2018

Essays: Growth and return to education in China: 1988-2013

Yun Chang
Iowa State University

Essays: Growth and return to education in China: 1988-2013

by

Yun Chang

A dissertation submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Economics

Program of Study Committee:
Wallace Huffman, Major Professor
Peter Orazem
Brent Kreider
Oleksandr Zhylyevskyy
Amy Froelich

The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this dissertation. The Graduate College will ensure this dissertation is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University

Ames, Iowa

2018

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ABSTRACT

This dissertation investigates per capita income convergence, inequality and return to human capital in China after the 1978 policy of reform and opening. It also considers the impact of the household registration system and migration policy on the labor market changes.

CHAPTER 1. INTRODUCTION

This dissertation investigates per capita income convergence, inequality and return to human capital in China after the 1978 policy of reform and opening. In particular, this dissertation considers the impact of the household registration system and migration policy on the labor market changes. The following is the background of labor market in China.

The household registration was established in the 1950s by the government during the period of central planning. The main mechanisms for enforcing the planned economy included the unified procurement and sale of agricultural commodities, and the Household Registration System that designated the legal place of residency and work for the entire population (Fleisher, 2003). Hence, rural industries were remained subsidiary to agriculture. The labor force within rural areas was governed under the communes who have to reach the production targets from the planning authorities. Urban labor arrangements under central planning included labor allocation by labor bureaus; hukou required for housing, food subsidy, schooling and health benefits.

Since there's an excessive concentration of capital in urban areas and of labor in rural areas (after the rural market reform from a planned economy to market oriented economy), the pressure of rural to urban migration has been magnified that reduce the demand for farm workers. In mid-1980s, the government relaxed the controls on labor mobility to solve the misallocation of labor between rural and urban sectors, as well as between agricultural and non-agricultural activities. However, the hukou system still take effect and became the most important legal barrier to rural to urban migration. After the restrictions on migration were gradually lifted, less rural workers were engaged in agricultural activities, they start to seek employment in urban area. These floating people are increasing each year, although the

incomplete hukou status subjects them the risk of public safety as well as the economic costs, for example, schooling, health care, wage and so on.

For urban market, the reform starts later. Under free market, workers seek jobs where pay is the greatest and firms tend to locate their production where pay is lowest. Because of the special economic zones and foreign direct investment (lead to the expansion of the non-state or private enterprises), the income growth rate increased but diverges, raising the income inequality (for both inter-urban disparity and rural-urban gap). One possible reason is the education investment and the return to schooling. There is evidence that the return to schooling has been lower than in comparable transition and emerging economies. The market reform would push the wage of educated workers closer to their marginal product. Hence, the reform will lead to rising income inequality in China.

To summarize, the reform and open policy in China changed its labor force from an immobile to a mobile one, especially for rural workers. In addition, the market oriented economy improved the welfare of employees since the wage changed from the planned one to market oriented one.

There are three research questions discussed in this dissertation. First question is motivated by the increasing growth rate after reform and the reallocation of labor force and asks is there any convergence pattern in regional per capita income. Second question focus on industry level income and asks what factors lead to the regional income inequality. Third question is related to the return to schooling over the transition, how the return has changed over time.

CHAPTER 2. PER CAPITA INCOME CONVERGENCE IN CHINA, 1994-2015

2.1 Introduction

After the end of the Cultural Revolution in 1976 and follow-up labor market reforms in 1978, there were radical changes in China's labor market. Since then China has become the fastest growing economy in the world. However, economic growth across provinces has been uneven. Chen and Fleisher (1997) researched on the post-reform income inequality in China, and they found income convergence during the reform period but income inequality rose between the coastal and inland regions since late 1980s because of the lower factor productivity in the noncoastal provinces. Also, due to the shift of rural to industrial reforms and the fiscal transfers to the relatively richer inland provinces, income convergence was slowing down.

Several reasons motivate us to reinvestigate the question of China's regional per capita income convergence. First, most studies only focused on the reform period in China, few studies have focused on the most recent years' income convergence pattern. Second, with the industrial reform and the migration of the labor force from agricultural to industry, the intra-provincial human capital mobility can contribute to the convergence of output per worker across Chinese provinces. Third, the increased pace of investment in human capital can also support the convergence.

As suggested by Restuccia and Rogerson (2017), living standard differs across countries are due to the misallocation effect: low income countries are not as effective in allocating their factors of production to their most efficient use. The misallocation includes the market imperfections (monopoly power, market frictions, and enforcement of property rights); government or other entities' favor or penalization to specific firms; and statutory

provisions (code vary with firm vary with firm characteristics, labor market regulations, tariffs, and land regulations). For example, Hsieh and Klenow (2009) found that state ownership in China created higher inefficiency. Various reform enacted during the period of 1998-2005 reduced the distortions and lead to a decrease in misallocations in China. Adamopoulos et al. (2016) found that misallocation in the agricultural sector in China has remained roughly constant for the period of 1993-2002, which is due to the uniformly distributed land among household members registered in the village and then the farm productivity is not related to land allocation. Tombe and Zhu (2013) provided evidence on the change of internal frictions of labor (and goods) mobility across spaces and sectors in China on aggregate productivity. They found that the reduction of internal migration frictions and trade restrictions account for about half of the growth in China between 2000 and 2005. Hence, I suggest the labor reallocation from less productive sectors to more productive sectors are key to growth in China.

This chapter undertakes a study of convergence in per capita income across provinces of China from 1994-2015, and over sub-periods 1994-2004 and 2005-2015, conditioning on a small set of economic factors generally observed at the beginning of the period. These variables are share of labor force in agriculture, average years of schooling completed, and net inflow migration rate. My hypotheses are: (i) regions with a lower share of agricultural workers (industrial transformation) will have higher convergence because these farm workers have skills that are less transferable to the nonfarm sector; (ii) regions with higher average education (higher investment in human capital) will have a higher rate of convergence because they are better able to adjust to changing labor markets; (iii) regions with higher net out migration will have higher convergence because migrants generally move from low to

higher wage areas, which should raise wages in the exiting region. Since the transition at the earlier period allowed the relatively richer coastal provinces to benefit disproportionately, I assume the convergence is more likely to present in the later subperiod.

Section 2 provides some literature on the growth pattern across countries in the world. To better understand per capita income convergence across provinces in China, I will improve the traditional beta convergence model and provide the details of mathematical derivations of new variables in section 3. And I will then describe the inputs related to human capital reallocation and their impact on the regional growth in section 4. Section 5 describes the data I used. After that, I conduct the convergence model to test my hypotheses mentioned above in section 6. Section 7 concludes and the regional income inequality issue China will have after dramatic growth.

2.2 Literature Review

There are many studies that discuss growth rate patterns and convergence or divergence across countries in the world covering various periods of time.

Pritchett (1997, 2000) distinguished two types of economies: industrial/developed countries primarily by membership in OECD and developing countries as the rest (China is one of the developing countries). He found that the growth rates for developed economies show similar patterns from 1870-1989, even the poorer members of this group grew sufficiently faster to produce considerable convergence in absolute per capita income levels. However, the growth rates were substantially lower in the developing countries than in the industrial countries, producing divergence in relative incomes. The gap in growth rates between industrial and developing countries grew substantially from 1982-1992. However,

China and India are two exceptions. The average GDP per capita growth rate of the OECD members from 1982-1992 was 0.3 percent, but in China, the per capita income growth rate for this period was 7.4 (the World Bank).

The variance in growth rates across countries is also much larger among developing countries: the range of annual growth from 1960 to 1990 was from -2.7 percent to positive 6.9 percent (Pritchett, 1997). Therefore, among the developing countries, there have been strikingly different patterns of growth, with some converging rapidly on the leaders while others stagnate. In contrast, there has been no obvious acceleration of overall growth rates in developed countries since 1870. With a negative correlation between growth rates and initial per capita income, the much larger variance in growth rates among countries that began the period below $3,000 is striking. China is an exception in that it began the period below $1000 in per capita income and has higher annual growth than other developing countries.

The wider range of growth experience among developing countries is also seen in comparing the extremes. Growth differentials of this magnitude produce rapid shifts in relative incomes. Although China was a poor country 50 years ago, its nominal GDP surpassed the United Kingdom in 2006 and Japan in 2008, making it the world's second largest economy after the United States. However, when calculating the growth rate in per capita GDP between 1870 and 1960, China is one third of the average for developed countries. Hence, China's per capita income diverged significantly relative to the leaders from 1870 to 1960.

Pritchett (2000) uses simple patterns to summarize income growth patterns over time. For China, the patterns of GDP per capita growth are classified as climbing a hill. He defined the Hills class as countries with growth rates higher than 1.5 percent in each period (1960-

1992) and with a relatively stable trend (hence, higher R-squared). Like the United States, most of the OECD countries are classified in the Hills group. Hence, China, as a developing country, has the similar characteristics of growth pattern as industrial countries. However, most developing countries fall into Mountains and Plains classes, experiencing implosive declines or stagnation in the growth rate. Hence, the "advantage to backwardness" by gaining significantly on the leaders is historically rare. Pritchett (2000) also suggested using cross-sectional analysis of changes in growth rates over time and research on the determinations (policies) on the evolution of potential growth because volatility and instability of growth in developing countries make the fixed effects panel data approach meaningless.

Durlauf et al (2005) provided a summary of econometric tools that have been employed to study economic growth relative to USA for the period 1960-2000. In their statistics, the GDP per capita in China is slightly lower than India in 1960, and then China catches up with India in 2000. However, per capita income in China relative to the US was much lower—only one tenth relative to USA in 2000. Like the conclusion from Pritchett, they found a diversity of growth rates, especially at lower levels of development. For many developing countries, growth was significantly lower after 1980, with many countries seeing a decline in real GDP per worker except for China and India. Hence, there was higher dispersion of national growth rates, with East and Southeast Asia being (temporary) winners. In the aspect of long-run output volatility, industrialized countries are relative stable, not all developing countries have higher volatility: South Africa is less volatile than the USA, Sri Lanka less volatile than Canada, and Pakistan less volatile than Switzerland. In their study of empirical growth rates, they suggested that details of individual countries (case study), including historical, political and institutional context, may be important. Theory and

evidence should be connected by supplanting calibration of theoretical models. Different types of growth (for example, open economy) and distinguished consequences should be considered.

Dufrenot et al (2012) focuses on developing countries, and studies the properties of the transient dynamics that characterized the catch-up of the poor countries to the rich long-run per capita incomes. He mentioned the speed of convergence process because the growth convergence in the developing countries displays slow transition dynamics, and the steady-state is not necessarily observed. Hence, the rejection of convergence does not necessarily indicate that they are diverging. The extreme cases – "fast convergence" or divergence are relaxed and non-stationary models are employed to test catch-up dynamics. He argued that the observed catch-up growth that characterizes the emerging economies does not necessarily produce convergence in per-capita income levels. The reason is that when a country starts to experience sustained increases in per capita income, the efficiency of resources allocation and constraints could encumber this process and restrict future growth.

Their aim is to see whether the disparities between the rich and the poor become widen or narrow over time. Instead of using cross-sectional concept, they use the integration framework to explain the slow catch-up and suggest that the convergence models can yield a phenomenon of "growth resistance" to long-run equilibrium. The method to break growth resistance is by new government policies (through technical improvement, cultural change and social adoption). They conclude that growth convergence in the developing countries is idiosyncratic and there's no way to drive the economies in such a way that they ultimately converge towards each other. Low technology adoption/absorption capacity and the different manner economic transitions across countries are the two main reasons for divergence. As for

China, they indicated “an initial phase of divergence from the group, followed by catching-up and then convergence”.

2.3 A Methodological Issue: Spatial Dependence in Provincial Income Data

There are several studies in empirical research on regional economic growth that discuss the sources of regional income inequality and convergence. Building on the Solow model and following empirical application (Mankiw, Romer, and Weil; Barro and Sala-i-Martin 1995), these studies regress the growth rates of regional per capita GDP over the sample period on the initial level of regional per capita GDP plus variables that could affect the steady-state rate of growth such as the nonhuman capital investment rate and average schooling levels. However, their aggregate level research on convergence has ignored the importance of inter-regional differences or spillover effects on each country’s rate of per capita income convergence, i.e., the growth rate in a region would depend not only on its own initial income level but also on its neighbors. There’s no doubt that the existence of production and trade linkages, and the clustering of factors affecting productivity, such as technological and knowledge spillovers, are some of the most important factors related to spatial effects. Part of the spatial dependence seems likely to be correlated with initial period value of per capita income, and ignoring this spatial correlation is likely to change the estimated rate of convergence in per capita income across regions.

Although there are a series of chapters showing that the presence of spatial effects matter in the estimation of the beta-convergence process, spatial spill-overs have been largely ignored in regional growth studies for China. Ying (2003) estimates the output growth for China using provincial data from 1978–1998 and using spatial lag model to determine the source of growth. The results suggest negative spatial autocorrelation, which is interpreted as

polarizing process undergoing within the Chinese spatial economies. Jeon (2007) tests Kaldorian spatial econometric approach using Chinese regional data and finds that regional dependence is very weak among the Chinese provinces. Conversely, Madariaga and Poncet (2007) rely on data at the sub-national level across cities to estimate a dynamic panel growth equation taking into account the issue of spatial dependence. Their results suggest significant spatial dependence and, hence, find a higher speed of convergence. In addition to beta-convergence, Lin et al. (2006) use spatial econometric techniques to investigate provincial sigma-convergence in China and find a relative lower level of dispersion in the economic development process. Tian (2010) investigates the regional convergence at a largely disaggregated level over 1991-2007 using the spatial Durbin growth model. They find strong evidence of positive spatial dependence between Chinese prefectures. Also, they find significant conditional convergent forces when the spatial spillover effects are controlled. Hence, the robust of spatial dependence in China is still under debate.

Before I conduct the convergence model, I will test whether the per capita income levels of provinces close to each other are correlated. To do this I apply a spatial model developed by Getis and Ord (1992) and conduct a test of no spatial effects using the statistic of Moran's I. This statistic is expressed as follows (Moran 1948):

$$I = \frac{n}{\sum_i \sum_j w_{ij}} \frac{\sum_i \sum_j w_{ij} (y_i - y)(y_j - y)}{\sum_i (y_i - y)^2}$$

Where y_i is the real per capita income of province i, y is the mean per capita income of China, w_{ij} is the element of the distance matrix W between each pair of provinces and $\sum_i \sum_j w_{ij}$ is a factor that corresponds to the sum of all the weights. With regard to the interpretation of Moran's I, it should be noted that a significant positive value indicates

positive spatial dependence, while a significant negative value reflects a pattern of spatial association between dissimilar values.

The results obtained (see table 2.1) are very significant, so we reject the null hypothesis that there is zero spatial autocorrelation present in the variable $lnGDP$ at $\alpha = .01$. Furthermore, it shows that positive spatial dependence increase slightly during period 1994-2005, suggesting growing importance of economic spillover among provinces that are close neighbors, and then decrease slightly during period 2005-2015 when inter-province migrants were traveling longer distances for work. This means that factors affecting the performance of a given province have a larger influence on neighboring provinces before 2005 than in later years.

The filtering method removes inter-province spatial effect, converts spatially dependent variables (y_i) into spatially independent ones (y_i^F). Hence, the filtered variables can be interpreted as that part of the provincial per capita income not explained by the spillover effects from the other provinces. he filtering methodology is defined as follows:

$$y_i^F = y_i \frac{\sum_j w_{ij}(\delta)}{(N-1)G_i(\delta)}$$

Where w_{ij} is the element of the distance matrix between each pair of provinces defined in Moran's I ($w_{ij} = (d_{ij})^{-\delta}$, where $\delta = 1, d_{ij}$ is the distance between provinces i and j, N is the number of provinces (N=31), y_i is the observed lnGDP, G is:

$$G_i(\delta) = \frac{\sum_j w_{ij}(\delta)\, y_j}{\sum_j y_j}, i \neq j$$

The only difference between y_i and its filtered counterpart y_i^F is a spatial variable, with a positive value indicating clustering of higher values of y_i and a negative value indicating clustering (or spatial autocorrelation) of lower y_i values. Also, these newly-generated spatial

variables (y_i^F) are associated, but not correlated with y_i. Hence, in my estimated of the growth convergence model for Chinese provinces, I will use both the unfiltered and filtered data.

2.4 Empirical Model Description and Hypotheses of Convergence

After we solve the spatial problem, we can do the analysis of convergence. The convergence model is as follows:

$$(lnGDP_{i,t+T} - lnGDP_{i,t})/T = \beta_1 + \beta_2 D_1 lnGDP_{1994} + \beta_3 D_2 lnGDP_{2004} + \beta_4 D_3 lnGDP_{2010} + X_{i,t}\gamma + \varepsilon_i$$

where $lnGDP$ is the province-level real GDP per person, T is the length of the period or sub-period growth, X contains conditioning variables that may explain convergence. $D_1 = 1$ if in period 1994-2004, $D_2 = 1$ if in period 2004-2010, $D_3 = 1$ if in period 2010-2015.

Short descriptions of the variables are as follows: $lnGDP_t$ - Natural log of per capita GDP; Aglabor (%) - Percentage of agriculture workers among all labor force; Edu - Average years of schooling completed; $NetInflowRate$ (%) - (Inflow population-outflow population)/total national floating population; $lnGDP_t * NetInflowRate$ - Interaction term between $lnGDP_t$ and $NetInflowRate$.

In equation (1) the evidence for growth convergence is summarized in the following expression:

(1) $\partial[(\ln GDP_{i,t+T} - \ln GDP_{i,t})/T]/\partial \ln(GDP_{i,t}) = \beta_2 + \beta_3 NetInflo_{i,t} < 0.$

In the standard growth convergence model, β_3 is zero, and hence, $\beta_2 < 0$ for conditional convergence.

The neoclassical theory of growth focuses on two types of sources: capital and labor. Here, I mainly focus on the human capital, especially the labor reallocation, to explain the growth gap between developed and developing area in China. Hence, three basic economic

indicators are selected, they are share of agriculture labor force, education and net inflow migration rate.

After the progress of economic reforms in 1978, there were radical changes in the labor-market. The fundamental changes in the distribution of the labor force have been the main feature of the rural labor market in China since the inception of reforms (Fleisher, 2006). From 1978 to 2014, the share of workers in the agricultural sector have declined from 71 to 30 percent, but the share of workers in industry rose from 18 to 30 percent and the share in services rose from 12 to 40 percent (Li, 2017). Several empirical evidence has shown that the rapid expansion of nonfarm activities had accounted for an increasing portion of the total farm income growth. As a consequence, the shift of labor from less productive to more productive sectors can accelerate growth. To examine the contribution of this structural transformation to the recent Chinese growth performance, the variable Aglabor is added. Provinces that have a larger share of its labor force employed in agriculture at the beginning of the growth period under analysis, are expected to have lower rates of per capita income convergence. The main reason is that they have skills that are not easily transferable to non-farm work.

During the reforms of the late 1970s, nonfarm jobs and urban employment in the non-state sector have grown rapidly. The transition from farm sector to nonfarm sector drives most rural workers to seek positions in urban area. Hence, internal labor migration become a new phenomenon in China's last half century. Connecting the rural-urban labor markets, there are about 77 million rural migrants working temporarily in cities in 2000 (Cai, 2003b). In addition, internal migration in China has a feature that "labor flows basically direct from the interior to coastal areas, and from central and western regions to eastern areas", which is

due to the discrepancy of wage level in different provinces (see table 2.2). During the reforms, the government created a series of special economic zones (SEZs) that are mainly located in coastal areas to attract foreign investment. They are relatively free of federal bureaucracy, regulations, and interventions. SEZs are also listed separately in the national planning reports (including financial planning) and have province-level authority on economic administration and legislation authority. Hence, the uneven allocation of natural resources and state policies were biased toward coastal provinces and cities in China, and this seems to have caused the eastern region to become richer and the western region to become poorer. For example, the average annual income for workers with high school degree, middle school degree and elementary school degree in coastal area was 1.56, 1.6 and 1.39 times higher than in interior regions, respectively (table 2.2). Hence, many workers migrated to the coastal areas to pursuit higher wage rates. The reallocation of labor to more productive regions seems likely to be an important part of Chinese economic growth during the post reform period. Cai and Wang (1999) concluded that labor reallocation, including labor transfers among regions, have accounted for 21 percent of annual GDP growth in the post-reform years. Hence, the variable provincial net in migration rate is added to measure the growth after the reform. I hypothesize that provinces with higher net in-migrants would have lower per capita income convergence. The main reason is the overly optimist expectations of obtaining a job in the new area frequently creates a backlog of people waiting for jobs in urban areas.

Education plays an important role in adults' ability to respond to labor and commodity market disequilibrium that are associated with economic growth (Schultz 1975). And there's a broad consensus that differences in human capital account for 10-30 percent of

country income differences. Li (2017)'s research based on the Chinese population Census in 1980 and 2010 shows that education has risen rapidly since the Cultural Revolution in 1976, with the average years of schooling for China's adult labor force rising from 4.3 years in 1980 to 9.6 years in 2010. Some studies assumed the education is the dominant source of economic growth. Fleisher (2010) found that education investment in developing, interior regions generate more return than in developed, eastern regions in China. Hence, it is interesting to test its contribution to the performance of Chinese economy, especially the different education investment by local government across provinces over time. I hypothesize that provinces that have an adult education population with high education levels will have a higher rate of convergence of per capita GDP.

2.5 Data Description

The data for this study is from the *China Statistical Yearbook*. The data reported in this yearbook are largely collected in surveys conducted by local governments and then summarized by the National Bureau of Statistics of the People's Republic of China (NBS). This yearbook reports key statistical data in recent years and some historically important years at the national level and the local levels of province (31), autonomous regions and municipalities directly under the Central Government. Its annual reports cover comprehensively the economics and social developments of China.

The target time period of our study is after economic reforms, 1994-2015, but I also split the 20-year period into two sub-period 1994-2004, and 2004-2015 (further split into 2004-2010 and 2010-2015). The per capita GDP is measured by provincial GDP divide by the resident population. The resident population is the number of people who actually live in

a certain location for more than a half year and the data are collected at year end. Hence, the per capita GDP can be affected by the number of migrants. The national cost of living index is used to covert per capita GDP data into real GDP per capita. However, to the extent that the cost of living varies across regions, this is also a possible source of measurement error.

The education, aglabor data are all from the different years of Census Data from NBS. The average schooling years are used to estimate the education level. It's calculated by adding the percentage of surveyed people completed each degree multiply by the estimated schooling years to complete this degree. Aglabor is measure by the number of labor participate in farming, forestry, animal husbandry and fishery sectors dividing by the total employed people.

The net inflow migration data is from Chan's summary of interprovincial migration data, 1990-2005 (Chan, 2008). He indicates and the data source is from the National Statistics Bureau (NSB, 2002, 2007). The net inflow rate is summarized into three subperiod: 1990-1995, 1995-2000 and 2000-2005. The net rate is calculated by total inflow population minus total outflow population as percentage of all migrating population in China. I use the 1990-1995 period data as my net inflow rate at the beginning period of 1994-2004 and the 2000-2005 period date as my net inflow rate at the beginning period of 2005-2015. I use the 2010 Population Census from NBS to calculate the net inflow rate for 2010.

2.6 Empirical Results

2.6.1 Summary of data

The Figure below (Figure 2.1) shows the variation of per capita GDP. We can see that the variation increases slightly from 1994 to 2004, then decrease sharply. Therefore, it seems

that convergence is not occurring in the early period but that convergence is much more likely in the most recent period.

A major factor affecting convergence starting in 2004 is a series of labor policy changes in China. During 2002-2004, two documents were initialized and legalized to protect migrant workers from labor market discrimination and guarantee a safe working environment. In 2006, a system was established to monitor wage delivery to migrant workers and protect their labor rights. In 2003, urban governments and public schools started to respond giving s' children equal access to education. Those policies have improved the working environment for migrants and hence attracted more migration activities across provinces. In addition, the new Hu-Wen Administration was planning for conservative economic growth starting in 2005 (the GDP growth rate has decreased from 2007 (14.2%) to 2016 (6.7%)). The Scientific Outlook on Development is one of the guiding principles, and it focuses on correcting the unbalanced growth. This socio-economic principle proposed by Hu-Wen Administration tends to reverse the 1978's Reform and Open policy in 2005. It emphasizes reduction in pollution and improving the environment by increasing taxes and controls over the heavy industry sector. In the rural area, the 2600 year-old tax on agricultural land was terminated in 2006, and this change improved farmers' incomes and productivity to some extent. In the urban area, the most important policy is the implementation of National Minimum Wage in 2004.

The following (table 2.3) presents a summary of $lnGDP$ per capita by each province, in 1994, 2004, and 2015. The last row reports the standard deviation of per capita income across provinces divided by the mean of per capita income in these years. The higher values of actual data means the positive spatial effect, and it further verifies that the convergence of

per capita income could be underestimated using the actual data without considering the spatial effect. We can see that inequality across provinces decreased from 1994 to 2015 in both actual data (decrease by 35% in total, 6% from 1994 to 2004 and 31% from 2004 to 2015) and filtered data (decrease by 33% in total, 9% from 1994 to 2004 and 27% from 2004 to 2015). These data also confirm that the variation decreased dramatically in the recent period relative to the earlier period.

The middle columns (of Table 2.3) report the net migrant inflow rate. Obviously, most coastal regions have net inflow migration, the other interior regions have net outflow. The most remarkable province is Guangdong, which has 19.6% of net migration during 1990-1995 and 27% during 2000-2005. With the highest net population change, per capita income of Guangdong is also among the highest in 1994 and the growth rate is among the lowest during 1994-2015 (approaching the steady state). This provides one piece of information supporting the hypothesis that provinces with higher net migrants have higher convergence.

The next two columns of Table 2.3 provide information on average number of years of schooling completed. The average schooling of adults in Beijing is 10.52 years in 1994, and it is the highest among all provinces. Beijing only grow 18% in twenty-one years and is among the provinces having the lowest growth in per capita income. The last column is agricultural labor force. Shanghai has only 11.9% agricultural workers, and this city has the lowest growth rate (14%) during the period, which is one example of a region with lower agricultural activates have a higher income convergence.

The last columns of Table 2.3 report the annual growth rate of per capita income. Compared to the western or interior regions, most coastal regions are experiencing

decreasing and lower growth rate in the second period. Especially in Shanghai and Beijing, the growth rate declined from 8.5% to 4.8% and 10.3% to 6.6%, respectively. In contrast, Guizhou, a less-developed province in the Southwest, has an average growth rate in the first period of 7.0%, but it was much faster in the second period at 15.8%.

I group the 31 provinces into eight regions (see Figure 2.2). Obviously, with higher migration rates, higher education and lower agricultural industries, the coastal areas exhibit the decreasing variation in per capita income over 1994-2015. The provinces and cities I mentioned above affect per capita income growth in neighboring coastal areas. Among those, the South coast (Guangdong as center) and North coast regions (Beijing as center) had slightly decreasing variation in income growth starting around 2004. The most remarkable is the East coast, the variance of per capita income decrease from 0.25 to almost 0 from 1994 to 2015. East coast includes Shanghai, Jiangsu and Zhejiang. The reason is the most important economic center: Shanghai. Due to the reform, Shanghai became one of Asia's center for commerce, which drives the improvement of surrounding Yangtze Delta metropolitan region (Ease coast)'s economic growth, productivity and per capita income. With the knowledge of regional differences, we would expect complex results in province level.

Is it possible for all the regions converge to a steady state? From the growth rate change mentioned above, we would expect the less developed regions catch up with the developed regions because of the increasing growth rate in interior and western regions. Of course, the lnGDP per capita in coastal regions are higher than other regions in our sample period (see Figure 2.3). We could see the gap between the "winner (Ease coast)" and "loser (Southwest)" was decreasing over time (the lnGDP per capita decreased from 1.24 to 1) and the bottom four regions were catching up with the top four regions.

Figure 2.4 shows the scatter plot of initial per capita income against subsequent growth rates across provinces. In the entire period, there's a negative correlation between growth and initial per capita income. For the first period, most provinces began the period below 6000 yuan and result in much larger variance in growth rates. The range of growth rate was from 6% to 15%. The outlier is Shanghai, began with 14300 yuan in 1994. In the second period, the negative relationship is more obviously, and the pattern is stretching out with more provinces in the right end. The provinces in the right tail (more than 15000 yuan in 2004) are those with higher growth rate in the first period and they are in coastal regions (see table 2.3 last columns for growth rate). The growth transition from coastal regions to other regions proves supports convergence.

Figure 2.5 shows the scatter plot of initial variables – net inflow rate, aglabor, education against annual growth rates across provinces. There are negative relationships between the initial net inflow rate and growth, and initial education and growth. For initial aglabor percentage, the relationship is not clear. To better understand the changing of net inflow over time, Figure 2.6 illustrates the changing relationship between the inflow migration and per capita income growth. In the first subperiod, the provinces with stable population have large variation in income growth. However, the provinces with larger population change (labor reallocation) have stable growth. Hence, we would not expect clear relationship between convergence and migration rate in the first period. In the first half of second period (2004-2010), the provinces with net outflow have higher growth and the provinces with positive net inflow have lower growth rate. This phenomenon could be explained by rapid inflow of low skilled migrants could slow convergence. In the second half the second period (2010-2015), the overall growth rate decreased from 14 percent to 7

percent on average but the migration scale remained the same (within around 11%). This can be explained by the low skilled migrants as well as the low spillover effects.

2.6.2 Regression results for the growth convergence model

I have data over 1994 to 2015, 21 years, but have only 31 provinces at any point in time. To gain more observations, I split the 21-year period into three sub-periods: 1994-2004, 2004-2010, and 2010-2015, and then measure the regressors at the beginning of each subperiod: 1994, 2004, and 2010. This gives me a total of 93 observations. I first estimate the growth model using lnGDP only (in Table 2.4. R1). Second, I estimate the model using lnGDP and an interaction term between lnGDP and net-migrant inflow rate plus conditioning variables for Aglabor and Education (in Table 2.4. R2). Last, I estimate the model using lnGDP and an interaction term between lnGDP and net-migrant inflow rate only (in Table 2.4. R3). The regression results from estimating the growth convergence model using the filtered data are reported in Table 2.4.

In regression R1, the estimated coefficients for three beginning period lnGDP are negative, decreased from -0.006 to -0.024 (significant at 1% level), which means the convergence rate increased from 0.6% to around 2.4% in the second half period. In the second regression, R2, we include lnGDP*net inflow, Aglabor, and Edu, to see if other factors can affect the magnitude of the convergence rate. The estimated coefficients for beginning period lnGDP was only significant in period 2004-2010, which is -0.018. The coefficient for lnGDP*net inflow at the beginning period of 2010-2015 is significantly negative at 5% level. Hence, countries that have a large net-inflow migration rate tend to raise the rate of growth convergence slightly. Also, countries with a larger share of the labor force in agriculture tend to grow more slowly (significant at the 10% level). Surprising is that

provinces that have higher education levels at the beginning of the period also grow more slowly. This unexpected sign might be due to the strong positive correlation between $\ln GDP_{i,t}$ and education at the beginning of the period. In the third regression, R3, we exclude Aglabor and Edu, which had low t-values in R2. These estimates of the growth model only provide the conditional convergence in per capita income in period 2004-2010. However, the evidence for conditional convergence is much stronger for the second and third sub-period 2004-2010 and 2010-2015, where the estimate of β_3 is -0.019 and β_4 is -0.016, compared to -0.018 and -0.007 in R2. The R^2 for regression R1 is 0.64, for R2 is 0.69, and for R3 is 0.65. Comparing three regressions, the R1 seems like the best regression.

Table 2.4 also presents estimates of the growth convergence model using the un-filtered data. Similar to the filtered data, the convergence rate for R1 increased from 0% to 2.5% (significant at 1% level) in 2004-2010 and 2.9% (significant at 1% level) in 2010-2015; the convergence rate for R2 increased from 1.9% to 2.9% (significant at 5% level) in 2004-2010; the convergence rate for R2 increased from 0% to 2% (significant at 5% level) in 2004-2010 and 2.7% (significant at 1% level) in 2010-2015.

2.7 Conclusion

In this chapter, I consider the problem of convergence of per capita income in China which attribute to the economic reform since 1978. I found the growth convergence only appears in recent period. The economic growth of China can be explained by the reallocation of human resources from agriculture sectors to industry and service sectors. The regional disparities in economic development reflect the uneven process of localized industrialization in a geographical context. The source of growth is from the decreasing in farm jobs, higher liquidity of workers and investment of education.

The reallocation of human capital can improve the economic growth and also deepen the income inequality across regions. The movement only occur for workers from developing area to developed area (not backwards). However, the movements mean the competition with the local residents for the same occupation. At the new century, China intends to move into higher value added manufacturing and service sectors that require higher professional skills, the inequality would occur due to the uneven geographical allocation of these high value added industries and the shortage of supply of labor force for higher-end industries. In the next chapter, we will look at how the structural change over time contributing to the income disparities. Given the potential relationship between inequality and economic growth, and the intrinsic link between economic growth and structural change, it is interesting to look at how migration workers respond to the income inequality by industry.

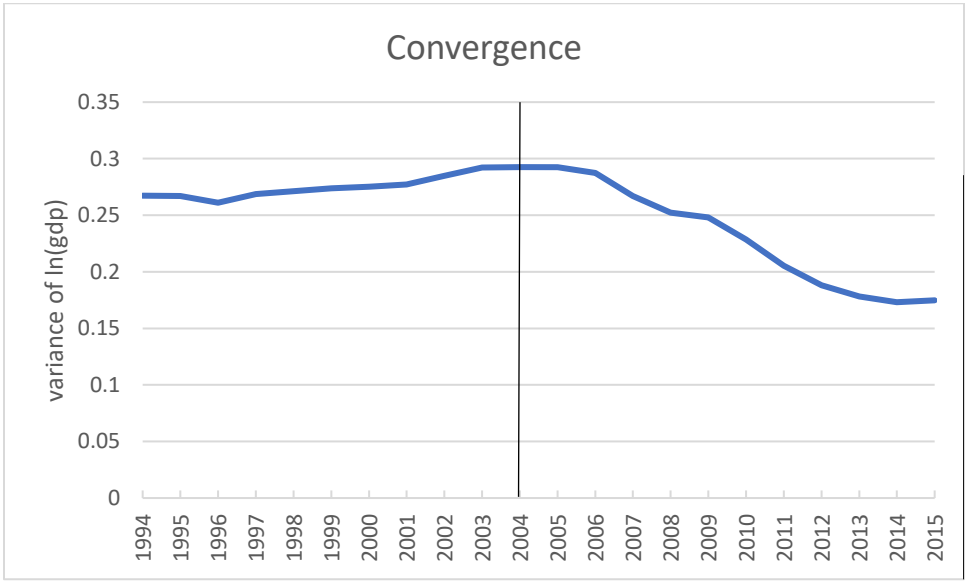


Figure 2.1 Convergence over time, 1994-2015

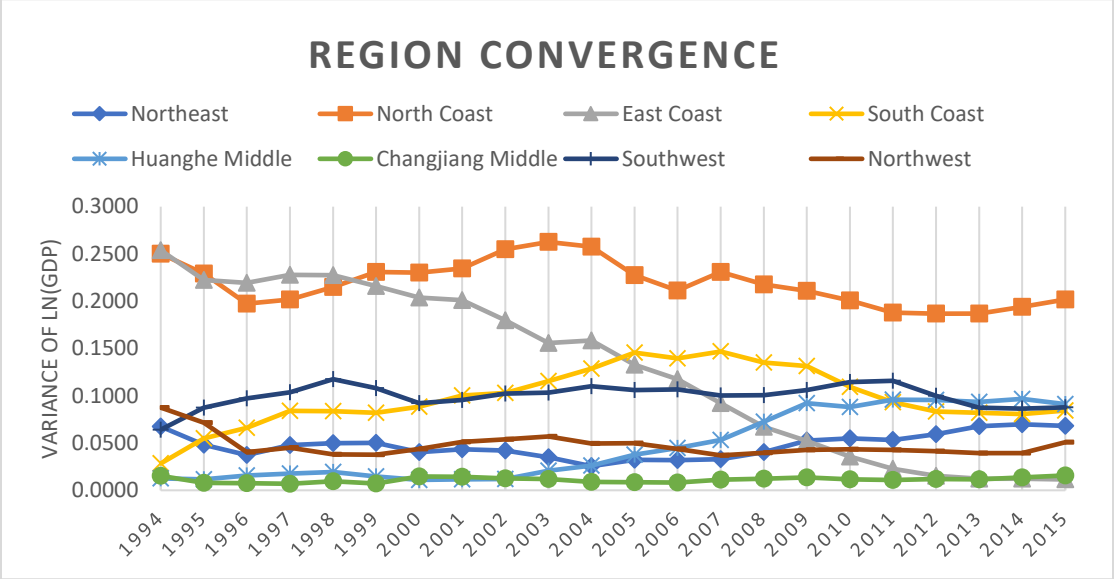


Figure 2.2 Convergence over time by region, 1994-2015

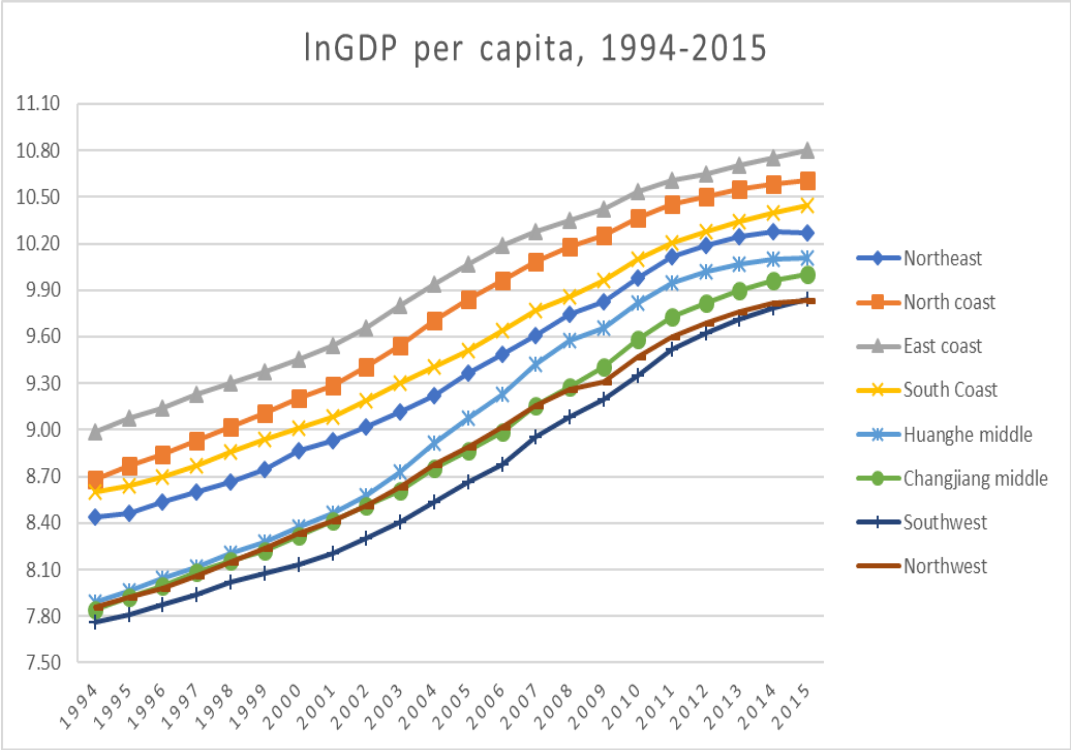
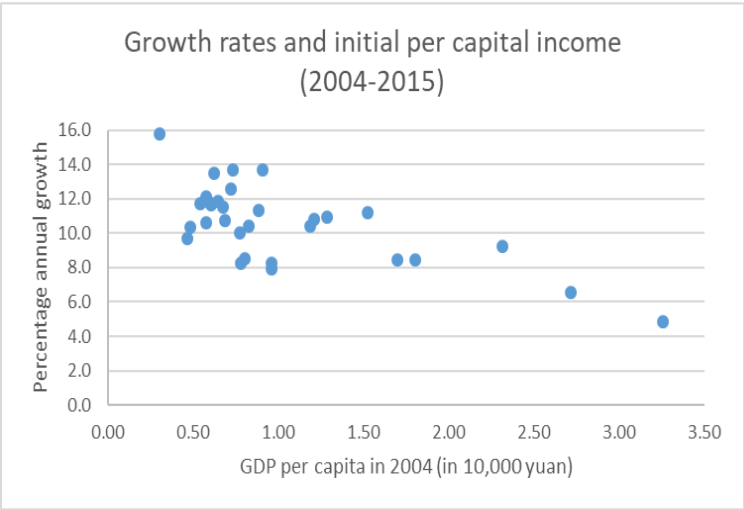
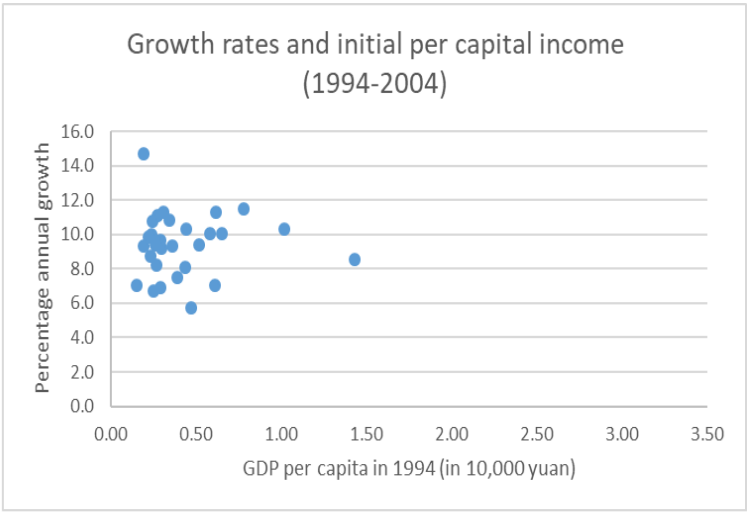


Figure 2.3 The trend of lnGDP per capita across regions, 1994-2015





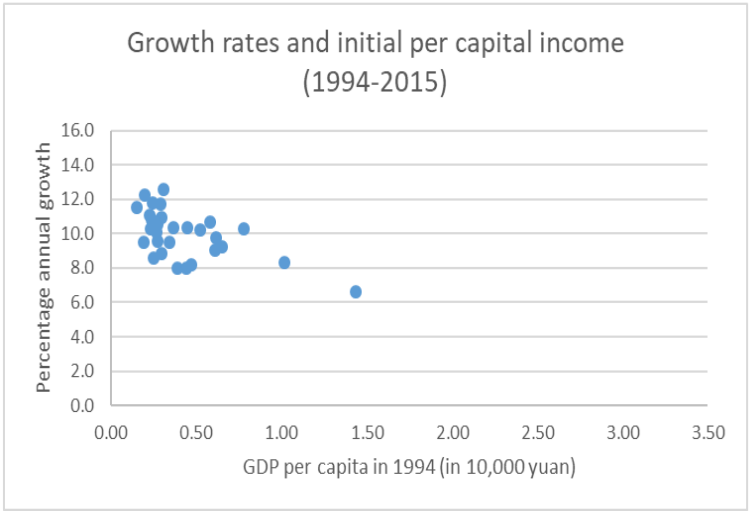
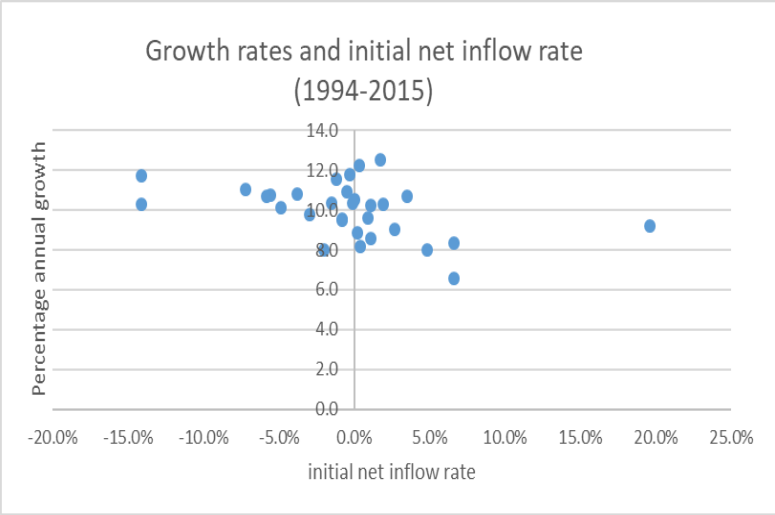
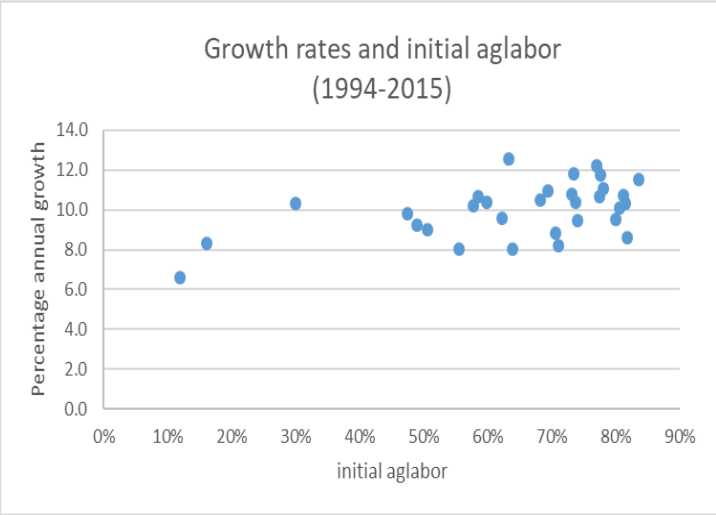


Figure 2.4 Growth rates and initial GDP per capita





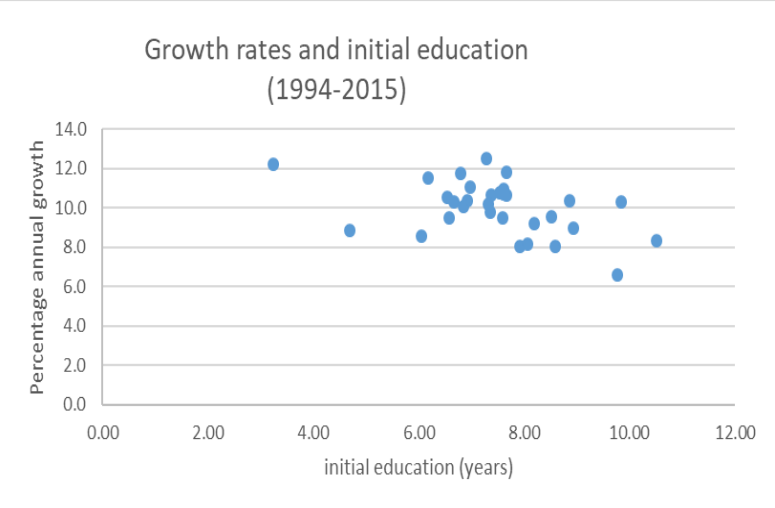


Figure 2.5 Growth rates and initial variable

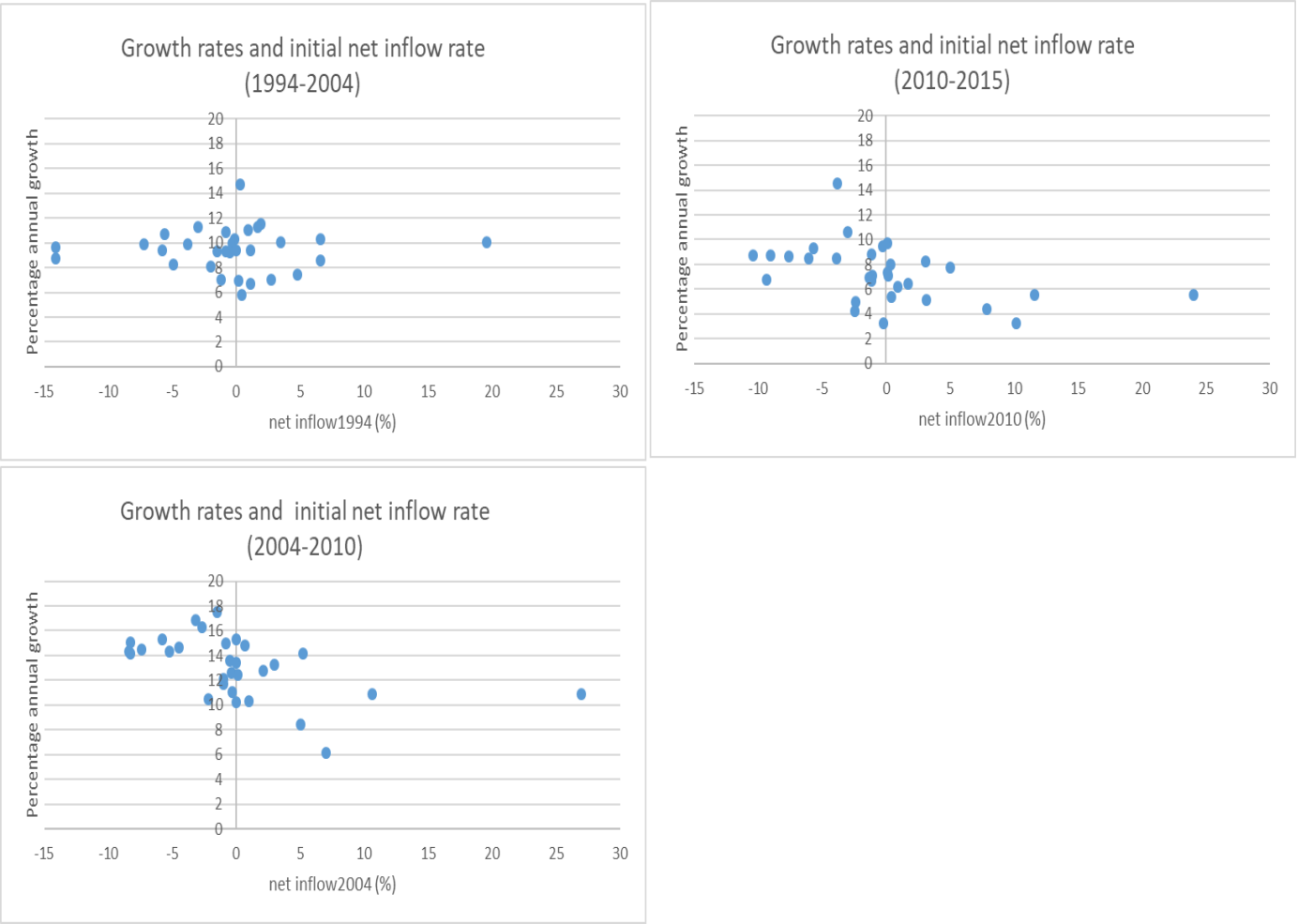


Figure 2.6 Growth rates and net inflow rate for three sub-periods

Table 2.1 Moran's I statistic for log of real GDP

Years	Moran's I
2015	0.1421753***
2014	0.1489543***
2013	0.1580336***
2012	0.1623837***
2011	0.1673267***
2010	0.1737904***
2009	0.1740602***
2008	0.1795798***
2007	0.1834563***
2006	0.1912374***
2005	0.1916563***
2004	0.1891529***
2003	0.1863985***
2002	0.1844255***
2001	0.1832807***
2000	0.1830427***
1999	0.1786872***
1998	0.1757577***
1997	0.1797555***
1996	0.180381***
1995	0.17373***
1994	0.1600818***

Table 2.2 Annual income by education level and province in 1995 (Unit: Yuan)

Average of annual income	**Education level**							
Province	**College or above**	**Professional school**	**Middle level of vocational school**	**High school**	**Middle school**	**Elementary school**	**Below elementary school**	**Average**
Beijing	9659	10177	7653	7723	7778	5410	3972	8263
Shanxi	6589	5204	5401	4556	4648	3763	2571	4893
Liaoning	7394	6653	6594	5425	5301	4496	1934	5771
Jiangsu	9272	8877	7543	6865	6104	5053	3452	6835
Anhui	7226	6337	5663	5226	4866	3824	3245	5254
Henan	7492	5650	5230	4545	4470	3998	3469	4901
Hubei	8129	7004	6376	5858	5596	4757	3076	6128
Guangdong	15259	14869	12631	9861	10823	7660	5355	11079
Sichuan	8119	6617	6490	5788	5769	4705	4000	6078
Yunnan	7095	6616	6580	5796	5794	5141	3359	6083
Gansu	6317	5400	5223	4506	4717	4008	3056	4839
Average	8442	7629	6829	6082	5898	4945	3566	6400

* Data are from CHIP 1995 individual survey data. I only use the selected provinces that include both rural and urban individual's information. I filtered the data so that it only included the people aged 18-65 and also exclude rural individuals who work outside the province in 1995.

Table 2.3 lnGDP and Net Migration rate by Province

		Actual lnGDP per capita			Filtered lnGDP per capita			Net inflow rate		Edu		Aglabor		annual growth rate (%)			
Regions	Provinces	2015	2004	1994	2015	2004	1994	90-95	00-05	1994	2004	1994	2004	15-94	15-04	04-94	diff
Northeast	Liaoning	10.53	9.4	8.72	10.42	9.25	8.59	2.7%	0.7%	8.9	9.3	51%	48%	9.0	10.8	7.0	3.8
	Jilin	10.27	9.09	8.2	10.18	8.95	8.03	-1.5%	-0.8%	8.9	9.1	60%	61%	10.4	11.3	9.3	2.0
	Heilongjiang	10.01	9.17	8.39	9.91	9.06	8.28	-2.0%	-2.2%	8.6	9.0	55%	57%	8.0	7.9	8.1	-0.2
North coast	Beijing	10.91	10.21	9.23	10.67	9.91	9.01	6.6%	5.0%	10.5	11.4	16%	9%	8.3	6.6	10.3	-3.7
	Tianjin	11.02	10.05	8.96	10.79	9.68	8.64	1.9%	2.1%	9.8	10.5	30%	25%	10.3	9.2	11.5	-2.3
	Hebei	10.04	9.17	8.14	9.95	9.03	8.06	-0.8%	-1.0%	7.6	8.9	74%	65%	9.5	8.2	10.8	-2.6
	Shandong	10.47	9.38	8.4	10.32	9.19	8.24	-0.1%	-0.5%	6.9	8.6	74%	62%	10.4	10.4	10.3	0.1
East coast	Shanghai	10.91	10.39	9.57	10.7	10.12	9.36	6.6%	7.0%	9.8	11.2	12%	7%	6.6	4.8	8.5	-3.7
	Jiangsu	10.8	9.63	8.67	10.72	9.53	8.59	3.5%	5.2%	7.4	8.4	58%	38%	10.7	11.2	10.1	1.1
	Zhejiang	10.69	9.8	8.73	10.45	9.43	8.36	-3.0%	10.6%	7.4	8.7	47%	24%	9.8	8.4	11.3	-2.9
South Coast	Fujian	10.6	9.46	8.56	10.55	9.4	8.5	1.1%	3.0%	7.3	8.0	58%	38%	10.2	10.9	9.4	1.5
	Guangdong	10.63	9.74	8.78	10.66	9.81	8.83	19.6%	27.0%	8.2	9.0	49%	31%	9.2	8.4	10.1	-1.6
	Hainan	10.11	9.02	8.46	10.14	9.09	8.51	0.4%	0.1%	8.1	9.1	71%	64%	8.2	10.4	5.8	4.7
Huanghe middle	Shanxi	9.83	8.96	7.91	9.8	8.92	7.92	0.9%	-0.4%	8.5	9.1	62%	54%	9.6	8.2	11.1	-2.8
	Inner Mongolia	10.52	9.11	8.04	10.54	9.12	8.08	1.7%	-0.1%	7.3	8.6	63%	56%	12.5	13.7	11.3	2.4
	Henan	9.95	8.83	7.81	9.94	8.82	7.83	-5.6%	-8.3%	7.6	8.7	81%	73%	10.7	10.7	10.7	0.0
	Shaanxi	10.13	8.74	7.79	10.21	8.86	7.92	-0.3%	-1.5%	7.7	8.8	73%	63%	11.8	13.5	10.0	3.5
Changjiang middle	Anhui	9.92	8.66	7.72	9.78	8.52	7.61	-7.2%	-8.3%	7.0	7.9	78%	65%	11.0	12.1	9.9	2.3
	Jiangxi	9.92	8.71	7.77	9.89	8.69	7.77	-3.8%	-5.2%	7.5	8.5	73%	56%	10.8	11.6	9.9	1.8
	Hubei	10.18	8.88	8	10.23	8.97	8.12	-0.5%	-5.8%	7.6	8.3	69%	60%	10.9	12.5	9.2	3.3
	Hunan	10	8.77	7.87	10.01	8.81	7.93	-5.8%	-7.4%	7.7	8.6	77%	65%	10.7	11.8	9.4	2.4
Southwest	Guangxi	9.91	8.68	7.89	9.97	8.79	7.97	-4.9%	-4.5%	6.8	8.5	81%	72%	10.1	11.8	8.2	3.6
	Chongqing	10.31	8.9	7.98	10.45	9.12	8.17	-14.1%	-2.7%	6.8	7.5	78%	62%	11.7	13.7	9.6	4.0
	Sichuan	9.82	8.6	7.76	9.93	8.77	7.91	-14.1%	-8.4%	6.7	7.8	82%	69%	10.3	11.7	8.8	3.0
	Guizhou	9.62	8.01	7.33	9.68	8.12	7.43	-1.2%	-3.2%	6.2	7.2	84%	75%	11.5	15.8	7.0	8.7
	Yunnan	9.56	8.48	7.83	9.65	8.64	7.97	1.1%	-0.3%	6.0	7.1	82%	74%	8.6	10.3	6.7	3.6
Northwest	Tibet	10	8.95	7.58	10.1	9.08	7.68	0.3%	0.0%	3.2	4.0	77%	77%	12.2	10.0	14.7	-4.7
	Gansu	9.47	8.45	7.56	9.53	8.58	7.7	-0.8%	-1.0%	6.6	7.5	80%	76%	9.5	9.7	9.3	0.4
	Qinghai	9.77	8.66	7.99	9.86	8.77	8.11	0.2%	0.0%	4.7	7.1	71%	65%	8.8	10.6	6.9	3.7
	Ningxia	10.02	8.82	7.92	10.1	8.94	8.05	0.0%	0.0%	6.5	8.1	68%	58%	10.5	11.5	9.4	2.1
	Xinjiang	9.89	8.99	8.27	9.95	9.06	8.35	4.8%	1.0%	7.9	8.9	64%	61%	8.0	8.5	7.5	1.1
	Standard deviation/mean	0.0404	0.0585	0.0622	0.034	0.0464	0.0511										

Table 2.4 Convergence Rate Pattern (t-values are in parentheses)

	Filtered Data			Actual Data		
	R1	R2	R3	R1	R2	R3
lnGDP94	-0.006 (0.88)	-0.014 (0.87)	-0.008 (0.80)	-0.0002 (0.03)	-0.019 (1.17)	-0.0005 (0.06)
lnGDP04	-0.023** (2.45)	-0.018** (2.18)	-0.019** (2.35)	-0.025*** (3.46)	-0.029** (2.27)	-0.020** (2.07)
lnGDP10	-0.024*** (2.71)	-0.007 (0.39)	-0.016 (1.08)	-0.029*** (4.17)	-0.024 (1.60)	-0.027*** (2.74)
lnGDP94*net inflow94		0.000002 (0.03)	0.00003 (0.51)		-0.00004 (0.65)	0.000005 (0.10)
lnGDP04*net inflow04		-0.00005 (0.92)	-0.00006 (1.18)		-0.00006 (1.13)	-0.00007 (1.44)
lnGDP10*net inflow10		-0.0001** (2.56)	-0.00006 (1.31)		-0.00007* (1.87)	-0.00002 (0.57)
Aglabor94		-0.051 (1.29)			-0.087* (1.67)	
Aglabor04		0.006 (0.16)			-0.019 (0.46)	
Aglabor10		-0.039* (1.70)			-0.057** (2.02)	
Edu94		-0.006 (1.01)			-0.004 (0.84)	
Edu04		0.001 (0.21)			0.002 (0.45)	
Edu10		-0.01*** (3.69)			-0.01*** (3.51)	
Constant	0.139** (2.40)	0.273* (1.76)	0.158* (1.80)	0.091* (1.86)	0.329* (1.93)	0.094 (1.33)
Observations R^2	93 0.6449	93 0.6864	93 0.6520	93 0.6611	93 0.7027	93 0.6651

Note: All variables are the initial value in each sub-period.

CHAPTER 3. INCOME INEQUALITY IN CHINA BY INDUSTRY

3.1 Introduction

During the economic transition over the past 4 decades, income inequality in China kept a very clear increasing trend. Based on the original Ravallion and Chen data for the 1981-2001 period and the latest data released by the NBSC for the period from 2003 to 2015, "income inequality in China substantially increased from its nadir of 28.3 points in 1983 to its peak of 49.1 points in 2008, then fall down slightly to 46.2 points in 2015" (R. Molero-Simarro, 2017: p. 108). R. Molero-Simarro (2017) investigated the inequality from the evolution of functional distribution of income and find out the increase of capital income share in top income urban household and the fall in labor share link to the worsening of the Gini index.

There are some literatures study the inequality in China. Khan et al. (1992) decompose the urban Gini index by income source based on CHIP survey data and find that the contributors are wage (34%) and house subsidies (24%). Meng (2004) finds that during the marketization of urban sectors, the increase in unemployment led to a fall in urban worker's income and then reduced the inequality in the urban labor market. Shi et al. (2016) investigate the evolution of urban inequality from the angle of wage structure between 1995 and 2013 and find that regional gap and inequality of human capital are major contributors to overall wage inequality. Ma and Li (2016) evaluate the effect of minimum wage on urban inequality from 1993 to 2013 and find that the increase of minimum wages had a positive effect on the wage levels of the low-wage group only from 2007–2013; there was no such effect from 1993–1995 and from 1998–2002. Song (2017) study the household consumption inequality in urban China over 1995-2013 using 1995, 2002 and 2013 CHIP data. She found

that the increase in consumption expenditure per capita increased remarkable after 2002. However, the consumption inequality increases over the period. She also found the inequality of basic food consumption is much smaller than the overall consumption and decreasing steadily. By contrast, clothing consumption inequality is much larger and increasing sharply with the time. The inequality of housing consumption is decreasing and is much larger in the upper half than in the lower half. In addition, the share of food expenditure decreases steadily to 25% as the overall consumption level moving up. The share of clothing in overall consumption remains about 7% over time but exhibits downward sloping. The share of housing consumption sharply increased to 38% in 2013. All those evidences imply the increase in income gap between the poor and the rich.

In this chapter, I focus on the income variances across industry sectors instead of the urban- rural gaps concluded by most authors as the main factor behind increasing inequality in China. During the globalization and privatization, the evolution of inequality, especially the structural change in the labor market, deserves intensive study. First, the urbanization process will continue for a long time in China. The farming activities is no longer an only sector in the rural area. With the investment in less-developed provinces, labor-intensive industries are declining, and the knowledge-intensive industries emerges. The employment structure change will play an important role in the evolution of overall inequality in China. There have been some studies on China's structural change, but few has attempted to bring the shift share for each industry and the evolution of income inequality together. Second, most existing studies focus on explaining the low return to schooling during the economic transition or expanding college access in recent years, but few attentions has been paid to associate the return to schooling with the structural change in employment. Third, the

inequality is based on the province level instead of the household registration system level. To investigate the structural change effect on income inequality, I use the CHIP data in 1988 and 2013, to make the inequality decomposition and regressions possible. I assume the transition from farming to manufacturing and then to service or high skilled sectors will increase the overall income inequality.

The chapter proceeds as follow. Section 2 provides some background for the industrial distribution, education and return to education. Section 3 introduces the data. Section 4 gives the decomposition of variables over time. Section5 is to investigate the determinations of income variances. Section 6 summarizes.

3.2 Sources of Inequality and Hypothesis

3.2.1 Industrial distribution

Since the economic reform started in 1978, China has received a large part of international direct investment flows. The introduction of foreign ownership through foreign direct investment (FDI) pushed the economy from collective towards marketization. In 1985, labor mobility across areas was relaxed and local governments were mandated to accept rural migrants into cities as part of their non-agricultural population. In mid-1990s, several policies were made to encourage more high-technology and more capital intensive FDI projects. In 1980, the first four Special Economic Zones (SEZs) were established in Guangdong and Fujian provinces and offered special incentive policies for FDI in these SEZs. The purposes are to attract overseas capital and also as a showcase for the potential impacts of reform. While FDI in-flows were highly concentrated within these provinces, the amounts remained rather limited (Cheung and Lin, 2004). After 1984, Hainan Island and fourteen coastal port

cities across ten provinces were opened, which were essential to support an export-oriented strategy. The realized value of inward FDI to China reached 3.49 billion dollars in 1990. Since SEZs and their positive economic impacts were solely a costal endeavor, the expected spillover effects from coastal to inland provinces failed to materialize. In reaction to the widening regional gap, more broadly-based economic reforms and open door policies were pushed forward in the 1990s. In 1992, Deng Xiaoping adopted a new approach which turned away from special regimes toward more nation-wide implementation of open policies. And the decentralization of state control, privatization of the state sector began to accelerate. Since 1992 inward FDI in China has accelerated and reached the peak level of 45.5 billion dollars in 1998. After a drop due to the Asian crisis, FDI inflows into China surged again, so that "by 2010 China had accumulated FDI stock of 579 billion, well ahead of other large developing and transition economies" (OECD, 2016: p. 10). In 1998, all state enterprises, except a few large monopolies, were liquidated and sold to private investors. "China's entry to the WTO in 2001 is likely to deepen China's integration in the international segmentation of production processes and as such should reinforce the FDI attractiveness position of China" (Madariaga, 2007: p. 839).

Thus, FDI plays a major role in transforming the Chinese economy. The role of foreign companies is to bring in new production and managerial technologies, together with local labor, to increase capital and improve the overall productivity of the economy. In addition, it creates employment opportunities. "Foreign firms employed around 20 million workers (three percent of China's total employment) at the end of the 1990s" (Madariaga, 2007: p. 840). Furthermore, foreign investment enterprises (FIEs) modifies China's industrial structure because FDI incorporates much more equipment and technology knowledge. An

important difference in industrial structure between FIEs and domestic firms is that FIEs are relatively more concentrated in the newly developing and fast-growing industries such as information technology and electronic equipment. By contrast, domestic firms are more present in the conventional basic capital-intensive and large-scale industries.

As mentioned above, the direction of FDI is encouraged by exogenous geographical and political factors. The SEZs were attracting more foreign investment enterprises ahead of other regions because of their accessibility to port infrastructures and foreign markets. Hence, I assume that the labor market structural change caused by the economic policies (labor force moving from low-skilled sectors to high-skilled sectors) would cause the income inequality. I would expect the more opened (coastal) provinces had more concentration in manufacturing industries at the beginning of reform and then transit to service sectors. The other regions had more farming activities at the beginning of reform will transit to conventional industry sectors. Overall, the different speed of economic reform across provinces could result in the income inequality.

3.2.2 Human capital investment

The geographical dispersion of China's investment in human capital is large. As shown in Table 3.1, the proportion of population with more than twelve years schooling (at least some college degree) was 4% in 2000 and had risen to 10% in 2010, this is due to the sharp increase in the enrollment and public funding for college students starting in 1999. The proportion of population with high school degree was 13% in 2000 and had risen to only 15% in 2010. The proportion of individuals who had at least a high school education was approximately 31% in coastal region, 27% in the northeast, 24% in the interior regions, but

19% in the west in 2010. The Chinese government made a law for nine-years of compulsory education (six years of primary education plus three years of secondary education) in 1986. The ratio of high school enrollment (three years later) to middle school enrollment increased from 26% in 2000 to only 51% in 2015 (National Bureau of Statistics of China, Various Years), which means only one of two children can get into high school if we assume the compulsory education applied to all children. In 2015 the high school enrollment rate is approximately 58%, which means there are 7% of students don't even graduate from middle school.

The Chinese government and society appear to have failed to keep enough of the country's young people in school during the recent decades of economic growth. The low rate of high school attendance can be attributed to high and rising costs. Academic high school tuition fees in China are not free and are among the highest in the world (Liu et al. 2009). College tuition fees also are burdensome for students from poor rural areas and they often do not qualify for need-based financial aid. More importantly, rural families encourage poor exam performance students to drop out from school because of high opportunity cost from staying in school. The parents would suggest their children to find jobs in cities because of increasing demand and wages of low-skills workers in urban area. Another thoughts are related to the poor teaching quality in the rural area. The annual college entrance exam (commonly known as "Gaokao") is the only way for entrance into almost all higher education institutions at the undergraduate level. It is usually taken by students in their last year of high school. By the time students are ready to take the exam, most of rural students have dropped out of the system. Since it is based on test scores only, the remaining students in the rural area are not competitive in this exam compared to the urban students. In addition,

major cities like Beijing and Shanghai are given higher quotas for admittance to college because the educational resources are not distributed evenly across China. Hence, the rural students are being discriminated in higher education. And that's why they choose to drop out of school. In the short run, drop-out students can gain from migration to cities earlier than other students stay in school. In the long run, as too many people drop out of school too soon and the low-skilled jobs that may have been plentiful, the migrant workers without secondary skills must struggle in the cities.

Table 3.2 shows the schooling gap between urban and rural required by each occupation for the young generation aged 25-35 in 2013 and the average schooling for all individuals in 1988. The education gap between urban residents and rural residents varies between 1.4 to 3.9 years across industries. Only the sectors require higher skills (ie., IT, Financial industry, Education) have slightly less education gap. The last column shows the average schooling in 1988. Since the compulsory education start after 1986, the young generation's average schooling in 2013 can roughly reflect the results of this policy. We could see that the agriculture sectors gain from this policy and the education increased by 3.2 years for rural workers and 5.9 years for urban workers compared to the average schooling in 1988. For other sectors, the improvement in schooling are subtle in rural area. In contrast, the education level in urban areas have increased more than that in rural area in all sectors, which implies the higher human capital investment in more developed regions. Since we assume a positive relationship between education and wage, I assume the provinces with more percentage of rural residents have lower education level and less developed.

Human capital has a direct role in production through the generation of worker skills. Fleisher and Chen (1996) find the regional inequality of investment in Chinese higher

education can explain the high and rising regional income inequality. Therefore, I assume that the discrepancy of education obtained will result in regional inequality in China.

3.2.3 Return to schooling

Campos et al. (2016) analyzes the impact of education on income inequality between ethnic minorities and Han in China by using the data from the China Health and Nutrition Survey (CHNS) over the period 1993–2011. They found that there exists significant income inequality to the disadvantage of ethnic minorities but the return to education for ethnic minorities is high, which implies that a portion of the income gap can be overcome with additional education. They found that in general one additional year of education will increase earned incomes of ethnic minorities by 26.3–28% and in particular by 13.5–14.4% for women from an ethnic minority group, by 10.4–14% for ethnic minorities with urban household registration, and by 10.8% for ethnic minorities with rural household registration.

Belskaya et al.(2014) evaluates whether the expansion of higher education is economically worthwhile based on a recent surge in the number of campuses and college graduates in Russia. They find that college expansion attracts individuals with lower returns to college, but the returns for marginal students who are directly affected by college expansion vary considerably depending on the scale of expansion and the type of location where new campuses are opened. Marginal individuals in smaller cities and locations without college campuses receive the largest benefits from new campuses.

In China, higher education expanded almost six-fold in the decade 1988-2008. J. Knight et al. (2017) shows that the share of higher education graduates in total employment

rose by 8 percentage points, but the graduate unemployment rate rose by only 1.4 percentage points. This implies that the higher education wage premium has been depressed by supply shock. Compared to high school leavers, the average hourly wage for the entry cohort of higher education graduates and university graduates fall over the five years. There's the same pattern in the proportion of the "good job" for the entry cohort of higher education graduates and university graduates. In addition, the unemployment rate increased only for these cohorts.

Keng, Lin and Orazem (2017) also investigated the expansion of college access and education quality on income inequality in Taiwan. They found that increasing college access alone will not lower inequality, the variance of wage income increased by 7 percent due to the surge of weakly- trained college graduates. As a result, firms substitute more experienced college-trained workers for their less experienced counterparts, leading to falling college premia for young college graduates. Hence, the college-high school wage gaps of young and older workers have moved in polarizing directions.

In this chapter, I will investigate if the structural change can be associated with rising wage premium for higher education. As mentioned above, the employment structures in China are shifting from labor-intensive industries to knowledge-intensive industries. The increasing labor demand of technology and high-skilled sectors during the globalization favor workers with higher education. Meanwhile, the expansion of college access and lower education quality can also reduce the advantages of college graduates. As suggested by Belskaya, the location of workers does make a difference. I assume the provinces with more universities (more college graduates) but lower concentration in higher-skilled industries will have lower wage premium because of the supply shock. To specify the structural change on

income across provinces, I will estimate return to schooling using sectors and provinces as income determinants.

3.3 Data Description

Individual data from Chinese Household Income Project (CHIP 2013 and CHIP 1988) are employed in this chapter to compare the provincial income inequality between 1988 and 2013. This survey contains fourteen provinces in common of two databases. Working individual aged 18-65 are used as samples. The individual employment rate across industry sectors is used to summarize the density of industries in each province. In addition, the annual income and schooling years for each individual are used to estimate the return to schooling. Hence, the provincial average income is computed by the average annual income for each sector and then summarized by the labor share of sectors.

3.4 Variables Decomposition

3.4.1 Decomposition of shift employment share of sectors

Table 3.3 shows the share of labor by industry in 1988, 2002 and 2013. We can see that the good-producing industries decreased substantially from 74% in 1988 to 49% in 2002, then decrease to 44% in 2013. The decline trend mainly caused by the decrease in agricultural sector (from 45% in 1988 to 4% in 2013). Since economic reform, the labor market in China has undergone major structural change. The most significant shift share is the farming to nonfarming transition. Compared to other OECD countries, China has relatively higher deduction in the employment rate in the agriculture sector (China decreased by 20% and the average OECD members decreased by 3% between 1999 and 2013 (Word bank, 2017)).

As opposed to the decline trend of other OECD countries, the employment rate in industry sector in China increased since 1999 and exceed the average OECD level at 2009 then stay stable at 24% after 2010 (Word bank, 2017). From CHIP survey (in Table 3.3), the construction sector increased by 12%. Since China enter WTO in 2001, the labor share in manufacturing increased from 24% in 1988 to 29% in 2002 but decreased to 22% in 2013 because of the increase in labor cost compared to other Asian countries. During the same time, the labor share of manufacturing in United States decreased slightly from 100 points in 1988 to 92 points in 2002, then decrease sharply to 67 points in 2013 (US bureau of Labor Statistics) as a result of competition from globalization.

Manufacturing is an important driver for economic growth in China, and China's exports depends on continued exports of manufacturing products. Most provinces have the manufacturing sector as its major sector. As suggested by R. Molero-Simarro (2017), the stagnating agricultural prices pushed the increasing in rural-urban migration while the hukou system and privatizations caused industrial wages to increase well below labor productivity, causing the fall in medium and low-income families' available earnings in the urban area (given the high relevance of labor share and disposable income).

The service-providing industries increased sharply from 26% in 1988 to 51% in 2002, then continue to increase to 56% in 2013. Trade, Restaurants & Catering, Materials Supply and Marketing sectors increased from 8% in 1988 to 13% in 2002 and reach 17% in 2013. Personal Service and Counseling Services increased from 1% to 7% in 2002 and reach 10% in 2013. In addition, there are three new industries: IT, computer service and software; Leasing and business services; and Production and Supply of Electricity gas and water, which account for 6% of the labor share. Although it's still far away from other OECD

countries, China has higher growth in service sectors (from 26% in 1991 to 45% in 2013 (Word bank, 2017)).

In the United States, the share of middle skilled jobs (manufacturing, operatives-assemblers, secretarial, clerical) decreased by 10% at the same time as the low skilled (local food and personal services) and high skilled jobs (managers, professionals) were increasing during 2002-2014 (Huffman, 2017). If China's structural change follow western country's change pattern, the employment in manufacturing sectors will continue to decrease. High-skilled sectors would replace the low-end jobs, the workers with less skills were most likely get laid off and lost the earning power.

The modern information technology and software automation have resulted in computerization of routine tasks and rapid displacement of labor in repetitive production and monitoring tasks. For example, online trading platform could replace the traditional bank teller; online shopping and Virtual Reality could reduce the physical stores and the automation could replace the manufacturing workers.

Hence, the low-skilled labor force needed by physical retail trading, residential service and banking sectors will be declining. Instead, these conventional industries require more high-skilled managerial workers to control the software or information technology. This also implies the difficulty for migrants from less-developed provinces or from rural originally participating in lower-skilled job to move to higher-skilled job in cities. Hence, the workers need to be upskilled to adapt themselves to the new environment.

Next, I will decompose the shift share into two parts to evaluate the impact of structure change on employment:

$$\Delta E = \sum_{j=1}^{J} \Delta E_j = \sum_{j=1}^{J} \theta_j \left(\sum_{p} \Delta E_{j_p} E_p + \sum_{p} E_{j_p} \Delta E_p \right)$$

Where E_p is the proportion of all employment in province p; E_{j_p} is the proportion of employment in sector j in province p; E_j is the proportion of employment in sector j in total employment; θ_j are the proportion of all country employment in sector j, where $\sum_{j=1}^{J} \theta_j = 1$.

The first term (within term) is the change in sector share due to growing share of this sector in employment within provinces, holding relative provincial demand for labor fixed (ie, individual provinces have increased their demand for this sector compared to other provinces, even if they did not change their overall share of the workforce).

The second term (between term) is the change in shares due to changes in employment between provinces, holding the mix of sectors within each province fixed (ie, sector share rises because provinces that hire this sector are growing).

Table 3.4 displays the shift share results. The changes in share across sectors are mainly due to the within-term changes (decrease by 17%). On average, the weighted average labor share of goods-producing industries decreased by 25% while the service-producing industries increased by 8%. Hence, we can conclude that the structural transition is from primary industry to secondary and tertiary industries.

Bai and Qian (2010) also used the Solow (1958) decomposition method to quantify the two forces driving the movement in the aggregate labor share (of national income) during 1978 and 2007 in China: structural transformation (estimated by value-added share change of each sector, use the income approach) and labor share changes within sectors. They found the

two effects are both negative and together drive down aggregate labor share of 5.48 percentage points from 1995 to 2003. They specified that "structural transformation from agriculture to non-agriculture sectors has shown negative impact on aggregate labor share since the mid-1980. Industry takes the major role in the within-sector change effect on aggregate labor share" (*op.cit.*: 651). They also questioned the China's national income accounts as the "NBS counts mixed income of rural household from agriculture as labor compensation" and "overstated the labor share in agriculture".

In this chapter, I did not use income approach to weight the sector share and the sector share is calculated by the employment rate across provinces. My results verified that the labor share decrease in agricultural sectors drive down the aggregate labor share. The within-sector change effect dominates the aggregate changes. The employment share transit from agricultural sector to construction and service sectors can explain the aggregate labor change.

3.4.2 Decomposition of change in income across provinces

The decomposition model displays as follows to evaluate the income decomposition across provinces:

$$\Delta \text{lny} = \sum_{p} \theta_p \, (\Delta lny_p) = \sum_{p} \theta_p \, (\sum_{j} \Delta lny_{p_j} Share_{p_j 1988} + \sum_{j} lny_{p_{j2013}} \Delta Share_{p_j})$$

Where lny_p is the average income in province p; lny_{p_j} is the average income in sector j in province p; $Share_{p_j}$ is the proportion of employment in sector j in province p; θ_p are the proportion of all country employment in province p, where $\sum_{p=1}^{P} \theta_p = 1$.

The first term (within term) is the change in average income due to raised income level within this sector, holding relative sectoral demand for labor fixed (ie, individual

sectors have increased their remuneration for employees compared to other sectors, even if they did not change their overall share of the workforce).

The second term (between term) is the change in average income due to changes in employment shares between sectors, holding the mix of wage within each sector fixed (ie, income rises because sectors that offer higher remuneration are growing).

Table 3.5 displays the change in average income for the decomposition across provinces between 1988 and 2013. Compared to 1988, the average income grows by 3.06. 89% of the income increase in China are due to the within-term changes. Due to the increased labor productivity and technology improvement after economic reform, the companies are willing to offer higher remunerations. The shift share can also contribute to 11% of the income increase. The employees in Chongqin and Sichuan are more likely to be affected by the sector change. Or we can say the provinces with more farming to nonfarming transition have higher between term effects. From the province perspective, most provinces have the income growth more than 3. Only Liaoning, Guangdong, Sichuan and Yunnan provinces have income growth less than 3. Among these provinces, Yunnan (2.41) has the lowest income growth and Jiangsu (3.37) has the highest income growth.

3.4.3 Decomposition of change in average schooling across provinces

The decomposition model displays as follows to evaluate the change in average schooling across provinces:

$$\Delta\text{Edu} = \sum_{p} \theta_p \left(\Delta Edu_p\right) = \sum_{p} \theta_p \left(\sum_{j} \Delta Edu_{p_j} Share_{p_j 1988} + \sum_{j} Edu_{p_{j2013}} \Delta Share_{p_j}\right)$$

Where Edu_p is the average schooling in province p; Edu_{p_j} is the average schooling in sector j in province p; $Share_{p_j}$ is the proportion of employment in sector j in province p; θ_p are the proportion of all country employment in province p, where $\sum_{p=1}^{P} \theta_p = 1$ .Here, the θ_p should be the same as in section 3.4.2.

The first term (within term) is the change in average education due to raised requirement for education level within this sector, holding relative sectoral demand for labor fixed (ie, individual sectors have increased their demand for higher educated employees compared to other sectors, even if they did not change their overall share of the workforce).

The second term (between term) is the change in average education due to changes in employment shares between sectors, holding the mix of skills within each sector fixed (ie, education rises because sectors that hire higher educated employees are growing).

Table 3.6 displays the change in average education for the decomposition across provinces between 1988 and 2013. Compared to 1988, the average education grows by 1.79 years. The within-sector and between sector components are almost equally responsible for the increase in education. The education change in Liaoning, Anhui, Hubei and Hunan are more likely to be affected by the sector shift share. The education change in Beijing, Henan and Gansu are more likely to be affected by the higher skills requirements within sectors. Among these provinces, Shanxi (0.27 years) has the lowest education improvement and

Chongqin (4.08 years) has the highest education improvement. However, the average income improved by 3.03 in Shanxi and 3.04 in Chongqin, which means the return to schooling are quite different across provinces.

Table 3.7 represents the average schooling and lny by sectors. Geological Prospecting, Scientific and Technical Services sector (13.96 years in 2013, 10.52 years in 1988) and Finance sectors (13.80 years in 2013, 10.65 years in 1988) have the relatively higher average schooling. This is very low education requirement compared to other countries. The samples used to calculate the average education are all adults aged 18-65. During Cultural Revolution (1966-76), the higher education system was almost shut down. Until late 1977, the national higher education entrance examination was officially resumed but less than 1% of Chinese people had attended higher education. From the CHIP 2013 database, the average education level for older workers (aged 50-65) is around two years lower than the young workers (aged 18-35). It's surprised that the average education level only increased by 2 years within almost two generations. From the return to schooling perspective, the sector with highest education level does not imply the highest wage. In addition, the return to schooling is not distributed equally across industries. From table 3.7, we could roughly estimate the Health, sports and social welfare sector has the highest return to schooling, Transport, communications, post and telecommunications sector has the lowest return to schooling between 1988 and 2013. Hence, in the following chapter, I will estimate the return to schooling in 1998 and 2013, separately and further investigate the impact of (1) changes in human capital investment (estimated by schooling), (2) changes in return to human capital and (3) changes in densities of each industry sectors (structural change) on income variances.

3.5 Variance Decomposition Approach

We are interested in monitoring how the changing shares of industry sectors composition contribute to the income inequality. Keng and Orazem (2017) uses the variance decomposition approach to decompose the changing variance of household income into three components: changing group population share, changing within-group income variance, and changing between-group income variance. In this chapter, I am going to use the same method to decompose the changing variance of individual income into three components: changing employment share of each sector, changing within-sector income variance, and changing between-sector income variance. The changing variance is based on two years: (1) 1988: in the beginning period of reform and increased basic education investment, FDI mainly in coastal/SEZ area; and (2) 2013: 35 years after the economic reform and surge of high-knowledge/tech intensive industries.

The decomposition for the total variance in income σ_Y^2 is given as (suggested by Keng and Orazem, 2017):

$$\sigma_{lnY}^2 = \sum_p \theta_p * \{\sum_{j=1}^k \alpha_{jp}\sigma_{lnY_{jp}}^2 + \sum_{j=1}^k \alpha_{jp}\left(\overline{lnY}_{jp} - \overline{\overline{lnY}}_p\right)^2\}$$

where $\sigma_{lnY_{jp}}^2$ is the within sector *j* variance of individual income in province *p*; α_{jp} is the sector *j* employment share of all labor force in province *p*; $\overline{lnY}_{jp}$ is the mean individual income for sector *j* in province *p*; and $\overline{\overline{lnY}}_p$ is the overall mean individual income in province *p*. The first term shows how much of the variance is due to inequality within sectors while the second term denotes how much of the income variance is due to inequality between sectors. The country-level variance σ_{lnY}^2 is the weighted average using employment proportion as weights: θ_p.

Table 3.8 reports the average values for the decomposition across provinces in 1988 and 2013. Over twenty-five years, the overall individual income variance increased 4 times from 0.16 to 0.64. The within-sector variance components increased more than 5 times and its share in variance jumped from 64% to 91%. However, the between sector component remain at 0.06. Hence, the income variances within the industry sectors is responsible for the increase in individual income variance. As suggested by R. Molero-Simarro (2017), the significant business profit income from both state and private enterprises have been channeled into top 10% households' income. It's understandable that the within-sector income variance worsened. For most province, we can also see the remarkable increase in income variance result from within-sector component, for example, Hubei, Hunan, Chongqin, Sichuan and Gansu. Hunan, Sichuan and Gansu are less developed provinces and mix of minorities and Han. Hence, the income inequality worsened in these areas. In addition, the between sector variance can also explain the increase in individual variance in some provinces including Beijing and Guangdong. As developed provinces/metropolis that consistent of more urban residents, more educated workers (in Beijing) and technical skilled workers (in Guangdong) can also explain the income inequality.

To illustrate the role of education effect, return to schooling effect and the sector share change on the increased income variances between 1988 and 2013, we set $\sigma^2_{lnY_p}$ in 1988 as the base case and change one variable each time to separate the three factors. First, we specify a baseline equation for the wage as a function of education, and control for industry sector and province only.

Since I emphasis the effect of structural change on income, other control variables will be investigated in the next chapter. Province level income can be summarized as the product of share of industry sectors and sector level income.

$$lny_{ipjt} = \beta_{ipjt} * edu_{ipjt} + \gamma_{ipjt} * Sector + \delta_{ipjt} * Province \quad (a)$$

$$\overline{lny_{pjt}} = \frac{1}{n} * \sum_i lny_{ipjt} \quad (b)$$

$$\overline{lny_{pt}} = \sum_j \alpha_{pjt} * \overline{lny_{pjt}} \quad (c)$$

In equation (a), lny_{ipjt} is the log of annual income for individual i, in sector j, year t and province p. edu_{ipjt} is the schooling years completed for individual i and β_{ipjt} is return to schooling. $Sector$ and $Province$ are both dummy variables. In Eq. (c), lny_{pt} is the average income in province p. α_{pjt} is the share of industries j in province p and lny_{pjt} is the average income for n individuals in sector j in province p. The baseline equations enable us to measure provincial income by estimating three variables: $edu_{ipjt}, \beta_{ipjt}\ and\ \alpha_{pjt}$. We can make variation on one variable use different data after fixing all other variables to get the different results.

Education effect Method: To demonstrate the role of the education effect on the income variance, we start from the actual individual income in 1988 and then construct counterfactual series of income use the individual schooling data from CHIP 2013 database instead of the schooling data in 1988 to estimate the individual income variances. First, estimate the regression coefficients ($\widehat{\beta_{ipj1988}}, \widehat{\gamma_{ipj1988}}$ and $\widehat{\delta_{ipj1988}}$) in equation (a11) using CHIP 1988 individual survey data. Second, apply these coefficients to equation (a12) to estimate $\widehat{lny_{ipj2013}}$ using CHIP 2013 individual schooling data for each individual in 2013. $\overline{lny_{pj2013}}$ could be computed by average $\widehat{lny_{ipj2013}}$ for n individuals in industry sector j in

province p (b1). By using the 1988's industry share α_{pj1988} to equation (c1), we can get the estimated average income in province p. (CHIP 2013 has three new industry sectors: IT, computer service and software; Leasing and business services; Production and Supply of Electricity gas and water. Individuals from new industries in 2013 are excluded in computing the average income because we only have return to education $\beta_{ipj1988}$ for the industries existing in 1998.)

$$lny_{ipj1988} = \beta_{ipj1988} * edu_{ipj1988} + \gamma_{ipj1988} * Sector + \delta_{ipj1988} * Province \quad (a11)$$

$$\widehat{lny_{ipj2013}} = \widehat{\beta_{ipj1988}} * edu_{ipj2013} + \widehat{\gamma_{ipj1988}} * Sector + \widehat{\delta_{ipj1988}} * Province \quad (a12)$$

$$\overline{lny_{pj2013}} = \frac{1}{n_{pj2013}} * \sum_i \widehat{lny_{ipj2013}} \quad (b1)$$

$$\overline{lny_p} = \sum_j \alpha_{pj1988} * \overline{lny_{pj2013}} \quad (c1)$$

Return to schooling Method: Similarly, we construct counterfactual series of income using the estimated return to schooling from CHIP 2013 database to estimate the individual income variances. First, estimate the regression coefficients in equation (a21) using CHIP 2013 individual survey data. Second, apply these coefficients to equation (a22) to estimate $\widehat{lny_{ipj2013}}$ using CHIP 1988 individual schooling data for each individual in 1988. Since the share of industries in each province are set to be unchanged, we could average $\widehat{lny_{ipj2013}}$ for n_p individuals in province p to calculate the province level income (equation c2).

$$lny_{ipj2013} = \beta_{ipj2013} * edu_{ipj2013} + \gamma_{ipj2013} * Sector + \delta_{ipj2013} * Province \quad (a21)$$

$$\widehat{lny_{ipj1988}} = \widehat{\beta_{ipj2013}} * edu_{ipj1988} + \widehat{\gamma_{ipj2013}} * Sector + \widehat{\delta_{ipj2013}} * Province \quad (a22)$$

$$\overline{lny_p} = \frac{1}{n_{p1988}} * \sum_i \widehat{lny_{ipj1988}} \quad (c2)$$

Sector share Method: To demonstrate the share change effect, we construct the counterfactual income variance by altering the sector employment share to be α_{jp} in 2013.

That is, change α_{pj1988} to be α_{pj2013} in equation (c), holding other variables (e.g. $\beta, edu, \gamma, sector, \delta$) unchanged.

In Table 3.8, the actual individual income variance has grown by 4 times from 0.16 to 0.64 between 1988 and 2013. In Table 3.9, the first counterfactual series (Education effect) suggests that the individual income variance would have decreased to 0.03 if the only factor changed is average schooling. Although all provinces have improved their education investment, the return to education in 1988 is only 0.5%. The low return to schooling explains the low volatility of individual income. In addition, the variance of individual education decreased from 16.87 in 1988 to 11.54 in 2013. The increased education investment in less-developed areas can also contribute the lower income variances. From the province perspective, Shandong, Chonqin and Sichuan have higher income variance than 1988. These three provinces have relatively higher education improvement than other provinces. However, the between-sector variation increased because almost all the labor force goes to farming in 1988, which resulted in lower province level income relative to sector level income (higher $\overline{lnY}_{jp} - \overline{\overline{lnY}}_{p}$). The second counterfactual series (Return to schooling) indicates that the individual income variance would have grown to 0.23 if the only factor changed is return to schooling. The overall return to schooling jumps to 7.1% in 2013. The higher income variances compared to 1988 are mainly due to the higher education variance in 1988 and higher return to schooling in 2013. And the third counterfactual series (Sector share) indicates that the individual income variance would have grown to 1.10 if the only factor changed is the share. Since we are using the sector share in 2013, the provinces with large movements from farming to nonfarming sectors during 1988 to 2013 will have large income variation because they are dominated by between sector variation (for example,

Shandong has 88% decrease in agricultural but 5.78 increase in income variance, and Hunan has 87% decrease in agricultural but 3.95 increase in income variance). Hence, from the direction of variance movements we could conclude that the return to schooling and share change are two key reasons for the increased income variance in 2013.

3.6 Conclusion

In recent decades China has experienced remarkably high and sustained economic growth rate. High growth rate depends on the industrial revolution from farming to nonfarming sectors, improvements in educational attainment and return on schooling. Although the return to schooling increased from 0.5% in 1988 to 7.1% in 2013, the average schooling years only increased by 1.8 years to 9.8 years in 2013. The increase in return to schooling can be explained by the economic transformation from labor intensive sectors to knowledge intensive sectors and rapid economic growth. Although the nine-year compulsory schooling policy improved the average schooling, the low requirement only eliminate illiteracy and far away from the quality-oriented education. If the increase in education investment could be matched with the increase in return to schooling, the income growth would be faster.

From the individual level perspective, the income inequality is widening since the economic transition in what was already considered to be one of the most unequal economies in the world. The individual level income variance increased from 0.16 in 1988 to 0.64 in 2013. The inequality decomposition suggests that it is mainly attribute to the within-sector income gap. In addition, I am trying to use three effects: schooling, return to schooling and employment share change to explain the inequality. From the movement of the variance, we

found that the increased return to schooling and shift share from agricultural sectors to other sectors can mainly contribute to the increase in inequality.

Since the returns to education in China has been lower and rising less rapidly than in other transition economics, I will discuss the trend of return to schooling and the factors that would contribute to the slow trend in the next chapter.

Table 3.1 Education investment by provinces

	2010			2000		
Province	<9 years	10-12 years	>12 years	<9 years	10-12 years	>12 years
Liaoning	72%	16%	12%	80%	13%	7%
Jilin	72%	18%	10%	79%	16%	5%
Heilongjiang	75%	15%	10%	80%	15%	5%
Beijing	45%	22%	33%	58%	24%	18%
Tianjin	60%	22%	18%	69%	22%	9%
Hebei	78%	14%	8%	86%	11%	3%
Shandong	76%	15%	9%	85%	11%	4%
Shanghai	55%	22%	23%	65%	24%	11%
Jiangsu	71%	18%	11%	82%	14%	4%
Zhejiang	76%	14%	10%	85%	12%	3%
Fujian	76%	15%	9%	86%	11%	3%
Guangdong	72%	19%	9%	82%	14%	4%
Hainan	75%	17%	8%	83%	14%	3%
Shanxi	74%	17%	9%	84%	12%	4%
Inner Mongolia	73%	16%	11%	81%	15%	4%
Henan	78%	15%	7%	86%	11%	3%
Shaanxi	72%	17%	11%	82%	13%	5%
Anhui	81%	12%	7%	89%	9%	2%
Jiangxi	79%	13%	8%	86%	11%	3%
Hubei	72%	18%	10%	83%	13%	4%
Hunan	75%	17%	8%	85%	12%	3%
Guangxi	81%	12%	7%	87%	10%	3%
Chongqin	77%	14%	9%	88%	9%	3%
Sichuan	81%	12%	7%	89%	8%	3%
Guizhou	86%	8%	6%	91%	7%	2%
Yunnan	85%	9%	6%	90%	8%	2%
Tibet	89%	5%	6%	95%	4%	1%
Gansu	78%	14%	8%	86%	11%	3%
Qinghai	79%	12%	9%	85%	11%	4%
Ningxia	76%	14%	10%	84%	12%	4%
Xinjiang	76%	12%	12%	81%	13%	6%
Average	75%	15%	10%	83%	13%	4%
Northeast	73%	16%	11%	80%	14%	6%
North coast	65%	18%	17%	74%	18%	8%
East coast	68%	17%	15%	77%	17%	6%
South Coast	75%	16%	9%	83%	13%	4%
Huanghe middle	74%	16%	10%	83%	13%	4%
Changjiang middle	77%	15%	8%	86%	11%	3%
Southwest	82%	11%	7%	89%	8%	3%
Northwest	80%	11%	9%	86%	10%	4%

* Data is from 2010 and 2000 China Population Census.

Table 3.2 Schooling years by industries

		Schooling years for aged 25-35 in 2013			1988
	Sectors	Urban	Rural	Urban-Rural	All individuals
Goods-Producing Industries	Agriculture, Forestry, Animal Husbandry, Fishing	11.7	9	2.7	5.8
	Construction	12.9	9.1	3.9	8.7
	Manufacturing	12.4	9.5	3	9.3
	Mining	11.9	9.6	2.3	10
Service-Providing Industries	Trade, Restaurants & Catering, Materials Supply and Marketing	12	9.9	2.1	9.4
	Personal Services and Counseling Services	11.8	9.5	2.3	8.6
	Education, Culture, and Art	15	13	1.9	12
	Party, Government, or Social Organs	14.5	11.8	2.6	11.2
	Finance, Insurance	15	13.3	1.7	11.4
	Real Estate and Public Utilities	13.7	12.3	1.4	10
	Health, Sports, and Social Welfare	14.8	11.7	3.1	11.9
	Transport, Communications, Post and Telecommunications	12.4	9.7	2.7	9.6
	Geological Prospecting, Scientific and Technical Services	15.9	13.2	2.7	12.8
	IT, computer service and software	14.3	12.3	1.9	N/A
	Leasing and business services	12.2	10.1	2.2	N/A
	Production and Supply of Electricity gas and water	14	10	3.9	N/A
	China	13.2	9.9	3.3	8.2

Table 3.3 Share of labor by industry, 1988, 2002 and 2013

	Sectors	2013	2002	1988
Goods-Producing Industries	Agriculture, Forestry, Animal Husbandry, Fishing	4%	7%	45%
	Construction	15%	11%	3%
	Manufacturing	22%	29%	24%
	Mining	3%	2%	2%
	Sum	44%	49%	74%
Service-Providing Industries	Trade, Restaurants & Catering, Materials Supply and Marketing	17%	13%	8%
	Personal Services and Counseling Services	10%	7%	1%
	Education, Culture, and Art	5%	6%	4%
	Party, Government, or Social Organs	6%	8%	5%
	Finance, Insurance	1%	2%	1%
	Real Estate and Public Utilities	2%	1%	1%
	Health, Sports, and Social Welfare	3%	3%	2%
	Transport, Communications, Post and Telecommunications	7%	7%	4%
	Geological Prospecting, Scientific and Technical Services	0%	1%	2%
	IT, computer service and software	2%	0%	0%
	Leasing and business services	2%	0%	0%
	Production and Supply of Electricity gas and water	2%	2%	0%
	Sum	56%	51%	26%

Table 3.4 Decomposition of the shift share between 1988 and 2013

		Within	Between	Sum
	Sectors	$\sum_p \Delta E_{j_p} E_p$	$\sum_p E_{j_p} \Delta E_p$	ΔE_j
Goods-Producing Industries	Agriculture, Forestry, Animal Husbandry, Fishing	-41%	0%	-41%
	Construction	12%	0%	12%
	Manufacturing	-2%	-1%	-3%
	Mining	1%	0%	1%
	Average	-25%	0%	-25%
Service-Providing Industries	Trade, Restaurants & Catering, Materials Supply and Marketing	9%	0%	9%
	Personal Services and Counseling Services	9%	0%	9%
	Transport, Communications, Post and Telecommunications	3%	0%	3%
	IT, computer service and software	2%	0%	2%
	Leasing and business services	2%	0%	2%
	Production and Supply of Electricity gas and water	2%	0%	2%
	Others*	4%	0%	4%
	Average	8%	0%	8%
	China	-17%	0%	-17%

*Others include Finance, Insurance, Real Estate and Public Utilities, Health, Sports, and Social Welfare, Geological Prospecting, Scientific and Technical Services, Education, Culture, and Art, Party, Government, or Social Organs sectors. These sectors have very small (~1%) shift share change.

Table 3.5 Decomposition of the lny change between 1988 and 2013 (Percentage are in parenthesis)

Province	Within $\sum_j \Delta lny_{p_j} Share_{p_j 1988}$	Between $\sum_j lny_{p_{j2013}} \Delta Share_{p_j}$	Sum Δlny_p
Beijing	3.27 (99%)	0.04 (1%)	3.31
Shanxi	2.91 (96%)	0.13 (4%)	3.03
Liaoning	2.65 (90%)	0.29 (10%)	2.93
Jiangsu	3.19 (95%)	0.18 (5%)	3.37
Anhui	3.01 (93%)	0.22 (7%)	3.22
Shandong	2.64 (84%)	0.49 (16%)	3.13
Henan	2.85 (94%)	0.19 (6%)	3.03
Hubei	2.85 (88%)	0.38 (12%)	3.23
Hunan	2.58 (83%)	0.54 (17%)	3.13
Guangdong	2.69 (96%)	0.12 (4%)	2.81
Chongqin	1.97 (65%)	1.07 (35%)	3.04
Sichuan	1.97 (70%)	0.85 (30%)	2.82
Yunnan	2.21 (92%)	0.19 (8%)	2.41
Gansu	3.08 (93%)	0.24 (7%)	3.33
China	2.73 (89%)	0.33 (11%)	3.06

Table 3.6 Decomposition of the schooling change between 1988 and 2013 (Percentage are in parenthesis)

Provinces	Within $\sum_j \Delta Edu_{p_j} Share_{p_j 1988}$	Between $\sum_j Edu_{p_j 2013} \Delta Share_{p_j}$	Sum ΔEdu_p
Beijing	1.67 (89%)	0.20 (11%)	1.87
Shanxi	0.14 (51%)	0.13 (49%)	0.27
Liaoning	0.07 (12%)	0.47 (88%)	0.54
Jiangsu	0.50 (35%)	0.91 (65%)	1.41
Anhui	-0.02 (-2%)	0.86 (102%)	0.84
Shandong	2.23 (62%)	1.36 (38%)	3.59
Henan	0.91 (71%)	0.36 (29%)	1.27
Hubei	0.14 (13%)	0.90 (87%)	1.04
Hunan	0.88 (27%)	2.37 (73%)	3.25
Guangdong	0.32 (32%)	0.66 (68%)	0.98
Chongqin	1.66 (41%)	2.42 (59%)	4.08
Sichuan	1.73 (53%)	1.50 (47%)	3.23
Yunnan	1.06 (66%)	0.54 (34%)	1.60
Gansu	1.28 (78%)	0.36 (22%)	1.64
China	0.86 (48%)	0.93 (52%)	1.79

Table 3.7 Average schooling and lny by sectors in 1988 and 2013 (Percentage change are in parenthesis)

		2013		1988		Change	
	Sectors	Schooling	lny	Schooling	lny	Schooling	lny
Goods-Producing Industries	Agriculture, Forestry, Animal Husbandry, Fishing	7.46	9.33	5.75	6.93	1.70 (30%)	2.40 (35%)
	Construction	8.05	9.96	8.91	7.18	-0.85 (-10%)	2.77 (39%)
	Manufacturing	9.42	10.12	9.63	7.08	-0.21 (-2%)	3.04 (43%)
	Mining	9.15	10.21	9.53	7.12	-0.38 (-4%)	3.09 (43%)
	Average	8.76	10.00	7.24	6.99	1.52	3.01
Service-Providing Industries	Trade, Restaurants & Catering, Materials Supply and Marketing	9.4	10	9.74	7.09	-0.34 (-3%)	2.91 (41%)
	Personal Services and Counseling Services	9.29	9.89	8.08	7.05	1.21 (15%)	2.83 (40%)
	Education, Culture, and Art	13.25	10.33	12.42	7.17	0.83 (7%)	3.16 (44%)
	Party, Government, or Social Organs	12.41	10.2	11.59	7.17	0.81 (7%)	3.03 (42%)
	Finance, Insurance	13.8	10.65	11.69	7.04	2.10 (18%)	3.60 (51%)
	Real Estate and Public Utilities	11.37	10.26	10.12	7.03	1.25 (12%)	3.23 (46%)
	Health, Sports, and Social Welfare	12.31	10.15	11.85	7.17	0.46 (4%)	2.99 (42%)
	Transport, Communications, Post and Telecommunications	9.62	10.28	9.8	7.24	-0.19 (-2%)	3.03 (42%)
	Geological Prospecting, Scientific and Technical Services	13.96	10.52	12.39	7.18	1.58 (13%)	3.33 (46%)
	IT, computer service and software	13.16	10.42				
	Leasing and business services	10.54	10.1				
	Production and Supply of Electricity gas and water	10.69	10.25				
	Average	10.58	10.21	10.83	7.14	-0.25	2.98
	China	9.81	10.07	8.24	7.01	1.57	3.06
	Variance	11.54	0.64	16.87	0.16		

Table 3.8 Decomposition of the Individual lny Variance: 1988 and 2013 (Percentage are in parenthesis)

	Within $\sum_{j=1}^{k} \alpha_{jp}\sigma^2_{lnY_{jp}}$		Between $\sum_{j=1}^{k} \alpha_{jp}(\overline{lnY}_{jp} - \overline{\overline{lnY}}_p)^2$		Total $\sigma^2_{lnY_p}$	
Province	1988	2013	1988	2013	1988	2013
Beijing	0.15 (98%)	0.51 (84%)	0.00 (2%)	0.10 (16%)	0.16	0.61
Shanxi	0.15 (84%)	0.68 (89%)	0.03 (16%)	0.08 (11%)	0.18	0.76
Liaoning	0.13 (91%)	0.65 (90%)	0.01 (9%)	0.07 (10%)	0.14	0.72
Jiangsu	0.14 (83%)	0.46 (94%)	0.03 (17%)	0.03 (6%)	0.16	0.49
Anhui	0.10 (57%)	0.57 (93%)	0.08 (43%)	0.04 (7%)	0.18	0.61
Shandong	0.01 (53%)	0.58 (94%)	0.01 (47%)	0.04 (6%)	0.02	0.61
Henan	0.10 (82%)	0.61 (96%)	0.02 (18%)	0.03 (4%)	0.12	0.64
Hubei	0.08 (43%)	0.56 (89%)	0.10 (57%)	0.07 (11%)	0.18	0.63
Hunan	0.03 (29%)	0.65 (95%)	0.07 (71%)	0.03 (5%)	0.09	0.68
Guangdong	0.20 (97%)	0.48 (94%)	0.01 (3%)	0.03 (6%)	0.20	0.51
Chongqin	0.01 (27%)	0.49 (88%)	0.02 (73%)	0.07 (12%)	0.03	0.56
Sichuan	0.01 (27%)	0.69 (92%)	0.02 (73%)	0.06 (8%)	0.03	0.75
Yunnan	0.09 (56%)	0.74 (87%)	0.07 (44%)	0.11 (13%)	0.15	0.85
Gansu	0.14 (28%)	0.58 (87%)	0.37 (72%)	0.09 (13%)	0.51	0.67
China	0.11 (64%)	0.58 (91%)	0.06 (36%)	0.06 (9%)	0.16	0.64

Table 3.9 Counterfactual Individual lny Variance decomposition across provinces (Percentage are in parenthesis)

	Education effect: $\sigma^2_{lnY_p}$			Return to schooling: $\sigma^2_{lnY_p}$			Sector share: $\sigma^2_{lnY_p}$		
Province	Within	Between	Sum	Within	Between	Sum	Within	Between	Sum
Beijing	0.00 (2%)	0.01 (98%)	0.01	0.04 (26%)	0.11 (74%)	0.15	0.16 (97%)	0.39 (3%)	0.16
Shanxi	0.00 (1%)	0.02 (99%)	0.02	0.04 (21%)	0.15 (79%)	0.19	0.20 (88%)	0.03 (12%)	0.22
Liaoning	0.00 (1%)	0.01 (99%)	0.01	0.03 (18%)	0.14 (82%)	0.17	0.15 (6%)	2.54 (94%)	2.70
Jiangsu	0.00 (1%)	0.02 (99%)	0.02	0.05 (23%)	0.19 (77%)	0.24	0.17 (92%)	0.01 (8%)	0.18
Anhui	0.00 (1%)	0.03 (99%)	0.03	0.06 (20%)	0.25 (80%)	0.31	0.16 (67%)	0.08 (33%)	0.24
Shandong	0.00 (1%)	0.05 (99%)	0.05	0.08 (65%)	0.04 (35%)	0.12	0.04 (1%)	5.74 (99%)	5.78
Henan	0.00 (1%)	0.03 (99%)	0.03	0.06 (21%)	0.22 (79%)	0.28	0.18 (86%)	0.03 (14%)	0.21
Hubei	0.00 (1%)	0.03 (99%)	0.03	0.05 (19%)	0.21 (81%)	0.26	0.09 (59%)	0.07 (41%)	0.16
Hunan	0.00 (1%)	0.05 (99%)	0.05	0.06 (56%)	0.04 (44%)	0.10	0.15 (4%)	3.80 (96%)	3.95
Guangdong	0.00 (1%)	0.02 (99%)	0.02	0.05 (22%)	0.17 (78%)	0.21	0.23 (98%)	0.00 (2%)	0.24
Chongqin	0.00 (1%)	0.05 (99%)	0.06	0.06 (60%)	0.04 (40%)	0.10	0.03 (1%)	3.56 (99%)	3.59
Sichuan	0.00 (1%)	0.05 (99%)	0.05	0.06 (60%)	0.04 (40%)	0.10	0.03 (1%)	3.56 (99%)	3.59
Yunnan	0.00 (1%)	0.02 (99%)	0.02	0.06 (20%)	0.23 (80%)	0.29	0.16 (72%)	0.06 (28%)	0.22
Gansu	0.00 (1%)	0.03 (99%)	0.03	0.06 (19%)	0.27 (81%)	0.33	0.19 (43%)	0.24 (57%)	0.43
China	0.00 (1%)	0.03 (99%)	0.03	0.05 (24%)	0.17 (76%)	0.23	0.15 (14%)	0.95 (86%)	1.10

CHAPTER 4. RETURN TO SCHOOLING IN CHINA: FROM 1988 TO 2013

4.1 Introduction

The economic reform policy since 1978 has transferred the economy in China from planned economy to market economy. In addition, other economic policies were implemented to stimulate the economic development. For example, foreign direct investment policy and special economic zones on 1980s, deregulation of labor migration in late 1980s, the state-owned enterprises (SOEs) reform in 1990s. With the transformation of economic system and technological innovation, wage determination is more influenced by market mechanism. As the annually GDP increased by around 10% from 1988 to 2013 (World bank, 2016), the labor demand for highly educated workers is increasing. Hence, I would expect the wage increasing for workers graduated from university or graduate school.

Government implemented university enrollment expansion policy in 1999 in order to increase the labor supply of highly-educated graduates, improve the economy and reduce the unemployment pressure for young workers because of the SOEs reform. Between 1992 and 1998, unemployment rate increased sharply due to SOEs reform and market economy reform. Poorly-operated SOEs collapsed or began to lay off the personnel. The restructuring of public sectors has prevented the firms from accepting university graduates on a large scale as before. Start from 1996, the system of assigned job position for university graduates in SOEs has been abolished and graduates had to find the jobs by themselves.

However, several issues were found after this policy. First, universities had problems with hardware and funding shortages at the beginning period. Second, the enrollment expansion has distorted the supply and demand system of university graduates, which has directly led to a decline in the employment rate and salary of university graduates. In addition to the huge

employment demand, the decline in the quality of education caused by enrollment expansion and unreasonable curriculum structure have also become a major cause of employment difficulties for university graduates.

In this study, I use five years of survey data (CHIPs data) from 1988 to 2013 to estimate the changing magnitude of the return to schooling and discuss the impact of higher education expansion on wages. The household registration disparity is also discussed because I suspect the impact of the policy on rural students may be different. I also analyzed the rate of return with respect to industry sector, occupation, ownership and region groups.

This study is structured as follows: section 2 introduces the related literature and ways in which the education can affect wages. Section 3 provides the framework of empirical model and dataset. Section 4 presents estimated results. Section 5 summarized the conclusions.

4.2 Literature Review

Before starting the discussion of the rate of return for the estimated coefficient of the years of schooling, I would like to first outline the conditions sequences for the log wage - education equation. Becker(1964) undertook early studies investigating returns to schooling based on the human capital theory. Students do not get employed until thy graduate from school, hence they have to afford the cost of schooling. The cost including direct costs, such as transportations, tuition, study supplies, and indirect costs including forgone earnings while in school. The model incorporates interest rates that allow people the borrow or lend to cover the costs and discount rate for future gain. The total investment can be computed by integrating the cost function by the years of education. Similarly, the schooling benefit is computed by integrating the benefit utility function by time. By adding these two terms together, the earning for entire life from education can be computed. The purpose is to maximize the lifecycle benefit

with respect to schooling. The human capital theory indicates that an individual's wage is determined by labor productivity. With the labor market in equilibrium, higher education implies higher labor productivity and causes higher wage. Mincer (1974) adopts the equation using a model for log earnings to depict the relationship between the education and experience and earnings; and the coefficients of education express the return to schooling. To make this equation to be an internal rate for the estimated coefficient of the years of schooling (or schooling completion group), we assume that (1) labor market in equilibrium for all schooling completion levels over time; (2) individual have an infinite life; and (3) the log wage – age profiles are equal distance expect.

The ordinary least squares (OLS) model is usually used to estimate for the rate of return. However, the OLS method might lead to the biased estimates (inaccurate observed years of schooling). Proxy variables (instrumental variable method, for example, parental education or birth month as IV), or Heckman two-step method (2SLS) are also utilized. The estimated results are different due to different period and methods in China. It is observed that the estimated return to schooling values range from 1.4% (Byron and Manaloto, 1990) to 8.6% (Gao and Smyth, 2015) from 1986 to 2010.

Other factors can also affect the influence of education on wages. For example, knight and Shi (1996) found that the most important factor influencing a person's education attainment is whether he lives in rural or urban area. The standardized mean difference in education attainment is no less than 4.6 years in favor of urban students. The estimated return to schooling among the rural area was 6.3% in Brauw and Rozelle's (2008) research. Despite rural workers can find jobs in the urban area without barriers, the problem of discrimination against migrants in a given industry is becoming more serious. Even though other factors are held constant, the

unexplained component of the intra-industrial wage gap differentials between migrants and local urban workers rises from 19.4% in 2002 to 68.0% in 2013 (Ma, 2016). The return to schooling can also be affected by the ownership type of employers. With the economic opening, private enterprises and foreign investment enterprises are dramatically developing after the 1980s. The market wage determinants mechanism affects the wage levels in these private sectors greatly. However, the wage structures were different between public and private sectors, and indicated that human capital exerted greater influence on wages among private than publics (Dong and Bowles, 2002; Xing, 2006; Demurger, Fournier, Li, and Wei, 2007). Ma (2016) found that the firm-specific human capital (tenure years) becomes more important in wage determination mechanism along with market-oriented reform in SOEs. Hence, the influence of educational level on wages may differ between various groups (urban vs rural workers, public vs private sectors).

My study contributes to this study as follows. First, I analyze the changes in return to schooling from 1988 to 2013 and the rate of return by various education groups. Second, I discuss the college expansion policy on the changes of rate of return and wages. Third, rate of return differs by household registration and I further discussed the disparity of rate of return for urban, rural and migrant workers. Lastly, rate of return is estimated for several groups: industrial sectors, occupation groups, ownership groups and regional groups from 1988 to 2013.

4.3 Methodology

4.3.1 Model assumptions

The assumptions and rationale for the wage equation – based an assumption of investing in one year of schooling after receiving the primary school diploma.

Let $PV_0(C_0) = W_0$, the real annual wage rate of a primary school graduate (assumed to be the same over time).

Let W_1 = The real annual wage rate after one year of middle school education (assumed to be unchanged over time)

The present-discounted value of getting one year of middle school education with an infinite life is:

$$PV_0 \text{ (Benefits)} = \sum_1^{\infty} (W_1 - W_0) / (1+r)^t = (W_1 - W_0)/r$$

where r is the real interest rate, maybe 2%.

If the labor market is in equilibrium for these two types of skilled individuals in all period, and the net present value of this investment is zero, we have the following relationship:

$$NPV_0 = - W_0 - (W_1 - W_0)/r = 0$$

$$\text{And } 0 = - r W_0 + W_1 - W_0 = W_1 - (1+r)W_0$$

$$\text{And } W_1 = (1+r)W_0$$

Therefore for the first year of middle school we have:

$$\ln W_1 = \ln W_0 + \ln(1+r) \sim \ln W_0 + r$$

For an investment in the 2nd year of middle school, we have:

$$\ln W_2 = \ln W_1 + \ln(1+r) \sim \ln W_1 + r = \ln W_0 + 2r$$

In general, we then have equation for investing in S year of added schooling:

$\ln W_S = \ln W_0 + r S$, i.e., the Mincer-Becker wage equation, and r is the average rate of return on S years of schooling.

Note: We ignore the direct cost of further education (books, tuition, and fees), assume ($W_t - W_{t-1}$) is constant over time, individual has an infinite life. In the case of China, the labor

market with different levels of schooling might not be in equilibrium over the infinite future (see figure 4.1).

4.3.2 Model

In this chapter, I adjust the Mincer-Becker wage equation to the following regression model:

$$\ln wage_i = \beta_0 + \beta_1 S_i + \beta_2 exp_i + \beta_3 exp_i^2 + \beta_x X_i + \varepsilon$$

$$\text{Where } S = \begin{cases} years\ of\ schooling - 6 & if\ years\ of\ schooling > 6 \\ 0 & otherwise \end{cases}$$

Where, $\ln wage$ is the dependent variable (logarithmic value of annual wage); i denotes individuals; S is the additional years of schooling after receiving the primary school diploma; exp denotes experience years; exp^2 denotes the experience squared that captures the concavity of the age-earnings profile; X are the other factors which affect the individual wage (e.g. gender, party, regions); β_0 indicates the natural log of the real annual wage rate of a primary school graduate; and ε is error item. The $\beta_1\ to\ \beta_x$ are estimated coefficients. Here, β_1 indicates the estimated rate of return on additional years of schooling after receiving the primary school diploma.

To estimate the private rates of return to different levels of education, we change the variable $eduyear$ to $edulevel$:

$$\ln wage_i = \beta_0 + \sum_i \beta_{1j} edulevel_{ij} + \beta_2 exp_i + \beta_3 exp_i^2 + \beta_x X_i + \varepsilon, \quad j = 1 \ldots 7$$

Where $edulevel_{ij}$ indicates the levels of education dummies for each j. In this study, they are junior high school; senior high school; vocational school; university; and graduate school.

The rate of return by various education category groups, r_j, is estimated by comparing the adjacent dummy variable coefficients:

$$r_j = \frac{\beta_{1j} - \beta_{1j-1}}{Year_j - Year_{j-1}}$$

Where, $Year_j$ is the number of years of schooling at the jth level.

I assume 6 years of schooling at primary school, additional over the previous year of schooling is 3 for junior high, 3 for senior high or vocational school, 4 for university, 3 for graduate school.

To investigate the interaction effect of registration and education, two methods are used. The first is to use subsamples (urban, rural and migrant), the second is to use the following equation:

$$\ln wage_i = \beta_0 + \sum_i \beta_{1j} S_{ij} + \beta_2 registartion_i + \sum_i \beta_{3j} S_{ij} * registartion_i + \beta_4 exp_i$$
$$+ \beta_5 exp_i{}^2 + \beta_x X_i + \varepsilon, \quad j = 1 \dots 7$$

Where $registartion$ indicates the household registration (Urban = 0, Migrant = 1, Rural = 2). $S_i * registartion_i$ is the interaction term of S and $registartion$. If β_3 is statistically significant, it indicated that rate of return differs by household registration even though the human capital is the same.

I also use the subsamples to estimate the rate of return among several groups: (1) industry sectors (primary, secondary and tertiary); (2) Occupation (manager, technician, clerk, and manual worker); (3) Ownership (government, SOE and private); (4) Regions (East, Central and West).

4.3.3 Data

Data used in this chapter are from the Chinese Household Income Project (CHIP) survey data for year 1988, 1995, 2002, 2007 and 2013. These surveys were carried out as part of a collaborative research project on incomes and inequality in China organized by Chinese and international researchers, with assistance from the National Bureau of Statistics (NBS). The five CHIP waves contain surveys of urban and rural individuals and households. In view of the increased importance of rural-to-urban migration, and because the urban and rural household subsamples do not adequately cover migrants, the survey added a survey of rural-to-urban migrants since 2002. Thus, the 2002, 2007 and 2013 CHIP survey includes three subsamples: rural, urban and migrant while the 1988 and 1995 CHIP survey includes rural and urban only. To consider the impact of higher education expansion and household registry differences on rate of return, all available survey data are used. The samples are composed of 17,898(CHIP1988), 12,413(CHIP1995), 21,268(CHIP2002), 20,514(CHIP2007), and 24,328(CHIP2013) individuals in 31 provinces and municipal cities, which covers nearly the whole of China. The CHIP also includes respective information about individual characteristics and job information.

Several types of data are dropped. First, individuals with missing data are dropped. Second, individuals with annual wage that is less than 100yuan are dropped in order to decrease the influence of outliers on the regression results. Third, the individuals between 22 and 65 are included while the retired and unemployed workers are excluded.

The dependent variable for the wage function is the logarithm of the annual wage. The wage is defined as the total earnings from work and the work-related cash transfer (including the benefit and compensation). Nominal wage is adjusted by CPI in each year (2010=100), provided by World Bank. The explaining variables are the variables likely to affect the wage, such as

years of schooling or education category dummy variables (no schooling; primary school; junior high school; senior high school; vocational school; university; and graduate school), experience years (calculated by age - 6), male dummy variable (male = 1, female = 0), communist party member (yes = 1), Han dummy variable (yes = 1), and regions (East, Central, West) dummy variables.

The statistical description of variables is shown in Table 4.1a-d. From 1988 to 2013, average number of years of schooling increased from 9.3 to 10.2 years for all workers; from 9.5 to 11.7 years for urban workers; from 7.6 to 9.2 years for rural workers. Urban workers experience around 1.9 to 3.7 years more schooling than rural workers. The gap increased from 1988 to 2013 and was highest in 2007 (3.7years more schooling for urban workers). Before 2007, the average schooling for rural workers were still less than 9years although the compulsory education started in 1986. Comparing rural to urban migrants and rural workers, the migrants have around half more years of schooling, but still two to three years less than their urban counterparties.

The proportion of urban workers who obtained at least as college degree increased from 7% in 1988 to 20% in 2013 while that of rural workers only increased from 1% in 1988 to 3% in 2013. It is shown that along with the implementation of the higher education expansion policy since 1999, the proportion of high-level education workers increased by 9% in urban area and only 3% in rural area between 2002 (the prior period of new workers graduated from the college) and 2013 (the year with most up to date information). Hence, we can conclude that the urban students take more advantage of this policy than the rural students. The students from the same province, no matter from urban or rural area, take the same College Entrance Examination, and the university admissions do not distribute more quota on the urban students. Instead, all students

in the same province are treated equally, the admission only depends on the examination scores. The emergence of so-called urban students has higher probability to go to college is not because of the rules of university admission, it is that education varies from primary to high school between urban and rural area. Although the students from either rural or urban area go to primary school, junior high school and senior high school, the overall quality of these schools in cities is better than those in towns. In addition, children in urban areas receive better family education than rural areas.

Table 4.2a summarized the mean value of log annual wage and Table 4.2b calculates the wage gaps between primary school and higher education category groups. The reference group is the wage mean value of "primary school" (lowest-level education group). First, the wages are higher for higher degree obtained. Workers with primary school diploma has the lowest average wages and workers graduated from graduate school have the highest average wage in each year. The average wage fluctuated around the senior high school wage level.

Second, the average wage gaps between the primary school graduates and the graduate school graduates widened from 29 in 1988 to 133 in 2013 (in percentage point difference). The wage gap between primary school graduates and senior high school graduates increased from 7 points in 1988 to 40 points in 2013 while the gap between the senior high school graduates and graduate school graduates increased from 23 points in 1988 to 93 points in 2013. This indicates that the rate of return is getting higher: the workers with lower education level were receiving lower wage while workers with higher education level were receiving higher wage. The increase in wage for urban junior high school graduates from 11 points to 18 points between 2002 and 2007 is due to the National Minimum Wage policy first implemented on 2003. The wage gap of university graduates to senior high school graduates decreased by 15 points for urban workers,

14 points for rural workers, and 24 points for migrant workers between 2007 and 2013. These results may be caused by the labor supply due to the college expansion and the demand for high-level education workers differing by household registration. For rural to urban migrants, their average wage for each education level is relatively lower than their urban counterparties.

4.4 Results

4.4.1 Results of returns to additional schooling after primary school

Table 4.3a-d summarized wage function results. The coefficient of years of schooling is estimated rate of return. Estimation (1) used the total sample, Estimation (2) used subsamples: rural, urban or rural-to-urban migrant.

First, the coefficients of years of schooling are 2.7% in 1988, 4.9% in 1995, 7.6% in 2002, 4.5% in 2007 and 7.2% in 2013 for total sample. For urban workers, the coefficients are 2.6% in 1988, 4.9% in 1995, 8.8% in 2002, 6.6% in 2007 and 9.0% in 2013. For rural workers, the coefficients are 4.9% in 1988, 5.0% in 1995, 7.1% in 2002, 3.1% in 2007 and 5.6% in 2013. For rural-to-urban migrants, the coefficients are 4.3% in 2002, 3.1% in 2007 and 4.6% in 2013. That is, the estimated rate of return increased by 4.9% from 1988 to 2002 and decreased by 3.1% from 2002 to 2007, then increased by 2.7% from 2007 to 2013. Overall, the rate of return increased by 4.5% during the whole period.

The increase in rate of return from 1988 to 2002 was caused by increase demand for high-level education workers. However, the rate of return decreased from 2002 to 2007. Since 2002 is the prior year of new workers graduated from the college, university or graduate school after the high education expansion policy implementations and 2007 is eight years after the policy, the decrease in rate of return can be explained by the labor supply of high-level education workers increasing greatly. Since a lot of college graduates enter the job market at the same time,

the over education problem may exist, which is caused by the mismatch between the labor demand and supply. From 2007 to 2013, the rate of return start increasing again because the technology improved as well as the increased demand of high-skilled workers.

Other factors also affect the wage level. One year more experienced workers have around 3.5% to 6.3% higher wages during the period. Average wage for men increased from 11.8% (1988) to 32.9% (2013) than that for women. That is, the gender wage gap increased by 21.1% from 1988 to 2013. Urban communist party members have relatively higher wage during 1995 and 2013. Most state sectors require the employees to participate in the communist party and the university also encourage the students to be the probationary party member. However, the impact is decreasing year by year as the large private enterprises are improving their compensation and the state sectors are not always the "dream" employers for students. To compare with the minority group, the wage is 3% to 18.7% higher for Han majority group and the dummy variable is not statistically significant in 1988 and 1995. When the other factors are consistent, the wage is around 21.4% to 49.6% higher for urban residents and 16.6% to 48.3% higher for rural to urban migrant residents than that for rural workers during the period. In addition, it is shown that the wage gap by registration system became smaller from 2002 to 2013. This might be because the improvement in the working environment for migrant workers, the increase in short-term out-for-work rural residents for temporary jobs in cities and the push forward of household registration reform. In addition to the registration discrepancy, there are regional wage gaps. Compared to West region, the East region has 10.3% to 44.3% higher wage during the whole period while the Central region only has relatively higher wage after 2007.

4.4.2 Rate of return by household registration

Table 4.4 summarizes the results of rate of return by registration. The estimation (1) used the subsamples: urban, rural and migrant. Estimation (2) uses the interaction of years of schooling and household registration. It shows the household registration disparity of rate of return based on the assumption that the other factors are similar.

First, the estimation (1) shows the rate of return is higher for rural workers than urban workers in 1988 and 1995 (2.6% vs 4.9% in 1988, 4.9% vs 5.0% in 1995) while the urban workers have higher rate of return during 2002 and 2013 (8.8% vs 7.1% in 2002, 6.6% vs 3.1% in 2007, 9.0% vs 5.6% in 2013). Migrant workers have lower rate of return than rural workers (4.3% vs 7.1% in 2002, 3.1% vs 3.1% in 2007, 4.6% vs 5.6% in 2013).

Second, the estimation (2) shows that when years of schooling and individual characteristics are consistent across three registration groups, the rate of return for rural workers is 2.1% lower in 2007 and 1.8% lower in 2013 than that for urban workers. The rate of return for migrant workers is 3.1% lower in 2002, 2.5% lower in 2007 and 3.6% lower in 2013 than that for urban workers.

In both estimation results, we can conclude that the rate of return is lower for rural and rural to urban migrant workers. There are several reasons for the disparity.

First, the lower rate of return for rural workers could be due to the discrimination hypothesis. The employer, colleague or customer prefer an urban worker rather than a rural worker, even though the education levels are similar. Discrimination against rural workers and migrant workers are caused by the household registration system. The policy of decentralization has contributed to the marginalization among rural migrants in urban China (Wong, 2007). Since most of the migrant workers are uneducated and do not have special skills, job mobility among

them is very low. Hence, they are lacking knowledge of the legal rights and subject to a great deal of exploitation. For example, delays in wage payment, work overtime without pay, required cash deposits with the firm to prevent the workers from leaving freely. In addition, the migrant workers are frequently portrayed negatively in social media. They are perceived as a threat to social stability and linked to the increase in crime rates in the cities. Hence, the public holds the view that migrant workers are ignorant and then widened the social gap between migrant workers and local residents.

Second, with the improvement of agricultural productivity and the acceleration of industrialization, Chinese government implemented urbanization strategies at the beginning of 21st century. With the process of urbanization, we could assume the rural workers who stay at home and participate in agricultural activities would not be affected because the only thing would affect them is the future land system policy. However, the rural workers who have already work in big cities will be affected by urbanization. When they live and work in cities, they have to pay the same tax as urban workers but their benefits of all aspects of public services cannot be guaranteed. Instead, the urban workers enjoy the more weighted resources from the government and other investment from foreign companies. Hence, we could say the urbanization lead to the unequal resource allocation and economic development between the urban and rural areas and a series of issues have not been solved (for example, rural property circulation, regular job positions available for migrant workers, education for migrant children, asset gap between urban and rural families).

Third, the higher rate of return for rural workers in 1988 could be due to the self-selection. There were less than 1% of rural workers go to higher education (compared to 7-11% of urban workers). In early stages, majority of rural workers who stay at home and participate in

agricultural activities and do not need education. The scarcity of high educated workers in rural area may cause the rate of return to be greater than urban workers. When the need for high-level education workers is greater in rural area, the rate of return will be higher for rural workers. However, because of higher opportunities and payback in big cities, the labor environment for high-educated migrant workers have been improved. Majority of rural students who have graduated from a well-known university would stay in cities. The wage for those workers have no difference from their urban counterparties. Hence, we would expect the rate of return of higher education group for migrant workers higher than that for rural workers in the future.

4.4.3 Results of returns to schooling by various education category groups

The rate of return between the various education category groups after primary school are summarized in Table 4.5a-d. From 1988 to 2013, the coefficient increased from 12.6% to 19.3% for junior high school, increased from 23% to 32% for senior high school, increased from 20.2% to 44.6% for vocational school, increased from 27.4% to 73.7% for university.

Wage gaps between the various education category groups fluctuated over the period. The coefficient differences between “junior high” and “university” education group increased from 14.8% in 1988 to 57.1% in 2013. The coefficients for “university” increased from 27.4% in 1988 to 73.7% in 2013. However, the value decreased from 79.5% in 2002 to 66.1% in 2007. This result may be caused by the implementation of the higher education expansion policy since 1999.

It is found that the intra-group wage gap differs by household registration. In both 1988 and 1995, the coefficients of education category dummy variables were greater for rural workers excepting the senior high category. From 2002 to 2013, the coefficients are greater for urban workers than rural workers among almost all education groups. For migrant workers, the

coefficients for each education category increased over time. The coefficients were higher than rural and urban workers in 2013 for "graduate" groups.

The rate of return for the various education category groups are summarized in Table 4.6. In 1988, the "Junior high school" groups have the highest rate of return (4.2%). In 1995 and 2002, the "vocational" group has the highest rate of return (7.2% in 1995 and 12.6% in 2007). In 2007, the "university" group has the highest rate of return (13.9%). In 2013, the "graduate" school has the highest rate of return (13.4%). This indicated the trend of the demand of high-level educated workers. The rate of return for "university" group increased from 1.1% in 1988 to 13.9% in 2007. Although the higher education expansion increased the labor supply of university graduates, the explosion of technological innovation resulted in the higher demand of high-level education workers. However, the rate of return for "university" group decreased to 10.4% in 2013. This indicates that the influence of higher supply of university graduates is greater than the labor demand. At the same time, the rate of return of "graduate school" group increased from 4.6% in 2007 to 13.4% in 2013. The increase in rate of return indicated that the expansion policy positively affects the wage for the highest-level education group. This could also be due to the stricter requirement for education and skills.

Comparing the return to schooling of vocational school with senior high school, the rate of return for "vocational school" is higher than "senior high school" since 1995. As education after junior high school are not mandatory, students who choose to go to senior high school are more likely to be admitted to university while students who go to vocational school are more like to work after school. These results indicated that skilled workers have higher wage when comparing high school graduates and vocational school graduates. If we assume all high school graduates go to university, the rate of return for "vocational school" is lower than "university"

after 2007, which indicated the higher labor demand for high-level education group because of the industry transition from low-technological level to higher level.

The rate of return differs by household registration for each education category. For example, the rate of return of higher education levels are lower for rural workers than urban workers as the education quality is higher in urban area. The migrant workers have the highest rate of return for "graduate" group and the lowest rate of return for other education groups, which could also be due to the competition in urban area.

4.4.4 Rate of return by industry, occupation, ownership and region groups

The results of rate of return by industry sector, occupation, ownership and regions are summarized in Table 4.7. Subsamples are used to estimate the return to schooling.

First, the rate of return is greater for tertiary industry than other industries from 1995 to 2007. The rate of return for tertiary industry increased from 3.5% in 1995 to 7.6% in 2013. As the industry sector of China improves every day with the great leap of science and technology, the labor demand for high-skilled workers are increasing, increasing the rate of return for tertiary industry.

Second, the rate of return for technician has become the highest among all occupations in recent years, followed by clerk. The gap of rate of return between the technician and other occupations are increasing. Since technicians need skills that is directly related to the education years, the results indicate that the higher education level the higher the wage.

Third, the rate of return is greater for government organizations than state-owned enterprises (SOEs) and private sector in recent years, and the rate of return of SOEs is greater than private sector from 1995 to 2013. In 1988, the private sector has the highest rate of return while SOEs has the highest rate of return in 1995. In addition, the rate of return for public sectors

(government and SOEs) has higher increases in rate of return than private sector from 1988 to 2013 (government increased from 1.8% to 9%, SOEs from 3.2% to 8.0% and private from 4.5% to 6.2%). This may due to the SOEs reform, transferring from planned economy to the market mechanisms (market-based salary system).

Fourth, the rate of return in Eastern region is the highest in 2007 and 2013 because of the highest economic development in East China. The rate of return of Eastern region increased from 2.5% in 1988 to 7.8% in 2013, whereas the rate of return of Central region increased from 2.7% in 1988 to 6.3% in 2013, Western region increased from 3.3% in 1988 to 7.5% in 2013. This result indicates the higher demand of highly-educated workers in the East.

4.5 Conclusion

This study computes the empirical results of rate of return (return to schooling after primary school) from 1988 to 2013 using the CHIP data. The estimated rate of return is 2.7% for 1988, 4.9% for 1995, 7.6% for 2002, 4.5% for 2007 and 7.2% for 2013. Urban workers have significantly highest rate of return followed by rural workers. Rural to urban migrant workers have the lowest rate of return

To compare the rate of return for different education groups, the rate of return was higher for mid-level education groups in 1988, and the rate of return are higher for higher-level education groups in later period. Workers with graduate degree has the highest rate of return in 2013.

The higher education expansion policy implemented since 1999, the rate of return are affected. The rate of return for “university” group decreased from 13.9% to 10.4% in 2007-2013. However, the rate of return for “graduate school” group increased from 4.6% to 13.4% in the same period. There are two sides of explanation on rate of return. On one side, the increase in

labor supply of highly-educated graduates would decrease the rate of return. On the other side, the need for skilled workers due to the technology improvement would increase the rate of return. Hence, this policy negatively affected the rate of return at university level while positively affected the rate of return at graduate school level.

By using the subsamples of various groups, I found the rate of return differs by industry, occupation, ownership and region groups. Tertiary industry sector, Technician, Government sector and East regions have the highest rate of return in recent years.

As we can see the rate of return of workers with graduate degree are highest in 2013, which indicates the increasing labor demand of higher-educated workers than those only has bachelor's degree. The increasing in rate of return for graduate school graduates can also improve the technology improvement in the industry. However, the higher education expansion policy only benefits the urban students (as few rural students be admitted to college from financial and ability perspective). In order to build an equal society, the education policy may be amended by government to increase the college quota for rural students as well as improve the education quality in rural regions. For workers migrate from rural to urban area, more social welfare (training, housing, health care, and labor union) are needed for those workers.

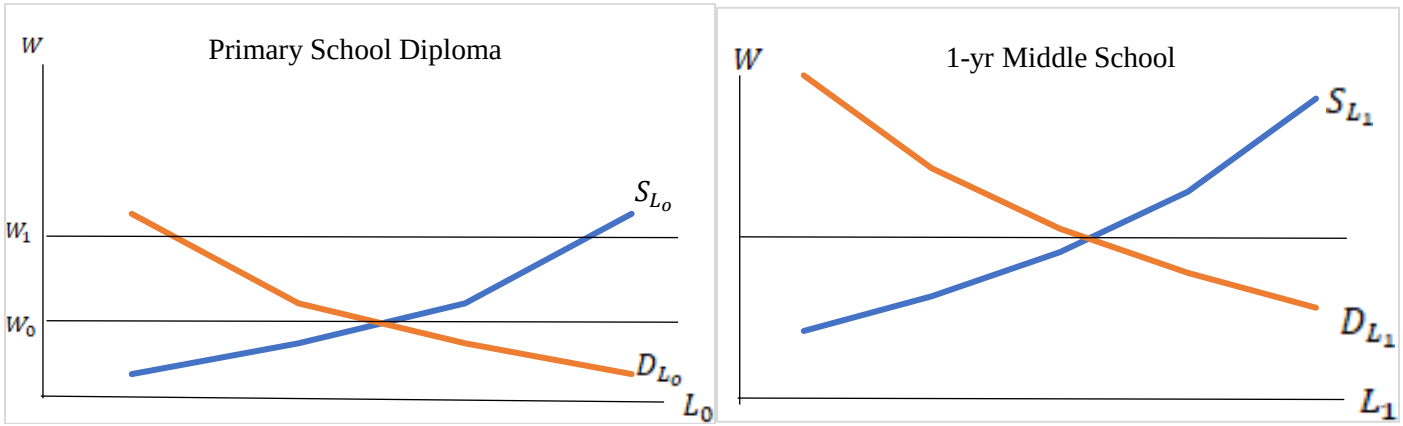


Figure 4.1 Wage equation equilibrium figure

Table 4.1a Statistical description for total samples

Total	1988	1995	2002	2007	2013
Annual wage (yuan)	5858	9252	12766	23888	29121
Years of schooling	9.3	9.9	9.5	9.8	10.2
Experience	32	33	33	31	34
Experience_sq.	1048	1099	1102	992	1137
Male	55%	54%	64%	62%	62%
Communist Party member	69%	25%	21%		12%
Han	96%	96%	94%	99%	95%
Permanent worker	99%	96%	63%	59%	32%
The married		90%	89%	81%	15%
Industry sector					
Primary		44%	16%	2%	6%
Secondary		3%	24%	39%	38%
Tertiary		47%	50%	58%	56%
Others		5%	11%	0%	0%
Occupations					
Manager	8%	14%	17%	7%	4%
Technician	16%	21%	11%	10%	13%
Clerk	27%	19%	24%	33%	39%
Manual worker	48%	40%	28%	36%	35%
Others	2%	6%	19%	14%	8%
Ownership					
Government	40%	54%	8%	9%	13%
SOE	54%	42%	28%	32%	13%
Private	1%	3%	44%	57%	65%
Others	5%	1%	20%	2%	9%
Regions					
East	43%	40%	39%	52%	41%
Central	41%	34%	34%	31%	38%
West	16%	26%	27%	18%	22%
Education category					
No schooling	1%	1%	4%	1%	1%
Primary	13%	6%	12%	11%	13%
Junior high	38%	32%	38%	45%	44%
Senior high	24%	24%	21%	19%	14%
Vocational school	17%	30%	19%	18%	18%
University	6%	7%	5%	6%	9%
Graduate	0%	0%	0%	1%	1%

Table 4.1b Statistical description for urban workers

Urban	1988	1995	2002	2007	2013
Annual wage (yuan)	5955	9205	14937	31033	35920
Years of schooling	9.5	10.1	10.9	12.2	11.7
Experience	32	33	35	34	34
Experience_sq.	1056	1119	1215	1174	1184
Male	53%	53%	56%	57%	57%
Communist Party member	74%	26%	33%		21%
Han	96%	96%	96%	99%	95%
Permanent worker	99%	96%	81%	76%	58%
The married		91%	90%	85%	88%
Industry sector					
Primary		42%	4%	2%	6%
Secondary		3%	32%	25%	22%
Tertiary		51%	61%	72%	72%
Others		4%	3%	0%	0%
Occupations					
Manager	8%	14%	11%	7%	6%
Technician	17%	23%	21%	23%	19%
Clerk	25%	21%	32%	47%	49%
Manual worker	51%	38%	29%	16%	21%
Others	0%	5%	7%	7%	5%
Ownership					
Government	44%	59%	16%	13%	26%
SOE	55%	38%	52%	49%	23%
Private	0%	3%	19%	35%	50%
Others	0%	0%	13%	3%	1%
Regions					
East	40%	37%	38%	50%	42%
Central	43%	35%	35%	30%	35%
West	17%	28%	27%	20%	23%
Education category					
No schooling	1%	0%	0%	0%	1%
Primary	12%	5%	3%	3%	5%
Junior high	38%	30%	24%	19%	26%
Senior high	24%	24%	28%	26%	18%
Vocational school	19%	32%	35%	34%	31%
University	7%	8%	10%	15%	18%
Graduate	0%	0%	1%	2%	2%

Table 4.1c Statistical description for rural workers

Rural	1988	1995	2002	2007	2013
Annual wage (yuan)	4844	9727	10338	18860	24171
Years of schooling	7.6	7.8	8.2	8.5	9.2
Experience	31	30	33	31	33
Experience_sq.	965	905	1068	985	1120
Male	74%	69%	77%	66%	66%
Communist Party member	20%	14%	14%		7%
Han	95%	97%	91%	99%	94%
Permanent worker					15%
The married		80%	85%	81%	84%
Industry sector					
Primary		61%	37%	4%	7%
Secondary		9%	17%	55%	49%
Tertiary		28%	25%	40%	44%
Others		3%	22%	0%	0%
Occupations					
Manager	15%	13%	10%	7%	3%
Technician	3%	4%	2%	5%	10%
Clerk	51%	6%	13%	21%	31%
Manual worker	19%	59%	36%	56%	46%
Others	13%	18%	39%	11%	10%
Ownership					
Government	2%	93%	4%		6%
SOE	35%	7%	12%		6%
Private	7%	0%	53%		73%
Others	57%	0%	32%		15%
Regions					
East	68%	74%	41%	51%	39%
Central	21%	18%	32%	32%	39%
West	10%	8%	27%	17%	22%
Education category					
No schooling	5%	5%	6%	1%	2%
Primary	27%	17%	19%	16%	18%
Junior high	41%	48%	52%	58%	56%
Senior high	21%	20%	16%	15%	12%
Vocational school	4%	9%	6%	9%	10%
University	1%	0%	0%	1%	3%
Graduate	0%	0%	0%	0%	0%

Table 4.1d Statistical description for rural to urban migrants

Rural to Urban Migrant	2002	2007	2013
Annual wage (yuan)	12102	22778	33741
Years of schooling	8.7	9.0	9.7
Experience	29	28	31
Experience_sq.	860	792	974
Male	57%	62%	59%
Communist Party member	3%		4%
Han	91%	98%	95%
Permanent worker	5%	38%	27%
The married	94%	76%	12%
Industry sector			
Primary	1%	0%	4%
Secondary	15%	31%	27%
Tertiary	76%	69%	69%
Others	8%	0%	0%
Occupations			
Manager	55%	6%	7%
Technician	4%	0%	9%
Clerk	28%	36%	52%
Manual worker	7%	28%	27%
Others	6%	29%	5%
Ownership			
Government	1%	5%	4%
SOE	10%	9%	10%
Private	81%	85%	86%
Others	8%	0%	0%
Regions			
East	37%	55%	43%
Central	34%	28%	40%
West	29%	17%	17%
Education category			
No schooling	10%	3%	1%
Primary	23%	12%	14%
Junior high	49%	57%	51%
Senior high	14%	17%	16%
Vocational school	4%	10%	14%
University	0%	1%	4%
Graduate	0%	0%	0%

Note: Missing variables are dropped.

Table 4.2a Mean values of lnwage for each education levels

Total	Primary	Junior high	Senior high	Vocational school	University	Graduate	Average
1988	8.6	8.6	8.7	8.7	8.9		8.7
1995	9.0	9.1	9.1	9.2	9.4		9.1
2002	9.1	9.3	9.5	9.7	10.0		9.5
2007	9.8	9.9	10.1	10.3	10.7	10.9	10.1
2013	9.9	10.1	10.3	10.5	10.7	11.2	10.3

Urban	Primary	Junior high	Senior high	Vocational school	University	Graduate	Average
1988	8.5	8.6	8.7	8.7	8.9		8.7
1995	9.0	9.0	9.0	9.2	9.4		9.1
2002	9.3	9.4	9.5	9.7	10.0		9.6
2007	9.9	10.1	10.2	10.4	10.7	10.9	10.3
2013	10.0	10.2	10.4	10.5	10.8	11.3	10.5

Rural	Primary	Junior high	Senior high	Vocational school	University	Graduate	Average
1988	8.4	8.5	8.5	8.7	8.7		8.5
1995	9.0	9.2	9.2	9.3	9.6		9.2
2002	9.0	9.2	9.4	9.7	9.9		9.2
2007	9.7	9.8	10.0	10.0	10.4	11.0	9.8
2013	9.9	10.1	10.2	10.3	10.5	10.6	10.1

Rural to Urban Migrant	Primary	Junior high	Senior high	Vocational school	University	Graduate	Average
2002	9.2	9.5	9.6	9.5	10.1		9.4
2007	9.9	10.0	10.1	10.1	10.5	11.2	10.0
2013	10.2	10.4	10.5	10.5	10.7	11.8	10.4

Table 4.2b Wage gaps between primary school graduates and higher education levels (in percentage points)

Total	Primary	Junior high	Senior high	Vocational school	University	Graduate	Average
1988	0	3	7	14	29		7
1995	0	4	4	20	35		11
2002	0	22	39	61	88		35
2007	0	17	33	53	92	114	32
2013	0	24	40	55	83	133	37

Urban	Primary	Junior high	Senior high	Vocational school	University	Graduate	Average
1988	0	17	22	27	42		22
1995	0	3	3	20	35		11
2002	0	11	26	47	73		36
2007	0	18	27	50	80	100	45
2013	0	22	41	54	79	127	50

Rural	Primary	Junior high	Senior high	Vocational school	University	Graduate	Average
1988	0	14	15	29	30		10
1995	0	17	20	30	51		15
2002	0	24	43	66	88		25
2007	0	15	28	34	73	136	17
2013	0	23	30	40	61	70	23

Rural to Urban Migrant	Primary	Junior high	Senior high	Vocational school	University	Graduate	Average
2002	0	23	32	25	90		16
2007	0	14	21	23	64	130	14
2013	0	19	32	30	52	155	22

Table 4.3a Results of wage function based on one additional years of schooling after primary school for total sample

Total	1988	1995	2002	2007	2013
Years of schooling	0.027***	0.049***	0.076***	0.045***	0.072***
	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)
Experience	0.057***	0.057***	0.050***	0.035***	0.063***
	(0.002)	(0.004)	(0.004)	(0.002)	(0.003)
Experience_sq.	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Male	0.118***	0.134***	0.177***	0.279***	0.329***
	(0.006)	(0.010)	(0.011)	(0.008)	(0.01)
Communist Party member	-0.083***	0.153***	0.162***		0.006
	(0.007)	(0.011)	(0.014)		(0.015)
Han	0.030**	0.030	0.187***	0.074*	0.163***
	(0.015)	(0.027)	(0.025)	(0.037)	(0.023)
Urban	0.412***	0.001	0.496***	0.288***	0.214***
	(0.017)	(0.024)	(0.015)	(0.012)	(0.011)
Migrant			0.483***	0.166***	0.298***
			(0.016)	(0.009)	(0.02)
Regions (West)					
East	0.103***	0.277***	0.443***	0.274***	0.270***
	(0.008)	(0.012)	(0.014)	(0.011)	(0.013)
Central	-0.141***	-0.095***	0.012	0.030***	0.051***
	(0.008)	(0.012)	(0.014)	(0.012)	(0.013)
Constant	6.999***	7.400***	7.212***	8.728***	8.271***
	(0.044)	(0.071)	(0.071)	(0.054)	(0.053)
Observations	17898	12413	21268	20514	24328
R-squared	0.2772	0.2180	0.2416	0.2232	0.2114

Table 4.3b Results of wage function based on one additional years of schooling after primary school for urban workers

Urban	1988	1995	2002	2007	2013
Years of schooling	0.026***	0.049***	0.088***	0.066***	0.090***
	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)
Experience	0.062***	0.068***	0.076***	0.047***	0.081***
	(0.002)	(0.004)	(0.005)	(0.005)	(0.005)
Experience_sq.	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Male	0.115***	0.147***	0.185***	0.302***	0.298***
	(0.006)	(0.010)	(0.012)	(0.015)	(0.014)
Communist Party member	-0.077***	0.149***	0.165***		0.035**
	(0.006)	(0.011)	(0.013)		(0.018)
Han	0.035***	0.024	-0.054*	0.068	0.103***
	(0.014)	(0.025)	(0.029)	(0.071)	(0.036)
Urban					
Migrant					
Regions (West)					
East	0.094***	0.283***	0.227***	0.457***	0.234***
	(0.008)	(0.012)	(0.015)	(0.019)	(0.018)
Central	-0.146***	-0.082***	-0.077***	-0.021	-0.014
	(0.008)	(0.012)	(0.014)	(0.021)	(0.019)
Constant	7.315***	7.191***	7.292***	8.468***	8.016***
	(0.039)	(0.076)	(0.096)	(0.118)	(0.094)
Observations	16370	11383	10006	6798	9309
R-squared	0.2871	0.2472	0.2275	0.2517	0.2167

Table 4.3c Results of wage function based on one additional years of schooling after primary school for rural workers

Rural	1988	1995	2002	2007	2013
Years of schooling	0.049***	0.050***	0.071***	0.031***	0.056***
	(0.008)	(0.010)	(0.006)	(0.003)	(0.003)
Experience	0.022**	0.017	0.037***	0.032***	0.051***
	(0.010)	(0.013)	(0.007)	(0.003)	(0.004)
Experience_sq.	-0.000*	-0.000	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Male	0.181***	0.018	0.159***	0.274***	0.348***
	(0.037)	(0.048)	(0.028)	(0.012)	(0.014)
Communist Party member	-0.028	0.103	0.126***		-0.101***
	(0.041)	(0.065)	(0.035)		(0.027)
Han	0.006	0.056	0.296***	0.070	0.181***
	(0.098)	(0.216)	(0.043)	(0.068)	(0.031)
Urban					
Migrant					
Regions (West)					
East	0.251***	0.041	0.824***	0.128***	0.318***
	(0.055)	(0.108)	(0.030)	(0.016)	(0.018)
Central	-0.036	-0.391***	0.141***	0.027	0.096***
	(0.060)	(0.118)	(0.030)	(0.017)	(0.019)
Constant	7.471***	8.522***	7.346***	8.955***	8.538***
	(0.192)	(0.303)	(0.114)	(0.089)	(0.069)
Observations	1528	1030	8062	8380	13869
R-squared	0.0714	0.0833	0.166	0.1207	0.1488

Table 4.3d Results of wage function based on one additional years of schooling after primary school for rural to urban migrants

Rural to Urban Migrant	2002	2007	2013
Years of schooling	0.043***	0.031***	0.046***
	(0.005)	(0.003)	(0.009)
Experience	0.048***	0.042***	0.08***
	(0.007)	(0.004)	(0.013)
Experience_sq.	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0)
Male	0.273***	0.231***	0.359***
	(0.021)	(0.013)	(0.039)
Communist Party member	0.046		0.076
	(0.059)		(0.138)
Han	0.034	-0.001	0.177**
	(0.041)	(0.047)	(0.091)
Urban			
Migrant			
Regions (West)			
East	0.205***	0.286***	0.112*
	(0.026)	(0.018)	(0.062)
Central	-0.021	0.073***	0.039
	(0.025)	(0.021)	(0.061)
Constant	8.136***	8.942***	8.460***
	(0.125)	(0.080)	(0.220)
Observations	3199	5336	1150
R-squared	0.133	0.1547	0.1448

Note: 1. *, **, *** denote statistical significant in 10%, 5%, 1% level.
2. Values in brackets estimated standard deviation.

Table 4.4 Results of registration disparity of rate of return

	1988	1995	2002	2007	2013
Estimation (1): years of schooling					
Urban	0.026***	0.049***	0.088***	0.066***	0.090***
	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)
Rural	0.049***	0.050***	0.071***	0.031***	0.056***
	(0.008)	(0.010)	(0.006)	(0.003)	(0.003)
Migrant			0.043***	0.031***	0.046***
			(0.005)	(0.003)	(0.009)
Estimation (2)					
Years of schooling	0.025***	0.048***	0.074***	0.055***	0.082***
	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)
Rural	-0.49***	-0.039	-0.563***	-0.196***	-0.133***
	(0.025)	(0.033)	(0.025)	(0.020)	(0.02)
Migrant			0.073***	-0.015	0.237***
			(0.023)	(0.021)	(0.038)
Years of schooling*Rural	0.034***	0.016	0.024***	-0.021***	-0.018***
	(0.008)	(0.010)	(0.007)	(0.004)	(0.004)
Years of schooling*Migrant			-0.031***	-0.025***	-0.036***
			(0.005)	(0.004)	(0.008)

Note: Experience, male and other variables are also estimated but the results are not shown in this table.

Table 4.5a Results of rate of return after primary school by education category for total sample

Total	1988	1995	2002	2007	2013
Education category (Primary school)					
Junior high	0.126***	0.083***	0.203***	0.090***	0.193***
	(0.011)	(0.022)	(0.019)	(0.013)	(0.016)
Senior high	0.230***	0.151***	0.335***	0.105***	0.320***
	(0.011)	(0.023)	(0.022)	(0.016)	(0.019)
Vocational school	0.202***	0.298***	0.582***	0.324***	0.446***
	(0.011)	(0.022)	(0.023)	(0.016)	(0.020)
University	0.274***	0.427***	0.795***	0.661***	0.737***
	(0.013)	(0.025)	(0.028)	(0.022)	(0.022)
Graduate			0.994***	0.800***	1.139***
			(0.049)	(0.049)	(0.041)
Urban	0.408***	0.001***	0.454***	0.27***	0.206***
	(0.017)	(0.025)	(0.016)	(0.012)	(0.011)
Migrant			0.539***	0.182***	0.301***
			(0.016)	(0.009)	(0.02)
Constant	6.918***	7.401***	7.225***	8.732***	8.260***
	(0.045)	(0.071)	(0.072)	(0.053)	(0.054)
Observations	17817	12408	21262	20526	24322
R-squared	0.2854	0.2237	0.2468	0.2429	0.2149

Table 4.5b Results of rate of return after primary school by education category for urban workers

Urban	1988	1995	2002	2007	2013
Education category (Primary school)					
Junior high	0.112***	0.059***	0.139***	0.104**	0.158***
	(0.01)	(0.024)	(0.037)	(0.049)	(0.036)
Senior high	0.227***	0.143***	0.349***	0.235***	0.357***
	(0.011)	(0.025)	(0.037)	(0.048)	(0.037)
Vocational school	0.190***	0.286***	0.603***	0.538***	0.532***
	(0.011)	(0.024)	(0.036)	(0.049)	(0.036)
University	0.260***	0.413***	0.828***	0.844***	0.814***
	(0.013)	(0.027)	(0.040)	(0.050)	(0.038)
Graduate			0.995***	0.963***	1.218***
			(0.058)	(0.067)	(0.052)
Urban					
Migrant					
Constant	7.225***	7.191***	7.280***	8.350***	8.025***
	(0.040)	(0.073)	(0.099)	(0.118)	(0.095)
Observations	16293	11383	10006	6810	9308
R-squared	0.296	0.2554	0.2524	0.3014	0.2252

Table 4.5c Results of rate of return after primary school by education category for rural workers

Rural	1988	1995	2002	2007	2013
Education category (Primary school)					
Junior high	0.189***	0.085	0.173***	0.047***	0.185***
	(0.039)	(0.053)	(0.030)	(0.017)	(0.019)
Senior high	0.225***	0.102	0.306***	0.019	0.290***
	(0.048)	(0.066)	(0.038)	(0.024)	(0.024)
Vocational school	0.397***	0.293***	0.520***	0.213***	0.351***
	(0.082)	(0.077)	(0.054)	(0.024)	(0.028)
University	0.616***	0.765***	0.712***	0.642***	0.652***
	(0.087)	(0.187)	(0.218)	(0.052)	(0.035)
Graduate				1.280***	0.854***
				(0.020)	(0.108)
Urban					
Migrant					
Constant	7.398***	8.556***	7.395***	8.951***	8.515***
	(0.193)	(0.311)	(0.116)	(0.083)	(0.070)
Observations	1524	1025	8059	8492	13864
R-squared	0.0796	0.0769	0.1638	0.1269	0.1498

Table 4.5d Results of rate of return after primary school by education category for rural to urban migrants

Rural to Urban Migrant	2002	2007	2013
Education category (Primary school)			
Junior high	0.133***	0.097***	0.053
	(0.023)	(0.020)	(0.056)
Senior high	0.207***	0.149***	0.160
	(0.035)	(0.024)	(0.072)
Vocational school	0.272***	0.192***	0.163
	(0.051)	(0.028)	(0.079)
University	0.578***	0.527***	0.508***
	(0.187)	(0.101)	(0.088)
Graduate		1.279***	1.696***
		(0.152)	(0.137)
Urban			
Migrant			
Constant	8.212***	8.975***	8.520***
	(0.125)	(0.082)	(0.218)
Observations	3197	5224	1150
R-squared	0.1307	0.1495	0.1587

Table 4.6 Results of return to schooling by various education category

Total	Junior high	Senior high	Vocational school	University	Graduate
1988	4.2%	3.5%	2.5%	1.1%	
1995	2.8%	2.3%	7.2%	6.9%	
2002	6.8%	4.4%	12.6%	11.5%	6.6%
2007	3.0%	0.5%	7.8%	13.9%	4.6%
2013	6.4%	4.2%	8.4%	10.4%	13.4%

Urban	Junior high	Senior high	Vocational school	University	Graduate
1988	3.7%	3.8%	2.6%	0.8%	
1995	2.0%	2.8%	7.6%	6.8%	
2002	4.6%	7.0%	15.5%	12.0%	5.6%
2007	3.5%	4.4%	14.5%	15.2%	4.0%
2013	5.3%	6.6%	12.5%	11.4%	13.5%

Rural	Junior high	Senior high	Vocational school	University	Graduate
1988	6.3%	1.2%	6.9%	9.8%	
1995	2.8%	0.6%	6.9%	16.6%	
2002	5.8%	4.4%	11.6%	10.2%	
2007	1.6%	-0.9%	5.5%	15.6%	21.3%
2013	6.2%	3.5%	5.5%	9.1%	6.7%

Migrant	Junior high	Senior high	Vocational school	University	Graduate
2002	4.4%	2.5%	4.6%	9.3%	
2007	3.2%	1.7%	3.2%	9.5%	25.1%
2013	1.8%	3.6%	3.7%	8.7%	39.6%

Table 4.7 Results of return by industry sector, occupation, ownership and regions

	1988	1995	2002	2007	2013
Industry sector					
Primary		0.035***	0.064***	0.036***	0.099***
		(0.003)	(0.009)	(0.012)	(0.011)
Secondary		0.028**	0.064***	0.040***	0.057***
		(0.011)	(0.005)	(0.003)	(0.004)
Tertiary		0.035***	0.081***	0.050***	0.076***
		(0.003)	(0.003)	(0.002)	(0.002)
Occupations					
Manager	0.010***	0.032***	0.043***	0.040***	0.049***
	(0.004)	(0.006)	(0.006)	(0.006)	(0.009)
Technician	0.019***	0.033***	0.066***	0.045***	0.081***
	(0.002)	(0.004)	(0.006)	(0.005)	(0.005)
Clerk	0.014***	0.037***	0.077***	0.047***	0.068***
	(0.002)	(0.006)	(0.005)	(0.003)	(0.003)
Manual worker	0.033***	0.028***	0.048***	0.025***	0.056***
	(0.003)	(0.004)	(0.006)	(0.003)	(0.004)
Ownership					
Government	0.018***	0.040***	0.072***		0.09***
	(0.001)	(0.003)	(0.008)		(0.004)
SOEs	0.032***	0.058***	0.071***		0.080***
	(0.002)	(0.003)	(0.004)		(0.005)
Private	0.045**	0.052***	0.051***		0.062***
	(0.023)	(0.017)	(0.005)		(0.003)
Regions					
East	0.025***	0.046***	0.074***	0.054***	0.078***
	(0.002)	(0.004)	(0.005)	(0.003)	(0.003)
Central	0.027***	0.054***	0.069***	0.038***	0.063***
	(0.002)	(0.004)	(0.004)	(0.003)	(0.003)
West	0.033***	0.049***	0.082***	0.050***	0.075***
	(0.003)	(0.004)	(0.005)	(0.004)	(0.005)

CHAPTER 5. CONCLUSION

This dissertation investigates the convergence trend of per capita GDP, income inequality and return to human capital after reform. Chinese society is segregated between urban and rural areas by the household system. China's labor market has been potentially influenced by this system. With the release of free migration policy, if the reallocation of human capital can improve the economic growth has been become an important issue in China.

Three conclusions can be drawn from this study. First, the convergence pattern of per capita income can be observed in recent period (2004-2015), mainly in coastal regions due to more open economy, higher education and higher net migration rate. The growth can be explained by the reallocation of human capital from agriculture sectors to industry and service sectors. The interior regions with the scarce resources and loss of human capital present lower convergence.

Second, although the growth in China is remarkably high, the income inequality is widening due to the economic transition. The natural log of income differences across provinces increased by 3.06 between 1998 and 2013. The overall individual level income variance increased from 0.16 in 1988 to 0.64 in 2013. From the perspective of industrial level of income, the knowledge intensive industries have higher wages than labor intensive industries. However, the within-industry sector income inequality is higher than between-industry sector income inequality which is due to the difference in the speed of education investment, return to schooling and employment share change in each industry.

Third, the education investment and return to schooling has been lower and rising less rapidly. Higher education expansion policy in 1999 and the household registration disparity might be two important reasons. From the result, we concluded that the average years of

schooling increased from 9.3 years to 10.2 years only from 1988 to 2013. The average rate of return on additional schooling after primary school increased from 2.7% in 1988 to 7.2% in 2013 for the entire workers, from 2.6% to 9.0% for urban workers, from 4.9% to 5.6% for rural workers, and from 4.3% to 4.6% for rural to urban migrant workers. Obviously, the return is greater for the urban workers and the high-level education groups. The higher education expansion policy resulted in decrease from 79.5% in 2002 to 66.1% in 2007 of return to university level education. In addition, the return is different by industry, occupation, ownership and regions.

The limitation of this dissertation should be the dataset used for this research. In chapter one, there are only thirty-one provinces. It might be interesting to collect the city-level data because there are growth differences among cities within the same province and the interprovincial migration is much smaller than intraprovincial migration. However, the net inflow migration rate data is hard to collect in city level.

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