Inequality and Productivity Growth in China

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1. Introduction

China has seen spectacular economic growth over the past thirty years with GDP growth averaging at nine percent per year. According to recent estimates from the World Bank, China's absolute poverty rate has decreased from over 70% at the beginning of the reform in 1978 to only 15% in 2004.[1] This elevation from poverty of more than a half billion persons is an unparalleled achievement in the history of economic development. Yet, the inequality picture in China has been less optimistic. One inequality metric, the urban-rural income ratio, was at an alarmingly high level of 3.28:1 in 2006,[2] one of the highest in the world. The former Chinese leader, Deng Xiaoping, is quoted as saying: "Let some people get rich first; to get rich is glorious." During at least the first 30 years of China's robust economic growth, it appears that a rising middle class, particularly in China's urban coastal region, was a corollary of rapid growth. The central question of this paper is whether over the next 30 years, high growth will entail the continuing growth of inequality.

In this paper, we tackle the relationship between China's inequality and productivity growth, and economic growth in general, from a unique perspective. We are not trying to produce another empirical research proving or disapproving the negative (or positive) relationship between the two. Economists have produced rather ambiguous results in this area. Those whose research concludes that inequality is bad for economic growth include Persson and Tabellini (1992) and Alesina and Perotti (1996), among others; on the opposite side, Forbes (2000) and Barro (2000) present some strong

[1] Absolute poverty rate is defined as percentage of people living under $1 per day in PPP term. The newest estimate of the $1 per day poverty rate in China is in the range of 13-17%. In contrast, at the beginning of the reform, the poverty rate was in 71-77% range. Source: World Bank, http://eapblog.worldbank.org/content/new-ppps-reveal-china-has-had-more-poverty-reduction-than-we-thought

[2] Source: Statistical Yearbook of China, 2007, National Bureau of Statistics (NBS).

evidence against the proposition that inequality is bad for growth. This paper takes a different approach. We argue that a decline in inequality and economic growth are not necessarily in conflict with each other. Specifically, this paper argues that in order to sustain China's high economic growth in coming decades, China will have to rely on a more balanced approach toward its economic development across regions. We show despite the fact that labor productivities in the interior regions are at a relatively lower level compared to the coastal region, they nonetheless have recently grown much faster. As a result, the productivity gap between the coastal and interior regions has been shrinking rather quickly. For example, from our calculation, during the 1995-2004 period, labor productivity in the western China has risen a cumulative 486%, whereas in the coastal area the growth rate was only about 263%,[3] a notable tendency toward productivity convergence. This convergence of labor productivity implies that China may be able to improve its current highly skewed income distribution while sustaining an overall high growth rate. As labor productivities across regions converge, income inequality will naturally improve.

We support our argument with overwhelming empirical evidence using industry-province level data. Our empirical analysis includes 14 major industrial branches in 31 provinces and municipalities from 1995 to 2004. We adopt the same empirical research framework as in Jefferson, Hu and Su (2006, JHS for short hereafter). Using aggregated data[4] of 14 industrial branches for each of China's 31 provinces, we investigate how the initial productivity gap of each industry-province observation with the international frontier affects future labor productivity growth. We measure productivity gap of each

[3] These were calculated using 1997 constant Yuan price.
[4] The aggregation method is described in data section.

industry-province observation by its relative distance to the productivity level at the international frontier within the same industry. For simplicity, we use the productivity level of each corresponding U.S.' industry as the proxy for the international technology frontier. Compared to JHS (2006), we extend the analysis one step further by constructing a unique series of industry-level PPPs for our China-US labor productivity comparison. JHS paper converted local productivity level to the US dollar using the uniform official exchange rate for *all* industries. In this paper, we use industry-level PPPs to better capture the different market conditions and price differences across different industries. In addition, we adjust the value-added in *current* prices to *constant* prices using the ex-factory price index at industry level.

Our main research finding is: the initial gap with frontier productivity plays an important role in determining productivity growth trajectory for Chinese industry --- The larger the initial gap for a given industry-province observation, the higher the subsequent growth rate of labor productivity. That is, the advantages of backwardness appear to motivate higher productivity growth for industry-provinces with relatively low productivities.

The rest of the paper is organized as follows: In the next section, we provide an overview of the inequality in China, in which we focus on the main sources and characteristics of China's inequality. In section three and four, we first outline our empirical estimation strategies, then we describe the data used for the research. We present our empirical results in section five, and the final section concludes.

2. Overview of China's Inequality and Productivity Growth

To get a comparative picture of China's inequality, another natural question to ask is how China's inequality compares to the rest of the world. According to Milanovic et al. (2007), China's Gini coefficient sits approximately in the middle among all countries. The Gini index for China in 2001 was at 41.6, worse than India at 32.6, UK at 37.4 and the US at 39.9, but slightly better than Turkey at 43.6, and much better than Malaysia at 47.9, Thailand at 50.9, Mexico at 53.8 and Brazil at 58.8.

Two distinctive features characterize China's inequality. First, there exists a huge income gap between urban and rural area. According to the estimate by Wan (2006), the urban-rural inequality accounts for 70-80% of China's overall inequality. The recent read on the income ratio between the urban and rural is 3.28:1, one of the highest in the world. However, contrary to the common belief, this huge income gap was not a direct result of economic reform initialized 30 years ago. Rather, it was largely a result of the legacy policies during the Mao-era. In the early years after 1949, to support rapid industrialization and to prepare for a possible military attack from the U.S., and later Soviet Union, China shifted huge resources into heavy industries. Policies were adopted that strongly favored urban dwellers to rural farmers. Urban workers received large amount of subsidies while income for rural farmers was intentionally depressed. In addition, collective farming was common in rural area, and it resulted in miserable agricultural productivity. As shown in Figure 1, in 1978 right before the reform, the urban-rural income ratio was in fact already at a very high level of 2.6:1. The income gap since 1978 has only increased gradually over the next thirty years. One exception was that during the early reform period (1978-1985), when the urban-rural income gap actually shrank as the "household individual responsibility system" had greatly increased labor productivity in the rural area. Still, when it comes to discussing China's inequality, the most common misconception is that economic reform had been the sole cause of today's high urban-rural income gap.

The second feature concerning China's inequality is that the income gap between the coastal and interior regions has increased dramatically since the reform began. Such gap was almost non-existent before the economic reform. China's economic policies in the early reform era have contributed to this sharply rising regional income disparities. As part of the gradualist approach, China first opened its borders of its coastal region to foreign trade and investment, and established various Special Economic Zones (SEZs) in the area. Those SEZs received disproportionate share of government support while offering foreign investors preferential tax treatment. In the years that followed, through a process of self-reinforcement, the region had formed its comparative advantage in export-oriented manufacturing and had attracted the majority of international capital inflow into China. Not surprisingly, the coastal region led well ahead of other regions in its economic takeoff. By 2005, the income gap between the eastern region and the rest of the country increased to more than 2:1.

With above big-picture about China's inequality in mind, next we analyze China's inequality in more details by comparing the *level* and *growth* of labor productivity across different regions. In Table 2-1, we present China's industrial labor productivity and growth rate by region, from 1995 to 2004. We report three different methods in our productivity calculation. The first method converts labor productivity into 1997 constant US dollar using 1997 industry-level PPPs;[5] the second method adjusts productivity in current-price Yuan to 1997 constant price, without currency conversion; The last method simply reports productivity in *current* Yuan prices, again without currency conversion.

Regardless of which method we use, the overall picture looks very similar. First, large disparities exist in the level of productivity across regions, with the coastal region positioning well ahead of other regions.[6] For example, in 1995, when measured in 1997 PPP USD, labor productivity in the coastal region is around $6,000 per employee-year, compared to $2,790 per employee-year in the western region, a ratio of 2.15:1. Put in another way, the labor productivity in the west is only about 46% of the east (see Table 2-2 for more details). Such gap, however, has declined over the years: in 2004, the labor productivity in the coastal region increased to $20,470, compared to $14,580 per employee-year in the west, resulting in a smaller ratio of 1.4:1. In terms of relative productivity to the coastal region, labor productivity in the west increased from 46% of that in the coastal region to 71% (again refer to Table 2-2 for details).

Secondly, in terms of growth rate, the interior regions have enjoyed a much faster productivity growth than the coastal region. For example, in constant Yuan term, from 1995 to 2004, the western region had experienced a staggering 486% increase in its labor productivity, while the growth in the coastal region was much slower, at 263%, or 54% of the growth rate in the wetern region. In general, during the 1995-2004 period, amongst

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[5] We describe how we calculated industry-level PPPs in Section 4.

[6] The coastal region includes the following cities or provinces: Beijing, Tianjin, Shanghai, Hebei, Shangdong, Jiangsu, Zhejiang, Fujian, Guangdong, Hai'nan; the northeastern region includes Liaoning, Jilin and Helongjiang; the central region includes Shanxi, He'nan, Hubei, Hu'nan, Anhui, Jiangxi and Guangxi; The western region includes Shaaxi, Sichuan, Chongqing, Yun'nan, Guizhou, Gansu, Ningxia, Qinghai, Neimenggu, Xinjiang and Xizang (Tibet).

all four regions, the northeastern region had grown the fastest, and it was followed by the western region and central region. The coastal region lagged other three regions in terms of labor productivity growth. These results are similar to the previous research by Jefferson, Rawski and Zhang (2008).

3. Estimation Strategy

In this section, we introduce our empirical model and outline our estimation strategy. We proceed by first describing our basic model setup in Section 3.1, then we introduce the model extensions in Section 3.2.

3.1. Basic Model

Our basic model is shown in equation (1). The variables are indexed at industry i, province j, and year t. Our model was directly taken out from JHS (2006).

$$
\begin{aligned}
[\ln(VA/L)_{i,j,2004} - \ln(VA/L)_{i,j,1995}] = {} & \alpha_0 + \alpha_1 \ln(GAP\_Front)_{i,j,1995}) \\
& + \alpha_2 \ln(GAP\_Front)_{i,j,1995} * regional\_dummies \\
& + \alpha_3 [\ln(GAP\_Front)_{i,j,1995}]^2 \\
& + \alpha_4 [\ln(VA/L)_{Front,j,2004} - \ln(VA/L)_{Front,j,1995}] + \varepsilon_{ij}, \qquad (1)
\end{aligned}
$$

The dependent variable is the growth of labor productivity at industry-province level for the period from 1995 to 2004. Labor productivity is measured by the value-added per person-year. The main explanatory variable is *Gap_Front,* or productivity gap between Chinese industries and the international frontier, proxied by the productivity level of the corresponding industries in the US. The gap with the frontier is the initial gap at the beginning year, 1995.

We expect the coefficient of the initial productivity gap, or α_1, to be positive. Our hypothesis is that as Chinese industry productivities narrow down the technology gap with the international frontier, those industry-province observations whose productivity levels are farther way form the international frontier will have relatively faster productivity growth rate in subsequent years than those with smaller productivity gap. This is essentially another way of saying productivity growth across different industry-provinces tends to converge over time.

So why do we bother to compare China's productivity with the international frontier? Why not just analyze the convergence of productivity growth within China? To answer that, first, our approach of expressing the initial productivity gap with respect to the international frontier enables us to conduct analysis from an international perspective. We are especially interested in knowing how the current industrial productivity in China compare to the US, and how this will imply on whether and when China will catch up with the US.[7] Also, China is an exceedingly open economy with a great deal of international trade, long-term capital and technology inflows, hence productivity growth of Chinese industries is believed to be greatly influenced by international technology and its gap with the international frontier. In addition, there is technical concern. If we were to measure productivity gap between China's coastal region and interior regions, we would lose the observations in coastal area in our regression analysis and such loss of coastal observations will make our analysis impossible on the productivity responses of coastal industries to the frontier productivity gap.

[7] After 30 years of high sustained growth, China's prospect of catching up with the US in coming decades has attracted a lot of attentions lately, see, for example, Robert Fogel (2006, 2007).

Another main variable we included in our regression analysis is the *growth* of frontier productivity itself. As the productivity at the frontier is constantly moving, this variable serves as a control variable and will be useful in our analysis on international productivity convergence. Indeed, the likelihood of China catching up with the US is a function of at least two variables: How fast China is moving up along the existing technological ladder, and how fast the US is moving onto the next new frontier. The expected sign of the coefficient, α_4, could be either positive or negative. A positive sign indicates a world of less friction in technology's international transfer and diffusion. In contrast, a negative sign may be an indication that Chinese industries have intensified their specialization in the lower-end manufacturing with the international frontier advancing forward.

In the basic model, we also included two additional variables: square of initial productivity gap, and the interaction term between initial productivity gap and regional dummy variable. We will discuss those two variables in details in Section 5, where we present our regression results.

Compared to the model in JHS (2006), there are some notable differences between the two versions. First and foremost, variable *GAP_Front*, or the initial productivity gap with the international frontier, was derived using industry-level PPPs, instead of using a uniform market exchange rate. The obvious rationale to use PPPs versus market exchange rate is that the former helps to avoid large fluctuations of market exchange rates due to, for example, short term international capital flows. This volatility tends to greatly distort international productivity comparisons. But since China's official exchange rate remained almost unchanged during 1995-2004, the volatility was actually not a major concern here. However, under China's fixed exchange rate system, the government set the official exchange rate arbitrarily. The official exchange rate, at about 8.27 Yuan per US Dollar, was almost unchanged during 1995-2004. This arbitrary number cannot reflect the relative price and productivity changes between the two countries and tends to distort China's real productivity growth. In addition, when it comes to which PPP exchange rate to use in international productivity comparisons, there is a strong case to be made for using industry-level PPPs (also called industry-of-origin PPPs) over the regular PPP and the official exchange rate, and its advantages are well documented in Maddison and Van Ark (1988) and Van Ark (1993). In a nutshell, industry PPPs better capture the industry-specific dynamics, including market structure, technological changes, which makes industry-specific performance comparisons across countries possible and more accurate.

The second difference is that this research focuses on the 14 major branches of China's manufacturing industry, instead of the more detailed SIC 2-digit industry classifications in JHS (2006).[8] The main reason for using 14 industrial branches is that in order to calculate industry PPPs, the ex-factory price index is needed. However, the ex-factory price index at the 2-digit industry level is only available from 2003; the index for the 14 major industrial branches can be traced back all the way to 1980. Since ex-factory price is vital in deriving our industry-level PPPs, we decided to match the more detailed 2-digit industries into the 14 major industrial branches.

3.2. Model Extensions

[8] SIC-2 industry classifications are from the Large and Medium Enterprises dataset from National Bureau of Statistics of China. Please refer to Data section for details.

Our basic empirical model is presented in equation (1), and it aims to replicate the results in Jefferson, Hu and Su (2006). We extend the basic model in two versions in equation (2) and (3), respectively.

Equation (2) splits the ten-year period from 1995 to 2004 into two separate periods, 1995-2000 and 2000-2005, and stacks (pools) them together in one regression. The purpose of doing so is to test whether the results in equation (1) are sensitive to the time length used in variable calculations.

$$\begin{aligned}
[\ln(VA/L)_{i,j,2000/2004} - \ln(VA/L)_{i,j,1995/2000}] = {} & \alpha_0 + \alpha_1 \ln(GAP_Front)_{i,j,1995/2000} \\
& + \alpha_2 \ln(GAP_Front)_{i,j,1995/2000} * regional_dummies \\
& + \alpha_3 [\ln(GAP_Front)_{i,j,1995/2000}]^2 \\
& + \alpha_4 [\ln(VA/L)_{Front,j,2000/2004} - \ln(VA/L)_{Front,j,1995/2000}] + \varepsilon_{ij} \qquad (2)
\end{aligned}$$

As pointed out in Forbes (2000),[9] the *length* of time period has big influence on the estimation of the relationship between inequality and growth, and it was one of the major causes to the empirical ambiguity in the relationship between inequality and economic growth. As we change the length of time period from ten years in equation (1) to five years, the number of observations also doubled.

In equation (3), we aggregate the dataset, which is indexed by industry i-province j-year t, into two-dimensional dataset by province j, and year t.

$$\begin{aligned}
[\ln(VA/L)_{jt} - \ln(VA/L)_{jt-1}] = {} & \alpha_0 + \alpha_1 lag_\ln(GAP_Front_{jt}) \\
& + \alpha_2 lag_\ln(GAP_Front_{jt}) * regional_dummy \\
& + \alpha_3 [\ln(GAP_Front)_{jt}]^2 + u_j + \tau_t + \varepsilon_{jt}, \qquad (3)
\end{aligned}$$

[9] See the discussion on page 871 of Forbes (2000).

This simple conversion enables us to use panel data estimation techniques to further test our hypothesis on growth convergence. Forbes (2000) and Barro (2000), in their research on the relationship between inequality and growth, both argue panel data regression is superior to the cross-sectional and pooled regressions, and it is another reason why empirical results on the relationship between inequality and economic growth remain unsettling. By aggregating the 14 industry-level data in each province-year into one observation, we lost our total observations by about a third. But since our main research focus is on the growth across regions, we think this partial loss of observations is worthwhile, and it enables us to further test our hypothesis in a panel data setting.

Since we now have ten years of data, we use a different method to calculate the productivity gap and growth variables. The productivity gap to international frontier, $\ln(GAP\_Front_{jt})$, now is defined as $\ln[(VA/L)_{jt,US} - (VA/L)_{jt,China}]$, and we use one-period lag of the gap in our regression. Similarly, the growth variables are revised, from the previous 10-year growth in equation (1) and five-year growth in equation (2), to the growth from year t-1 to year t. Finally, we control for province-level fixed effects, u_j, and time effects, τ_t. Controlling for time effects is important in our research as from mid 1990s to early 2000s, China had experienced a big macroeconomic fluctuation --- inflation first soared to over 25% around 1995, and then it went straight back down to deflation in 1999 (see Figure 2). We think adding in year dummies will help us control for macroeconomic time effects that simple adjustments from current prices to constant prices cannot capture. This is because deflation often coexists with excessive production capacity in the economy. Facing excessive output capacity, firms cut down their capital investment and workers are also not working at their full potential, resulting in a stall in the labor productivity growth. This was certainly true for China's steel industry during the time period.

4. Data

In this section, we describe our datasets and methods used in calculating the variables in our regression analysis. We used two main datasets in our empirical work. The first dataset is the Large and Medium Enterprises database (LME) from National Bureau of Statistics of China (NBS). This is a rich firm-level dataset and it includes over 20,000 firms per year, from 1995 to 2004; and according to our calculation, LME database covers over 60% of China's total industrial output.[10] We drive all industry-province-level variables from the aggregation of the firm-level variables within LME.

The second dataset is from European Union's KLEMS database. The EU KLEMS database is an improved version of the previous *60-industry Database* for international productivity comparison hosted at University of Groningen.[11] This dataset includes the labor productivity at industry level for all EU countries and the US. Through our self-constructed industry-level PPPs between China and the US, we establish a link between industry-level productivities in China and EU KLEMS dataset. And through this linkage we can easily expand our research scope in the future to include more countries, making it possible the international comparison of productivities at industry-level between China and other countries.

One of the most difficult tasks in our research is to obtain the industry-level PPPs, with which we use to convert labor productivity of each industry in Chinese Yuan to the

[10] From our own calculation for the year of 2002.
[11] For details, please refer to the description of the new dataset by Timmer, Ypma and Van Ark (2007).

US dollar in the corresponding industry in the US. We follow the production approach to calculate industry-of-origin PPPs. In this approach, industry-level PPP is defined as "unit value ratio" or UVR, in each corresponding industry between China and the US. UVR is the average value per production unit in each industry. Wu (2001) and Ren (2000) each produced their version of industry PPPs based on China's Industrial Statistical Yearbook in mid 1980s. Wu's version used 1987 as the base year and Ren's version used 1985 as the base year. After careful comparison, we think Wu's version is a better choice as it is more in line with the methodology outlined in Maddison and Van Ark (1988) and Van Ark (1993). Since the base year in EU KLEMS dataset is 1997, we need to first convert Wu's 1987 PPPs to 1997 PPPs so that our comparisons of industrial productivities can match across countries. To do so, we construct a chained price index for each of the 14 major industrial branches from the ex-factory price index, and link the 1987 PPPs in Wu (2001) to our 1997 PPPs. We also adjust all value-added in Chinese industries to 1997 constant Yuan price using the same chained price index.

Another major task is to match China's 14 industrial branches with the industry classifications in EU KLEMS database. We study the detailed descriptions of the each industry in EU KLEMS dataset, and aggregate the industries in KLEMS database into the corresponding branches according to China's industrial classification.

The results of industry-level 1997 PPPs are presented in Table 2-3. The PPP exchange rate for total manufacturing is 5.47 Yuan per US Dollar. In contrast, the official exchange rate in 1997 was set at 8.29.[12] This arbitrary number under China's fixed exchange rate system greatly distorts China's relative level of productivity when compared to the US. As shown in the table, in general, we observe those industries with

[12] China fixed its exchange rate to 8.27 Yuan per US dollar entirely from 1997-2004.

larger degree of openness to the world trade, i.e., the tradable sectors, tend to have a lower PPP exchange rate relative to the average. For example, PPP for textile is at 1.16, and clothing industry is at 1.99. In contrast, those industries that largely remain local, or the non-tradable sectors, tend to have a very high PPP value relative to the industry average, 5.47. For example, the PPP for coal industry is at 11.63, petroleum at 15.42 and power industry at 15.9. The higher the value in our production-approach PPP means the higher relative production cost per production unit in that industry, indicating these industries operate relatively less efficiently compared to their US peers.

The industry-of-origin PPPs are not without shortcomings. One of the drawbacks is although we adjust value-added from current prices to constant price, the ex-factory price index used for the adjustment is intended for the gross output, not for the value-added. Ideally, we would want to have price-index for intermediate inputs, so we can remove the price movements of intermediate inputs from the price movements of output. Alternatively, we can just use current prices in productivity growth calculations, and arguably the value-added and labor productivity expressed in current prices is probably a better measure because current prices reflect the equilibrium of both price movement and technology advancement. However, current price sometimes can seriously distort the productivity calculation. In our case, during the 1995-2004 period, China had experienced a roller-coaster ride in inflation. The CPI index (as shown in Figure 2) rose to over 25%, then fell back straight down to the outright deflation. Such huge movement in prices will undermine the reliability of our calculation of China's true productivity growth. Since none of these methods are perfect, we chose to test our models using three different prices: current prices, constant prices and industry-PPPs. We will test how sensitive these estimation results to the different methods used.

With industry-level PPPs in hand, we convert China's industrial productivities into US dollars and compare how China's productivity level is relative to the international frontier. Table 2-4 presents our international comparison of productivities between China's total manufacturing in different regions and the United States. In 1995, China's total manufacturing productivity was only 6% of the US; in 2004, it was 16%, an increase of 167%. The costal region leads the international comparison amongst all regions: in 1995, the average productivity in coastal area was about 8% of the US' level, while the western and central regions were only about 4%. In 2004, the coastal region still had higher comparative productivity, 18% of the US' level, but the interior regions had narrowed the gap significantly, with the west being 13% and the central 11% of the US' level.

In Table 2-5, we report the detailed comparison of industrial productivities between China and the US. The comparative productivities shown in the table are relative productivities expressed in percentage terms with the US being normalized at 100. In 1995, the most productive Chinese industries relative to the US were textile and clothing industries, both at about 30% of the US' productivity level. The least productive industries were coal and power industries. Ten years later, in 2004, China further advanced its comparative advantage, with productivities in textile and clothing industries increasing to 84% and 60% of the US' level. Other notable advances include food and beverages industry at 25% of the US level, metallurgical industry at 17%, and machinery industry at 16.5%. Our international productivity comparison at industry level generally confirms the existing facts about China's manufacturing: namely, China enjoys comparative advantages in the lower-end manufacturing industries; and in recent years, productivities in metallurgical (steel making, for example) and machinery (including electric, electronics and transportation equipment) industries have achieved remarkable growth, narrowing down the productivity gap with the U.S. significantly.

Finally, we present the industrial productivities of China and the US, in absolute terms, in Appendix I and II.

5. Empirical Results

In this section, we present and analyze our main regression results. Table 5-1 presents the summary statistics of the major variables used in regression. The average growth rate of productivity growth among all industry-province observations was 152% over the 1995-2004 period. And the average growth rate of capital-labor ratio over the same period was 106%. Our main independent variables, log of initial productivity gap in 1995, averaged at 11, for which the anti-log conversion corresponds to 79,000 USD per employee-year.

Table 5-2 presents the regression results of equation (1), our basic model. Column (1) shows the basic results from the simple regression of labor productivity growth of industry-province observation from 1995-2004 on the initial productivity gap between the industry-province and the international frontier, or $Gap\_Front_{i,j,1995}$. Column (2)-(4) gradually include more variables. As reported in the table, the coefficient on the initial productivity gap is highly significant and positive as expected, and it remains so throughout Column (1) to (4). This renders strong support to our hypothesis that the larger the initial productivity gap with the international frontier, the faster the subsequent productivity growth. The coefficient on the interactive term is negative and statistically significant. This suggests that given the same productivity gap with the frontier, the coastal industries tend to grow slower than the industries in the interior regions. Normally, the productivity gap in coastal industries should exhibit a higher level of productivity (or smaller gap with the international frontier) than the rest of the country. However, when the coastal industries have the same productivity gap with their interior peers, we suspect those coastal industries are the true backward industries. The true backwardness may be the result of the "substitution effect", where in coastal regions most resources are devoted to the more productive industries, thus the very least productive industries in the coastal area suffer a resources "deprivation", or a negative outflow of asset reallocation Of course, there could be other alternative explanations for the negative coefficient and it's interesting to see if the negative sign remains robust in our later model configurations.[13]

The coefficient on the square of the initial productivity gap to the frontier, as shown in Column (3) and (4), is negative and statistically significant. The negative sign indicates the second derivative of labor productivity growth on the initial gap is negative, suggesting as productivity gap increases, the rate at which labor productivity increases slows. This is line with general economic theory of the law of the diminishing returns.

The coefficient on the growth of frontier productivity, as shown in Column (4), is positive and significant. This may well indicate, at least in China's case, the faster the international technological frontier advances, the faster the productivity growth in China.

[13] The coefficient on the interactive terms became not statistically significant when we test our model in a more robust panel data setting, see Table 5-4 for more details.

Given China's degree of openness to foreign direct investment and international trade, this result is not surprising.

As noted in the data section, our calculation of industry-of-origins PPPs does have some drawbacks. To cross-check our estimation results, we present a comprehensive comparisons of regression results using three different approaches to convert Chinese industry productivities to the US Dollar. Column (1) and (2) duplicate the regression results using the default industry-PPP approach as shown in Table 5-2; Column (3) and (4) present the estimation results with industrial productivities of China converted into US Dollar using official exchange rate and the Yuan terms adjusted from current prices to constant 1997 prices; Finally, Column (5) and (6) present the results with Chinese industry productivities converted to US dollars using the official exchange rate, but without adjusting for the constant price. Through the comparison, we find the results are very similar across board and it again demonstrates that our empirical results are very robust.

Table 5-3 presents the regression results of equation (2). As described in Section 3.2, the main difference between equation (2) and equation (1) is that we split the ten-year time period into two periods and then pool them together in one regression. As a result, the number of observations doubled and the new estimation equation also offers us an opportunity to test whether our regression results are sensitive to the choice of the length of the time period. We ran a similar group of regressions as in Table 5-2 except that we also control for the growth of capital-labor ratio in the last column. The coefficient on the productivity gap remains strongly positive throughout, but the interaction term became statistically insignificant, although the sign still remains negative.

As expected, growth of capital intensity has a large strong positive effect on labor productivity growth and this effect is highly robust.

Table 5-4 presents the regression results of equation (3) in a panel data setting. This is our preferred specification as panel data regressions are generally believed to be more reliable as it takes into account the fixed effects. Again, our main variable, the productivity gap to the international frontier shows up to be positive and statistically significant. The productivity gap variable we included in the regression has one-period lag. The rationale of doing so is similar to using productivity gap at the beginning of the time period in equation (1) and (2). To make our results more robust, besides province-level fixed-effects, we also included year dummies in Column (3) and (4) to control for the time effects. The positive and significant coefficient on the productivity gap to the international frontier again confirms our hypothesis that the provinces with larger productivity gap to the frontier productivity tend to growth faster than those with smaller gap. And roughly 1% increase of such gap in the previous year tends to correlate with about 7% increase of labor productivity growth in the subsequent year, everything else being equal (refer to Colum 3). However, the growth rate tends to increase at a rate that decreases with the increase of the productivity gap, as indicated by the negative sign of the coefficient on the square term. Lastly, similar to Column (5) in Table 5-3, our control variable in Column (4), the growth of capital intensity, also remains statistically significantly positive.

One notable difference in Table 5-4 is that the interactive term between the coastal dummy and the productivity gap became not significant throughout our regressions in the panel data setting. This gives us pause in our previous interpretation of the negative coefficient on the interactive term in Table 5-2. Since the coefficient on the initial frontier gap is positive, suggesting the more backward interior regions tend to grow faster than the coastal region, our estimation results post an immediate question as to whether our empirical model is capable of explaining China's growth experience that the initial growth rate was higher in the coastal region in the early period of the reform. In JHS (2006), the coefficient on the interactive term is positive and significant, suggesting the coastal region may follow a different growth trajectory and grow faster than the interior region given the same productivity gap with the frontier. In our panel regressions, we did not find positive sign for the interactive term. So how should we reconcile this difference in our estimation results?

In Figure 3, we model China's regional growth patterns based on different assumptions. In model (a), our preferred model, we assume the coastal region has the same growth trajectory as the interior regions, but the coastal region took off earlier than the interior regions. This assumption matches China's economic development in the early reform period, when most trade and investment activities happened in the Special Economic Zones (SEZs) in the coastal region. Represented in the graph, the coastal region (the solid line) started to grow at point O, while the interior region (the dotted line) started at point O'. We derive interior region's growth trajectory by simply shifting coastal region's growth trajectory rightward by the distance OO'. As a result, at each point after O' on the horizontal axis, if we draw a vertical line, the coastal region will always have higher *level* of labor productivity than the interior regions while the *growth* rate of the productivity (the second derivative of the curve) is lower (point A vs. B in the graph). This is in line with what we observe in Table 2-1. In between point O and O', the growth rate of the coastal region is higher than the interior region as the latter did not start to grow until point O'. Model (a) can also produce the desired convergence effect between different regions within the same country (see Barro and Sala-i-Martin, 1991).

Model (a) only captures the growth differences due to capital-intensity. In reality, coastal region enjoys the advantage of openness, so the initial productivity gap between coastal region and interior regions may be a combination of both capital-intensity and openness. Later on, the interior regions grew faster than the coastal region due to the advantage of backwardness, thus reducing the income gap across regions. In the end, although the incomes in the two regions tend to converge, there should still exists a productivity gap due to differences in openness and its related qualities in different regions.

In graph (b) and (c), we present two alternative models. Model (b) assumes the initial development levels in the two regions were different while both regions still have the same growth trajectory. As shown in the graph, we simply shift down the curve of the coastal region (the solid line) to arrive at the growth trajectory for the interior region (the dotted line). The initial productivity gap is represented by the distance OI. Although model (b) can replicate higher level of productivity in the coastal region, it predicts a divergence of incomes between the two regions and fails to explain why the interior region has grown faster in recent years (point A has the same growth rate as point B).

Finally, model (c) assumes the two regions have *different* growth trajectories, with each point of the growth trajectory of the coastal region lying above that of the interior regions. As shown in graph (c), the higher slope of the coastal region's growth trajectory can produce higher level of productivity in the coastal region, but also higher growth rate than the interior region, which seems to contradict what we observe; and it also predicts an income divergence between the two regions.

To sum up, we think model (a) is the best model to match China's economic growth over the past 30 years and our panel data estimation results also matche the model (a) quite nicely.

In Table 5-4b, we compare our panel data estimation results using three different prices and exchange rate combinations. The results look very similar: The coefficient on the previous productivity gap is again positive and significant; and the coefficient on the quadratic term of the productivity gap is negative and significant; and the negative coefficient on the interaction term between coastal dummy and productivity gap again turns out to be not statistically significant. One question arises as to why the regression results look all similar regardless of which price-exchange rate combination used. We think this is due to the fact we have added in year dummies to smooth out the business-cycle effect, so prices will not alter results much as one would normally expect. But notice that compared to industry-PPP and constant-price regressions, the size of the coefficient on the frontier gap in the current-price regressions is larger, suggesting official exchange rate tend to overestimate the initial productivity gap thus making the convergence look artificially faster.

In summary, our regression results from Table 5-2 to 5-4 strongly confirm our hypothesis that the larger the initial productivity gap with the international frontier, the faster growth of labor productivity in subsequent years. And this result is very robust and not sensitive to different model specifications, even after the growth of capital intensity and province-level fixed effects are both controlled.

Our empirical results have strong implications for the prospect of China's future economic growth and inequality picture. Since the interior regions have grown at a much faster rate than the coastal region, economic policies that aim to take advantage of this growth differential and encourage a more balanced approach in economic development across regions should put China onto a new sustained growth trajectory, while at the same time it can dramatically improve the current skewed income distribution across regions.

6. Conclusive Remarks

We show with strong empirical evidence that China has been experiencing a rapid convergence in labor productivity across different regions. Productivity in the more advanced coastal region tends to grow slower while labor productivity in other regions tends to grow much faster. Such growth dynamics offer China a potential way out of the traditional inequality-growth tradeoff. It is very likely that China will grow itself out of the current high level of income inequality by relying on the higher growth in the less developed region.

One might caution on our approach of using labor productivity growth to infer income growth. Indeed, as shown in Table 6-1, there exists quite a large difference between labor productivity and the actual labor (wage) income. This is not surprising giving China's heavy reliance on capital investment and the high rigidity in China's labor market. Yet, in terms of *growth rate* of wage income, we do observe a pattern that is very similar to labor productivity growth, i.e., wage income in interior regions has grown much faster than the coastal region. To prove this in a more robust empirical setting, we ran some simple regression analysis to look at the explanatory power of labor productivity on wages. As shown in Table 6-2, labor productivity is capable of explaining as much as 80% (adjusted R-sq.) of changes of wage income, which provides strong evidence that growth of labor productivity and wage income are highly correlated.

Lastly, our current research focuses on the productivity growth of China's manufacturing industries across different regions. We justify this approach by the fact that China is still in her early stage of industrialization, and for a long period of time, China will remain manufacturing-centric. However, we do recognize the inequality between different sectors, i.e., rural agricultural sector versus urban industrial sector, is another big source of China's inequality. In our view, the decline of rural-urban inequality is also a function of the speed of China's industrialization and urbanization processes. One would reasonably expect to see continued improvement of urban-rural inequality situation as the rapid industrialization and urbanization move more and more surplus labor in rural area into the cities.

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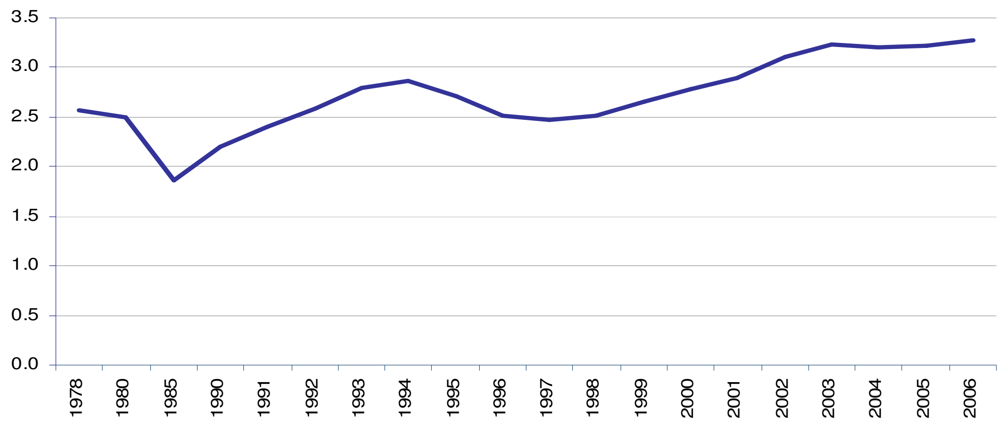
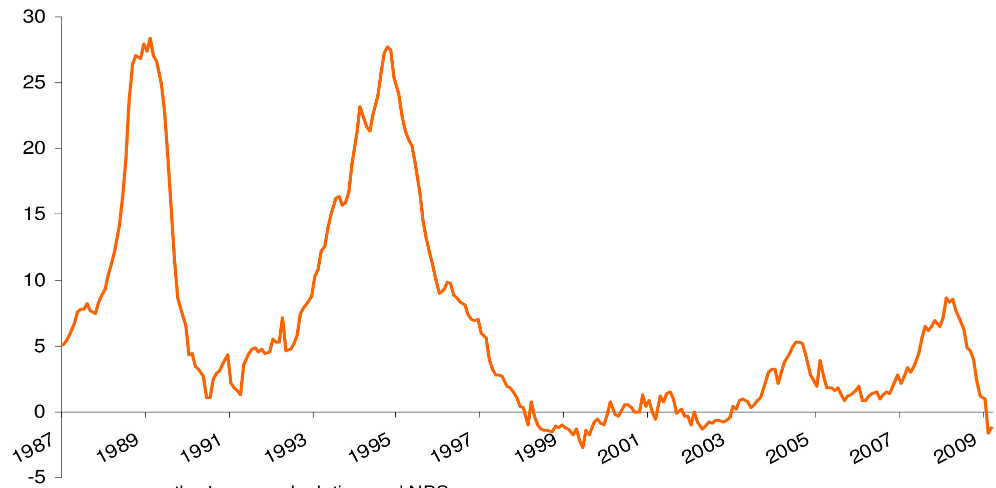
Figure 1. China's Urban-Rural Income Ratio 1978-2006



Source: National Bureau of Statistics of China and authors' own calculation

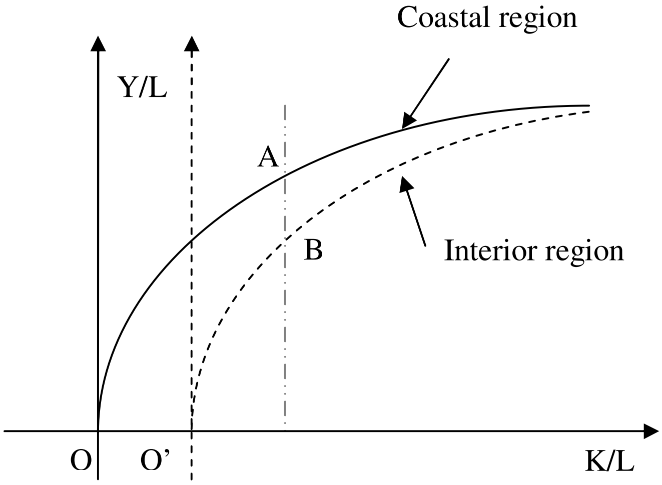
Figure 2. China's Consumer Price Index (CPI) 01/1987 --- 02/2009



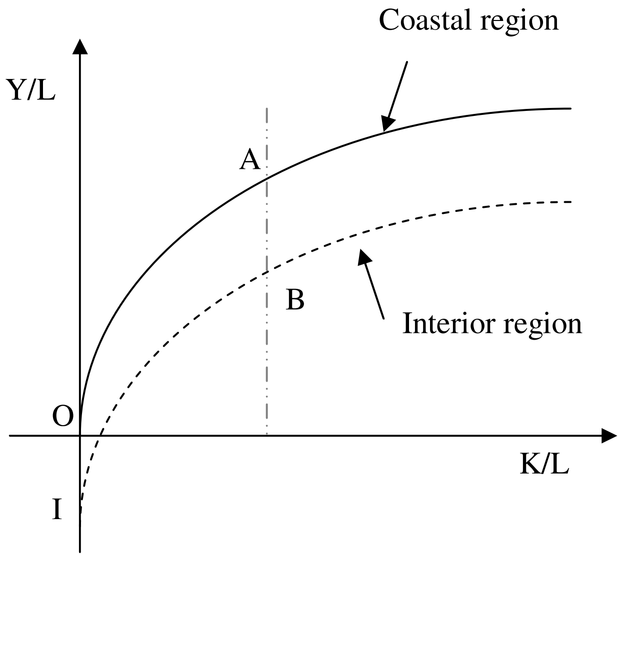
source: author's own calculation and NBS

Figure 3. Model Regional Growth Patterns in China

(a)



(b)



(c)

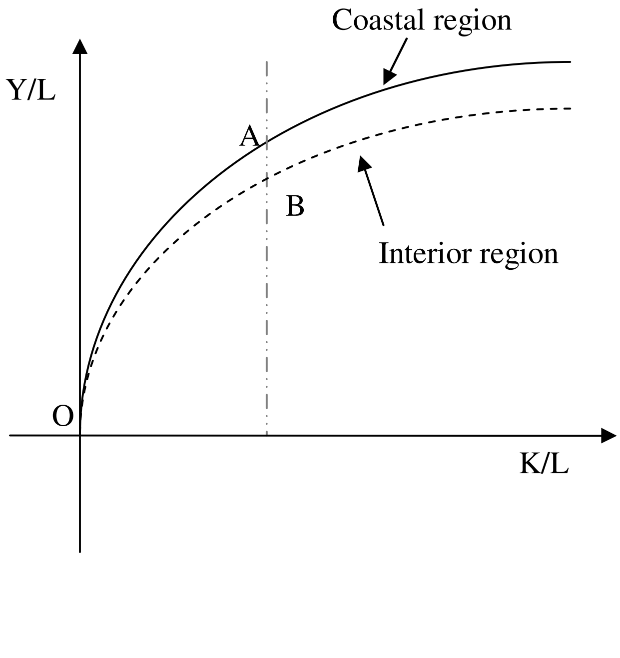


Table 2-1 China's Industrial Labor Productivity and Growth by Region

area	1995	2000	2004	percentage change of		
				1995-2000	2000-2004	1995-2004
1. in 1997 PPP, thousands of US$ per employee						
coastal	6.06	12.53	20.47	106.8%	63.4%	**237.8%**
northeast	2.57	8.05	17.45	213.2%	116.8%	**579.0%**
center	3.15	5.67	12.53	80.0%	121.0%	**297.8%**
west	2.79	6.57	14.58	135.5%	121.9%	**422.6%**
2. in 1997 constant Chinese Yuan (thousands) per employee						
coastal	29.82	66.76	108.24	123.9%	62.1%	**263.0%**
northeast	18.96	61.04	142.89	222.0%	134.1%	**653.7%**
center	16.16	30.89	80.58	91.2%	160.8%	**398.8%**
west	16.46	39.40	96.45	139.4%	144.8%	**486.1%**
3. in current Chinese Yuan (thousands) per employee						
coastal	32.15	70.57	119.83	119.5%	69.8%	**272.8%**
northeast	20.81	58.02	127.35	178.8%	119.5%	**512.0%**
center	17.48	32.90	83.73	88.2%	154.5%	**379.0%**
west	17.73	39.97	91.34	125.4%	128.5%	**415.1%**

Table 2-2 China's Industrial Labor Productivity by Region (with coastal area normalized)

area	1995	2000	2004
coastal	1.00	1.00	1.00
northeast	0.42	0.64	0.85
center	0.52	0.45	0.61
west	0.46	0.52	0.71

Table 2-3 1997 PPPs by major Chinese industry branches, per US dollar

branch	*PPPs*
food and beverages	3.48
textile	1.16
clothing	1.99
leather	4.16
timber, wood products	6.97
paper and printing	5.50
coal	11.63
petroleum	15.42
chemicals	6.08
building materials	3.53
metallurgical	7.76
machinery	5.77
power	15.90
other manufacturing	3.86
total manufacturing	**5.47**

Table 2-4 China's Industrial Labor Productivity vs. International Frontier

year	Whole China	Region			
		Coastal	Northeast	Center	West
	ratio of productivity in China to productivity at international frontier				
1995	0.06	0.08	0.03	0.04	0.04
2000	0.10	0.14	0.09	0.06	0.07
2004	0.16	0.18	0.16	0.11	0.13

Table 2-5 *Comparative* Productivity by Manufacturing Branch (China/USA, 1995-2004, USA=100)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	food and beverages	textile	clothing	leather	wood products	paper and printing	coal	petroleum	chemicals	building materials	metallur-gical	machinery	power	other manufactu-ring	**total manufactu-ring**
1995	9.6	27.4	30.7	10.1	4.2	3.1	0.5	3.2	3.3	6.8	5.9	4.1	2.1	9.5	**5.6**
1996	11.5	29.3	41.1	15.3	5.2	5.2	0.7	2.3	4.0	6.6	5.6	4.5	2.5	11.9	**6.5**
1997	13.3	31.5	37.4	15.1	6.4	5.4	0.7	2.7	4.0	6.3	5.3	5.1	3.0	10.8	**6.9**
1998	13.0	30.7	36.5	17.3	5.8	5.0	0.7	5.0	4.2	6.6	5.4	6.3	3.9	12.0	**7.4**
1999	16.7	35.4	34.1	12.7	8.0	5.9	0.7	5.3	4.3	6.9	6.1	7.9	4.0	10.2	**8.6**
2000	18.2	43.2	38.8	12.2	10.2	6.0	0.8	15.5	4.2	7.6	7.5	9.8	3.6	12.3	**10.4**
2001	18.8	50.9	45.9	13.2	13.5	7.8	1.2	17.2	4.7	8.8	9.3	12.1	3.6	12.5	**12.1**
2002	19.4	54.0	43.5	17.2	10.6	8.7	1.5	22.8	4.9	9.3	10.1	13.8	4.4	10.0	**12.7**
2003	20.8	67.5	49.6	15.7	11.4	9.2	2.1	9.9	5.1	12.2	13.4	15.1	3.3	9.0	**14.1**
2004	24.6	83.5	59.9	12.6	10.3	9.5	3.1	8.7	5.4	14.0	17.2	16.5	3.5	9.6	**15.8**

Table 5-1 Descriptive statistics

	Mean	Std. dev	Min	Max
Labor productivity growth	1.52	0.69	-1.22	5.17
ln(productivity gap to frontier)	11.08	0.66	9.21	12.26
Growth of frontier productivity	0.55	0.30	0.08	1.27
Growth of capital intensity	1.06	0.60	-2.10	2.86

Table 5-2 Estimates of the Response of Labor Productivity Growth to the International Productivity Gap, 1995-2004, labor productivity in 1997 USD using 1997 industry PPPs

	dependent var: growth of labor productivity $_{i,j,1995-2004}$			
Independent variable	1	2	3	4
ln(Gap_Front $_{i,j,1995}$), log of initial productivity gap to frontier	0.204***	0.197***	3.468***	3.105**
	(0.054)	(0.054)	(1.394)	(1.387)
ln(Gap_Front $_{i,j,1995}$) x coastal dummy		-0.018***	-0.017***	-0.017***
		(0.007)	(0.007)	(0.007)
ln(Gap_Front $_{i,j,1995}$)_square			-0.149***	-0.134**
			(0.063)	(0.063)
ln(VA/L) $_{front,j,2004}$ - ln(VA/L) $_{front,j,1995}$, productivity growth at international frontier				0.333***
				(0.118)
Constant	0.674***	-0.590	-18.515***	-16.508**
	(0.228)	(0.597)	(7.654)	(7.616)
obs	368	368	368	368
adj. R-sq.	0.035	0.05	0.062	0.079

Notes: *** (**, *) indicates statistical significance at the 1 (5, 10)-percent level.

Table 5-2b Estimates of the Response of Labor Productivity Growth to the International Productivity Gap, with different prices and exchange rates, 1995-2004

	Dependent var: growth of labor productivity $_{i,j,1995\text{-}2004}$					
	1	2	3	4	5	6
Independent variable	*constant 1997 Yuan using 1997 industry PPPs*		*constant 1997 Yuan using official exchange rate*		*current Yuan prices using official exchange rate*	
ln(Gap_Front $_{i,j,1995}$)	0.197***	3.106***	0.180***	2.873	-0.041	7.260***
	(0.054)	(1.387)	(0.060)	(1.965)	(0.057)	(1.970)
ln(Gap_Front $_{i,j,1995}$) x coastal	-0.018***	-0.017***	-0.019***	-0.019***	-0.018***	-0.019***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)
ln(Gap_Front $_{i,j,1995}$)_square		-0.134**		-0.123		-0.328***
		(0.063)		(0.088)		(0.088)
ln(VA/L) $_{front,j,2004}$ - ln(VA/L) $_{front,j,1995}$, productivity growth at international frontier		0.333***		0.359***		0.126
		(0.118)		(0.119)		(0.121)
Constant	-0.589	-0.590	-0.398	-15.330	1.935***	-38.652***
	(0.597)	(0.597)	(0.674)	(10.923)	(0.643)	(10.971)
obs	368	368	368	368	368	368
adj. R-sq.	0.05	0.05	0.045	0.065	0.017	0.048

Notes: *** (**, *) indicates statistical significance at the 1 (5, 10)-percent level.

Table 5-3 Estimates of the Response of Labor Productivity Growth to the International Productivity Gap: 1995-2000 and 2000-2004, pooled regressions, labor productivity converted using 1997 industry-PPPs

	dependent var: growth of labor productivity $_{i,j,(1995\text{-}2000 \text{ or } 2000\text{-}2004)}$				
Independent variable	*1*	*2*	*3*	*4*	*5*
ln(Gap_Front), log of productivity gap to frontier	0.118***	0.116***	1.895**	2.122**	1.617**
	(0.036)	(0.036)	(0.909)	(0.918)	(0.866)
ln(Gap_Front) x coastal		-0.007	-0.006	-0.006	-0.004
		(0.005)	(0.005)	(0.005)	(0.004)
ln(Gap_Front)_square			-0.080**	-0.091**	-0.069*
			(0.041)	(0.041)	(0.039)
Productivity growth at international frontier				0.180*	0.200**
				(0.108)	(0.102)
growth of capital-labor ratio					0.341***
					(0.035)
Constant	-0.570	-0.517	-10.357	-11.615**	-8.953**
	(0.408)	(0.409)	(5.037)	(5.088)	(4.801)
obs	752	752	752	752	752
adj. R-sq.	0.013	0.014	0.020	0.020	0.130

Notes: *** (**, *) indicates statistical significance at the 1 (5, 10)-percent level.

Table 5-4 Estimates of the Response of Labor Productivity Growth to the International Productivity Gap: Panel Data Estimation, 1995-2004, by province-year, labor productivity converted into 1997 USD using industry PPPs

	Dependent var: growth of labor productivity growth ,gLP_{jt}			
Independent variable	*1*	*2*	*3*	*4*
lag_ln(Gap_Front)$_{jt}$, lag of productivity gap to frontier	2.835***	2.926***	7.022***	6.692***
	(0.313)	(0.338)	(0.310)	(0.339)
lag_ln(Gap_Front)$_{jt}$ x coastal	0.002	-0.568**	-0.237	-0.227
	(0.002)	(0.281)	(0.160)	(0.159)
productivity gap to frontier_square	-0.088***	-0.082***	-0.256***	-0.246***
	(0.012)	(0.012)	(0.012)	(0.013)
growth of capital-labor ratio				0.086***
				(0.038)
Constant	-20.568***	-20.224***	-45.319***	-25.788***
	(2.208)	(2.392)	(2.931)	(4.614)
year dummies	No	No	Yes	Yes
province fixed-effects	No	Yes	Yes	Yes
obs	273	273	273	273
adj. or overall R-sq.	0.248	0.015	0.044	0.046

Notes: *** (**, *) indicates statistical significance at the 1 (5, 10)-percent level.

Table 5-4b Comparison of Estimates of the Response of Labor Productivity Growth to the International Productivity Gap, Using Different Prices and Exchange Rates: Panel Data Estimation, 1995-2004, by province-year

Independent variable	*Dependent var: growth of labor productivity growth ,gLP_{jt}*					
	1	*2*	*3*	*4*	*5*	*6*
	constant 1997 Yuan using 1997 industry PPPs		*constant 1997 Yuan using official exchange rate*		*current Yuan prices using official exchange rate*	
lag_ln(Gap_Front)$_{jt}$, lag of productivity gap to frontier	2.835***	7.022***	3.723***	10.815***	4.963***	12.288***
	(0.313)	(0.310)	(0.400)	(0.391)	(0.406)	(0.408)
lag_ln(Gap_Front)$_{jt}$ x coastal	0.002	-0.237	-0.001	-0.029	-0.001	-0.056
	(0.002)	(0.160)	(0.002)	(0.132)	(0.002)	(0.085)
productivity gap to frontier_square	-0.088***	-0.256***	-0.121***	-0.388***	-0.193***	-0.449***
	(0.012)	(0.012)	(0.015)	(0.015)	(0.018)	(0.015)
Constant	-20.568***	-45.319***	-26.355***	-71.917***	-31.055***	-81.199***
	(2.208)	(2.931)	(2.779)	(3.289)	(2.461)	(3.817)
year dummies	No	Yes	No	Yes	No	Yes
province fixed-effects	No	Yes	No	Yes	No	Yes
obs	273	273	273	273	273	273
adj. or overall R-sq.	0.248	0.044	0.255	0.517	0.376	0.261

Notes: *** (**, *) indicates statistical significance at the 1 (5, 10)-percent level.

Table 6-1 Labor Productivity versus Wage Income by Region, in China's Manufacturing Sector, 1995-2004

Labor productivity

area	1995	2000	2004	growth during the period of 1995-2000	2000-2004	1995-2004
in 1997 constant Chinese Yuan (thousands) per employee						
coastal	29.82	66.76	108.24	123.9%	62.1%	263.0%
northeast	18.96	61.04	142.89	222.0%	134.1%	653.7%
center	16.16	30.89	80.58	91.2%	160.8%	398.8%
west	16.46	39.40	96.45	139.4%	144.8%	486.1%
in current Chinese Yuan (thousands) per employee						
coastal	32.15	70.57	119.83	119.5%	69.8%	272.8%
northeast	20.81	58.02	127.35	178.8%	119.5%	512.0%
center	17.48	32.90	83.73	88.2%	154.5%	379.0%
west	17.73	39.97	91.34	125.4%	128.5%	415.1%

Wage Income

area	1995	2000	2004	growth during the period of 1995-2000	2000-2004	1995-2004
coastal	7.83	12.17	18.01	55.5%	48.0%	130.1%
northeast	6.29	9.72	17.52	54.6%	80.2%	178.6%
center	5.95	8.25	15.47	38.6%	87.5%	159.9%
west	6.26	9.71	17.71	55.0%	82.4%	182.8%

Table 6-2 Regression of Wage Income on Labor Productivity, by provinces, 1995-2004

	dependent variable: ln(wage)$_{i,t}$		
Independent variable	1	2	3
ln(labor productivity)$_{i,t}$	0.545***	0.580***	0.441***
	(0.017)	(0.018)	(0.035)
ln(labor productivity)$_{i,t}$ x coastal		-0.021***	-0.006
		(0.007)	(0.007)
ln(labor productivity)$_{i,t}$ x northeast		-0.055***	-0.044***
		(0.010)	(0.010)
ln(labor productivity)$_{i,t}$ x center		-0.013*	-0.020***
		(0.008)	(0.008)
Constant	0.269***	0.197***	0.564***
	(0.065)	(0.067)	(0.110)
year dummies	NO	NO	YES
obs	306	306	306
adj. R-sq.	0.773	0.794	0.806

Appendix I China's Industrial Labor Productivity by Manufacturing Branch (1995-2004, value-added per employee, in thousands of US$ using 1997 industry PPPs)

	(1) food and beverages	(2) textile	(3) clothing	(4) leather	(5) wood products	(6) paper and printing	(7) coal	(8) petroleum	(9) chemicals	(10) building materials	(11) metallur-gical	(12) machinery	(13) power	(14) other manufactu-ring	(15) **total manufactu-ring**
1995	6.8	8.5	7.9	3.1	2.1	2.3	0.8	3.7	3.7	4.5	3.7	3.5	4.4	4.4	**4.2**
1996	9.2	10.3	12.2	5.2	2.5	3.9	1.0	5.2	4.6	4.7	3.7	3.8	5.0	6.2	**5.0**
1997	10.7	11.8	12.0	5.9	3.3	4.4	1.1	6.2	4.7	4.8	3.7	4.5	6.5	6.2	**5.5**
1998	11.2	12.0	12.4	6.1	2.9	4.4	1.2	6.2	4.7	5.4	3.8	5.3	8.5	7.1	**5.9**
1999	14.2	15.6	14.9	6.1	4.2	5.5	1.1	7.7	5.5	6.4	4.4	6.5	9.2	6.3	**7.1**
2000	16.1	19.2	16.9	6.8	4.8	6.3	1.2	23.5	7.1	7.5	5.8	8.2	9.6	8.0	**9.3**
2001	18.4	22.0	18.7	7.7	6.3	8.5	1.6	27.3	8.2	8.8	7.0	9.9	11.9	8.6	**10.8**
2002	20.0	24.1	17.4	8.9	5.2	10.2	2.2	28.5	9.4	10.1	8.4	11.9	13.4	8.0	**12.2**
2003	23.5	30.1	19.5	9.2	6.0	11.3	3.1	27.9	11.5	14.0	11.7	14.3	11.7	7.4	**14.6**
2004	30.2	36.0	22.0	8.3	7.0	12.5	5.4	36.0	15.4	17.1	18.8	15.4	13.6	7.7	**17.8**

Appendix II The US Industrial Labor Productivity by Manufacturing Branch (1995-2004, value-added per employee, in thousands of 1997 constant US$)

	(1) food and beverages	(2) textile	(3) clothing	(4) leather	(5) wood products	(6) paper and printing	(7) coal	(8) petroleum	(9) chemicals	(10) building materials	(11) metallur-gical	(12) machinery	(13) power	(14) other manufactu-ring	(15) **total manufactu-ring**
1995	70.7	30.9	25.7	30.9	49.2	74.0	147.2	116.2	109.5	65.9	62.7	85.5	214.0	46.9	**74.7**
1996	79.8	35.1	29.6	33.8	47.6	75.3	146.0	226.7	113.1	71.8	65.2	84.7	202.5	52.3	**77.1**
1997	80.4	37.3	32.0	39.3	52.2	80.6	162.7	232.1	117.1	76.0	69.6	88.0	216.7	56.7	**80.6**
1998	86.1	39.1	33.9	35.3	50.6	88.0	175.7	125.0	112.0	82.0	70.2	83.5	220.4	59.4	**79.8**
1999	85.2	44.1	43.8	48.0	52.7	93.7	160.8	145.8	129.2	92.4	72.0	82.5	229.2	62.2	**83.2**
2000	88.4	44.5	43.6	55.4	46.6	104.8	152.8	151.7	169.6	99.1	77.5	84.6	266.1	64.7	**89.2**
2001	97.9	43.2	40.6	58.2	46.6	108.2	134.9	158.6	175.5	99.5	75.6	82.0	336.0	68.9	**89.6**
2002	103.2	44.6	39.9	51.9	48.9	117.8	148.2	125.1	190.7	108.6	83.1	86.2	306.1	79.8	**95.5**
2003	113.0	44.6	39.4	59.0	52.3	123.4	152.2	281.0	226.6	114.2	87.5	94.6	350.1	82.4	**103.7**
2004	122.9	43.1	36.7	66.1	67.7	131.4	173.8	414.4	282.8	122.7	109.0	93.0	390.8	81.0	**112.3**