 1995, Table 2-11 & Table 3-3.

4. Convergence trends in compensation, productivity and unit labor cost

To obtain a better understanding of the degree of convergence that has taken place across regions, we look at the distribution of the comparative levels of ALP, ALC and ULC across provinces and regions in 1995 and 2004. Table 3 shows the coefficients of variation (CVs), expressed as the ratio of the standard deviation to the mean for each variable, for major industry groups across the seven regions as defined above in section 3. This is a standard measure of inequality that is useful for the purpose of this study.

When focusing first on aggregate manufacturing, the strong decline in inequality across regions is most strongly established at the level of the seven region grouping. The CVs for all three variables (ALP, ALC and ULC) show a dramatic fall to well below 0.1. Even though the CVs across provinces are considerably higher, picking up more variation due to interregional specialization which is by definition excluded from the seven region grouping, the decline in inequality between 1995 and 2004 is still impressive.[19]

In particular, the huge decline in the CV for ULC to 0.18 on the basis of the provincial grouping, and even to 0.05 when using the seven region grouping, suggests that aggregate unit labor cost levels are now very close between regions. This essentially suggests that provinces (or regions) with high productivity levels relative to the all nation average also have relatively high compensation levels. This aligning of the ALC and ALP levels across provinces (regions) can essentially be ascribed to the transformation from planning towards a market system. As a result inefficient activities which were carried out at the wrong place, given the large differences in gaps for comparative productivity and labor cost levels relative to the national average, have been mostly eradicated during this period.

We find that the strong decline in the coefficient of variation for aggregate manufacturing is largely but not fully confirmed by the decline in regional inequality for six of the eight major industry groups. With the exception of the wood & paper and transport equipment groups, the CVs for average labor compensation have declined for all other industry groups. For labor productivity, the CV for the chemicals group remained constant, but it increased for the last two industry groups, transport equipment and electronics. Indeed transport equipment also exhibited an increase in CV for unit labor cost. On the whole

[19] See Appendix Table A.3 for CV's at the industry level. Here we do not report the coastal-central-western grouping, which is generally seen as too crude to deal adequately with the variation. See, for example, Wan (2007) showing that the three-region distribution of income inequality leaves a very large portion of within-region inequality unexplained.

these results suggest that the relatively capital and skill intensive part of the manufacturing sector has not been contributing much to the overall convergence trend.

Indeed when focusing on the industry level (rather than major industry groups), figures 3a-3c show several industries with CVs for 2004 which are larger than for 1995. For average labor compensation (figure 3a) these include, for example, beverages, tobacco, chemicals and textiles, in addition to transport equipment. Increased regional inequality for labor productivity (figure 3b) is observed, among others, for tobacco, non-ferrous metals, chemicals, in addition to transport equipment and electronics. Figure 3c shows increased inequality for unit labor cost for as many as 10 industries between 1995 and 2004, including major industries such as chemicals raw materials and fibers and metal products, in addition to transport equipment.

Hence the convergence trend observed for aggregate manufacturing is certainly not ubiquitous across industries. It is also clear from table 3 that the inequality at the level of industry groups is much higher than for the aggregate manufacturing sector. This is in the first place a statistical phenomenon, which may be best understood on the basis of a simple example. If a country consists of only two regions (1 and 2) and two industries (A and B), region 1 may have a high level of compensation relative to region 2 in industry A and a relatively low compensation level in industry B. For both industries, the inequality levels would be higher than the average inequality of region 1 to region 2 as the relative inequality levels cancel out.

However, in the second place, the trend towards relatively low levels in inequality of ALC, ALP and ULC at the aggregate level compared to the industry level is also supported by some of the institutional and market reforms that have taken place in China over the past decade. This has allowed regions to specialize in those industries where they have a comparatively high productivity advantage and pay high compensation levels. Standard neoclassical trade theory, however, would predict that these market reforms may also cause an equalization of compensation and productivity levels at industry levels across regions. While this may happen in due time, there is another strand of theory that would predict that greater specialization will attract higher paid resources and cause further divergence rather than convergence at industry level, and perhaps even at the aggregate level.

5. The causes of the convergence-divergence dichotomy at industry level

As we observed above that the huge convergence in ALC, ALP and ULC for aggregate manufacturing is not always reflected in similar convergence trends at the industry level, and that the low coefficient of variation for the aggregate manufacturing is in part the result of different specialization trends, the question arises what factors have caused some industries to converge and others to diverge across regions.

To study this we proceeded as follows. First we looked for variables that could 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 hold (source: 2004 Census, 95 N/A)
2. "Firm size" defined as the total GVA divided by the number of firms, in thousand yuan (source: 2004 & 1995 Censuses)
3. "Labor intensity" measured as the total labor compensation as percentage of total GVA, i.e., ULC (ULC95 and ULC04 from this study)
4. "Skill level" defined as a categorical variable, with 1 representing a high skill industry and 0 representing a low skill industry. (source: skill level classification from Kochhar, 2006)
5. "Openness" defined as the export value as percentage of GVA (source: 2004 & 1995 Censuses).

Figures 4-8 show, for each variable, a comparison of the diverging and converging industries, corresponding to figure 3. As distinguishing criteria for these variables we used the following cut-off points:

Ad 1) For state share we distinguish between industries that have in total more or less than 20% of capital controlled by state or collectively.

Ad 2) For firms size we distinguish between industries with average mean firm size of up to 10 million yuan in GVA, between 10 and 50 million yuan in GVA, and above 50 million GVA

Ad 3) For labor intensity we distinguish between industries with more or less than 25% labor compensation (LC) as a percentage of gross value added (GVA)

Ad 4) For skill level we use the distinction between low and high skill industries as applied in Kochlar (2006)

Ad 5) For openness we use a clear distinctive criterion between industries with an export value as percentage of GDP of less than 0.6 and industries with a percentage of 0.85 or above.

Figures 4-8 show that none of these factors are distinctive in terms of identifying specific subgroups of industries to converge or diverge. We therefore needed a more systematic analysis, and perhaps one that also took care of differences in the initial level of CV. For this purpose we applied a logistic regression (logit) analysis which reveals the "probability" that an industry with a given characteristic will converge or diverge on anyone of the specified factors.

For this purpose we converted the ratio of the CV for 2005 over 1995 into a binary variable, taking the value of 1 if the CV ratio is less than 1, indicating convergence, and otherwise 0 indicating divergence. If we take ULC, as an example and denote $P = Prob(CV_{ULC}^{04} / CV_{ULC}^{95} < 1)$, the estimating logit regression takes the following form:

$$logit(P/1-P) = \alpha_0 + \alpha_1 CV_{ULC}^{95} + \alpha_2 X + \varepsilon \qquad (4)$$

with CV_{ULC}^{95} representing the level of the coefficient of variation in 1995 and with X representing one of the categorical variables for an industry (state ownership, firm size, labor intensity, skill 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., $\partial P / \partial X$. thus the following manipulation is employed:

$$\hat{p} = \frac{e^{\alpha_0 + \alpha_1 CV_{ULC}^{95} + \alpha_2 X}}{(1 + e^{\alpha_0 + \alpha_1 CV_{ULC}^{95} + \alpha_2 X})} \qquad (5)$$

$$\frac{\partial \hat{p}}{\partial X} = \frac{e^{\alpha_0 + \alpha_1 CV_{ULC}^{95} + \alpha_2 X}}{(1 + e^{\alpha_0 + \alpha_1 CV_{ULC}^{95} + \alpha_2 X})^2} \alpha_2 \qquad (6)$$

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 the tables below only the marginal effects on probability are listed.

First we estimated the regression with all of the 28 observations, with each observation being the seven regions CV ratio for a particular industry. Due to our small sample size (28 industry observations), we could only use two variables for each regression. In the case of ULC we also carried out diagnostic tests for ULC to identify influential observations. 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.[20]

Second, as a sensitivity analysis, we did the analysis for the 30 provinces CV ratio as well as the seven region CV ratio. Using the provincial CV ratio as dependent variable generated unsatisfactory results as we did not find any statistically significant relation between convergence and any of the variables. Furthermore the regression results by province appeared very sensitive to the selection of influential points. For these reasons we focused on the logit regressions for the seven region.

The results are summarized in tables 4 (panels a to e). For each dependent variable we report the estimated marginal effect for the 1995 CV ratio and the characterizing variable (for state share and skill we have only one set of observations, whereas for the other variables we have 1995 and 2004 independent characterizing variables). Analogous to R^2 in OLS, a pseudo R^2 is reported, which provides a quick way to describe or compare the fit 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.

[20] The influential observations are detected by the following diagnostic tests demonstrated in Appendix Table A.4: 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. The numbers in this diagnostic test table (Appendix Table A.4) represent the industry code as reported in Appendix Table A.2.

The following observations stand out from the analysis:

1. Among all models, the initial level of CV has a positive significant effect on convergence probability. This implies that if the level of CV in 1995 is high, there is more room for convergence making it easier to reduce the regional inequality over the years.

2. Labor intensity (the inverse of capital intensity) significantly affects the convergence no matter whether we use 1995 data or 2004 data, and no matter whether we exclude the influential points for ULC or not. Specifically, at the sample mean, a 1% increase in labor intensity raises the convergence probability for ULC by 1.5% to 2.3%, depending on the year of the data used and the treatment of influential points. The results for ALC are only between 0.4% to 0.7%, but a much stronger and more significant effect exists for ALP, i.e. between a 3.4% and 4% higher convergence probability for a 1% increase in labor intensity. These results imply that industries with a high share of labor compensation in GVA show a higher probability to converge than capital intensive industries which are more likely to diverge. The latter group of includes industries such as electrical machinery, electronics and transport equipment.

3. Being characterized as a high skill industry significantly reduces the convergence probability for ULC: being a high skill industry has around 30% lower probability to be convergent. This result reinforces the previous result as low skill industries are usually also labor intensive industries and the probability of convergence for these industries are higher than their counterpart. However, in contrast to labor intensity we find no significant result for skills on ALP and ALC convergence.

4. State share and degree of openness do not have statistic significant influence on convergence probability. Firm scale significantly decreases the convergence probability after excluding the influential points, but the magnitude is small: a thousand yuan more in firm size brings down the convergence probability by 0.00013% and 0.0068% using 2004 and 1995 data respectively.

Obviously this analysis could be further improved if we could make use of more observations in our logit analysis. With 28 industry observations we cannot have more than two independent variables (the 1995 CV and the characterizing variable) in our regression[21]. We also have limited room for dropping influential observations. With more observations we can control the regressions for other characteristics, which might strengthen our result. In future work we will be looking for alternative measures to CV's which may give us a large range of observations.

For now we conclude that labor intensive industries have contributed most to the decline in inequality in China – which is partially confirmed by the evidence for typically low-skilled industries, at least for ULC. This observation also raises at least two important questions for the future. As capital intensive industries have been contributing to divergence trends, and with these industries becoming more important in the process of modernizing the manufacturing sector, (1) what is driving this divergence for capital intensive industries and (2) will the aggregate convergence trends continue in the future? We will deal with these questions in a little more detail in the concluding section.

6. Conclusions and further observations

In this paper we have analyzed a detailed data set for China on labor compensation, labor productivity, and unit labor cost measures by manufacturing industry (28) and province (30) in 1995 and 2004. Our estimates show a rapid decline in ULC as a result of much faster productivity growth relative to labor compensation – across the board (province and industry). In contrast to the more widely available evidence of an increased trend in income inequality in China, we find convergence in compensation, productivity and unit labor cost across provinces and major regions, in particular at the aggregate level. Among other things, we find that the rapid convergence in unit labor cost signals an alignment of compensation and productivity, with high levels for both compensation and productivity in one province and low levels for both variables in another province. This alignment of productivity and compensation gaps relative to the national average is due to the transition towards a market economy, which has eradicated inefficient activities where regional productivity and compensation levels relative to the national average are not aligned.

Despite the overall convergence trends, we do find a significant number of industries signaling weak convergence or even divergence trends. In particular chemicals, transport

[21] Because logistic regression uses a maximum likelihood to get the estimates of the coefficients, many of desirable properties of maximum likelihood are found as the sample size increases. According to Long (1997, pages 53-54), at least 10 observations are need for each predictor.

equipment and electronics frequently show divergence trends. Applying a logit analysis we find capital intensive and high skill industries to show a higher probability to diverge rather than converge.

Backed by the evidence of relatively lower levels in inequality of ALC, ALP and ULC at the aggregate level relative to the industry level, we conclude that regions have specialized in industries where they have a comparatively high productivity advantage and pay high compensation levels relative to the national average, and that the different regional distribution of those industries cancels out some of the industry level inequality at the aggregate level . This trend has most likely been driven by liberalization and the drive towards a market economy. Standard neoclassical trade theory would predict that in due time these market reforms may also cause an equalization of compensation and productivity levels at industry levels 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 (Krugman, 1991; Fujita, Krugman and Venables, 1999).

Given the evidence that in particular capital intensive and high skill intensive industries show a tendency towards divergence rather than convergence, we hypothesize that the second strand of explanation might carry some value. As capital and skill intensive industries may in particular be benefiting from typical concentration forces that trigger spillovers (access to capital, education, specialized services, etc.), the greater importance of these industries over time may reduce the convergence trends at the labor intensive end of the spectrum of industries. It may eventually even reverse the convergence trend and trigger divergence.

This hypothesis would also make it possible to align our evidence with that of the generally observed trend of greater inequality in income levels. Indeed it will be higher income workers who benefit more from the concentration and specialization effects, and these high income workers will be mainly located in the capital and skill intensive industries. In contrast the labor intensive industries, which have been driving much of the convergence observed in this study, will decline in importance during the process of industrial modernization, and ultimately become less dominant for the aggregate trend.

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Table 1: Change in Average Labor Compensation (ALC), Labor Productivity (ALP) & Unit Labor Cost (ULC) by Industry Group and Region

ALC Index (04/95)

	Bohai	SouthEast	NorthEast	Central	SouthWest	NorthWest	Tibet	All Nation
Food Products	2.9	3.2	4.6	3.4	3.5	3.7	2.9	3.3
Textile & Clothing	2.4	2.2	3.3	2.4	2.3	2.5	3.2	2.6
Wood & paper	2.8	2.3	3.4	3.1	2.6	3.9	4.2	3.0
Chemicals	2.7	2.6	3.8	3.0	2.8	3.2	0.1	3.0
Metal products	3.6	2.5	3.9	3.4	2.7	3.3	1.7	3.1
Machinery	3.0	2.4	3.6	3.0	3.8	3.4		3.0
Transport equipment	3.1	3.0	3.9	3.9	3.1	3.9	1.6	3.5
Electronics	3.7	2.6	4.8	3.8	4.3	2.8		3.2
Total Manufacturing	3.0	2.5	4.0	3.2	3.2	3.4	1.6	3.0

ALP Index (04/95)

	Bohai	SouthEast	NorthEast	Central	SouthWest	NorthWest	Tibet	All Nation
Food Products	4.1	6.3	8.0	5.1	4.9	7.3	11.1	5.3
Textile & Clothing	3.8	2.8	6.8	3.2	6.4	4.1	5.9	3.6
Wood & paper	4.9	3.5	6.6	5.6	6.0	7.4	6.5	5.0
Chemicals	3.6	4.1	5.8	3.6	6.0	4.4	22.0	4.4
Metal products	5.1	4.3	8.4	5.9	5.4	6.1	3.3	5.5
Machinery	6.0	4.6	8.2	5.2	8.0	7.6		6.2
Transport equipment	6.2	6.0	8.7	7.5	7.6	9.1	1.3	7.4
Electronics	6.6	4.7	7.5	10.3	-1.0	5.1		5.9
Total Manufacturing	4.4	3.9	7.5	5.0	6.0	6.3	7.3	4.9

ULC Index (04/95)

	Bohai	SouthEast	NorthEast	Central	SouthWest	NorthWest	Tibet	All Nation
Food Products	0.69	0.51	0.57	0.68	0.72	0.51	0.26	0.63
Textile & Clothing	0.63	0.79	0.49	0.77	0.37	0.61	0.54	0.70
Wood & paper	0.58	0.67	0.52	0.55	0.44	0.53	0.65	0.60
Chemicals	0.76	0.65	0.66	0.81	0.47	0.72	0.00	0.67
Metal products	0.71	0.59	0.47	0.57	0.50	0.54	0.51	0.57
Machinery	0.50	0.52	0.45	0.57	0.47	0.45		0.49
Transport equipment	0.51	0.50	0.45	0.52	0.41	0.42	1.24	0.47
Electronics	0.56	0.55	0.64	0.37	-4.43	0.54		0.54
Total Manufacturing	0.69	0.63	0.53	0.63	0.53	0.53	0.22	0.62

Table 2: Relative level of Average Labor Compensation (ALC), Labor Productivity (ALP) & Unit Labor Cost (ULC) by Industry Groups and Region in 1995

95 ALC relative to all nation (all nation = 100)

	Bohai	SouthEast	NorthEast	Central	SouthWest	NorthWest	Tibet	All Nation
Food Products	98	135	71	82	113	79	110	100
Textile & Clothing	90	130	61	75	81	80	91	100
Wood & paper	103	139	65	77	108	67	127	100
Chemicals	104	128	84	76	94	88	3575	100
Metal products	88	127	92	87	104	95	179	100
Machinery	96	136	79	79	84	84	57	100
Transport equipment	101	133	91	83	100	78	71	100
Electronics	113	123	59	69	65	92		100
Total Manufacturing	96	129	81	80	96	87	194	100

95 ALP relative to all nation (all nation = 100)

	Bohai	SouthEast	NorthEast	Central	SouthWest	NorthWest	Tibet	All Nation
Food Products	93	106	45	99	178	54	40	100
Textile & Clothing	99	141	33	77	38	62	54	100
Wood & paper	123	143	53	84	83	58	97	100
Chemicals	127	132	85	75	66	69	41	100
Metal products	110	138	76	86	80	88	154	100
Machinery	110	152	60	81	66	56	24	100
Transport equipment	110	167	89	72	75	45	85	100
Electronics	153	124	50	47	54	74		100
Total Manufacturing	112	132	67	82	91	69	78	100

95 ULC relative to all nation (all nation = 100)

	Bohai	SouthEast	NorthEast	Central	SouthWest	NorthWest	Tibet	All Nation
Food Products	105	127	158	83	63	145	274	100
Textile & Clothing	91	92	182	97	210	129	169	100
Wood & paper	84	98	122	92	130	116	130	100
Chemicals	82	97	98	102	144	127	8683	100
Metal products	80	92	121	101	130	108	116	100
Machinery	88	89	131	97	128	149	238	100
Transport equipment	92	79	102	114	134	173	83	100
Electronics	74	99	117	149	120	124		100
Total Manufacturing	85	98	120	98	106	125	250	100

Table 3: Coefficient of Variation in Average Labor Compensation (ALC), Labor Productivity (ALP) & Unit Labor Cost (ULC) by Industry Group in 1995 and 2004

Coefficient of Variation in 1995

	Average Labor Compensation			Labor Productivity			Unit Labor Cost		
	30 provinces	7 regions	3 regions	30 provinces	7 regions	3 regions	30 provinces	7 regions	3 regions
Food Products	0.384	0.231	0.200	1.185	0.546	0.387	0.381	0.507	0.336
Textile & Clothing	0.385	0.246	0.297	0.523	0.526	0.521	0.489	0.353	0.330
Wood & Paper	0.396	0.299	0.320	0.383	0.357	0.367	0.235	0.172	0.062
Chemicals	2.934	2.219	0.225	0.410	0.390	0.323	3.847	2.431	0.110
Metal products	0.323	0.302	0.151	0.435	0.292	0.242	0.250	0.162	0.103
Machinery	0.340	0.276	0.262	0.476	0.531	0.440	0.338	0.400	0.184
Transport Equipment	0.327	0.218	0.160	0.690	0.420	0.395	0.597	0.297	0.301
Electronics	0.374	0.310	0.316	0.869	0.532	0.553	0.594	0.221	0.257
Total Manufacturing	0.330	0.375	0.214	0.435	0.266	0.244	0.302	0.447	0.028

Coefficient of Variation in 2004

	Average Labor Compensation			Labor Productivity			Unit Labor Cost		
	30 provinces	7 regions	3 regions	30 provinces	7 regions	3 regions	30 provinces	7 regions	3 regions
Food Products	0.400	0.177	0.111	0.672	0.294	0.244	0.278	0.171	0.129
Textile & Clothing	0.256	0.202	0.224	0.466	0.242	0.342	0.910	0.145	0.148
Wood & Paper	0.287	0.342	0.162	0.311	0.174	0.098	0.249	0.239	0.068
Chemicals	0.272	0.141	0.140	0.488	0.390	0.184	0.253	0.218	0.047
Metal products	0.230	0.083	0.064	0.414	0.128	0.146	0.216	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	0.322	0.294	0.124	0.775	0.482	0.296	0.409	0.365	0.180
Electronics	0.368	0.203	0.134	1.243	0.745	0.753	1.013	-5.993	1.236
Total Manufacturing	0.219	0.078	0.090	0.336	0.094	0.072	0.177	0.052	0.035

Table 4: Results of Logistic Regression
(Dependent Variable: Between 7 Region CV ratio)

Panel a

	ALC	ALP	ULC	ULC W/O influential obs.
CV 95	.63638	1.049318	1.72852**	2.151693***
State Share 04	-0.4571021*	-1.466559*	-0.8701934	-0.7908715
Pseudo R2	0.3076	0.2135	0.2067	0.2955
Lstat	82.14%	78.57%	67.86%	66.67%

Panel b

	ALC	ALP	ULC	ULC W/O influential obs.
CV 95	0.7279717*	2.12204*	2.808787**	1.922229**
Firm Scale 95	-3.45e-06	-0.0000378	-0.0000566*	-0.0000668*
Pseudo R2	0.3073	0.2515	0.3401	0.5343
Lstat	75.00%	71.43%	78.57%	81.48%

	ALC	ALP	ULC	ULC W/O influential obs.
CV 95	1.142363*	1.574165*	2.18066*	0 .1428081**
Firm Scale 04	-2.68E-06	-0.0000134*	-9.89E-06	-1.31e-06*
Pseudo R2	0.3413	0.3374	0.28	0.5643
Lstat	78.57%	78.57%	75.00%	80.77%

Panel c

	ALC	ALP	ULC	ULC W/O influential obs.
CV 95	0 .4899053*	1.666324*	2.08478**	1.594981 **
Labor Intensity 95	0.3874722**	3.371495***	2.342093 **	1.46804 **
Pseudo R2	0.3221	0.4223	0.33	0.5178
Lstat	82.14%	85.71%	75.00%	84.62%

	ALC	ALP	ULC	ULC W/O influential obs.
CV 95	0.5072548	0.6638421	1.728732*	1.439047**
Labor Intensity 04	0.7346925*	3.957446***	2.244494*	1.828482 *
Pseudo R2	0.2828	0.3365	0.2453	0.4086
Lstat	78.57%	78.57%	75.00%	80.77%

Panel d

	ALC	ALP	ULC	ULC W/O influential obs.
CV 95	0.755508*	1.116353	1.631382 **	1.827841 **
Skill	0.076407	0.0734175	-0.2953392*	-0.2745583*
Pseudo R2	0.1805	0.0605	0.2144	0.3523
Lstat	82.14%	67.86%	67.86%	73.08%

Panel e

	ALC	ALP	ULC	ULC W/O influential obs.
CV 95	0.6485716	0.6538697	1.620994 *	1.916306 **
Openness 95	0.1055371	0.3423524	0.1743057	0.2425459
Pseudo R2	0.1927	0.1444	0.1777	0.3612
Lstat	71.43%	75.00%	60.71%	68.00%

	ALC	ALP	ULC	ULC W/O influential obs.
CV 95	0.4646486	0.7154345	1.69032**	1.799621**
Openness 04	0.1135483	0.1609378	0.0263572	0.0850052
Pseudo R2	0.2394	0.0968	0.1449	0.23
Lstat	78.57%	71.43%	64.29%	73.08%

Note:

ALC means the logit regression is run using the CV of ALC, i.e., the dependent variable is the ALC CV ratio between 7 regions, and CV 95 indicates ALC CV 95. Same notation for ALP and ULC.

ULC W/O influential obs. means that the influential observations are excluded from the logit regression.

* significant at 10% level, ** significant at 5% level, *** significant at 1%* level

State share: state capital and collective capital among total capital hold

Firm Scale: total GVA/number of firms, in thousand

Labor intensity: total labor compensation among total GVA

Skill level: categorical variable, with 1 being high skill industry and 0 being low skill industry. Based on the skill level classification in Africa (Kochhar et al., 2006)

Openness: export value/GVA

Figure 1: Change in Average Labor Compensation (ALC), Labor Productivity (ALP) & Unit Labor Cost (ULC) by Province for Total Manufacturing

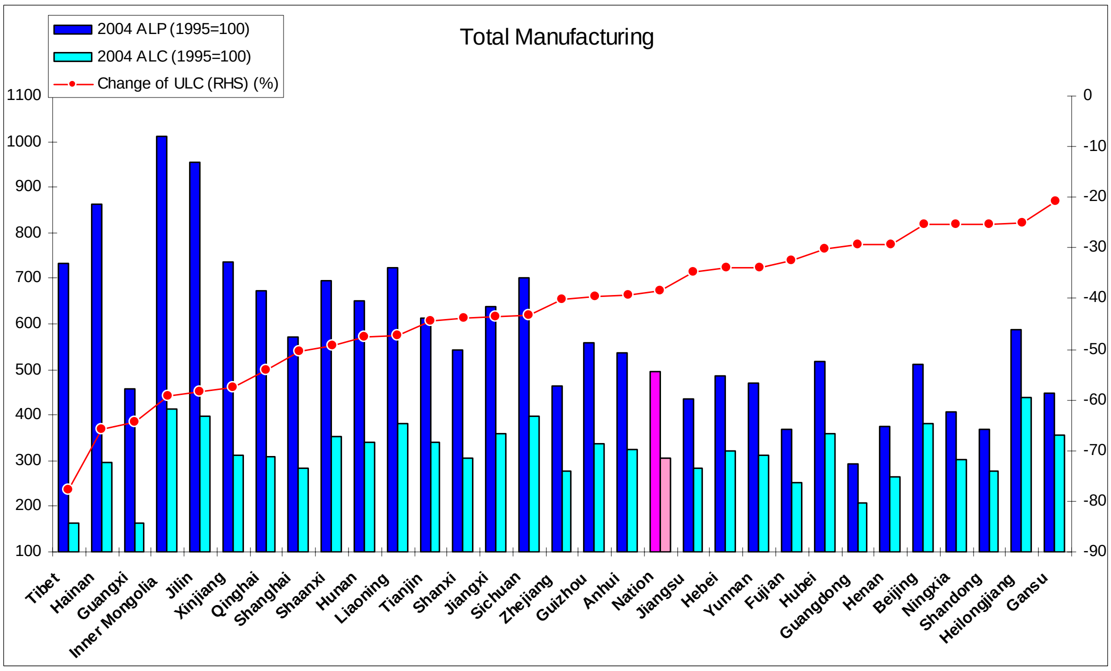


Figure 2: Change in Average Labor Compensation (ALC), Labor Productivity (ALP) & Unit Labor Cost (ULC) by Industry for Whole Nation

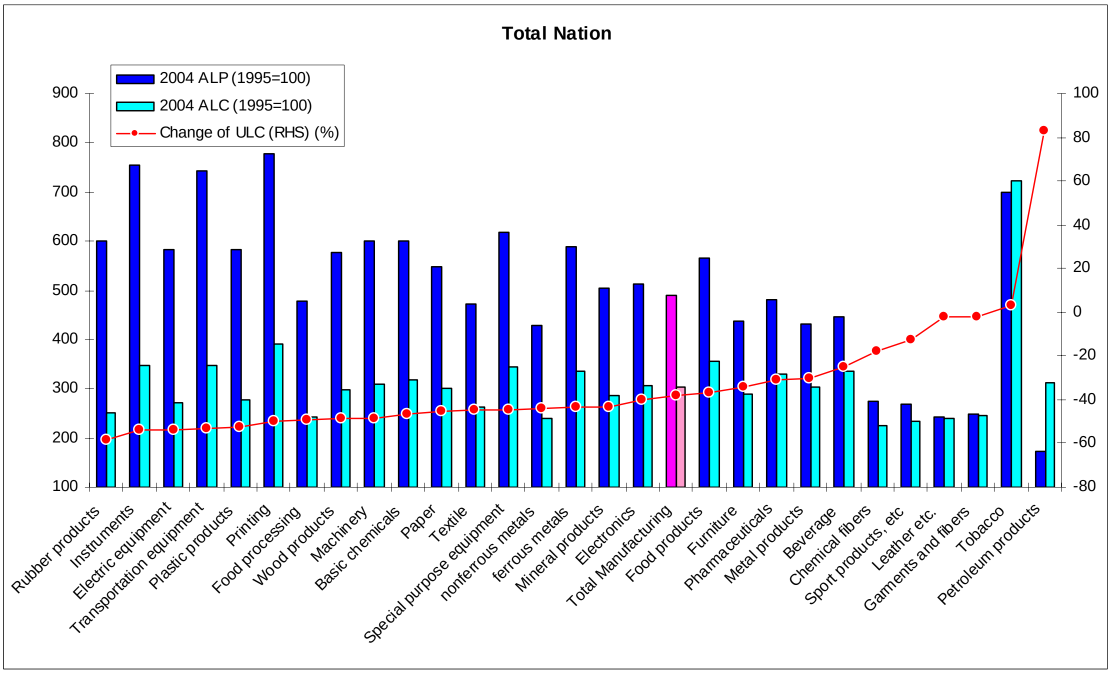


Figure 3a: Coefficient of Variation for Average Labor Compensation (ALC)

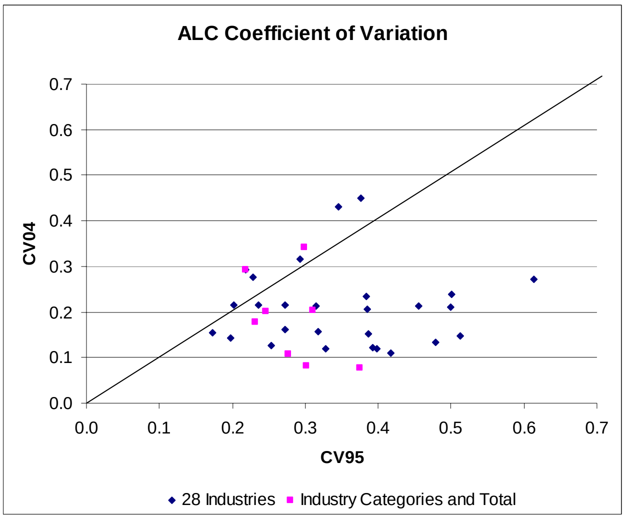


Figure 3b: Coefficient of Variation for Labor Productivity (ALP)

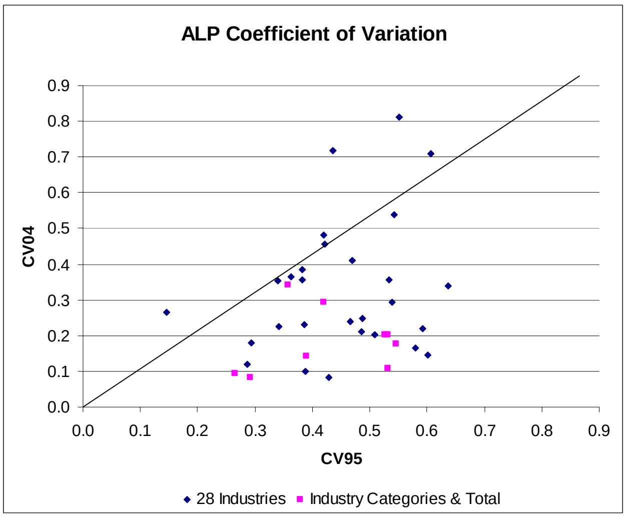


Figure 3c: Coefficient of Variation for Unit Labor Cost (ULC)

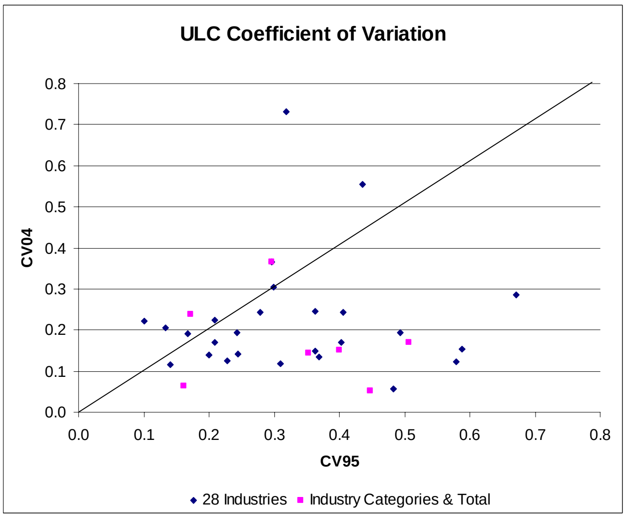
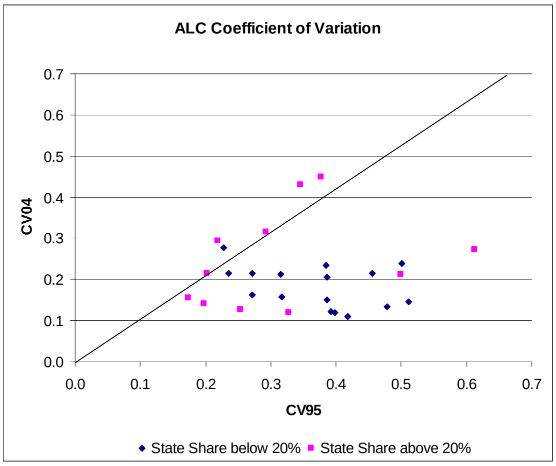
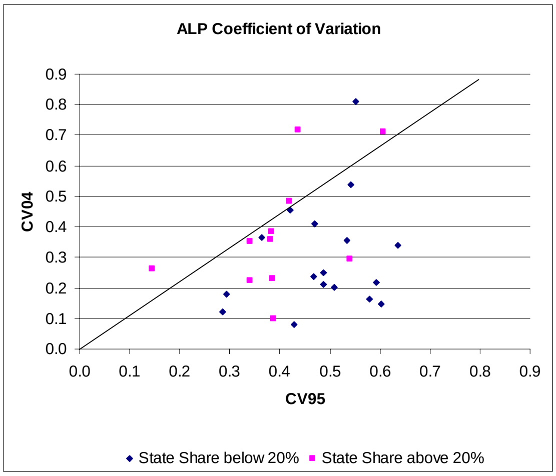


Figure 4: Coefficient of Variation grouped by State Share





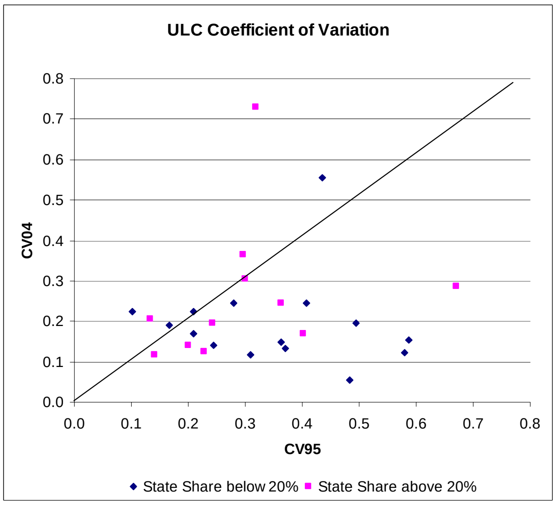
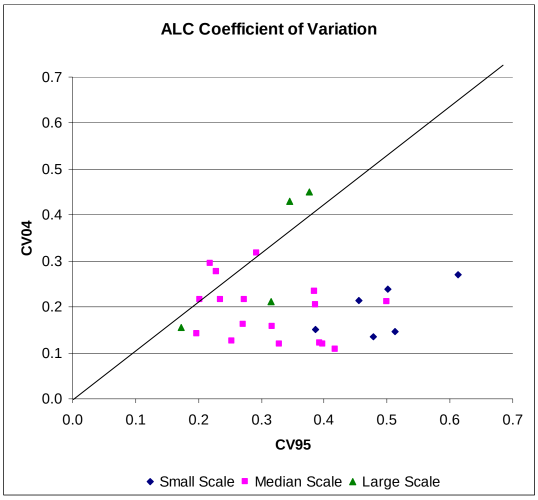
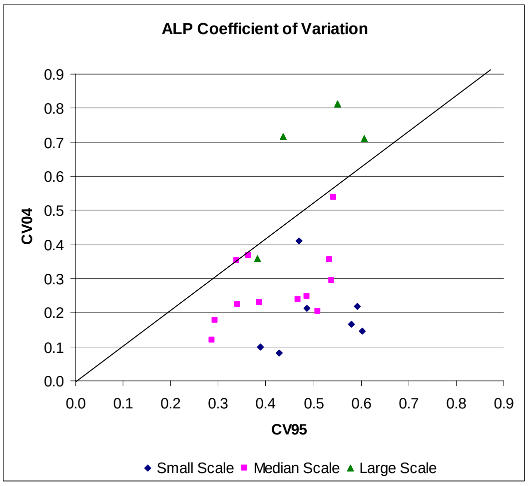


Figure 5: Coefficient of Variation grouped by Firm Size





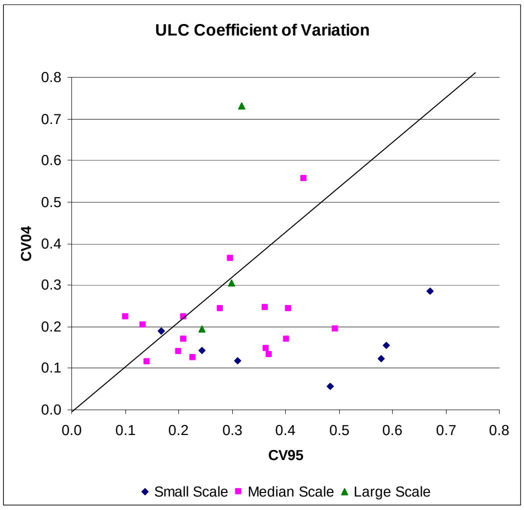
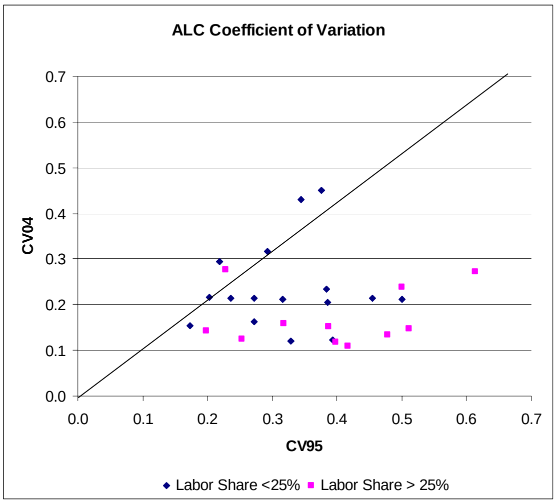
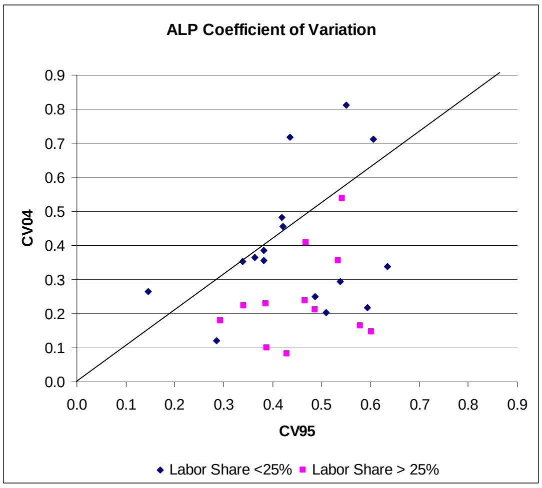


Figure 6: Coefficient of Variation grouped by Labor Intensity





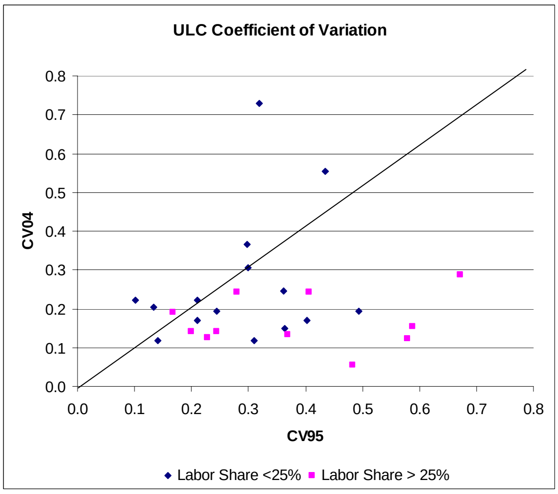
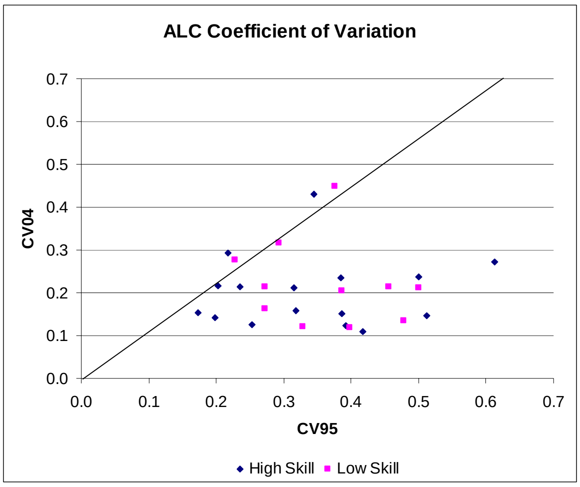
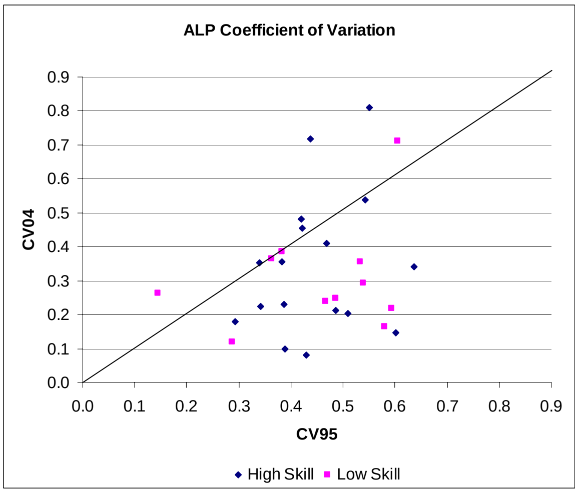


Figure 7: Coefficient of Variation grouped by Skill Level





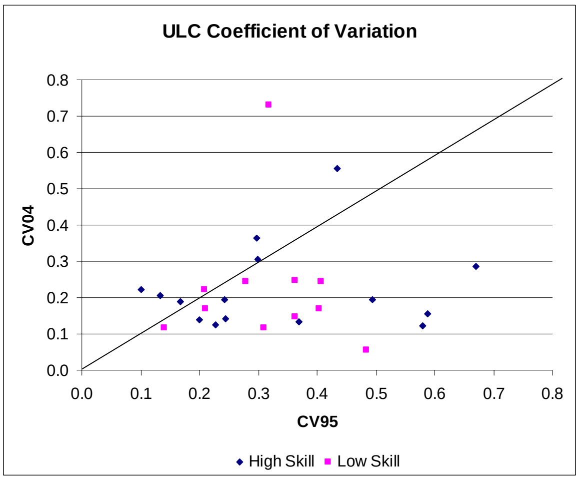
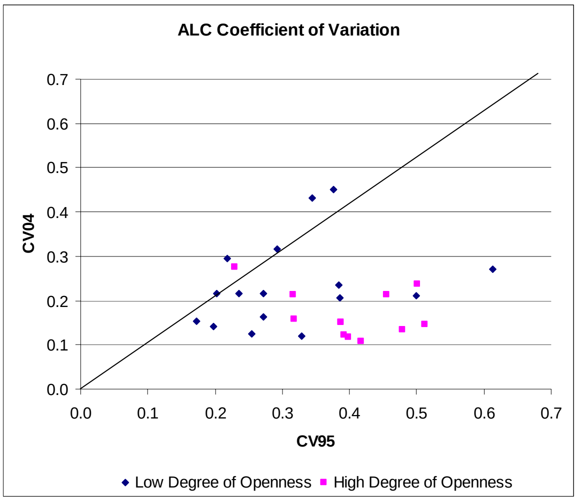
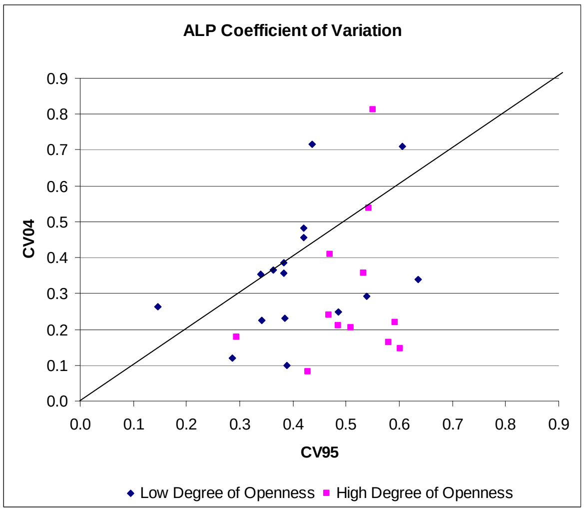
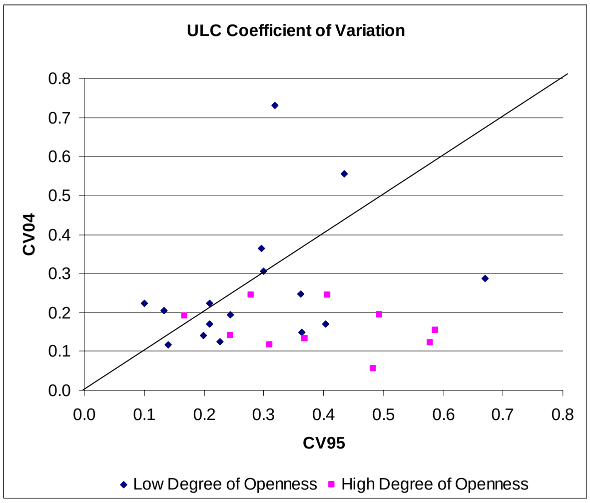


Figure 8: Coefficient of Variation grouped by Openness







Appendix A.1: Average Labor Compensation (ALC), Labor Productivity (ALP) & Unit Labor Cost (ULC) by Industry at the National Level

	ALC (Nominal Value)			ALP (95 Value)			Current Value	ULC (95 Value)			Current Value
	95	04	04/95	95	04	04/95	04	95	04	04/95	04
Food processing	5033	12200	2.424	20505	97904	4.775	100068	0.245	0.125	0.508	0.122
Food products manufacturing	4541	16194	3.566	13622	77061	5.657	78764	0.333	0.210	0.630	0.206
Beverage manufacturing	5192	17465	3.364	23716	106099	4.474	108445	0.219	0.165	0.752	0.161
Tobacco processing	11192	80797	7.219	190604	1335425	7.006	947484	0.059	0.061	1.030	0.085
Textile industry	4890	12787	2.615	10295	48610	4.722	43275	0.475	0.263	0.554	0.295
Garments and other fiber products	5496	13428	2.443	12832	32037	2.497	33910	0.428	0.419	0.979	0.396
Leather, furs, down and related products	5230	12464	2.383	13297	32416	2.438	34124	0.393	0.385	0.977	0.365
Timber, bamboo, natural fiber & straw products	3785	11257	2.974	9141	52773	5.774	48557	0.414	0.213	0.515	0.232
Furniture manufacturing	4765	13756	2.887	11284	49273	4.367	45337	0.422	0.279	0.661	0.303
Papermaking and paper products	4821	14447	2.997	12790	69998	5.473	67538	0.377	0.206	0.548	0.214
Printing & record medium reproduction	5093	19883	3.904	11289	87774	7.775	62276	0.451	0.227	0.502	0.319
Cultural, educational, and sport products	5643	13222	2.343	12704	34033	2.679	28410	0.444	0.389	0.875	0.465
Petroleum processing and coking products	9368	29353	3.133	70795	121428	1.715	249916	0.132	0.242	1.827	0.117
Chemical raw materials & products	6439	20573	3.195	19542	117535	6.014	109772	0.330	0.175	0.531	0.187
Medical & pharmaceutical products	6511	21563	3.312	22868	109802	4.802	102550	0.285	0.196	0.690	0.210
Chemical fibers manufacturing	8375	18808	2.246	36126	98813	2.735	92287	0.232	0.190	0.821	0.204
Rubber products	6035	15130	2.507	14111	84917	6.018	60249	0.428	0.178	0.417	0.251
Plastic products	5477	15132	2.763	14024	81545	5.815	57856	0.391	0.186	0.475	0.262
Nonmetal mineral products	4742	13564	2.860	11257	56739	5.040	55284	0.421	0.239	0.567	0.245
Smelting & pressing of ferrous metals	8674	29037	3.348	27119	160035	5.901	168352	0.320	0.181	0.567	0.172
Smelting & pressing of nonferrous metals	8732	20919	2.396	24522	105407	4.298	110884	0.356	0.198	0.557	0.189
Metal products	5218	15778	3.024	13549	58656	4.329	61704	0.385	0.269	0.698	0.256
Ordinary machinery manufacturing	6189	19102	3.086	13770	82488	5.990	67628	0.449	0.232	0.515	0.282
Special purpose equipment manufacturing	5952	20423	3.431	12539	77314	6.166	63387	0.475	0.264	0.556	0.322
Transportation equipment manufacturing	7199	24928	3.463	19070	141609	7.426	100471	0.377	0.176	0.466	0.248
Electric equipment and machinery	6694	18124	2.707	19388	113277	5.843	80370	0.345	0.160	0.463	0.226
Electronics and telecommunications	7817	23945	3.063	32506	166995	5.137	118483	0.240	0.143	0.596	0.202
Instruments & stationery machine tools	6281	21720	3.458	12750	96145	7.541	68215	0.493	0.226	0.459	0.318
Total manufactuirng	5949	18043	3.033	17498	85494	4.886	80769	0.340	0.211	0.621	0.223

Table A.2: 8 Industry Categories

Industry Category	Industry	Industry code
Food Products	Food processing	1
	Food products manufacturing	2
	Beverage manufacturing	3
	Tobacco processing	4
Textile & Clothing	Textile industry	5
	Garments and other fiber products	6
	Leather, furs, down and related products	7
Wood & Paper	Timber, bamboo, natural fiber & straw products	8
	Furniture manufacturing	9
	Papermaking and paper products	10
	Printing & record medium reproduction	11
	Cultural, educational, and sport products	12
Chemicals	Petroleum processing and coking products	13
	Chemical raw materials & products	14
	Medical & pharmaceutical products	15
	Chemical fibers manufacturing	16
	Rubber products	17
	Plastic products	18
Metal Products	Nonmetal mineral products	19
	Smelting & pressing of ferrous metals	20
	Smelting & pressing of nonferrous metals	21
	Metal products	22
Machinery	Ordinary machinery manufacturing	23
	Special purpose equipment manufacturing	24
	Electric equipment and machinery	26
Transport Equipment	Transportation equipment manufacturing	25
Electronics	Electronics and telecommunications	27
	Instruments & stationery machine tools	28

Seven region group

7 Regions	Provinces
Bohai	Beijing
	Tianjin
	Hebei
	Shandong
SouthEast	Shanghai
	Jiangsu
	Zhejiang
	Fujian
	Guangdong
NorthEast	Liaoning
	Jilin
	Heilongjiang
Central	Anhui
	Jiangxi
	Henan
	Hubei
	Hunan
SouthWest	Guangxi
	Hainan
	Sichuan
	Guizhou
	Yunnan
NorthWest	Shanxi
	Inner Mongolia
	Shaanxi
	Gansu
	Qinghai
	Ningxia
	Xinjiang
Tibet	Tibet

Table A.3: Coefficient of Variation for Industries and Industry Groups

Coefficient of Variation between 7 Regions

	ALC		ALP		ULC	
	CV95	CV04	CV95	CV04	CV95	CV04
Food processing	0.272	0.163	0.286	0.120	0.363	0.149
Food products manufacturing	0.386	0.206	0.486	0.249	0.209	0.170
Beverage manufacturing	0.293	0.316	0.383	0.385	0.403	0.170
Tobacco processing	0.377	0.450	0.606	0.710	0.318	0.731
Textile industry	0.228	0.277	0.534	0.357	0.407	0.244
Garments and other fiber products	0.478	0.134	0.580	0.165	0.483	0.056
Leather, furs, down and related products	0.398	0.118	0.467	0.238	0.279	0.244
Timber, bamboo, natural fiber & straw products	0.455	0.214	0.593	0.219	0.310	0.118
Furniture manufacturing	0.512	0.146	0.602	0.146	0.588	0.154
Papermaking and paper products	0.272	0.215	0.363	0.366	0.209	0.224
Printing & record medium reproduction	0.613	0.271	0.388	0.100	0.671	0.286
Cultural, educational, and sport products	0.387	0.151	0.486	0.212	0.245	0.142
Petroleum processing and coking products	0.345	0.430	0.436	0.717	0.299	0.305
Chemical raw materials & products	0.202	0.216	0.340	0.352	0.133	0.205
Medical & pharmaceutical products	0.384	0.234	0.421	0.455	0.101	0.223
Chemical fibers manufacturing	0.235	0.215	0.636	0.340	0.435	0.555
Rubber products	0.417	0.109	0.293	0.179	0.369	0.134
Plastic products	2.511	0.148	0.429	0.081	0.579	0.123
Nonmetal mineral products	0.500	0.212	0.539	0.293	0.140	0.117
Smelting & pressing of ferrous metals	0.173	0.155	0.382	0.357	0.243	0.195
Smelting & pressing of nonferrous metals	0.328	0.120	0.145	0.264	0.362	0.246
Metal products	0.501	0.238	0.469	0.410	0.167	0.190
Ordinary machinery manufacturing	0.254	0.125	0.386	0.230	0.200	0.140
Special purpose equipment manufacturing	0.198	0.142	0.341	0.224	0.228	0.125
Transportation equipment manufacturing	0.218	0.294	0.420	0.482	0.297	0.365
Electric equipment and machinery	0.393	0.122	0.509	0.203	0.494	0.194
Electronics and telecommunications	0.315	0.212	0.551	0.812	0.250	6.600
Instruments & stationery machine tools	0.318	0.158	0.542	0.539	0.262	1.964
Total manufactuirng	0.375	0.078	0.266	0.094	0.447	0.052
Food	0.231	0.177	0.546	0.177	0.507	0.171
Textile & clothes	0.246	0.202	0.526	0.202	0.353	0.145
Wood & paper	0.299	0.342	0.357	0.342	0.172	0.239
Chemicals	2.219	0.141	0.390	0.141	2.431	0.218
Metal product	0.302	0.083	0.292	0.083	0.162	0.063
Machine	0.276	0.107	0.531	0.107	0.400	0.151
Transportation	0.218	0.294	0.420	0.294	0.297	0.365
Electronics	0.310	0.203	0.532	0.203	0.221	-5.993

Coefficient of Variation between 30 Provinces

	ALC		ALP		ULC	
	CV95	CV04	CV95	CV04	CV95	CV04
Food processing	0.341	0.234	0.410	0.292	0.348	0.249
Food products manufacturing	0.512	0.401	0.594	0.451	0.329	0.267
Beverage manufacturing	0.509	0.495	0.579	0.453	0.338	0.249
Tobacco processing	0.529	0.623	0.911	0.979	0.602	0.826
Textile industry	0.316	0.311	0.560	0.579	0.544	0.485
Garments and other fiber products	0.943	0.344	0.612	0.359	0.573	0.191
Leather, furs, down and related products	0.500	0.289	0.587	0.505	0.519	0.354
Timber, bamboo, natural fiber & straw products	0.487	0.298	0.633	0.337	0.847	0.207
Furniture manufacturing	0.666	0.267	0.558	0.490	0.731	0.375
Papermaking and paper products	0.420	0.454	0.392	0.431	0.268	0.307
Printing & record medium reproduction	0.470	0.278	0.530	0.434	0.432	0.269
Cultural, educational, and sport products	0.527	0.334	0.760	0.381	0.493	0.353
Petroleum processing and coking products	0.447	0.432	0.738	0.792	1.239	0.523
Chemical raw materials & products	0.372	0.354	0.493	0.844	0.536	0.360
Medical & pharmaceutical products	0.374	0.374	0.449	0.447	0.278	0.233
Chemical fibers manufacturing	0.397	1.053	0.887	2.196	1.283	3.239
Rubber products	0.862	0.239	0.761	0.529	1.308	15.314
Plastic products	4.457	0.269	0.565	0.463	1.372	0.574
Nonmetal mineral products	0.376	0.272	0.488	0.393	0.195	0.221
Smelting & pressing of ferrous metals	0.274	0.436	0.638	0.976	0.419	0.328
Smelting & pressing of nonferrous metals	0.984	0.214	0.504	0.381	0.671	0.291
Metal products	0.422	0.233	0.507	0.602	0.280	0.344
Ordinary machinery manufacturing	0.344	0.274	0.494	0.443	0.306	0.248
Special purpose equipment manufacturing	0.296	0.313	0.435	0.506	0.380	0.585
Transportation equipment manufacturing	0.327	0.322	0.690	0.775	0.597	0.409
Electric equipment and machinery	0.391	0.239	0.494	0.417	0.406	0.349
Electronics and telecommunications	0.396	0.390	1.013	1.024	0.848	1.416
Instruments & stationery machine tools	0.452	0.355	0.681	0.927	0.787	0.488
Total manufactuirng	0.330	0.219	0.435	0.336	0.302	0.177
Food	0.384	0.400	1.185	0.672	0.381	0.278
Textile & clothes	0.385	0.256	0.523	0.466	0.489	0.910
Wood & paper	0.396	0.287	0.383	0.311	0.235	0.249
Chemicals	2.934	0.272	0.410	0.488	3.847	0.253
Metal product	0.323	0.230	0.435	0.414	0.250	0.216
Machine	0.340	0.249	0.476	0.399	0.338	0.254
Transportation	0.327	0.322	0.690	0.775	0.597	0.409
Electronics	0.374	0.368	0.869	1.243	0.594	1.013

Table A.4: Diagnostic Tests for Influential Points in ULC Logit Regression

	Standardized Pearson Residue	Deviance Residue	Hat Diagonal	chi square fit	deviance	dbeta	Influential Points to be dropped
State Share	16	16	4	16	16	16	16
Firm Scale 95	20	20	16	20	20	20, 16	20
Firm Scale 04	16, 20		13, 20	16, 20	16, 20	20	16, 20
Labor Intensity 95	28	28	3, 16	28	16, 25, 28	16, 28	16, 28
Labor Intensity 04	16, 28		4	16, 25, 28	16, 28	16, 28	16, 28
Skill	4		19, 20	4, 16	4, 16	4, 16	4, 16
Openness 95	16		7, 12	16, 19	16, 19, 27	16, 19, 27	16, 19, 27
Openness 04	16		12, 27	16	16	16, 27	16, 27

Numbers indicate industry code, please refer to appendix Table A.2