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Growth Accounting Analysis in China 1978-2009

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Abstract

This paper applies the growth accounting model to Chinese economy at region and province levels from 1978 to 2009. We measure the components in the growth accounting model such as capital services, labour inputs and Total Factor Productivity (TFP) using various data sources. The economic growth has been decomposed into the contribution of physical capital, labour inputs, labour composition index (LCI) and TFP. We find that Chinese economic growth was mainly pushed by the growth of physical capital, especially in the fastest growing Coastal region. Labour inputs and TFP growth contribute more in the Interior and West regions. Moreover, the contribution shares of physical capital in labour productivity have been declining for the Coastal region, as the TFP contributions have been increasing over the same period. Our results show that the human capital formation from technological and institutional shifts is becoming more and more important in the Coastal region.

Keywords: Growth Accounting, Total Factor Productivity, Labour Cost

JEL Classification Codes: O47, D24, J30

1. Introduction

Economic reforms in China have resulted in unprecedented economic growth since 1978. In the early years of the new millennium, however, China found itself with one of the highest degrees of regional inequality in the world and over its history (Yang, 2002; Kanbur and Zhang, 2005; Fleisher et al., 2010).

Chinese 28 administrative divisions show quite different growth paths with wide regional disparities in growth rates after the reforms and open-door policies launched at the end of the 1970s[1]. We categorize these 28 administrative divisions into four regions: the northeast region (including Heilongjiang, Jilin, Liaoning), the Coastal (including Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, and Guangdong-Hainan), the Interior (Shanxi, Anhui, Jiangxi, Henan, Hubei and Hunan) and west (Guangxi, Sichuan-Chongqing, Guizhou, Yunnan, Inner Mongolia, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang). The division of the four regions is based on research regarding the major economic and geographical clusters in economic growth and development in China (see geographic graph of regions in Appendix Figure A1).

In the first year of our study (1978), the industrial Northeast region was the growth engine of China with the highest level of real GDP per worker (5,288 Yuan, about 633 US dollar in 1995)[2] among the four regions. At the same time, the real GDP per worker of the Coastal region was 2,964 Yuan which was a little higher than that of the Interior (2,022 Yuan) and the West (2,514 Yuan) regions, but only 56 percent of the Northeast region.

(Figure 1 around here)

However, the Coastal has been growing much faster than other regions so that by the last year of our study (2009), its GDP per worker (48,818 Yuan) has increased about 16.5 fold over the thirty-two years. The Coastal has the highest annual growth rate at 8.6 percent per year among the four regions, while the old growth engine, the Northeast gradually loses its power and achieves annual growth rate at 7.0 percent per year before 1994. In 2009, GDP per worker in the Coastal and Northeast regions are nearly double that in the two lagging regions - the Interior and West (see Figure 1). Therefore, the much higher economic growth rates of the Coastal enlarge the regional disparities of productivity in China.

This paper aims to explain the regional disparities of economic growth using a growth accounting approach. The rest of this paper is organized as follows. The next section reviews the growth accounting model; in Section 3, we measure and analyse the capital service, labour composition and TFP in China; Section 4 decompose the economic growth to contribution of production factors; Section 5 concludes.

2. Growth accounting model

2.1 Methodology

We apply the growth accounting framework to assess the contributions of the various inputs to aggregate economic growth. This methodology was first introduced by

[1] China now has 31 administrative divisions, but we focus on 28 administrative divisions in this paper. Tibet is excluded due to lack of data. And, Hainan is combined with Guangdong, and Chongqing with Sichuan to ensure consistency over the entire period of 1978-2009, because Hainan was separated from Guangdong in 1988 and Chongqing was separated from Sichuan province in 1996.

[2] All variables are in real terms based on 1995 RMB Yuan in this paper. We use exchange rate 1US dollar=8.35 RMB Yuan to calculate the equivalent value in US dollar in 1995.

Solow (1957) and later developed in Kendrick (1961). Dension (1962) and Jorgenson and Griliches (1967) extended and refined the analysis by considering changes in the composition of capital and labour. The growth accounting model is based on production possibility frontiers where value added is a function of capital, labour, and technology. The production function is given by:

$$Y_{pt} = f(K_{pt}, L_{pt}, A_{pt}) \tag{1}$$

where Y is value added; K is an index of capital services; L is an index of labour inputs; A reflects Hicks-neutral technical change, all of which are indexed by provinces p (= 1,…, 28) and time t (=1978,…, 2009).

Under the assumptions of competitive factor markets, full input utilisation and constant returns to scale (CRS), the growth of value added can be expressed as the cost-share weighted growth of inputs and technological change. Using the trans-log functional form in such analyses, the growth accounting equation is:

$$\Delta \ln Y_{pt} = \overline{V}^{K}_{pt} \Delta \ln K_{pt} + \overline{V}^{L}_{pt} \Delta \ln L_{pt} + \Delta \ln A^{Y}_{pt} \tag{2}$$

The above equation indicates the proportions of value added growth accounted for growth in capital services K, labour inputs L and technical change measured as Hicks-neutral technical change A or Total Factor Productivity (TFP), respectively.[3] Because of our approach to measure capital services, Hicks-neutral technical change A only includes disembodied technical change. Moreover, $\overline{v}$ denotes the two-period average share of inputs K or L in nominal output defined as follows:

$$V^{K}_{pt} = \frac{P^{K}_{pt} K_{pt}}{P^{Y}_{pt} Y_{pt}}, \quad V^{L}_{pt} = \frac{P^{L}_{pt} L_{pt}}{P^{Y}_{pt} Y_{pt}}, \quad \overline{V}^{K} + \overline{V}^{L} = 1 \tag{3}$$

2.2 Measuring capital services

The starting point to measure capital stock is the perpetual inventory method (PIM), introduced by Goldsmith (1951). The PIM consist of adding the net investment data of the current year to an assumed base year of capital stock. Assuming geometric depreciation, the general formula is given by:

$$K_t = (1 - \varphi) K_{t-1} + I_t \tag{4}$$

where K_t is capital stock; φ is the depreciation rate; I_t is the investment which refers to investment in fixed assets.

For the aggregation of capital services over the different asset types (k, assuming two kinds of asset types, for example, S for structures and E for equipment assets), it is assumed that aggregate capital services are a trans-log function of the services of individual assets. It is also assumed that the flow of capital services for

[3] The composition of labour inputs is measured as the labour composition index (LCI) which will be discussed later.

each asset type k (=S or E) is proportional to its stock, independent of time. The Tornqvist quantity index of individual capital types as follows:

$$\Delta \ln K_{pt} = \sum_{k} \overline{w}^{K}_{k,pt} \Delta \ln K_{k,pt} \tag{5}$$

where $\Delta \ln K_{k,pt}$ indicates the growth of capital stock by capital type k, and weights are given by the period average shares of each type in the value of capital compensation. As we assume that marginal products are equal to real returns, also equal to rental costs, the weighting procedure ensures that inputs which have a higher price also have a larger influence in the input index. Hence, equation (5) can be rewritten as follows:

$$\Delta \ln K_{pt} = \overline{w}^{S}_{pt} \Delta \ln K^{S}_{pt} + \overline{w}^{E}_{pt} \Delta \ln K^{E}_{pt} \tag{6}$$

where $\overline{w}^{S}_{pt}$ are the period-average shares of asset S in total capital costs in province p and year t, and similarly for asset E. Weights are given by the average shares of each component in the value of capital compensation $\overline{W}^{S}_{pt} = \frac{1}{2}(W^{S}_{pt} + W^{S}_{p,t-1})$ and $W^{S}_{pt} = \frac{P^{S}_{pt} * K^{S}_{pt}}{P^{S}_{pt} * K^{S}_{pt} + P^{E}_{pt} * K^{E}_{pt}}$, where P^{K}_{spt} is the price of capital service from asset S.

Rental prices, or user-cost of capital, can be estimated using the standard approach grounded in the arbitrage equation derived from neoclassical theory of investment, introduced by Jorgenson (1963) and Jorgenson and Griliches (1967). In equilibrium, an investor is indifferent between two alternatives: buying a unit of capital at investment price $P^{I}_{sp,t-1}$, collecting a rental fee and then selling the depreciated structures for $(1-\delta_s)P^{I}_{spt}$ in the next period, or earning a nominal rate of return i_{spt}, on a different investment opportunity. The cost-of-capital equation is:

$$P^{S}_{pt} = P^{I}_{sp,t-1} * i_{spt} + \delta_S * P^{I}_{spt} - (P^{I}_{sp,t} - P^{I}_{sp,t-1}) \tag{7}$$

This formula shows that the rental fee is determined by the nominal rate of returns, the rate of economic depreciation and the asset specific capital gains. We will use this method to measure capital services.

2.3 Measuring labour composition index

The labour composition index (LCI) [4] is an important component in the

[4] The labour composition index adjusts the total hours worked for the composition of labour, which requires identification of separate, heterogeneous groups of labour input whose work-hours are likely to have varying effectiveness. The LCI is particularly important when we consider changes over time in the labour input. For example, consider the effect of the total number of hours remaining fixed over time, but the composition changing so that the hours are being performed by increasingly intelligent workers. These hours being more efficient will result in greater output.

decomposition of labour input in the growth accounting literature (O'Mahony and Timmer, 2009), which is also called the "labour quality" index in Jorgenson *et al.* (2005) and Schwerdt and Turunen (2007). In emerging knowledge economy, changes in labour composition index is mostly driven by greater demand for skilled workers (Timmer et al., 2010).

To consider labour heterogeneity, we can multiply the number of employed persons[5] by the labour composition index to proxy human capital in the labour inputs. Labour composition index accounts for the level of skill provided per worker which increases with improvement of knowledge and innovation. Ignoring the growth of labour composition will underestimate the contribution of labour inputs to economic growth (Jorgenson, 2005). The growth rate of labour composition is as follows:

$$\Delta \ln LCI_{pt} = \Delta \ln L_{pt} - \Delta \ln H_{pt} \tag{8}$$

$\Delta \ln H_{pt}$ is the growth rate of unadjusted labour input - number of employed persons at different education levels, which is defined as follows:

$$\Delta \ln H_{pt} = \ln \frac{H_{pt}}{H_{p,t-1}} \tag{9}$$

$$H_{pt} = \sum_{m=1}^{4} h_{mpt} \tag{10}$$

where h_{mpt} is the number of persons employed for the particular educational level m in the province p and year t. $\Delta \ln L_{pt}$ is the growth rate of weighted composition-adjusted labour inputs, and the weight is the average labour compensation share for a particular group (assuming there are four groups)

$$\Delta \ln L_{pt} = \Sigma_{m=1}^{4} [\frac{1}{2} (\frac{W_{mpt} h_{mpt}}{\sum_{m=1}^{4} W_{mpt} h_{mpt}} + \frac{W_{mp,t-1} h_{mp,t-1}}{\sum_{m=1}^{4} W_{mp,t-1} h_{mp,t-1}}) * \ln(\frac{h_{mpt}}{h_{mp,t-1}})] \tag{11}$$

where W_{mpt} is the average measured wage rate for particular education level m in province p and year t. In a competitive market, wage differentials should represent individuals' productivity differentials. The use of wage as a measure of a worker's productivity is based on the underlying assumption that relative wages are equal to the relative marginal products of workers. Various characteristics of actual labour markets, such as discrimination, union bargaining, signalling and mismatch, may result in violations of this assumption (Ho and Jorgenson, 1999). However, due to the lack of more direct measures, wage remains the best available proxy of a worker's productivity.

There are two methods, the average approach and the regression approach to measure wages. The average approach is to use the average compensation share attributable to a particular cell (Ho and Jorgenson, 1999) to estimate the wages W_{mpt}. They construct a quality/composition-adjusted measure of labour inputs based on a cross-classification of number of employed persons into a number of cells by

[5] The information of annual hours worked by education level/province/year is not available in China, so we use the number of employed persons instead.

observed worker characteristics. On the other hand, the regression approach is applied by the U.S. Bureau of Labor Statistics (BLS) (1993) and Schwerdt and Turunen (2007), using a Mincerian wage regression approach to estimate cell means. We try both methods in this paper.

3. Measurement

3.1Measuring capital services in China

3.1.1 Data sources

To illustrate the effect of physical and human capital on productivity, we need measure variables such as value added, capital services, labour inputs and the labour composition index. Our data on capital services are mainly from macro level data in various years of the China Statistical Yearbook (CSYs), Population Census (State Council Population Census Office and the NBS Population Division, 1985, 1993 and 2001), Hsueh and Li (1999) and National Bureau of Statistics (1999). In this sector, we firstly follow the methods in Timmer *et al.* (2007) to construct the capital services in China.

Our investment data are from the National Bureau of Statistics (1999) and various Chinese Statistical Yearbooks, which provide information for three categories of capital - buildings and structures, machinery and equipment, and other assets. The "other assets" refers to the expenses related to the structures and installation projects and to the purchase of equipment. In line with Fu (2008), we reallocate the "other assets" into structures and equipments according to their ratios in investment excluding "other assets".

3.1.2 Measurement method

Hulten and Wykoff (1981) estimated depreciation rates of 3.7 percent for structure and 13.3 percent for equipment in the US. The Chinese official depreciation rates are unusually low, in line with the overestimated service life of fixed assets in the absence of markets during the central-planned period (Wu and Xu, 2002). Since the National Bureau of Statistics does not provide life length and depreciate rates for the different kinds of investments, we derive depreciation rates based on Chinese tax regulations.[6] According to equation (4), we have the capital stock of structures as follows:

$$K_{pt}^{S} = (1-\delta^{S})K_{p,t-1}^{S} + I_{pt}^{S} \tag{12}$$

The nominal rate of returns here is the one-year deposit rate, and the asset price is the capital deflator of investment for structure. To decide the starting point of capital stock from the value of gross fixed capital formation (1952 value, or the average value between 1952 and 1956) adjusted by its depreciation rates, we make a sensitivity test to compare their derived capital stock. We find that these two lists of capital stocks calculated are similar, because the investment was very low in the newly founded the People's Republic of China (PRC). So we choose to rely on the gross fixed capital formation in 1952 multiplying life time as the starting point to

[6] Before 1994, the legal life of structures is 40 years, and equipment's legal life is 18 years. After 1994, the structures' legal life is 30 years, and equipment's legal life is 13 years. Thus, the geometric depreciation rates for structures are 5 percent and 7 percent, and for equipment are 11 percent and 15 percent, with the 1994 as break.

calculate the capital stock. After we get the nominal capital stock for structure and equipment, we add them together to get the nominal capital stock for each province *p* in each year *t*. Using the capital stock deflators, which equal to the GDP deflators from 1878-1991, and the investment deflators from 1992-2009, and imputed by the general retail price index for 1952 to 1977, we derive the real capital stock for our productivity analysis.

3.1.3 Results

Table 1 presents the annual growth rate of real capital stock during three time periods, 1978 to 1988, 1989 to 1999 and 2000 to 2009 by region. Physical capital grows faster in the Coastal than other regions before 2000, but becomes slower in 2000-2009. It suggests that the Coastal is shifting its growth driver from physical capital to other factors (such as human capital) after 2000.

(Table 1 around here)

3.2 Measuring labour composition index in China

3.2.1 Data sources

Macro level data in the China Statistics Yearbooks 1989-2009 are used to investigate the change of labour composition index over long and continuous time period. Notwithstanding, a major limitation of macro level data is that only mean (average) income are reported at the provincial level. Directly using macro level data is equivalent to assuming that all individuals in a group have the same income. This potentially underestimates inequality within each province. Hence, micro level data of the CHNS is also used to improve the data quality of the labour composition index in this sector.

The CHNS dataset is conducted by China's National Institute of Nutrition and Food Safety, the Chinese Centre for Disease Control and Prevention, and the University of North Carolina. It is typically available for isolated years and individual provinces for urban and rural areas, containing accurate information on wages, education, and other demographic information. The survey employs a multistage random-cluster sampling process to draw households from eight provinces during 1989-1997 and nine provinces thereafter.[7] Jorgenson (1990) measures labour quality indices, incorporating both individual data on hours worked and labour compensation from the Censuses of Population. Following his work, this paper derives the wages from the CHNS dataset, and then incorporates the macro level data to compare the two methods of labour composition index.

3.2.2 Measurement method

First, we need to identify categories to identify workers with different effectiveness. The categories should be workers' demographic characteristics relevant to marginal products, under the assumption of perfect competition. Dension (1962) measures

[7] 8 provinces (Liaoning, Jiangsu, Shandong, Henan, Hubei, Hunan, Guangxi and Guizhou) for years 1989-1993; 8 provinces in 1997 (replace Liaoning with Heilongjiang, others are the same); 9 provinces for years 2000-2009 (with both Liaoning and Heilongjiang, and other provinces as well). In 1989, the CHNS surveyed 15,917 individuals from 3,795 households. From 1993 onwards, the survey added new households and communities to replace those that were no longer participating. But most households have been followed up across the eight waves.

labour quality changes due to the age, sex and education. Chinloy (1980) uses gender, class of worker, age, educational attainment and occupation. And, Jorgenson *et al.* (1987) use gender, age, educational attainment, class of worker, occupation and industry.

In this paper, workers' education attainment is considered as a proxy for human capital. The China Statistical Yearbooks have only categorized provincial persons employed by education levels. The information of education levels by age and gender is limited in macro level data. In terms of economic theory, formal education is the main source of general human capital, with the basic proposition that investment in education results in higher human capital and productivity (Becker, 1993). Individuals with the same education level are regarded as an isolated island within which all hours worked have the same productivity, but facing different productivities when compared with each other. Hence, different education groups are imperfect substitutes in production (Lindley and Stephen, 2011; Katz and Murphy, 1992).[8]

From macro level dataset, we get variables such as number of persons employed over 1989-2009, and education levels of persons employed from 1996 to 2009. Following Cheng and Kwan (2000), we construct the education levels of persons employed from 1989 to 1995 based on information of the entire population (the percentages of the population aged 6 and over with primary school, junior secondary school, senior secondary school and college education) by province. Consequently, we compute changes in the aggregate labour inputs as a weighted average of the working hours of each cell and time period, where the weights are given by the average share of compensation attributable to each cell in two adjacent years. We calculate growth in labour composition as the difference between growth in this aggregate labour inputs and growth in a raw measure of hours worked.

Second, we apply two methods, the average approach and the regression approach to measure average wages using the CHNS dataset. We consider urban and rural areas separately and then weight them by the urban-rural ratios of persons employed.[9] The average approach applies the average compensation share attributable to a particular cell (Ho and Jorgenson, 1999). We construct a composition-adjusted measure of labour input based on a cross-classification of hours worked into a number of cells by observed worker characteristics (education levels in this paper).

The regression approach is applied by the U.S. Bureau of Labor Statistics (BLS) (1993) and Schwerdt and Turunen (2007), using a Mincerian wage regression to estimate cell means. With the regression approach, we can increase the dimensionality of factors in the composition adjustment with few observations by incorporating the interactive variables. We estimate wage equations for the persons employed in available provinces and years using the Ordinary Least Square (OLS) regression.

$$\begin{aligned} \ln w_{it} &= \beta_0 + \beta_1 age_{it} + \beta_2 age2_{it} + \beta_3 male_{it} \\ &+ \sum_{m=1}^{4}\sum_{p=1}^{9}\sum_{u=0}^{1} \beta_{mpu} edu_{mt} * pro_{pt} * urban_{ut} + \varepsilon_{it} \end{aligned} \quad (13)$$

[8] Previous studies also uses only one variable (education) to obtain quality indexes. For example, Barro and Lee (1996) used actual years of schooling to compare the human capital stock of different countries.

[9] The effect of education is significantly different between the urban and rural areas, which are verified by the sensitivity tests. The huge urban-rural inequality results in significant differences in the accumulation of human capital and their returns.

where w_{it} is the nominal hourly wage rate for a worker i with education level m in province p in year t;[10] edu_{mt} are dummies for education categories (m=1 - 4): primary school and below, lower middle school, upper school (including upper middle school and vocational school), and college and above; pro_{pt} represents 9 provinces in the surveys; and $urban_{ut}$ represent individual's location (u=0 for rural; 1 for urban). In the regression, the interactive variable "primary school and below*Guizhou province*rural" is the baseline group. Quadratic age and gender are control variables.[11] We run this regression for each year t. Following the BLS method, average values for the control variables for the whole sample are used to calculate measured wages, such that their impact is excluded from the calculation of the labour composition index (BLS, 1993).

Then, we construct measured wages W_{mpt} for education level m, province p and year t based on the coefficients of the interactive variables in the equation as follows:

$$W_{mpt} = \exp(\beta_{mpt}) \tag{14}$$

For both the average approach and the regression approach, we then impute the measured wages between the surveyed years. For example, the measured wages in 1994 can be imputed by the annual growth rate g between 1993 and 1997:

$$\begin{aligned} g &= \left(\frac{W_{mpt}^{1997}}{W_{mpt}^{1993}}\right)^\wedge(1/4) - 1 \\ W_{mpt}^{1994} &= W_{mpt}^{1993} * (1+g) \end{aligned} \tag{15}$$

3.2.3 Results

Table 2 shows the ratio of persons employed who work in the urban area to total persons employed, i.e. urban share for the nine provinces and the four regions from 1989 to 2009. These urban-rural ratios will be used as weights for the labour composition index calculation. After the foundation of P. R. China in 1949, the Northeast (including Liaoning and Heilongjiang provinces) was centrally planned to focus on the secondary industries. Hence, this region had the highest urban share among regions in 1989 (about 56 percent), but declined to about 44 percent in recent years. The Coastal developed quickly over time as its urban share increased from 27 percent in 1989 to 38 percent in recent years. The urban shares of the other two regions (the Interior and the West) are quite stable around 20 percent.

(Table 2 around here)

Table 3 presents the nominal hourly wages derived from the average approach by region (results by province are listed in Appendix Table A1). Generally, hourly

[10] We divide the nominal annual earning (including wages, subsidy and bonus) by annual hours worked to derive a measure of nominal hourly wage rate for each individual. Different from the aggregate provincial dataset from CSYs, the CHNS micro data provides the individual's annual hours worked.

[11] Age is a proxy for the stock of general experience that embodied in a person. We use age rather than experience because the CHNS dataset does not provide information for experience. Women earn less than males even when controlling for all the other relevant characteristics.

wage rates of all sub-groups increase over time. In 1989, most of the wage rates was nearly 0.55 - 0.65 Yuan per hour, reflecting the national rigid wage-setting irrelevant education level or location. With the deepening wage reforms, for all education levels and locations, the wage rates doubled from 1993 to 1997. And, the wage rates in 2009 doubled the wage level in 1997 again. The difference across education levels and locations mainly happened in the 2000s.

The highest returns to education occurred in both the urban and rural areas of the Coastal and Interior. Nearly in all provinces and regions, workers with upper school and above degrees earned more in the urban area (urban premium), suggesting complementarities between technology in the urban and high skilled workers. Similarly, workers with lower middle school and below degrees earn more in the rural area (rural premium), suggesting complementarities between technology in the rural and medium skilled workers.

(Table 3 around here)

Table 4 represents the coefficients of the OLS regression model in equation (13) by region, using "primary school and below * the West region * rural area" as the baseline group.[12] These coefficients are regarded as the incremental effects on the baseline group. In the urban areas, the significantly positive incremental effects are found in higher educated groups (for example College and above) since 1993 as we expect. However, the incremental effects of higher educated workers in the rural areas are only found prominent since 2004. For those medium or low education groups, the wage differentials are significant in the urban areas only after 2000, being similar to the rural areas. It is consistent with what we find in the average approach and suggests that the skill-biased technology, for instance, the Information and Communication Technology (ICT) in O'Mahony *et al*. (2008) was firstly introduced to the urban areas from the advanced western countries with the openness policies, and later the rural areas. Therefore, the significant wage differentials among education levels and locations mainly appear in the 2000s and more prominent for medium and higher education groups such as upper school, and college and above. These results are also consistent with the transition processes of Chinese labour markets.

(Table 4 around here)

With the nominal hourly wage rates from the average approach and OLS regression approach, we get the labour composition index by region (with the West as the baseline region starting from 100 in 1989) and province (with Guizhou as the baseline province starting from 100 in 1989) in Table 2.5. The detailed labour composition indices per year by province are presented in Appendix Table A3 and in Appendix Table A4 by region. In general, the labour composition indices increase over time especially after 2000.

The labour composition indices calculated from the regression approach have less variation than from the average approach possibly due to better controlling. In both methods, the Interior (101.61 and 102.33 respectively) always has the highest LCI among four regions. The outstanding growth rates of the LCI in the Interior suggest the catching up processes of this region to the richest Coastal.

Moreover, from the OLS regression approach, Heilongjiang province in the

[12] The coefficients of the OLS regression model by province can be seen in Appendix Table A2.

Northeast also has high LCI as in the Interior. For example, in the first survey year 1989, the highest LCI from the average approach is in Henan province (109.76) while the highest LCI from the OLS regression approach is in Heilongjiang province (104.79). Therefore, after two decades, Henan province has become the one with highest LCI (121.20 and 114.18 respectively) among all provinces. The lowest labour composition index is in Liaoning from the average approach and in Guizhou from the regression approach.

(Table 5 around here)

Table 6 indicates the annual growth rates of labour composition indices derived from both the average and OLS approaches, by region and province over the two periods, 1989 to 1999, and 2000 to 2009. Provinces and regions perform much better in the 2000s, especially in Henan province with the annual growth rates above 1.1 percent. Besides Henan and Hunan, the growth rates of LCI in Jiangsu and Heilongjiang are also outstanding. Gansu has no much progress in LCI in the past two decades. Therefore, the disparities of growth rates of LCI between provinces and regions in the recent years suggest the contribution of human capital formation to decrease the regional disparities in China.

We will use the labour composition index calculated by the OLS regressions in the rest of this thesis, since the OLS method can increase the dimensionality of factors in the composition adjustment with few observations by incorporating the interactive variables. The interactive variables "education level dummies * province dummies * urban dummies" can describe the human capital analysis more precisely, especially for a transition country as China.

(Table 6 around here)

3.3 Total factor productivity (TFP)

We calculate the TFP growth according to method referred to O'Mahony and Timmer (2009) which is based on the index number approach.

$$\Delta \ln A_{pt} = \Delta \ln Y_{pt} - (1-\bar{V}_{pt}^{L})\Delta \ln K_{pt} - \bar{V}_{pt}^{L}\Delta \ln L_{pt} \qquad (17)$$

where Y, K and L are GDP, capital stock and labour inputs. $\bar{V}_{pt}^{L}$ denotes the two-period average labour share, which is defined as the ratio of labour compensation to GDP.

First of all, the labour share V_{pt}^{L} is regarded as the weight for the production factor - labour, reflecting the marginal cost of labour usage in growth accounting decompositions. According to the income approach in the China Statistics Yearbooks (CSYs), GDP is the sum of labour remuneration, depreciation, operating surplus and net taxes on production[13]. To avoid the potential underestimation of labour shares due

[13] Net taxes on production refer to taxes on production less subsidies on production. The taxes on production refers to the various taxes, extra charges and fees levied on the production units on their production, sale and business activities as well as on the use of some factors of production, such as fixed assets, land and labour in the production activities they are engaged in. Subsidies on production refer to the unilateral government transfer to the production units, including subsidies on the loss due to implementation of government policies, price subsidies, etc.

to non-reported incomes, we use labour remuneration[14] rather than wage bills to measure labour compensation. Returns to capital are represented by depreciation and the operating surplus. In addition, in the absence of detailed information about the various tax types of net taxes on production, we follow Holz (2006)'s suggestion to split the net taxes on production as follows:

Split ratios for labour = Labour remuneration / (labour remuneration + depreciation + operating surplus)

The imputed labour returns within Net taxes on production = Net taxes on production * Split ratios for labour

Total labour returns = Labour remuneration + the imputed labour returns in net taxes on production

Labour share = Total labour returns / GDP

Then, there are various kinds of price index used here. The implicit GDP deflators are applied as in many previous studies (Rawski, 1993; Maddison, 1998; Woo, 1998; Wu, 2000) to deflate nominal values into real ones. To transfer the nominal capital stock into real values, we use the "price index of investment in fixed assets" from the national CSYs as capital deflator. This capital deflator is collected by the urban survey team of National Bureau of Statistics (NBS) since 1991, based on 600 enterprises and expanding to 4500 enterprises after 1998. For years before 1991, we splice the price index of investment in fixed assets to the GDP implicit deflator. All the monetary values are calculated in 1995 price.

Table 7 presents the annual growth rates of the TFP indices by region and province during the three time periods, 1978 to 1988, 1989 to 1999 and 1999 to 2009.[15] The main difference between using composition-adjusted labour input or unadjusted labour input to calculate TFP mainly lies during the time period 2000-2009 in the Interior region. In general, the Coastal, Interior and West perform better than the Northeast. The highest annual growth rates are 6.6 percent for Xinjiang during 1978-1988, 6.8 percent for Fujian during 1989-1999 and 5.9 percent in Hubei in the 2000s possibly due to their much lower initial levels. It suggests convergence processes among provinces and regions. Only three provinces (Tianjin, Beijing and Shanghai) during 1978-1988 show the negative annual growth rates, possibly associated with the slow processes of political and economic reforms in before 1989 these three "special municipalities/cities" which are directly under control of the Central Government. Moreover, the annual growth rates during 1989-1999 are the highest among the three periods, which is consistent with the dramatic institutional reforms after Deng Xiaoping's south trip's speech about deepening reforms in 1992.

(Table 7 around here)

4. Contributions of production factors to productivity

According to the growth accounting methodology, we decompose the annual growth rate of GDP into its components: employment (*L*), LCI, physical capital (*K*) and factor productivity (TFP). We list two tables (Table 8 and 9) to consider the contributions of

[14] Labour remuneration not only refers to the total payment of various forms to workers including wages, bonuses and allowances earned in cash or other kinds, but also includes all benefits such as free medical services, medicine expenses, transport subsidies, social insurance, and housing fund paid by the employers.

[15] The TFP indices (1995=100) by province and region from 1978 to 2009 can be seen in the Appendix Table A4.

production factors (excluding or including LCI, respectively) to productivity.

Table 8 shows the sources of growth (annual percentage rate of change) by region and province during three time periods: 1978 to 1988, 1989 to 1999 and 2000 to 2009. As we expect, the physical capital input is the main contributor to labour productivity growth before 1989 and after 2000. For example, during the period of 1978-1988, the physical capital grows at 11.63 percent for Shanghai and 10.41 percent for Jiangsu, which account for most of growth of labour productivity. Hence, we can find the provinces with more physical investment have higher growth rates, as well as higher contribution proportions from physical capital. The Coastal has the highest growth rate of physical capital (for instance, 7.44 percent over the period 1978-1988), the highest growth rate of GDP (10.5 percent), the highest growth rate of labour productivity (9.04 percent) and the highest contribution of physical capital to labour productivity growth (82.3 percent). Therefore, the disparities of the formation speed of physical capital among regions (provinces) are the dominant factor to understand the regional (provincial) disparities in China. The three negative growth of TFP appear in the three municipal cities (Beijing, Tianjin and Shanghai) which are tightly controlled by the central government during the beginning stage of "Open-up Policy" with cautious optimism.

In 1990s, the TFP growth is much higher than the LP growth, leading to the falling contribution of capital deepening. The highest contribution of TFP occurs in the Interior region, especially the Henan province, consistent with the outstanding performance of LCI in Table 9. In contrast, the labour productivity and capital deepening rise simultaneously after 2000, supported by the huge investment of physical capital such as government spending, especially in the Industrial Northeast region may due to the "Revitalize the Northeast" policy implemented in 2003.

(Table 8 around here)

Since the LCI are calculated by using the CHNS dataset (1989-2009), we only can impute the LCI contributions during the latter two time periods: 1989-1999 and 2000-2009 (see Table 9). Human capital formation is becoming more and more important factor in economic growth. The performance of the Interior region (especially Henan province) are outstanding across the two time periods, marked by the lowest contribution of physical capital and highest contribution of LCI. It suggests that human capital formation from technological and institutional shifts is taking place of physical capital formation in the economic growth (Ding and Knight, 2011). Labour composition index has also contributed more than before from about 0.2 percent in the 1990s to about 1.4 percent in the 2000s. The changing growth pattern in the Coastal points out the development direction for the other regions in the future.

5. Conclusions

This paper reviews the growth accounting model and measurement methods of its components such as physical capital services, labour inputs, labour composition index (LCI) and Total Factor Productivity (TFP). We apply this model to Chinese empirical studies for regions and provinces from 1978 to 2009.

We use the LCI to adjust labour inputs. Both average approach and Ordinary Least Square (OLS) regression approach are applied to calculate the measured wage rates for employees with different education levels, provinces and years, weighted by urban/rural ratios. The LCI keeps on increasing from 1989 to 2009. Among the provinces and regions, the Interior region especially Henan province has the highest

LCI, maybe because it is centre-located between Beijing and Shanghai (two educational and economic centers in China).

After we decompose the annual growth rate of GDP into its components of employment, LCI, physical capital and TFP, we find that Chinese economic growth was mainly pushed by the growth of physical capital. The annual growth rate of labour productivity in the Coastal is the highest among all regions in China, while labour inputs and TFP growth contribute more in the Interior and West regions. It can explain the regional disparities reasonably. The growth rate of physical capital in the Coastal was at about double speed of the other three regions (the Northeast, the Interior and the West) before 2000. During the period of 2000-2009, the growth rates of physical capital in the left-behind regions have caught up with the Coastal. Since there is no significant difference between the Coastal and the other three, with more investment of physical capital, we would find more evidence of convergence on economic growth in the future research.

Moreover, the contribution shares of physical capital in labour productivity have been declining for the most advanced Coastal, while the TFP contributions have been increasing over the same period. It is consistent with findings of Ding and Knight (2011) that both physical and human capital formation contribute to the economic growth in China. Our results show that the human capital formation from technological and institutional shifts (TFP) is becoming more and more important in the Coastal. Labour composition index (education) also contribute to economic growth. Although its contribution is not as dominant as physical capital and TFP in current stage, the LCI is taking more space in the growth accounting model. The new growth pattern of the Coastal suggests that human capital formation including education will be the next potential engine of economic growth for other less developed regions, leaving much more space for them to compete.

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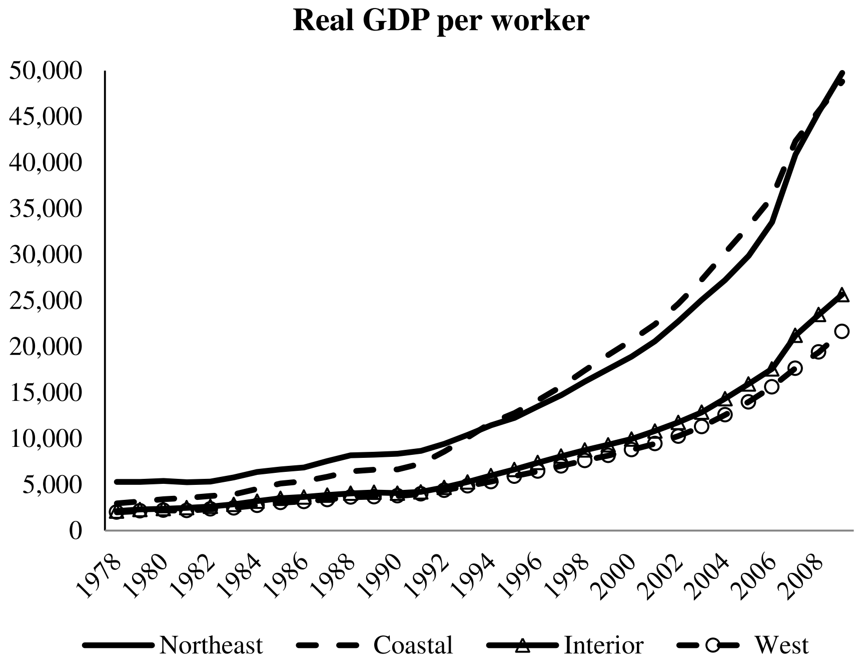
Figure 1: Real GDP per worker by region (Yuan in 1995)



Data sources: (Hsueh and Li, 1999); various years China Statistical Yearbook (NBS, 1999); National Bureau of Statistics (1999).

Table 1 Annual growth rate of real capital stock

Location	1978-1988	1989-1999	2000-2009
Northeast	0.1	0.09	0.16
Coastal	0.16	0.15	0.14
Interior	0.1	0.11	0.16
West	0.09	0.12	0.16

Note: The real capital stock is calculated by the perpetual inventory method.

Table 2: Urban Share (by province and region)

Urban share	1989-2009	1989-1999	2000-2009
Northeast	**0.49**	**0.55**	**0.43**
Liaoning	0.51	0.56	0.45
Heilongjiang	0.52	0.60	0.43
Coastal	**0.30**	**0.29**	**0.32**
Jiangsu	0.29	0.26	0.31
Shandong	0.24	0.23	0.25
Interior	**0.22**	**0.23**	**0.20**
Henan	0.18	0.19	0.16
Hubei	0.30	0.32	0.28
Hunan	0.19	0.20	0.18
West	**0.21**	**0.21**	**0.21**
Guangxi	0.16	0.17	0.16
Guizhou	0.14	0.15	0.13

Note: Urban share is the ratio of persons employed who work in the urban area to total persons employed: $\text{Urban share} = \frac{\text{Persons employed who work in the urban area}}{\text{All persons employed}}$

Table 3: Average wages by region (the average approach)

Average	1989	1991	1993	1997	2000	2004	2006	2009
Primary school and below (urban area)								
Northeast	0.66	0.85	0.93	2.81	3.49	4.5	8.32	6.24
Coastal	0.63	0.99	1.43	2.87	5.3	5.71	5.66	8.27
Interior	0.65	0.95	1.6	2.93	4.09	5.03	5.5	10.85
West	0.57	0.7	1.66	3.08	4.63	3.23	4.67	5.94
Lower middle school (urban area)								
Northeast	0.5	0.65	1.07	3.37	4.53	5.1	6.29	8.27
Coastal	0.65	0.83	1.49	3.36	5.53	6.6	6.81	10.97
Interior	0.69	0.82	1.29	3.13	4.05	6.29	10.03	9.27
West	0.58	0.59	1.3	2.7	5.57	4.24	5.11	7.81
Upper school (urban area)								
Northeast	0.6	0.67	0.86	2.99	5.11	7.92	9.2	10.58
Coastal	0.6	0.83	1.62	3.62	6.01	8.1	8.39	14.26
Interior	0.77	0.8	1.15	3.78	6.44	7.11	9.31	12.88
West	0.53	0.64	1.23	2.64	4.08	8.12	10.03	13.35
College and above (urban area)								
Northeast	0.63	0.75	1.09	3.04	6.7	10.08	13.87	17.66
Coastal	0.65	0.78	1.44	4.16	8.66	9.45	13.22	17.33
Interior	0.71	0.86	2.35	5.27	8.5	11.7	16.08	17.32
West	0.59	0.69	1.41	2.92	5.06	14.29	10.22	16.06
Primary school and below (rural area)								
Northeast	0.79	1.14	1.43	2.63	6.42	4.84	5.91	16.09
Coastal	0.61	0.93	1.28	3.66	4.34	5.08	3.92	8.28
Interior	0.63	0.88	1.39	3.58	5.04	5.09	6.43	11.76
West	0.72	0.89	1.12	2.79	4.15	3.77	4.43	5.58
Lower middle school (rural area)								
Northeast	0.56	0.93	1.39	3.35	4.09	8.03	7.17	8.84
Coastal	0.68	0.76	1.17	3.07	4.27	5.62	5.76	9.73
Interior	0.93	0.79	1.84	2.82	4.16	4.55	6.4	15.16
West	0.55	0.76	1.42	3.18	4.73	5.93	6.43	8.21
Upper school (rural area)								
Northeast	0.47	1.87	1.17	1.86	3.88	6.32	8.1	10.37
Coastal	0.63	0.75	1.23	3.58	5.31	7.29	8.36	10.71
Interior	0.64	0.74	0.89	3.65	5.31	6.29	7.43	12.75
West	0.49	0.67	0.95	2.94	4.84	6.56	6.48	13.03
College and above (rural area)								
Northeast	0.59	0.82	1.02	1.88	4.27	6.26	11.01	13.15
Coastal	0.48	0.65	1.03	2.51	5.01	16.39	11.19	13.44
Interior	0.65	0.77	1.32	3.21	12.36	6.82	8.27	18.08
West	0.53	0.69	0.6	3.48	4.62	5.79	9.92	17.76

Note: The average approach is to calculate the average wages for a particular cell, such as "Northeast * Primary school and below * 1989".

Table 4: Measured coefficients of wages by region (OLS regression)

OLS	1989	1991	1993	1997	2000	2004	2006	2009
Primary school and below (Urban Area)								
Northeast	0.076	0.013	-0.124	-0.059	-0.153	0.151	-0.018	0.023
Coastal	0.047	0.03	0.255	0.031	0.135	0.180*	0.219	0.328**
Interior	0.085	0.107	0.128	0.051	-0.064	0.077	0.178	0.519***
West	-0.1	-0.132*	0.143	-0.022	-0.179	-0.214	0.1	0.029
Lower middle school (Urban Area)								
Northeast	-0.048	-0.111	-0.064	0.109	0.061	0.168	0.219	0.299**
Coastal	0.173*	0.058	0.249*	0.065	0.105	0.436***	0.322**	0.481***
Interior	0.155	0.106	0.141	0.117	-0.046	0.201	0.421***	0.368***
West	-0.022	-0.191**	0.047	-0.053	0.009	0.075	0.098	0.219*
Upper school (Urban Area)								
Northeast	0.099	-0.034	-0.141	0.075	0.247**	0.653***	0.589***	0.565***
Coastal	0.095	0.12	0.413***	0.265***	0.299**	0.698***	0.550***	0.775***
Interior	0.191*	0.111	0.069	0.205**	0.308***	0.560***	0.670***	0.741***
West	-0.062	-0.115	0.171	-0.008	0.085	0.680***	0.641***	0.685***
College and above (Urban Area)								
Northeast	0.131	0.002	0.027	-0.055	0.474***	0.982***	1.042***	1.171***
Coastal	0.215*	-0.004	0.216	0.444***	0.620***	0.888***	1.003***	1.124***
Interior	0.242**	0.116	0.306**	0.550***	0.633***	1.047***	1.119***	1.116***
West	0.117	-0.014	0.249**	0.141	0.249	0.863***	0.949***	1.022***
Primary school and below (Rural Area)								
Northeast	0.151	0.208	-0.006	-0.041	0.002	0.038	0.181	0.553***
Coastal	-0.045	-0.027	0.062	0.11	0.013	-0.063	-0.069	0.194
Interior	-0.091	-0.092	-0.18	0.07	-0.114	-0.119	0.135	0.347**
Lower middle school (Rural Area)								
Northeast	-0.088	0.069	0.028	-0.166	-0.125	0.205	0.159	0.253**
Coastal	0.055	-0.018	0.105	-0.034	0.014	0.208*	0.201*	0.326***
Interior	0.048	-0.087	-0.077	-0.051	-0.001	0.187	0.24	0.446***
West	-0.024	-0.036	0.168**	0.099	0.077	0.313***	0.189**	0.263**
Upper school (Rural Area)								
Northeast	-0.08	0.039	-0.19	-0.331***	0.024	0.456***	0.504***	0.582***
Coastal	0.099	-0.046	0.08	0.159*	0.224*	0.473***	0.507***	0.405***
Interior	-0.098	-0.087	-0.147	0.135	0.083	0.403***	0.454***	0.680***
West	-0.117	-0.104	-0.091	0.08	0.174	0.458***	0.380***	0.568***
College and above (Rural Area)								
Northeast	0.136	0.08	-0.032	-0.297***	0.111	0.508***	0.848***	0.866***
Coastal	-0.018	-0.058	0.02	-0.047	0.235	1.242***	0.848***	0.924***
Interior	0.11	0.072	0.122	0.189	0.673**	0.633***	0.697***	0.905***
West	-0.136	0.026	-0.570***	0.283***	0.131	0.517***	0.819***	0.891***
R-square	0.092	0.093	0.089	0.081	0.086	0.173	0.191	0.181
N	3325	2981	2498	2562	2555	1841	1988	2277

Notes:

1. The coefficients are incremental effects on the baseline group "primary school and below * the West region * rural area".
2. Notes: Standard errors are in italics. The stars *, ** and *** indicate the significance level at the 10%, 5% and 1%, respectively for two-tail test.

Table 5: Average labour composition index

Average LCI	Average approach			OLS approach		
	1989-2009	1989-1999	2000-2009	1989-2009	1989-1999	2000-2009
Northeast	**95.60**	**95.40**	**95.81**	**98.95**	**98.33**	**99.64**
Liaoning	94.53	94.34	94.74	101.44	100.94	101.99
Heilongjiang	105.42	104.89	106.00	105.96	105.06	106.96
Coastal	**99.15**	**98.66**	**99.70**	**101.85**	**100.99**	**102.80**
Jiangsu	100.77	99.72	101.92	104.95	103.27	106.80
Shandong	101.82	101.74	101.91	104.30	104.03	104.61
Interior	**102.91**	**101.91**	**104.01**	**104.47**	**102.85**	**106.26**
Henan	115.70	111.83	119.95	108.48	104.36	113.03
Hubei	104.36	104.00	104.76	106.17	104.98	107.48
Hunan	104.65	100.46	109.26	103.64	100.97	106.57
West	**100.49**	**99.54**	**101.54**	**101.20**	**100.23**	**102.25**
Guangxi	98.68	97.31	100.19	101.96	100.35	103.74
Guizhou	99.16	98.75	99.61	100.17	99.91	100.45

Table 6: Annual growth rates of Labour composition index

	Average approach			OLS approach		
	1989-2009	1989-1999	2000-2009	1989-2009	1989-1999	2000-2009
Northeast	**-0.02%**	**-0.10%**	**0.07%**	**0.10%**	**-0.06%**	**0.27%**
Liaoning	0.01%	-0.11%	0.16%	0.14%	-0.02%	0.35%
Heilongjiang	0.04%	0.19%	-0.13%	0.09%	0.04%	0.10%
Coastal	**0.06%**	**-0.10%**	**0.19%**	**0.13%**	**0.03%**	**0.19%**
Jiangsu	0.17%	-0.15%	0.52%	0.29%	0.07%	0.55%
Shandong	0.07%	-0.03%	0.17%	0.07%	0.01%	0.10%
Interior	**0.15%**	**0.02%**	**0.19%**	**0.23%**	**0.09%**	**0.27%**
Henan	0.50%	0.31%	0.45%	0.53%	0.29%	0.49%
Hubei	-0.01%	0.16%	-0.19%	0.17%	0.22%	0.03%
Hunan	0.62%	-0.03%	1.10%	0.39%	-0.09%	0.75%
West	**0.10%**	**-0.01%**	**0.18%**	**0.10%**	**0.08%**	**0.07%**
Guangxi	0.18%	0.11%	0.21%	0.19%	0.11%	0.18%
Guizhou	0.00%	-0.15%	0.14%	0.00%	0.02%	-0.03%

Table 7: Annual growth rates of Total Factor Productivity

TFP growth	Considering LCI 1989-1999	Considering LCI 2000-2009	Not considering LCI 1978-1988	Not considering LCI 1989-1999	Not considering LCI 2000-2009
Northeast	**0.039**	**0.029**	**0.015**	**0.039**	**0.030**
Liaoning	0.033	0.028	0.022	0.033	0.029
Jilin	0.060	0.032	0.034	0.060	0.034
Heilongjiang	0.036	0.037	0.001	0.036	0.037
Coastal	**0.047**	**0.033**	**0.016**	**0.047**	**0.034**
Beijing	0.034	0.013	-0.011	0.034	0.014
Tianjin	0.046	0.045	-0.006	0.046	0.046
Hebei	0.051	0.024	0.016	0.051	0.025
shanghai	0.024	0.039	-0.040	0.024	0.040
Jiangsu	0.046	0.045	0.002	0.046	0.047
Zhejiang	0.052	0.020	0.049	0.053	0.021
Fujian	0.068	0.030	0.057	0.069	0.031
Shandong	0.051	0.034	0.017	0.051	0.035
Guangdong*	0.054	0.028	0.039	0.054	0.030
Interior	**0.050**	**0.034**	**0.042**	**0.051**	**0.036**
Shanxi	0.046	0.016	0.023	0.046	0.017
Anhui	0.053	0.021	0.033	0.053	0.022
Jiangxi	0.058	0.021	0.027	0.059	0.023
Henan	0.050	0.031	0.059	0.052	0.035
Hubei	0.039	0.059	0.051	0.040	0.059
Hunan	0.054	0.039	0.033	0.054	0.044
West	**0.043**	**0.035**	**0.040**	**0.043**	**0.036**
Inner Mongolia	0.051	0.047	0.057	0.052	0.048
Guangxi	0.067	0.042	0.016	0.068	0.044
Sichuan*	0.035	0.033	0.035	0.036	0.034
Guizhou	0.039	0.024	0.050	0.040	0.024
Yunnan	0.026	0.022	0.048	0.027	0.024
Shaanxi	0.039	0.036	0.053	0.039	0.038
Gansu	0.039	0.026	0.013	0.039	0.027
Qinghai	0.030	0.058	0.018	0.031	0.059
Ningxia	0.021	0.034	0.029	0.021	0.035
Xinjiang	0.047	0.032	0.066	0.047	0.033

Notes:

1. The labour composition index has information from 1989 to 2009.
2. The "Labour input" in the equation 2.17 is calculated by "LCI * Number of employed persons" in the columns "Considering LCI", while only by "Number of employed persons" in the columns "Not considering LCI" imply that the Labour input.

Table 8: Sources of growth (annual percentage rate of change)

1978-1988	GDP	L	LP	K/L	TFP	Contribution to LP (%) K/L	TFP
Northeast	**8.33**	**2.04**	**6.29**	**4.83**	**1.46**	**76.79**	**23.21**
Liaoning	8.98	1.68	7.3	5.15	2.15	70.55	29.45
Jilin	10.18	3.41	6.77	3.42	3.35	50.52	49.48
Heilongjiang	6.72	1.68	5.04	5.04	0	100.00	0.00
Coastal	**10.5**	**1.46**	**9.04**	**7.44**	**1.60**	**82.30**	**17.70**
Beijing	9.35	0.93	8.42	9.57	-1.15	113.66	-13.66
Tianjin	8.23	0.85	7.38	7.95	-0.57	107.72	-7.72
Hebei	8.6	1.64	6.96	5.39	1.57	77.44	22.56
shanghai	7.98	0.39	7.59	11.63	-4.04	153.23	-53.23
Jiangsu	11.83	1.29	10.54	10.41	0.13	98.77	1.23
Zhejiang	12.95	2.01	10.94	6.03	4.91	55.12	44.88
Fujian	11.59	2.29	9.3	3.61	5.69	38.82	61.18
Shandong	10.49	1.59	8.9	7.25	1.65	81.46	18.54
Guangdong*	11.44	1.8	9.64	5.82	3.82	60.37	39.63
Interior	**9.48**	**2**	**7.48**	**3.34**	**4.14**	**44.65**	**55.35**
Shanxi	8.49	1.52	6.97	4.78	2.19	68.58	31.42
Anhui	9.88	2.5	7.38	4.13	3.25	55.96	44.04
Jiangxi	9.31	2.25	7.06	4.43	2.63	62.75	37.25
Henan	10.58	2.23	8.35	2.51	5.84	30.06	69.94
Hubei	9.9	1.41	8.49	3.34	5.15	39.34	60.66
Hunan	8.18	1.96	6.22	2.96	3.26	47.59	52.41
West	**9.2**	**2.11**	**7.09**	**3.09**	**4.00**	**43.58**	**56.42**
Inner Mongolia	10.2	1.93	8.27	2.53	5.74	30.59	69.41
Guangxi	7.3	2.33	4.97	3.38	1.59	68.01	31.99
Sichuan*	9.1	1.8	7.3	3.76	3.54	51.51	48.49
Guizhou	9.72	2.38	7.34	2.28	5.06	31.06	68.94
Yunnan	9.76	2.21	7.55	2.77	4.78	36.69	63.31
Shaanxi	10.3	2.14	8.16	2.85	5.31	34.93	65.07
Gansu	8.09	3.44	4.65	3.24	1.41	69.68	30.32
Qinghai	7.02	2.14	4.88	3.11	1.77	63.73	36.27
Ningxia	9.48	2.25	7.23	4.35	2.88	60.17	39.83
Xinjiang	10.67	1.26	9.41	2.84	6.57	30.18	69.82

1989-1999	GDP	L	LP	K/L	TFP	Contribution to LP (%) K/L	TFP
Northeast	**8.31**	**0.43**	**7.88**	**3.99**	**3.89**	**50.63**	**49.37**
Liaoning	8.24	0.32	7.92	4.67	3.25	58.96	41.04
Jilin	9.34	-0.13	9.47	3.54	5.93	37.38	62.62
Heilongjiang	7.84	0.93	6.91	3.3	3.61	47.76	52.24
Coastal	**12.4**	**0.99**	**11.41**	**6.65**	**4.76**	**58.28**	**41.72**
Beijing	9.86	0.21	9.65	6.45	3.2	66.84	33.16
Tianjin	10.4	0.4	10	5.49	4.51	54.90	45.10
Hebei	11.71	0.87	10.84	5.84	5	53.87	46.13
shanghai	10.81	-0.61	11.42	9.1	2.32	79.68	20.32
Jiangsu	12.62	1.22	11.4	6.79	4.61	59.56	40.44
Zhejiang	13.28	0.22	13.06	7.7	5.36	58.96	41.04
Fujian	14.38	1.38	13	5.95	7.05	45.77	54.23
Shandong	12.46	1.6	10.86	5.73	5.13	52.76	47.24
Guangdong*	13.05	1.21	11.84	6.45	5.39	54.48	45.52
Interior	**10.3**	**1.45**	**8.85**	**3.74**	**5.11**	**42.26**	**57.74**
Shanxi	8.7	0.64	8.06	3.48	4.58	43.18	56.82
Anhui	11	1.23	9.77	4.3	5.47	44.01	55.99
Jiangxi	10.7	1.18	9.52	3.66	5.86	38.45	61.55
Henan	10.43	1.88	8.55	3.44	5.11	40.23	59.77
Hubei	10.8	2.05	8.75	4.62	4.13	52.80	47.20

Hunan	9.48	1.07	8.41	3.02	5.39	35.91	64.09
West	**9.29**	**0.86**	**8.43**	**4.12**	**4.31**	**48.87**	**51.13**
Inner Mongolia	9.12	0.71	8.41	3.27	5.14	38.88	61.12
Guangxi	11.84	1.35	10.49	3.79	6.7	36.13	63.87
Sichuan*	9.17	0.63	8.54	4.99	3.55	58.43	41.57
Guizhou	7.89	1.2	6.69	2.82	3.87	42.15	57.85
Yunnan	9.03	1.11	7.92	5.21	2.71	65.78	34.22
Shaanxi	8.32	1.12	7.2	3.27	3.93	45.42	54.58
Gansu	8.74	-0.14	8.88	4.9	3.98	55.18	44.82
Qinghai	7.35	2.19	5.16	2.16	3	41.86	58.14
Ningxia	7.65	1.75	5.9	3.76	2.14	63.73	36.27
Xinjiang	9.61	0.69	8.92	4.15	4.77	46.52	53.48
						Contribution to LP (%)	
2000-2009	GDP	L	LP	K/L	TFP	K/L	TFP
Northeast	**11.3**	**0.28**	**11.02**	**7.76**	**3.26**	**70.42**	**29.58**
Liaoning	11.55	0.37	11.18	8.18	3	73.17	26.83
Jilin	11.9	0.12	11.78	7.77	4.01	65.96	34.04
Heilongjiang	10.57	0.27	10.3	6.44	3.86	62.52	37.48
Coastal	**11.7**	**1.07**	**10.63**	**7.1**	**3.53**	**66.79**	**33.21**
Beijing	11.06	4.07	6.99	5.63	1.36	80.54	19.46
Tianjin	13.72	0.2	13.52	8.6	4.92	63.61	36.39
Hebei	10.74	0.83	9.91	7.14	2.77	72.05	27.95
shanghai	10.71	1.54	9.17	5.11	4.06	55.73	44.27
Jiangsu	12.43	0.15	12.28	7.49	4.79	60.99	39.01
Zhejiang	11.72	1.87	9.85	7.81	2.04	79.29	20.71
Fujian	11.53	1.58	9.95	6.81	3.14	68.44	31.56
Shandong	12.45	0.01	12.44	8.77	3.67	70.50	29.50
Guangdong*	10.98	2.09	8.89	5.9	2.99	66.37	33.63
Interior	**11.1**	**0.33**	**10.77**	**6.92**	**3.85**	**64.25**	**35.75**
Shanxi	10.56	0.65	9.91	7.92	1.99	79.92	20.08
Anhui	10.83	0.56	10.27	7.89	2.38	76.83	23.17
Jiangxi	11.45	0.54	10.91	8.48	2.43	77.73	22.27
Henan	11.45	0.43	11.02	7.16	3.86	64.97	35.03
Hubei	11.08	-0.72	11.8	5.58	6.22	47.29	52.71
Hunan	10.96	0.6	10.36	5.73	4.63	55.31	44.69
West	**11.4**	**0.79**	**10.61**	**6.85**	**3.76**	**64.56**	**35.44**
Inner Mongolia	15.7	0.73	14.97	9.88	5.09	66.00	34.00
Guangxi	11.44	0.88	10.56	5.83	4.73	55.21	44.79
Sichuan*	11.18	0.47	10.71	7.25	3.46	67.69	32.31
Guizhou	10.32	1.45	8.87	6.39	2.48	72.04	27.96
Yunnan	9.65	1.07	8.58	6.17	2.41	71.91	28.09
Shaanxi	11.69	0.35	11.34	7.24	4.1	63.84	36.16
Gansu	10.12	1.07	9.05	6.23	2.82	68.84	31.16
Qinghai	11.37	0.04	11.33	5.38	5.95	47.48	52.52
Ningxia	10.93	1.22	9.71	6.16	3.55	63.44	36.56
Xinjiang	9.65	1.33	8.32	5.01	3.31	60.22	39.78

Notes:

1. Annual growth rate of LP = Annual growth rate of GDP – Annual growth rate of L
2. Annual growth rate of LP = Annual growth rate of capital deepening (K/L) + Annual growth rate of TFP

Table 9: Sources of growth (annual percentage rate of change)

							Contribution to LP (%)		
1989-1999	GDP	L	LP	K/L	LCI	TFP	K/L	LCI	TFP
Northeast	**8.31**	**0.43**	**7.88**	**3.99**	**0**	**3.89**	**50.63**	**0.00**	**49.37**
Liaoning	8.24	0.32	7.92	4.67	-0.01	3.26	58.96	-0.13	41.16
Jilin	9.34	-0.13	9.47	3.54	-0.04	5.97	37.38	-0.42	63.04
Heilongjiang	7.84	0.93	6.91	3.3	0.02	3.59	47.76	0.29	51.95
Coastal	**12.4**	**0.99**	**11.41**	**6.65**	**0.02**	**4.74**	**58.28**	**0.18**	**41.54**
Beijing	9.86	0.21	9.65	6.45	0.02	3.18	66.84	0.21	32.95
Tianjin	10.4	0.4	10	5.49	0.02	4.49	54.90	0.20	44.90
Hebei	11.71	0.87	10.84	5.84	0.02	4.98	53.87	0.18	45.94
shanghai	10.81	-0.61	11.42	9.1	0.01	2.31	79.68	0.09	20.23
Jiangsu	12.62	1.22	11.4	6.79	0.04	4.57	59.56	0.35	40.09
Zhejiang	13.28	0.22	13.06	7.7	0.02	5.34	58.96	0.15	40.89
Fujian	14.38	1.38	13	5.95	0.02	7.03	45.77	0.15	54.08
Shandong	12.46	1.6	10.86	5.73	0.01	5.12	52.76	0.09	47.15
Guangdong*	13.05	1.21	11.84	6.45	0.02	5.37	54.48	0.17	45.35
Interior	**10.3**	**1.45**	**8.85**	**3.74**	**0.06**	**5.05**	**42.26**	**0.68**	**57.06**
Shanxi	8.7	0.64	8.06	3.48	0.05	4.53	43.18	0.62	56.20
Anhui	11	1.23	9.77	4.3	0.05	5.42	44.01	0.51	55.48
Jiangxi	10.7	1.18	9.52	3.66	0.06	5.8	38.45	0.63	60.92
Henan	10.43	1.88	8.55	3.44	0.2	4.91	40.23	2.34	57.43
Hubei	10.8	2.05	8.75	4.62	0.14	3.99	52.80	1.60	45.60
Hunan	9.48	1.07	8.41	3.02	-0.06	5.45	35.91	-0.71	64.80
West	**9.29**	**0.86**	**8.43**	**4.12**	**0.05**	**4.26**	**48.87**	**0.59**	**50.53**
Inner Mongolia	9.12	0.71	8.41	3.27	0.05	5.09	38.88	0.59	60.52
Guangxi	11.84	1.35	10.49	3.79	0.08	6.62	36.13	0.76	63.11
Sichuan*	9.17	0.63	8.54	4.99	0.05	3.5	58.43	0.59	40.98
Guizhou	7.89	1.2	6.69	2.82	0.01	3.86	42.15	0.15	57.70
Yunnan	9.03	1.11	7.92	5.21	0.05	2.66	65.78	0.63	33.59
Shaanxi	8.32	1.12	7.2	3.27	0.06	3.87	45.42	0.83	53.75
Gansu	8.74	-0.14	8.88	4.9	0.05	3.93	55.18	0.56	44.26
Qinghai	7.35	2.19	5.16	2.16	0.05	2.95	41.86	0.97	57.17
Ningxia	7.65	1.75	5.9	3.76	0.05	2.09	63.73	0.85	35.42
Xinjiang	9.61	0.69	8.92	4.15	0.05	4.72	46.52	0.56	52.91
							Contribution to LP (%)		
2000-2009	GDP	L	LP	K/L	LCI	TFP	K/L	LCI	TFP
Northeast	**11.3**	**0.28**	**11.02**	**7.76**	**0.14**	**3.12**	**70.42**	**1.27**	**28.31**
Liaoning	11.55	0.37	11.18	8.18	0.18	2.82	73.17	1.61	25.22
Jilin	11.9	0.12	11.78	7.77	0.16	3.85	65.96	1.36	32.68
Heilongjiang	10.57	0.27	10.3	6.44	0.05	3.81	62.52	0.49	36.99
Coastal	**11.7**	**1.07**	**10.63**	**7.1**	**0.1**	**3.43**	**66.79**	**0.94**	**32.27**
Beijing	11.06	4.07	6.99	5.63	0.1	1.26	80.54	1.43	18.03
Tianjin	13.72	0.2	13.52	8.6	0.09	4.83	63.61	0.67	35.72
Hebei	10.74	0.83	9.91	7.14	0.1	2.67	72.05	1.01	26.94
shanghai	10.71	1.54	9.17	5.11	0.08	3.98	55.73	0.87	43.40
Jiangsu	12.43	0.15	12.28	7.49	0.28	4.51	60.99	2.28	36.73
Zhejiang	11.72	1.87	9.85	7.81	0.1	1.94	79.29	1.02	19.70
Fujian	11.53	1.58	9.95	6.81	0.1	3.04	68.44	1.01	30.55
Shandong	12.45	0.01	12.44	8.77	0.05	3.62	70.50	0.40	29.10
Guangdong*	10.98	2.09	8.89	5.9	0.1	2.89	66.37	1.12	32.51
Interior	**11.1**	**0.33**	**10.77**	**6.92**	**0.15**	**3.7**	**64.25**	**1.39**	**34.35**
Shanxi	10.56	0.65	9.91	7.92	0.13	1.86	79.92	1.31	18.77
Anhui	10.83	0.56	10.27	7.89	0.15	2.23	76.83	1.46	21.71
Jiangxi	11.45	0.54	10.91	8.48	0.15	2.28	77.73	1.37	20.90
Henan	11.45	0.43	11.02	7.16	0.29	3.57	64.97	2.63	32.40
Hubei	11.08	-0.72	11.8	5.58	0.02	6.2	47.29	0.17	52.54

Hunan	10.96	0.6	10.36	5.73	0.46	4.17	55.31	4.44	40.25
West	**11.4**	**0.79**	**10.61**	**6.85**	**0.04**	**3.72**	**64.56**	**0.38**	**35.06**
Inner Mongolia	15.7	0.73	14.97	9.88	0.15	4.94	66.00	1.00	33.00
Guangxi	11.44	0.88	10.56	5.83	0.11	4.62	55.21	1.04	43.75
Sichuan*	11.18	0.47	10.71	7.25	0.16	3.3	67.69	1.49	30.81
Guizhou	10.32	1.45	8.87	6.39	-0.02	2.5	72.04	-0.23	28.18
Yunnan	9.65	1.07	8.58	6.17	0.15	2.26	71.91	1.75	26.34
Shaanxi	11.69	0.35	11.34	7.24	0.15	3.95	63.84	1.32	34.83
Gansu	10.12	1.07	9.05	6.23	0.04	2.78	68.84	0.44	30.72
Qinghai	11.37	0.04	11.33	5.38	0.04	5.91	47.48	0.35	52.16
Ningxia	10.93	1.22	9.71	6.16	0.04	3.51	63.44	0.41	36.15
Xinjiang	9.65	1.33	8.32	5.01	0.04	3.27	60.22	0.48	39.30

Notes:

1. Annual growth rate of LP = Annual growth rate of GDP – Annual growth rate of L
2. Annual growth rate of LP = Annual growth rate of capital deepening (K/L) + Annual growth rate of LCI + Annual growth rate of TFP

Appendices

Figure A1: Geographic graph of four regions in this thesis

(1) Northeast region: Heilongjiang, Jilin, Liaoning;

(2) Coastal region: Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, and Guangdong-Hainan;

(3) Interior region: Shanxi, Anhui, Jiangxi, Henan, Hubei and Hunan;

(4) West region: Guangxi, Sichuan-Chongqing, Guizhou, Yunnan, Inner Mongolia, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang.

Note: We do not study Tibet due to data limitation.

Table A1: Measured wage rate – average approach (by province)

	Urban Area								Rural Area							
	1989	1991	1993	1997	2000	2004	2006	2009	1989	1991	1993	1997	2000	2004	2006	2009
Primary school and below																
LN	0.66	0.85	0.93		4.09	5.01	4.14	4.63	0.79	1.14	1.43		5.85	4.76	6.31	17.4
HLJ				2.81	2.89	3.47	12.5	7.05				2.63	6.78	5.19	5.31	13.01
JS	0.68	1.16	1.55	3.01	5.24	6.02	6.12	8.08	0.54	1.04	1.29	4.21	4.61	3.52	3.94	7.61
SD	0.55	0.65	1.12	2.5	5.57	4.2	3.18	9	0.68	0.82	1.26	3.11	4.1	6.46	3.88	9.59
HEN	0.57	1.19	0.81	2.48	2.84	3.28	3.57	7.45	0.65	0.97	0.73	2.55	2.62	2.52	3.59	7.63
HB	0.61	0.74	1.15	3.01	3.13	3.22	6.18	13.12	0.42	0.79	0.82	2.76	6.57	6.88	7.88	21.52
HUN	0.79	1.05	2.71	3.06	5.24	8.88	6.99	9.24	0.87	0.93	2.58	5.51	4.44	5.85	6.23	6.41
GX	0.6	0.79	1.22	2.53	5.39	2	3.69	5.25	0.77	0.87	1.14	2.58	4.2	3.6	3.77	5.61
GZ	0.52	0.61	2.23	3.75	3.12	3.85	4.86	7.57	0.65	0.91	1.09	3.27	4.03	4.57	6.33	5.37
Lower middle school																
LN	0.5	0.65	1.07		3.63	4.51	6.21	7.34	0.56	0.93	1.39		4.3	10.34	8.5	9.67
HLJ				3.37	5.92	6.34	6.51	9.62				3.35	3.71	4.47	4.78	7.13
JS	0.63	1	1.6	3.87	4.48	7.23	7.67	11.23	0.61	0.73	1.18	3.31	4.31	5.63	4.98	8.44
SD	0.67	0.7	1.36	2.61	7.39	4.68	5.34	10.6	0.79	0.79	1.16	2.8	4.23	5.6	6.74	11.13
HEN	0.68	0.76	1.06	2.46	4.67	4.14	4.85	8.52	1.66	0.6	1.09	2.73	4.59	3.41	6.21	11.69
HB	0.6	0.78	1.26	3.08	3.73	7.97	13.42	11.12	0.49	0.62	1.13	2.63	4.16	4.22	3.9	7.99
HUN	0.83	0.94	1.55	3.88	3.94	6.87	13.33	7.71	0.95	1.09	3.44	3.08	3.81	5.97	10.07	27.86
GX	0.62	0.59	1.59	2.84	3.72	4.77	3.76	7.89	0.51	0.88	1.35	3.08	5	4.95	5.24	7.31
GZ	0.49	0.58	1.01	2.54	7.63	4.08	5.5	7.74	0.61	0.52	1.57	3.43	4.08	10.03	8.42	11.78

Continue...

	Urban Area								Rural Area							
	1989	1991	1993	1997	2000	2004	2006	2009	1989	1991	1993	1997	2000	2004	2006	2009
	Upper school															
LN	0.6	0.67	0.86		4.56	5.77	9.21	7.53	0.47	1.87	1.17		3.33	5.45	7.95	10.22
HLJ				2.99	5.78	9.58	9.19	14.09				1.86	4.33	7.17	8.21	10.5
JS	0.6	0.93	1.7	3.9	5.45	9.55	10.83	15.83	0.55	0.69	1.04	3.54	5.97	7.46	9.98	14.28
SD	0.6	0.71	1.48	3.18	7.1	5.65	5.57	11.98	0.72	0.81	1.44	3.62	4.5	7.11	6.47	7.14
HEN	0.58	0.69	0.84	2.89	4.56	7.03	8.34	9.71	0.4	0.66	0.78	2.69	6.16	4.3	5.51	7.8
HB	1.05	0.8	1.24	3.47	5.2	5.19	7.87	14.12	0.52	0.59	0.89	3.44	5.1	5.76	8.07	15.03
HUN	0.77	0.89	1.31	5.17	8.87	8.88	11.32	13.91	0.91	0.96	0.93	4.27	4.84	8.46	7.89	13.25
GX	0.54	0.57	1.18	2.75	3.97	6.24	7.43	12.94	0.49	0.69	1.08	2.95	4.62	5.87	6.28	7.97
GZ	0.52	0.68	1.26	2.58	4.13	8.93	10.83	13.68	0.48	0.64	0.77	2.92	5.35	8.34	7.02	23.6
	College and above															
LN	0.63	0.75	1.09		5.84	10.31	11.79	16.17	0.59	0.82	1.02		3.85	6.16	9.51	12.29
HLJ				3.04	7.33	9.97	14.83	18.79				1.88	4.79	6.41	13.64	13.92
JS	0.6	1.05	1.49	4.64	9.68	12.16	18.26	22.02	0.48	0.67	1.12	3.32	6.15	21.2	12.81	14.57
SD	0.74	0.6	1.25	3.25	3.91	5.28	5.92	11.68		0.56	0.71	1.83	3.86	6.07	9.32	11.3
HEN	0.61	0.83	3.13	4.96	7.23	9.27	16.07	14.27	0.77	1.17		2.98	5.96	4.26	9.11	8.84
HB	0.82	0.94	2.1	5.47	8.53	7.63	8	17.38	0.51	0.65	1.43	4.32	6.02	7.27	8.51	11.48
HUN	0.8	0.84	1.32	5.69	10.09	14.63	18.85	19.99	0.7	0.87	0.98	2.33	47.32	8.7	7.95	23.75
GX	0.51	0.69	1.68	4.12	6.87	6.44	11.67	14.18	0.48	0.79	0.6	3.7	4.82	5.3	9.04	11.29
GZ	0.64	0.7	1.2	2.6	4.56	16.6	10.16	17.31	0.58	0.59	0.61	3.19	4.38	6.77	11.1	25.99

Note: Province abbreviations (LN: Liaoning; HLJ: Heilongjiang; JS: Jiangsu; SD: Shandong; HEN: Henan; HB: Hubei; HUN: Hunan; GX: Guangxi; GZ: Guizhou)

Table A2: Ordinary Least Square model (by province)

Primary school and below	1989	1991	1993	1997	2000	2004	2006	2009
	Urban Area							
Liaoning	0.184	0.051	-0.056		0.081	0.025	-0.83	-0.267
Heilongjiang				-0.233	-0.324	-0.344	-0.004	0.083
Jiangsu	0.259	0.165	0.396**	-0.095	0.152	-0.042	-0.112	0.275*
Shandong	0.008	-0.131	0.13	-0.275*	0.232	-0.19	-0.543***	0.238
Henan	0.036	0.226	-0.188	-0.280*	-0.289	-0.447	-0.557***	0.121
Hubei	0.181	0.023	0.035	-0.084	-0.32	-0.598*	-0.195	0.627**
Hunan	0.365**	0.238*	0.653***	-0.101	0.26	0.591***	0.149	0.443**
Guangxi	0.053	-0.033	0.147	-0.213	-0.113	-0.834***	-0.402	-0.11
Guizhou	-0.055	-0.167*	0.293	-0.185	-0.219	-0.285	-0.277	0.171
	Rural Area							
Liaoning	0.261	0.246	0.063		0.216	-0.258	-0.181	0.532***
Heilongjiang				-0.217	-0.082	0.014	-0.274	0.420**
Jiangsu	0.03	0.027	0.143	0.088	0.118	-0.426**	-0.467***	0.145
Shandong	0.095	-0.004	0.118	-0.219	-0.027	-0.209	-0.471***	0.118
Henan	0.147	-0.087	-0.266*	-0.404**	-0.593**	-0.843***	-0.648***	0.098
Hubei	-0.205	-0.148	-0.226	-0.224	0.116	-0.176	0.034	0.738**
Hunan	0.225*	0.078	0.141	0.271	0.023	-0.021	-0.409	0.05
Guangxi	0.185	0.059	0.118	-0.251**	0.047	-0.308*	-0.539***	-0.064

Continue...

Lower middle school	1989	1991	1993	1997	2000	2004	2006	2009
	Urban Area							
Liaoning	0.06	-0.072	0.004		-0.059	-0.178	-0.213	0.101
Heilongjiang				-0.07	0.329*	0.111	-0.084	0.447***
Jiangsu	0.268*	0.287	0.480***	0.031	0.133	0.308*	0.069	0.467***
Shandong	0.292**	-0.055	0.138	-0.324**	0.146	-0.203	-0.317*	0.370**
Henan	0.260*	0.092	0.006	-0.249	0.028	-0.381	-0.269*	0.287*
Hubei	0.213	0.148	0.226	-0.044	-0.07	0.061	0.069	0.426***
Hunan	0.329*	0.194	0.374**	0.095	0.044	0.319**	0.557***	0.176
Guangxi	0.142	-0.155*	0.208	-0.183	-0.104	-0.004	-0.637***	0.113
Guizhou	-0.038	-0.15	0.02	-0.285	0.205	-0.229	-0.206	0.21
	Rural Area							
Liaoning	0.022	0.108	0.097		-0.092	-0.022	-0.158	0.243
Heilongjiang				-0.345**	-0.089	-0.095	-0.380*	0.106
Jiangsu	0.149	-0.059	0.165	-0.079	0.095	-0.012	-0.264*	0.308**
Shandong	0.184	0.101	0.178	-0.358**	-0.004	-0.089	-0.114	0.227*
Henan	0.283	-0.169	0.069	-0.390**	-0.069	-0.249*	-0.104	0.312**
Hubei	-0.036	-0.095	-0.017	-0.312**	0.058	-0.221	-0.433***	0.174
Hunan	0.343**	0.076	-0.06	-0.028	0.07	0.241*	0.157	0.747**
Guangxi	0.072	0.143	0.209	-0.116	0.13	-0.014	-0.319*	0.125
Guizhou	0.106	-0.291**	0.287*	0.008	0.068	0.354*	-0.026	0.537***

Continue...

Upper school	1989	1991	1993	1997	2000	2004	2006	2009
	Urban Area							
Liaoning	0.207	0.004	-0.073		0.17	0.143	0.048	0.242*
Heilongjiang				-0.103	0.409**	0.594***	0.364**	0.815***
Jiangsu	0.226*	0.280***	0.593***	0.175	0.358*	0.681***	0.435**	0.891***
Shandong	0.183	0.015	0.298**	-0.06	0.282	0.036	-0.175	0.471**
Henan	0.181	0.004	-0.152	-0.099	0.187	0.24	0.21	0.452***
Hubei	0.348*	0.197**	0.256	0.001	0.243	0.01	0.058	0.692***
Hunan	0.365**	0.242**	0.268*	0.199	0.536***	0.619***	0.507***	0.825***
Guangxi	0.029	-0.166*	0.223	-0.116	0.045	0.293	0.115	0.412*
Guizhou	0.07	-0.011	0.249*	-0.224	0.151	0.483***	0.282	0.797***
	Rural Area							
Liaoning	0.03	0.077	-0.121		-0.11	0.032	0.085	0.420**
Heilongjiang				-0.510***	0.197	0.364**	0.127	0.626***
Jiangsu	0.109	-0.07	0.07	0.011	0.321	0.306	0.25	0.558***
Shandong	0.329*	0.054	0.239	-0.053	0.178	0.127	-0.053	0.138
Henan	-0.186	-0.158	-0.189	-0.228*	-0.012	-0.105	-0.176	0.199
Hubei	-0.006	-0.137	-0.063	-0.112	0.135	0.163	0.138	0.796***
Hunan	0.152	0.11	-0.058	0.099	0.218	0.346**	0.11	0.709***
Guangxi	-0.006	-0.08	0.064	-0.117	0.175	0.133	-0.069	0.275**
Guizhou	-0.016	-0.034	-0.149	-0.063	0.281	0.384*	0.12	1.012***

Continue...

College and above	1989	1991	1993	1997	2000	2004	2006	2009
	Urban Area							
Liaoning	0.239**	0.04	0.095		0.369*	0.785***	0.636***	1.005***
Heilongjiang				-0.233	0.608***	0.699***	0.650***	1.195***
Jiangsu	0.197	0.311***	0.294	0.374**	0.775***	0.934***	1.005***	1.367***
Shandong	0.516***	-0.149	0.251*	0.066	0.084	0.164	0.018	0.701***
Henan	0.220*	0.123	0.353**	0.362**	0.690***	0.637**	0.666***	0.818***
Hubei	0.482**	0.216**	0.574***	0.042	0.494**	0.471***	0.266*	1.121***
Hunan	0.488***	0.153	0.265	0.539***	0.784**	1.005***	0.907***	1.242***
Guangxi	0.131	0.065	0.432***	0.326***	0.611	0.441***	0.847***	0.966***
Guizhou	0.292**	-0.014	0.234*	-0.135	0.189	0.657*	0.538***	0.965***
	Rural Area							
Liaoning	0.246	0.119	0.037		0.04	0.195	0.420**	0.751***
Heilongjiang				-0.474***	0.272	0.339**	0.508***	0.873***
Jiangsu	0.089	-0.038	0.201	0.093	0.438*	1.316***	0.693***	0.970***
Shandong	0	0.073	-0.359***	-0.493***	0.1	0.274	0.171	0.669***
Henan	0.467***	0.845***		0.005	0.574	0.1	0.487*	0.479**
Hubei	-0.053	-0.078	0.27	0.290**	0.499*	0.424***	0.298**	0.647***
Hunan	0.287**	0.135	-0.039	-0.265	1.783	0.598***	0.242	1.058***
Guangxi	0.014	0.21	-0.523**	0.195*	0.332	0.194	0.390**	0.763***
Guizhou	-0.06	-0.081	-0.430***	-0.015	-0.038	0.389**	0.466**	0.927***

Note: The coefficients are incremental effects on the baseline group “primary school and below * Guizhou province * rural area”.

Table A3: Labour composition index (by province)

Average	LN	HLJ	JS	SD	HEN	HB	HUN	GX	GZ
1989	95.21	103.70	100.88	101.86	109.76	103.16	100.76	97.15	100.00
1990	94.74	104.01	100.79	101.85	111.11	103.34	100.88	96.63	99.70
1991	94.36	104.31	100.28	101.87	110.87	103.17	101.01	96.41	99.14
1992	94.13	104.59	99.79	101.84	110.40	103.11	101.09	96.48	98.67
1993	94.10	104.87	99.55	101.82	110.92	103.42	101.11	96.79	98.52
1994	94.14	105.13	99.42	101.80	111.78	103.82	101.01	97.18	98.47
1995	94.14	105.37	99.28	101.76	112.41	104.13	100.74	97.55	98.39
1996	94.11	105.60	99.13	101.72	112.84	104.36	100.34	97.89	98.28
1997	94.33	105.12	99.05	101.55	113.26	105.55	98.91	97.81	98.27
1998	94.24	105.30	99.33	101.53	113.56	105.10	98.77	98.27	98.31
1999	94.19	105.74	99.41	101.57	113.17	104.84	100.44	98.27	98.48
2000	94.06	105.85	99.50	101.71	116.40	104.66	103.36	98.90	98.68
2001	93.94	106.13	99.88	101.91	119.94	104.15	106.95	99.63	99.06
2002	94.01	105.97	98.35	101.94	121.52	106.52	108.10	99.31	100.42
2003	94.98	105.82	100.99	101.71	119.38	104.92	110.21	100.20	100.82
2004	95.69	106.02	100.37	101.50	121.91	104.75	110.02	102.34	102.33
2005	94.64	108.28	104.69	100.71	119.36	104.99	109.29	99.46	96.96
2006	94.52	107.02	104.67	101.08	119.27	105.51	108.76	100.66	97.48
2007	94.59	105.65	103.09	102.54	119.73	104.80	110.64	100.35	98.88
2008	95.54	104.68	103.39	102.74	120.81	104.37	111.15	100.21	101.50
2009	95.40	104.60	104.29	103.27	121.20	102.89	114.15	100.80	99.94
OLS	LN	HLJ	JS	SD	HEN	HB	HUN	GX	GZ
1989	101.30	104.79	103.09	103.68	102.72	103.58	101.68	99.89	100.00
1990	101.04	104.88	103.15	103.76	102.97	103.87	101.78	99.77	100.02
1991	100.82	104.95	103.16	103.96	103.04	104.08	101.80	99.80	99.84
1992	100.69	105.02	103.14	104.11	103.21	104.32	101.70	99.94	99.68
1993	100.71	105.08	103.19	104.21	103.77	104.70	101.41	100.11	99.73
1994	100.77	105.14	103.24	104.27	104.42	105.08	101.06	100.31	99.85
1995	100.79	105.20	103.26	104.28	104.91	105.35	100.75	100.52	99.91
1996	100.77	105.24	103.26	104.24	105.23	105.52	100.47	100.73	99.92
1997	101.37	105.00	103.07	104.11	105.73	106.39	99.66	100.70	99.94
1998	100.99	105.08	103.60	103.90	106.19	106.05	99.60	101.08	99.96
1999	101.06	105.25	103.85	103.77	105.72	105.84	100.81	100.98	100.17
2000	100.90	105.84	104.08	104.32	109.28	106.84	102.62	102.13	100.27
2001	100.72	106.63	104.59	105.06	113.17	107.99	104.85	103.35	100.47
2002	100.46	106.66	102.99	105.46	114.94	105.33	105.42	103.00	101.20
2003	103.19	106.76	105.81	104.96	112.03	107.07	106.91	104.26	101.90
2004	101.57	106.93	105.13	104.97	115.42	108.40	107.50	106.53	102.15
2005	101.76	108.92	109.81	103.20	112.52	107.54	106.56	103.49	99.33
2006	101.73	107.28	109.91	103.58	112.30	108.88	105.86	104.45	98.68
2007	101.78	107.34	108.03	104.42	112.69	107.92	107.66	103.40	99.51
2008	103.70	106.49	108.28	104.86	113.73	107.70	108.44	103.00	100.94
2009	104.10	106.77	109.34	105.23	114.18	107.16	109.83	103.79	100.03

Note: Province abbreviations (LN: Liaoning; HLJ: Heilongjiang; JS: Jiangsu; SD: Shandong; HEN: Henan; HB: Hubei; HUN: Hunan; GX: Guangxi; GZ: Guizhou)

Table A4: Labour composition index (by region)

	Average approach				OLS regression			
Year	Northeast	Coastal	Interior	West	Northeast	Coastal	Interior	West
1989	96.31	99.31	101.61	100.00	98.83	100.79	102.33	100.00
1990	95.81	99.28	101.96	99.62	98.57	100.88	102.52	99.96
1991	95.44	99.01	101.90	99.27	98.34	100.95	102.60	99.89
1992	95.22	98.73	101.81	99.09	98.20	100.98	102.67	99.87
1993	95.18	98.60	101.95	99.16	98.20	101.02	102.80	99.98
1994	95.24	98.52	102.12	99.31	98.27	101.06	102.93	100.14
1995	95.36	98.44	102.16	99.47	98.33	101.06	103.02	100.30
1996	95.52	98.36	102.11	99.62	98.38	101.04	103.04	100.47
1997	94.85	98.32	101.86	99.68	98.10	100.98	103.12	100.54
1998	95.16	98.33	101.76	99.82	98.20	101.07	103.11	100.64
1999	95.32	98.31	101.79	99.95	98.26	101.09	103.21	100.79
2000	95.26	98.83	102.98	100.41	98.38	101.76	104.68	101.41
2001	95.24	99.68	104.39	101.02	98.54	102.81	106.48	102.15
2002	95.31	99.72	104.00	101.22	98.64	102.90	105.56	102.22
2003	96.40	100.14	103.82	102.40	100.51	103.31	105.86	103.48
2004	96.52	99.82	104.49	103.87	99.41	103.16	107.64	104.58
2005	96.11	99.18	103.67	100.08	100.20	102.38	105.98	101.38
2006	95.67	99.46	103.71	100.74	99.54	102.66	106.04	101.47
2007	95.67	99.47	103.97	101.37	99.80	102.45	106.28	101.65
2008	96.06	100.15	104.31	102.20	100.51	103.05	106.82	102.14
2009	95.90	100.56	104.77	102.08	100.84	103.53	107.24	102.06