Human Capital in China

Principal Investigator

Haizheng Li

China Center for Human Capital and Labor Market Research

Central University of Finance and Economics

Beijing, China

October 2010

Contact information is available at

http://humancapital.cufe.edu.cn/

This project is funded by

National Natural Science Foundation of China

and

Central University of Finance and Economics

A Brief Introduction of
China Center for Human Capital and Labor Market Research

Established in March 2008, China Center for Human Capital and Labor Market Research (CHLR) at the Central University of Finance and Economics (CUFE) is an integral part of the Advantageous Program Platform in Economics and Public Policy. It is an international research center for the study of human resources, labor markets, and their impact on economic development, focusing on China and related economies. The CHLR has masters, doctoral and post-doctoral programs. Our advisory board includes two Nobel laureates, Kenneth J. Arrow and James Heckman, and the founder of the income-based method for measuring human capital, Dale W. Jorgenson.

Our major research areas include: human capital investment, human capital mobility, human capital, innovation and technology, and health and human capital.

Faculty members and research fellows of the CHLR all hold U.S. PhD degrees and many are tenured professors at U.S. universities. The CHLR Special-term Director, Dr. Haizheng Li, is also Professor at the School of Economics, Georgia Institute of Technology. Currently the Center has 3 full-time faculty, 4 special-term faculty, 7 senior research fellows, and 3 research fellows.

The Center has established its graduate programs following international standards. The curriculum and instruction are rigorously designed. All the courses are taught in English. Currently the CHLR has 40 Master's students, 3 doctoral students, and 1 post-doctoral fellow.

The Center is first and foremost an international research institution. We not only have a team of international scholars and train graduate students to international standards. We also adopt international management practices in the Center's daily business. Faculty performance is evaluated using standards similar to those commonly adopted by institutions in the U.S. All graduate students are involved in research projects soon after they join the program.

Research Team Members

Principal Investigator

Haizheng Li	Special-term Director, CHLR at CUFE Professor of Economics, Georgia Institute of Technology

Team Members

Professors and Staff

Åke Blomqvist	Professor, CHLR
Belton Fleisher	Special-term Professor and Senior Fellow, CHLR Professor of Economics, Ohio State University
Barbara Fraumeni	Senior Fellow, CHLR Professor of Public Policy, Muskie School of Public Service, University of Southern Maine
Zhiqiang Liu	Special-term Professor, CHLR Associate Professor of Economics, State University of New York at Buffalo
Xiaojun Wang	Special-term Professor, CHLR Associate Professor of Economics, University of Hawaii at Manoa
Kang-Hung Chang	Assistant Professor, CHLR
Li Yu	Assistant Professor, CHLR
Zhiyong Liu	Post-doctoral Student, CHLR
Song Gao	Assistant Professor, China Academy of Public Finance and Public Policy, CUFE

Ruiju Wang	Former Executive Assistant to Director, CHLR
Hao Deng	Executive Assistant to Director, CHLR
Jing Xiao	Graduate Coordinator, CHLR

Graduate Students

China Center for Human Capital and Labor Market Research (CHLR)

2008's: Yunling Liang (Ph.D.), Huajuan Chen, Yuhua Dong, Mengxin Du, Jinquan Gong, Jingjing Jiang, Rui Jiang, Qian Li, Sen Li, Chen Qiu, Xinping Tian, Mo Yang

2009's: Na Jia (Ph.D.), Jing Bai, Jing Fang, Chao Guo, Xin Gao, Xiaoyan Gan, Jun Li, Jin Li, Tianyi Liu, Dandan Wu, Yuanyuan Xin, Pengfei Xing, Yanqiu Yang, Chen Zhang, Linghua Zhang

Georgia Institute of Technology

Chongyu Lu, Yuxi Xiao

Hunan University

Xiaobei Zhang (Ph.D.), Lin Ding, Qinyi Liu, Hongling Wang, Qiujie Wu, Xiaomin Yan

Acknowledgement

We thank the participants in the 2009 International Symposium on Measuring Human Capital and Its Impact on Welfare and Growth in Beijing, and in the 31st conference of the International Association for Research in Income and Wealth in Switzerland for their valuable suggestions, and especially Professor Harry Wu for comments. We also acknowledge with appreciation the valuable comments and suggestions from anonymous referees of *Economic Research Journal* and many other scholars.

This research project and its related international symposiums have benefited tremendously from the supports of the administration at the Central University of Finance and Economics (CUFE). President Guangqian Wang provided strong support and encouragement for the project. Vice President Junsheng Li, Assistant to President Lifen Zhao, and Director of Research Office Baowen Sun coordinated with various departments to ensure the success of the project and the symposiums.

Many offices in the University, such as the President's Office, Office of Research, Assets Management Office, Finance Office, Human Resources Office, and International Cooperation Office, provided administrative supports that facilitated the Center's research endeavors. Office space, conference facilities, and computer labs were generously provided by the University. We also acknowledge the supports of the Virtual Experiment Lab, the School of International Exchange, the Academy of Public Finance and Policy, and the School of Marxism Studies.

The School of Economics at Georgia Institute of Technology, especially the Chair, Professor Patrick McCarthy, also offered support to the project. Last but not least, we greatly appreciate the help from two Chinese academic journals – *Economic Research Journal* and *Labor Economics and Relations*.

What's New in the 2010 Report

This report updates the 2009 Report in the following aspects:

1. National Level

(1) Discount rate. The 2009 Report used 3.14% at the discount rate, which was derived from the rates of return of long-term government bonds. The 2010 Report mainly uses 4.58% as the discount rate, which is the rate employed in the OECD human capital project. The 2010 Report also gives alternative estimates based on different discount rates.

(2) Survival rate. The 2010 Report revises the survival rate estimates for 2005, 2006, and 2007.

(3) Divisia index. The 2010 Report also includes various Divisia indices for human capital growth.

2. Provincial Level

(4) The 2010 Report provides human capital stock estimates for five provinces (cities) - Beijing, Liaoning, Jiangsu, Guangdong, and Gansu - based on alternative discount rates and deflators.

(5) The 2010 Report provides estimates of active human capital stock for the selected provinces (cities) listed above.

Human Capital in China

China Center for Human Capital and Labor Market Research
Central University of Finance and Economics

Contents

Executive Summary

In this project we estimate both national and provincial (Beijing, Liaoning, Jiangsu, Guangdong, Gansu) human capital stocks for the period 1985 to 2008, using the Jorgenson-Fraumeni lifetime income approach. An individual's human capital stock is equal to the discounted present value of all future incomes he or she can generate. In our model, human capital accumulates through formal education as well as on-the-job training. The value of human capital is assumed to be zero upon reaching the mandatory retirement ages.

1. China's total real (nominal) human capital reached 90.5(370) trillion yuan in 2008, implying an average annual growth rate of 6.72% during 1985-2008, and 7.67% during 1995-2008. Urban (rural) real human capital in 2008 was 56.7 (33.8) trillion yuan, accounting for nearly 62.6% (37.4%) of total real human capital (that is, human capital measured at 1985 prices).
2. Per capita real human capital tripled during 1985-2008, reaching 81.3 thousand yuan in 2008. Urban (rural) per capita real human capital was 109.5 (56.7) thousand yuan. Male (female) per capita real human capital was 92.0 (69.3) thousand yuan in 2008. In addition, total human capital grew at a higher rate than per capita human capital before 1995, but the two grew at more comparable rates after 1995.
3. The urban and rural gap in total and per capita human capital has widened. Rural total human capital grew at an annual rate of 4.66% during 1985-2008, while urban total human capital grew 8.67% per year over the same period.
4. Both total and per capita human capital are larger for males than for females. While the gender gap in human capital rose in urban area, it

decreased in rural area over the period studied.

5. The growth rates of the partial Divisia index based on education and location are higher than those based on age and sex, implying that education and urbanization have a greater impact on the accumulation of human capital in China.
6. China has a large total human capital stock, but small per capita human capital compared to other countries. China's per capita human capital stock is one-fourths of Canada's and one-sixths of USA's. Thus, there is still a long way to go before China will become a leading country in human capital.
7. The growth rate of human capital was lower than the growth rate of GDP and the growth rate of physical capital; the ratio between human capital and GDP and the ratio between human capital and physical capital were decreasing in China.
8. Assuming that the values of our model parameters remain constant at their 2008 levels and only population changes for the period 2009 to 2020, our projection shows that total and per capita human capital will grow at a much lower annual rate, and rural total human capital may even decline.
9. We provided human capital stock estimates for five provinces (city): Beijing, Liaoning, Jiangsu, Guangdong, and Gansu.

Chapter 1 Introduction

Since the concept of human capital was introduced to modern economic analysis by Schultz (1961) and Becker (1964), it has been widely used in academic studies and policy analysis. Human capital is probably "the most important and most original development in the economics of education" in the second part of the 20^{th} century (Coleman, 1990, page 304). The latest definition of human capital from the Organization for Economic Co-operation and Development (OECD) is "The knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being" (OECD, 2001, page 18). In most countries, human capital accounts for more than 60% of the nation's wealth, which includes natural resources, physical capital and human capital (World Bank, 1997).

It is generally believed that human capital is an important source of economic growth and innovation, an important factor for sustainable development, and for reducing poverty and inequality (see, for example, Stroombergen et al., 2002, and Keeley, 2007). For example, detailed analyses of human capital accounts for Canada, New Zealand, Norway, Sweden, and the United States unanimously show that human capital is a leading source of economic growth.[1]

In China, since the start of economic reforms, the economy has grown at a dramatic rate. It is believed that human capital has played a significant role in the Chinese economic miracle (see, for example, Fleisher and Chen,

[1] These include Jorgenson-Fraumeni (J-F) accounts for Canada (Gu and Ambrose 2008), New Zealand (Li, Gibson, and Oxley 2005), Norway (Greaker and Liu 2008), Sweden (Alroth 1997), and the United States (Jorgenson and Fraumeni 1989, 1992a, 1992b, and Christian 2009).

1997, and Démurger, 2001). Additionally, studies show that human capital also has an important effect on productivity growth and on reducing regional inequality in China (Fleisher, Li and Zhao, 2009).

Despite the important role of human capital in the Chinese economy, however, until now, there has been almost no comprehensive measurement of the total stock of human capital in China. Human capital measures for China are central to any understanding of the global importance of human capital for a number of reasons. First, China is the most populous country in the world. It is important to understand the dynamics of human capital caused by demographic changes (for example, due to the one-child policy, migration, and urbanization) and by the rapid expansion of education during the course of economic development. Second, such measures would allow for better assessment of the contribution of human capital to growth, development, and social well-being in empirical and theoretical research. Construction of comprehensive human capital measures is an important step in assessing the contribution of human capital to economic growth. Currently, only partial measurement of human capital, such as education characteristics, has been used in such studies.

Additional benefits from human capital measures include the provision of useful information for policy makers for the purpose of assessing how education policies of central and local governments affect the accumulation of human capital. This is especially important, given the long-term nature of human capital investment. For example, since the early 1980s, there has been a remarkable increase in the educational attainment of the Chinese population. In 1982 the largest population mass was concentrated in the “no schooling” category (Figure 3.1.4). By 2007 the largest population mass was concentrated in the “junior middle” school category (Figure 3.1.7). Developing comprehensive measures of human capital in China provides the necessary early work for constructing China’s human capital account and for eventually incorporating human capital into the national accounting so that China can join the international OECD initiative in this area. This initiative will facilitate international comparison of human capital accumulation and growth across nations.

There is an ongoing international effort in developed countries to measure a nation's total human capital stock and to develop national human capital accounts. For example, the United States formed the Committee on National Statistics' Panel to Study the Design of Nonmarket Accounts (Abraham 2005, and Christian 2009); in early 2008, Statistics Canada set up a program "Human Development and its Contribution to the Wealth Accounts in Canada" (Gu and Wong 2008); Australian Bureau of Statistics (Wei 2008), Statistics Norway (Greaker and Liu 2008) and New Zealand (Li, Gibson, and Oxley 2005), have also established similar research programs on the measurement of human capital. In addition, seventeen countries (Australia, Canada, Denmark, France, Italy, Japan, Korea, Mexico, Netherlands, Norway, New Zealand, Poland, Spain, the United Kingdom, the United States, Romania, and Russia), and two international organizations, Eurostat and the International Labour Organization, have agreed to join the OECD consortium to develop human capital accounts. A researcher from Statistics Norway, Gang Liu, is at the OECD as of October 1, 2009, for nine months, to coordinate this effort. The work of this consortium will facilitate cross-country comparisons. In addition, the Lisbon Council European Human Capital Index has been constructed for the 13 European Union (EU) states and 12 Central and Eastern European states (see Ederer 2006 and Ederer *et. al.* 2007). Developed countries have obviously realized the importance of monitoring human capital accumulation, while most developing countries, including China, have yet to start such projects.

Until now, there has been no systematic effort to construct comprehensive measures of the total human capital stock in China, but there are a few studies on human capital measurement published in Chinese journals. For example, Zhang (2000) and Qian and Liu (2004) calculated China's human capital stock based on total investment (cost-side); others, such as Zhu and Xu (2007), Wang and Xiang (2006), estimated human capital from the income side. Zhou (2005) and Yue (2008) used some weighted averages of human capital attributes to construct a measurement. In most cases, these studies partially measure human capital based on some education characteristics such as average education, for example, Cai (1999), Hu (2002), Zhou (2004), Hou (2000), Hu (2005), etc.

While the above studies have contributed to the understanding of human capital in China, there are major limitations. First, there has been no comprehensive and systematic measurement of the total human capital stock in China from the 1980s up to date, especially on the changes of human capital in rural and urban areas and for males and females respectively. Second, the methodology used has been limited by data availability, feasibility of parameter estimation, and some technical treatment difficulties. Limitations of this kind have made it difficult to implement internationally recognized methods for human capital estimation based on China's data.

We attempt to construct a comprehensive measurement of human capital in China by applying the methods used in other countries after modifying them to fit China's special cases. We estimate total human capital at the national level, for males and females, for urban and rural areas from 1985 to 2008. Our estimates include nominal values, real values, indexes, and quantity measures. We mostly adopted the Jorgensen-Fraumeni (J-F) lifetime income based approach, which has been widely used in other countries.

In addition to a full-implementation of the J-F approach to China's data to estimate the human capital series, another contribution of this study is that we combine micro-level survey data in human capital estimation to mitigate the lack of earnings data in China. In particular, we apply the Mincer equation to estimate earnings by using various available household survey data. Thus, it is possible to integrate the changes of returns to education and experience (on-the-job-training) into our estimates during the course of economic transition.

Moreover, by separating the calculation of human capital for urban and rural areas, we are able to capture the changes caused by rapid urbanization as well as by the large scale rural-urban migration since the start of economic reform in China. This framework is not only important for any transitional economy because of its changing economic structure and migration, it can also at least partially measure the effect of another type of human capital investment-migration, which helps realize a higher value of one's human capital.

The rest of this report is arranged as follows. Chapter 2 discusses methodology for human capital measurement. Chapter 3 describes our data and data treatments. The estimated national results of human capital are reported in Chapter 4, followed by the disaggregated results for Beijing, Liaoning, Jiangsu, Guangdong and Gansu.

Chapter 2 Methodology

In general, human capital can be produced by education and training (child bearing and rearing are investments that increase future human capital), as well as by job turnover and migration that help to realize the full potential value of human capital. Like physical capital, the human capital stock can be valued using two methods: i) it can be valued as the sum of investment, minus depreciation, added over time to the initial stock; ii) it can be valued as the net present value of the income flow it will be able to produce over an assumed lifetime. The first method, the perpetual inventory method, is used in the cost approach; while the second method is the income-based approach (this method is used to estimate the value of most natural resources). When human capital is measured using the perpetual inventory approach, only costs or expenditures are included in investment. When physical capital is measured in this way, investments are valued at their purchase price which is not generally available for human capital.

These and other measures of human capital have been used by researchers in many studies:

(1) The lifetime income approach of Jorgenson and Fraumeni (1989, 1992a, 1992b);

(2) The cost approach of Kendrick (1976);

(3) The indicator approach;

(4) Laroche and Merette (2000) construct indexes with either relative wage weights or relative lifetime income weights;

(5) The Lisbon Council's approach (2006) is described as an example of the indicator approach;

(6) The World Bank residual approach (2006).

The approach of Jorgenson-Fraumeni is discussed further in the next section.

2.1 Jorgenson-Fraumeni income-based approach

The J-F method estimates human capital stock as the expected future lifetime income of all individuals. If human capital could be traded in the market like physical capital, the asset price would be the net present value of the individuals' lifetime labor income.[2] The lifetime income approach can reflect the importance of long-term investments, such as education and health, in human capital accumulation.

The Jorgenson and Fraumeni (J-F) income-based approach is the most widely used method in estimating human capital stock, and has been adopted by a number of countries in constructing human capital accounts (see footnote 1 for examples). The advantages of this approach are that it has a sound theoretical foundation and that the data and parameters are relatively easier to obtain than they are for other approaches.

---

[2] In China, the labor market may still be at a stage where wage income does not fully reflect the marginal productivity of labor. Therefore, in the studies involving wages, there may be a certain degree of distortion. When estimating human capital using the wages income, one must recognize that this problem may exist. Therefore, our study is clearly limited by the current development level of the labor market mechanism I n China. But the income approach is the most common used method for measuring human capital. Even in the United States and other developed countries, wages do not fully reflect the marginal productivity, because its labor market is not perfectly competitive. Even so, wages are still representative of the human capital gains in from an individual perspective, and still a measure of human capital in that sense. With the improvement of market mechanism in China, this limitation will gradually decrease. According to estimates of the current literature, wages are generally lower than the marginal productivity (see Fleisher, Li and Zhao, 2010). Therefore, from this perspective, our calculation can be interpreted as a conservative estimate of human capital.

When estimating lifetime income to calculate human capital, an important issue is that income (or implicit income) can be generated from both market and non-market activities. Market activities of individuals produce goods and services, foster innovation and growth through managerial and creative activities, and generate income that allows for the acquisition of market goods and services. Nonmarket activities of individuals include household production, e.g., cooking, cleaning, and care-giving. Investment is generated from both market and nonmarket activities. Because household production activities are difficult to quantify and value and require time-use estimates, we have opted to exclude them in this first approximation to estimating China's human capital.[3] The J-F approach imputes expected future lifetime incomes based on survival, educational enrollment, and employment probabilities. Expected future wages and incomes are estimated from the currently observed wages and incomes of the cross section of individuals who are older than a given cohort at the time of observation. Future incomes are augmented with a projected labor income growth rate and discounted to the present with a constant interest rate. Estimation is conducted in a backward recursive fashion, from those aged 75, 74, 73, and so forth to those aged 0.[4]

With the J-F income-based approach, we first need data or estimates of individual's annual market labor income per capita. Then lifetime incomes are calculated by a backward recursion, starting from the oldest cohorts in

---

[3] Among the most recent human capital estimates, i.e., Gu and Ambrose (2008), Greaker and Liu (2008) and Christian (2009), only Christian, for the United States, includes a full set of nonmarket activities and estimates human capital for those too young to go to school or to perform market work.

[4] The J-F inclusion of nonmarket lifetime income and expected lifetime income for youngsters produces human capital estimates that are notably higher than those in the studies mentioned above who have adopted the J-F methodology.

the population. The life cycle is divided into five stages, and the equations used for calculating the lifetime expected incomes are as follows.

The fifth and final stage is retirement or no school or work (males older than 60 years old, females older than 55 years old):

$$mi_{y,s,a,e} = 0 \quad (1)$$

where the subscripts y, s, a, and e denote respectively year, sex, age and educational attainment, and mi stands for lifetime market labor income per capita.

The fourth stage is work but no school (male 25-59 or female 25-54 years old):

$$mi_{y,s,a,e} = ymi_{y,s,a,e} + sr_{y+1,s,a+1} \times mi_{y,s,a+1,e} \times \frac{1+G}{1+R} \quad (2)$$

where sr is the survival rate, defined as the probability of becoming one year older, ymi denotes annual market income per capita, G is the real income growth rate, and R is the discount rate.

The third stage is school and work (16-24 years old):

$$mi_{y,s,a,e} = ymi_{y,s,a,e} + \left[senr_{y+1,s,a+1,e+1} \times sr_{y+1,s,a+1} \times mi_{y,s,a+1,e+1} + (1-senr_{y+1,s,a+1,e+1}) \times sr_{y+1,s,a+1} \times mi_{y,s,a+1,e}\right] \times \frac{1+G}{1+R} \quad (3)$$

where senr is school enrollment rate--the probability of an individual with educational attainment e to enroll in education level e+1.

The second stage is school but no work (6-15 years old):

$$mi_{y,s,a,e} = \left[senr_{y+1,s,a+1,e+1} \times sr_{y+1,s,a+1} \times mi_{y,s,a+1,e+1} + (1-senr_{y+1,s,a+1,e+1}) \times sr_{y+1,s,a+1} \times mi_{y,s,a+1,e}\right] \times \frac{1+G}{1+R} \quad (4)$$

The first stage is no school and no work (0-5 years old):

$$mi_{y,s,a,e} = sr_{y+1,s,a+1} \times mi_{y,s,a+1,e} \times \frac{1+G}{1+R} \quad (5)$$

If we let $L_{y,s,a,e}$ stand for the population in the respective categories, the expected lifetime income in a country, i.e., the total human capital stock, can be written as:

$$MI(y) = \sum_s \sum_a \sum_e mi_{y,s,a,e} L_{y,s,a,e} \quad (6)$$

Similar equations can be applied to estimate lifetime nonmarket labor income[5], which can be added to lifetime market labor income to obtain total lifetime labor income:

$$LIFE(y) = \sum_{s}\sum_{a}\sum_{e}(mi_{y,s,a,e} + nmi_{y,s,a,e}) \cdot L_{y,s,a,e} \tag{7}$$

2.2 Cost approach

Kendrick is an early pioneer in the construction of human capital accounts. Kendrick (1976) estimates both tangible and intangible human capital. Tangible human capital includes child rearing costs. Intangible human capital includes education, training, medical, health and safety expenditures, and mobility costs. Human capital stocks are created using a perpetual inventory method where investment expenditures are cumulated and existing stocks are depreciated. Implementation of a Kendrick approach for China is difficult as Kendrick's human capital investment is the sum of a long list of human capital related costs, and reliable data on such information is only available for the most recent decades.

Tangible human capital investment is average lifetime rearing costs including expenditures on food, shelter, health, schooling, and so on. The cost of parental time is not included in this measure. Intangible human capital investment in formal and informal education includes both private and government costs. Private formal education costs include net rental for private education sector's plant and equipment and students' expenditures on supplies. Estimate for the total cost of rentals of books and equipment and opportunity cost depends on a student's imputed potential compensation. Government formal education costs include all types of expenditure,

---

[5] Nonmarket activities include household production, e.g., cooking, cleaning etc. In our calculation we exclude the nonmarket lifetime income because it is difficult to quantify.

including those for construction. Personal informal education expenditures include a portion of those for radio, TV, records, books, periodicals, libraries, museums, and so forth. Business and institutional expenditures include a portion of those for media expenditures. Religious education expenditures are imputed from figures on religious class attendance and imputed interest on plant and equipment of religious organizations. Government expenditures include those for library, recreation costs and military education expenditures.

Intangible human capital investment in training values initial nonproductive time and nonwage costs and includes explicit training expenditures. Both specific and general training is captured, as well as military training. A substantial fraction of medical, health and safety expenditures, which are split between investment and preventive expenditures, are by governments. Annual rental costs for plant and equipment are imputed when not available.

Kendrick considers his human capital mobility investment estimates to be tentative. These include unemployment, job-search, hiring, and moving costs, for both residents and immigrants. Depreciation is estimated using the depreciation methodology most widely used at the time of his research: A double declining balance formula with a switch to a straight-line method. Lifetimes in these formulas are assumed to be the reciprocal of the percentage of persons in the group.

Kendrick estimate of nominal human capital is about five times Gross Domestic Product. However, the Jorgenson-Fraumeni human capital estimate is substantially larger than Kendrick's.[6] The Kendrick approach covers detailed aspects of human capital formation from the cost side and provides a very complete menu for summing up all related costs to estimate the value of human capital. Yet, the data requirements are enormous, for

[6] See table 37 of Jorgenson-Fraumeni (1989).

example, we may need to get government statistics ninety years back to do the calculation. This is impossible, given the People's Republic of China is only 61 years old in 2010. Additionally, the Kendrick approach gives no clear rationale for some important assumptions, such as for the split of health expenses between investment and preventative costs. For all these reasons, we do not adopt this approach for our calculation.

2.3 Indicator approach

An example of an indicator approach is the Human Capital Index of the Lisbon Council. It is a human capital input cost, or cost of creation approach. This index has been constructed for the 13 European Union (EU) states and 12 Central and Eastern European states as previously noted.[7] The Human Capital Endowment measure is an input to two of the other three components of the overall European Human Capital Index. The Human Capital Endowment measure sums up expenditures on formal education and the opportunity cost of parental education, adult education, and learning on the job. Parental education includes teaching their children to speak, be trustful, have empathy, take responsibility, etc. The Human Capital Utilization Index is the endowment measure divided by total population and the Human Capital Productivity Measure is Gross Domestic Product (GDP) divided by the endowment employed in the country.

Finally the Demography and Employment measure estimates the number of people who will be employed in the year 2030 in each country by looking at economic, demographic, and migratory trends.[8] As it has cost

---

[7] See Ederer (2006) and Ederer *et. al.*(2007). The 2006 paper states that the index was developed by the German think tank Deutschland Denken. In addition the paper states that it is part of a research project undertaken by several individuals in the think tank and with the institutional support of Zeppelin University.

[8] Ederer (2006), p. 4 and p. 20.

components and index components, it is best viewed as a blend of a cost approach and an indicator approach. Since the technical details for this approach have not been released, we do not apply it here in our calculation.[9]

2.4 Attribute-based approach

The attribute-based approach is usually considered to be a variant of the income-based approach (Le, Gibson and Oxley 2003, 2005). However, it constructs an index value of human capital instead of a monetary value in other income-based methods. The primary advantage of an index value is that it nets out the effect of aggregate physical capital on labor income, therefore this measure captures the variation in quality and relevance of formal education across time and country.

Based on the pioneer work of Mulligan and Sala-i-Martin (1997), Koman and Marin (1997) applied the attribute-based method to Austria and Germany. However, our method is akin to Laroche and Merette (2000) in that we also incorporate work experience into the model along with formal education. That is, we also emphasize informal channels, such as work experience, in the accumulation of human capital.

Specifically in this method, the logarithm of human capital per capita in a country at any time is computed using the following formula

$$\ln\left(\frac{H}{L}\right) = \sum_e \sum_a \omega_{e,a} \ln\left(\rho_{e,a}\right) \tag{8}$$

$$\omega_{e,a} = \frac{e^{\sum_s \left(\beta_s e + \gamma_s Exp + \delta_s Exp^2\right)\varphi_{s,a}} L_{e,a}}{\sum_e \sum_a e^{\sum_s \left(\beta_s e + \gamma_s Exp + \delta_s Exp^2\right)\varphi_{s,a}} L_{e,a}} \tag{9}$$

9 We have discussed with Dr. Ederer on possible collaboration of applying the China data to their method in the future.

where e and a denote years of formal schooling and age, respectively. $\rho_{e,a} = L_{e,a} / L$ is the proportion of working age individuals of age a with e years of schooling. $\omega_{e,a}$ is the efficiency parameter defined as proportion of wage income of workers of age a with e years of schooling in the total wage bill of the economy. $\exp$ represents work experience, which is defined as a-e-6. s is a gender index and $\varphi_{e,a}$ is the share of men and women of age a in the population. Parameters β, γ and δ are estimates from a standard Mincer equation. The parameter β is often considered to be the rate of return to one more year of formal education.

In order to implement this method, we need to construct a population data set by age, gender and educational attainment for each year we study. Secondly, we need two sets of estimates from Mincer equations for each year, one for each gender. It is feasible to calculate a human capital measure based on this approach. The major issue is that in this setup, the measurement is actually a Cobb-Douglas formula. In other words, the proportions of different education groups by construction are not "perfect substitutes." When the share of one education group increases, it could cause the total measurement to decline. For example, if we increase the proportion of population with higher education, the measurement should increase as the overall education get higher, but it could decline due to the Cobb-Douglas formulation. This happened in our calculation. Since we believe that an education-based human capital measurement should be a monotonically increasing function of the overall education, we do not report the results of the attribute-based approach. In our future work we plan to modify the structure, using, for example, average years of schooling.[10]

[10] This point was confirmed by email communication with Dr. Reinhard Koman.

2.5 Residual approach

The World Bank (2006) uses a residual approach to estimate human capital for 120 countries. Due to data and methodological limitations, total wealth in the year 2000 is measured as the net present value of an assumed future consumption stream. The value of produced capital stocks is estimated with the perpetual inventory method. Produced capital includes both structures and equipment. Natural capital is valued by taking the present value of resource rents. Natural capital includes nonrenewable resources, cropland, pastureland, forested areas, and protected areas. Intangible capital is equal to total wealth minus produced and natural capital. Intangible capital is an aggregate which includes human capital, the infrastructure of the country, social capital, and the returns from net foreign financial assets. Net foreign financial assets are included because debt interest obligations will affect the level of consumption. Intangible capital represents greater than 50% of wealth for almost 85% of the countries studied.

Using a net present value approach to estimate total wealth requires assumptions about the time horizon and the discount rate. The World Bank chooses 25 years as the time horizon as it roughly corresponds to one generation. It chooses a social discount rate rather than a private rate as governments would use a social discount rate to allocate resources across generations. The social discount rate is set at 4%, which is at the upper range of estimates it reviewed for industrialized countries. The same rate is used for all countries to facilitate comparisons across countries.

A Cobb-Douglas specification is employed to estimate the marginal returns and contribution of three types of intangible capital in the model. The model's independent variables include per capita years of schooling of the working population, human capital abroad, and governance/social capital. Human capital abroad is measured by remittances by workers outside the country. Governance/social capital is measured with a rule of law index. Although the marginal return to human capital in the aggregate is the highest of the three included intangible capital components, the contribution decomposition demonstrates that the relative contributions can differ significantly across countries (World Bank, 2006, chapter 7).

To sum up, taking into account the data availability in China, we believe that the J-F income approach is most suitable for measuring China’s human capital. Moreover, this method is widely used internationally, so using it is facilitates comparisons of China's human capital level with other countries’. At the same time, it is easier to calculate and implement scientifically and accurately in China. For all these reasons we will use the method of J-F to measure human capital in China.

Chapter 3 Data

3.1 Population

In order to implement the various methods used in estimating human capital, we first and foremost need annual population data by age, sex, and educational attainment. We construct such data sets according to the following procedure.

First, data sets are available for the years 1982, 1987, 1990, 1995, 2000, and 2005. They are reported in various issues of Population Census, Population Sampling Survey, and Population Yearbooks. The data sets also contain disaggregated numbers for urban and rural populations.

For all other years, we collect population data by age and sex from various issues of China Population Yearbooks. Then we combine birth rate (China Statistical Yearbook), mortality rate by age and sex (China Population Yearbook), and enrollment (including new enrollment and graduation, China Education Statistical Yearbook) at different levels of education to impute population by age, sex and educational attainment for each and every year. We define the following levels of educational attainment: illiterate (no schooling), primary school (Grade 1-6), junior middle school (Grade 7-9), senior middle school (Grade 10-12), and college and above. From 2000 on, additional information makes it possible to separate the population at the level of college and above into two: one is college, and the other is university and above.

Specifically, we use the following perpetual inventory formula to deduce population by age, sex and educational attainment in missing years:

$$L(y,e,a,s)=L(y-1,e,a,s)\cdot(1-\delta(y,a,s))+IF(y,e,a,s)-OF(y,e,a,s)+EX(e,a,s) \quad (10)$$

$L(y,e,a,s)$ is the population in year y at education level e, with age a and sex s. $\delta(y,a,s)$ is the mortality rate in year y, with age a and sex s. $IF(y,e,a,s)$ and $OF(y,e,a,s)$ are inflow and outflow of this particular group. For example, inflow would include individuals just achieved this level of education, while outflow would include those who just achieved the next level of education. $EX(e,a,s)$ is a discrepancy term. Moreover,

$$IF(y,e,a,s)=\lambda(y,e,a,s)\cdot ERS(y,e,s) \quad (11)$$

$$OF(y,e,a,s)=\lambda(y,e+1,a,s)\cdot ERS(y,e+1,s) \quad (12)$$

$$\sum_a \lambda(y,e,a,s)=1 \quad (13)$$

ERS is the matriculation at education level e, λ is the age distribution at education level e. In order to obtain accurate estimate for λ, we use both microeconomic data sets (China Health and Nutrition Survey and China Household Income Project) and macroeconomic data sets (China Education Statistical Yearbook). Details can be found in Appendix A.

Next we discuss several salient features of China’s population growth, especially the educational attainment by age, sex, and location (i.e. urban and rural). First of all, during our sample period, China’s total population increased from 1.02 billion in 1982 to 1.33 billion in 2008. The urban population increased by 396 million, while the rural population decreased by 83 million (Figure 3.1.1). As a result, the urban share in the total population rose from 21% in 1982 to 45.9% in 2008. The male and female population almost rose at the same pace, with the male's share remained at around 51% (Figure 3.1.2).

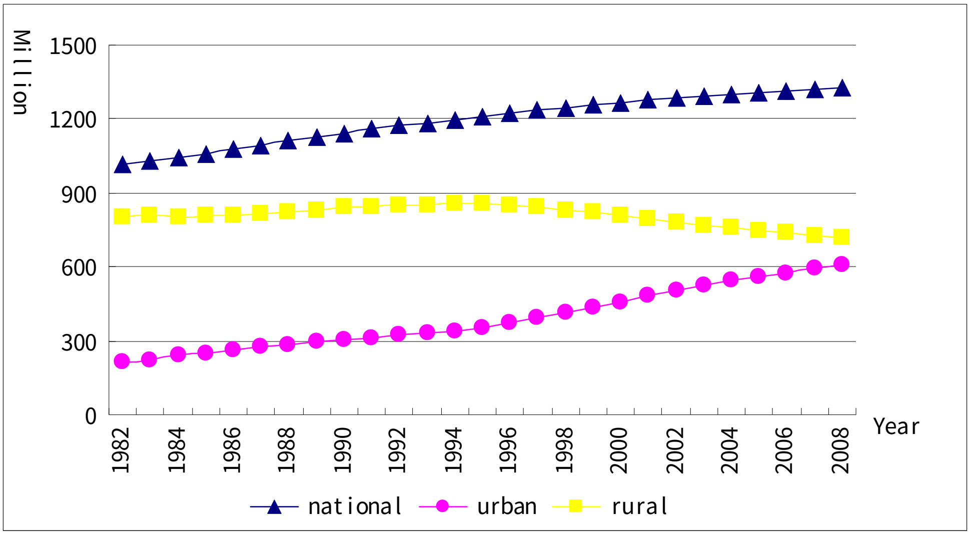


Figure 3.1.1 Population in China, 1982-2008

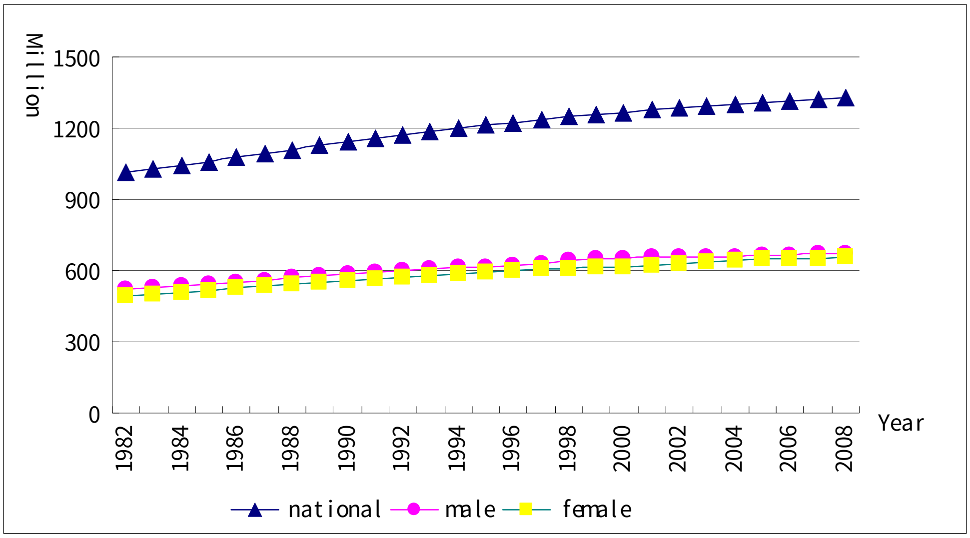


Figure 3.1.2 Population in China, 1982-2008

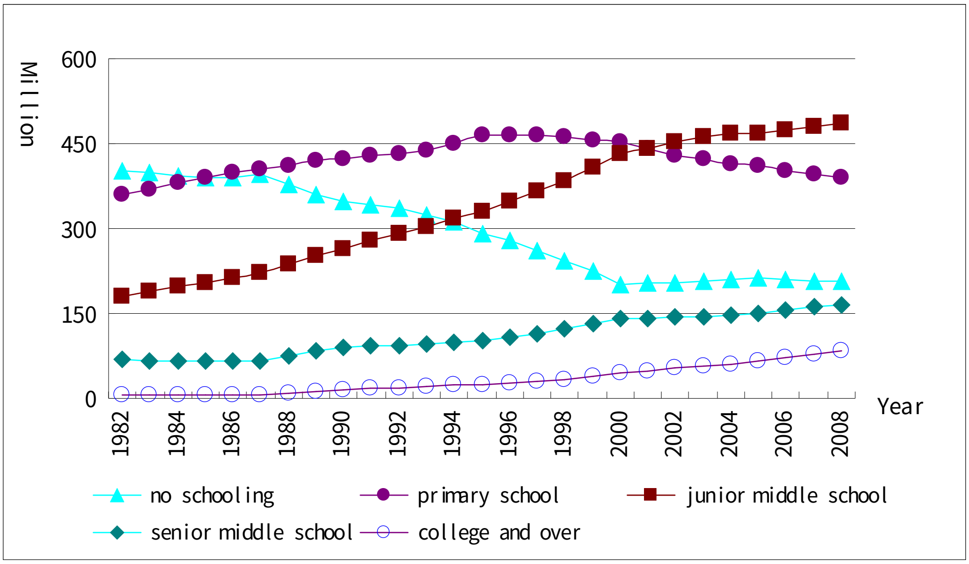


Figure 3.1.3 Population by educational attainment, 1982-2008

Figure 3.1.3 shows population by educational attainment from 1982 to 2008. The illiterate population was cut in half from 402 million in 1982 to 201 million in 2000, but was relatively stable from 2000 to 2008. The number of primary school graudates increased from 359 million in 1982 to the peak of 466 million in 1997, then declined gradually to 389 million in 2008. This decline is expected as more primary school graduates continue on to higher education level instead of terminating formal education. This is also evident in the rapid growth of junior middle school graduates.

Junior middle school students registered the largest growth among all education levels: the number of junior middle school graduates increased from 181 million in 1982 to 485 million in 2008. This might be related to the implementation of 9-Year Compulsory Schooling since 1994 (9-year schooling amounts to completing junior middle school). However, the growth slowed after 2001. Senior middle school and college and over, both started from very low numbers and have grown significantly. Senior middle school graduates increased from 68 million in 1982 to 165 million in 2008, while college and above increased from only 6 million in 1982 to 84 million in 2008.

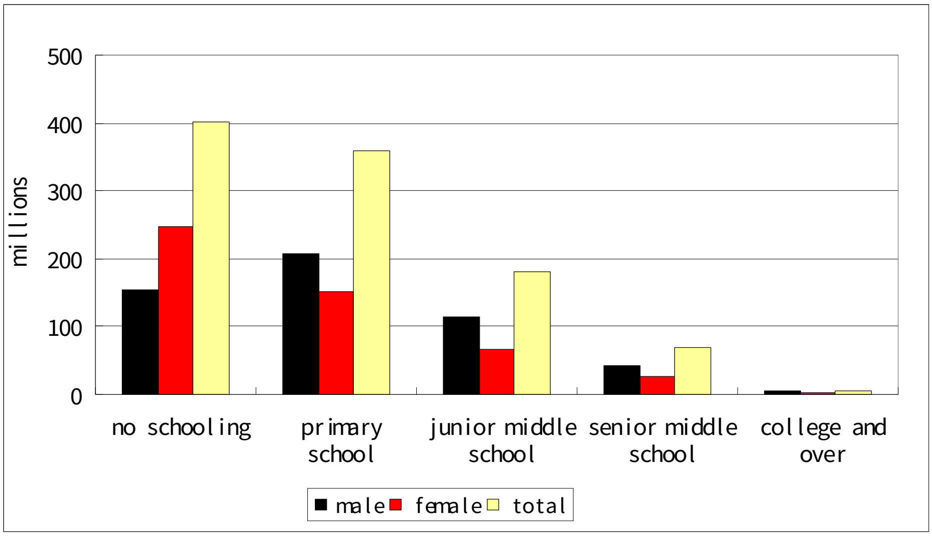


Figure 3.1.4 Population of different educational levels by gender, 1982

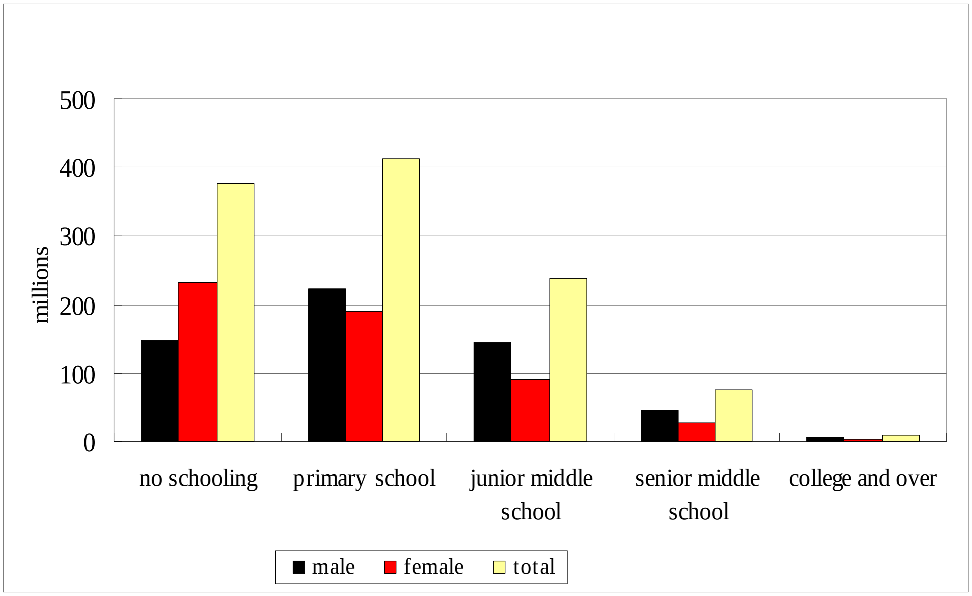


Figure 3.1.5 Population of different educational levels by gender, 1988

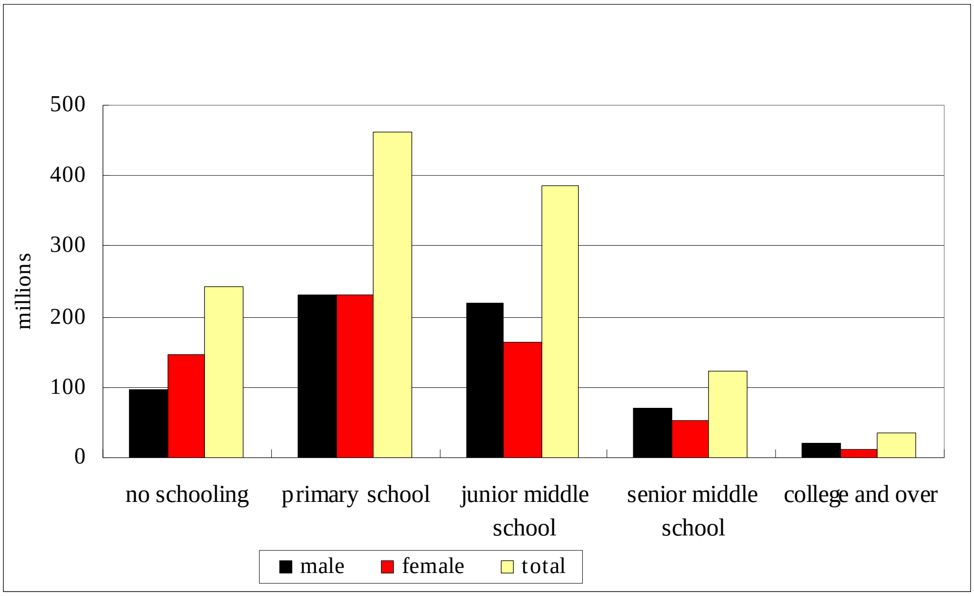


Figure 3.1.6 Population of different educational levels by gender, 1998

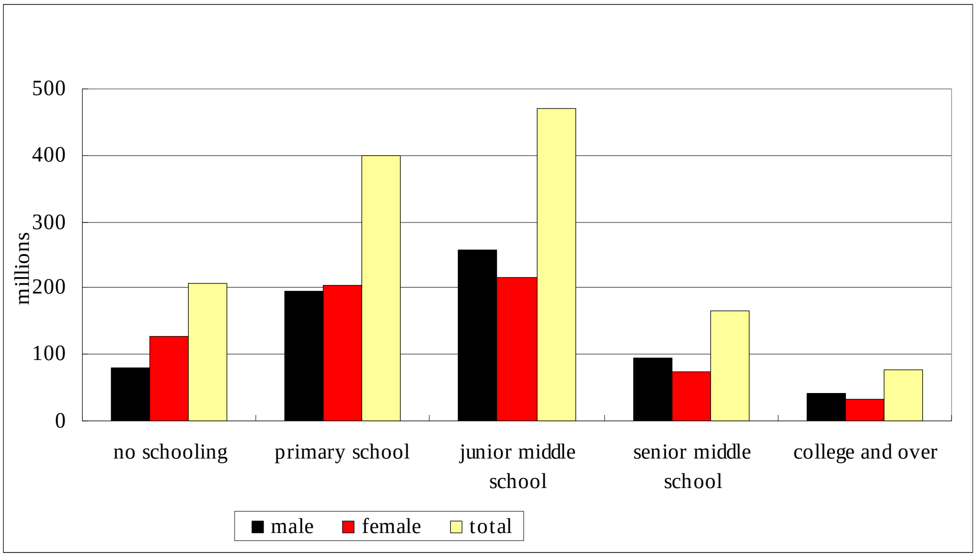


Figure 3.1.7 Population of different educational levels by gender, 2007

We next take a closer look at the changes in the distribution of education attainment in the population from 1982 to 2008. Figures 3.1.4~7 show the rightward shift of the educational attainment distribution in the population. In 1982, among the five education levels, the illiterates take up the largest portion. The 1988 distribution is dominated by people with primary and less education, i.e. the distribution remains heavily skewed to the right. In 1998, the distribution is dominated by primary and junior middle graduates. By 2007, junior middle has become the dominant education level. The distribution is still skewed to the right, but it is much less so than in 1982. Moreover, female educational attainment has improved more relative to that of males; the number of illiterate females decreased faster than that of illiterate males, while the gender differences at higher education levels shrunk considerably. As a result, the female educational attainment distribution is becoming similar to that of the male, despite the very large difference in 1982.

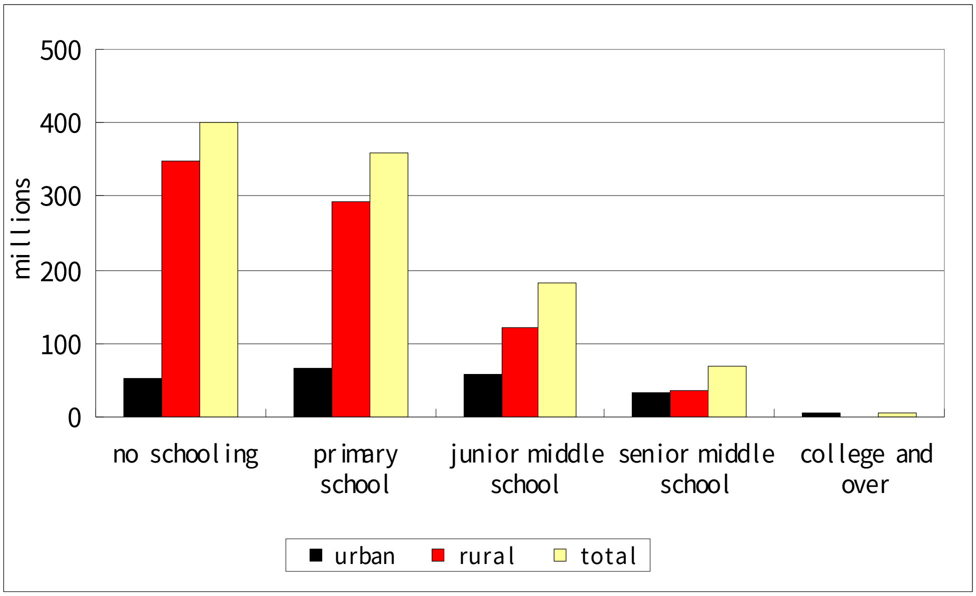


Figure 3.1.8 Population of different educational levels by urban and rural, 1982

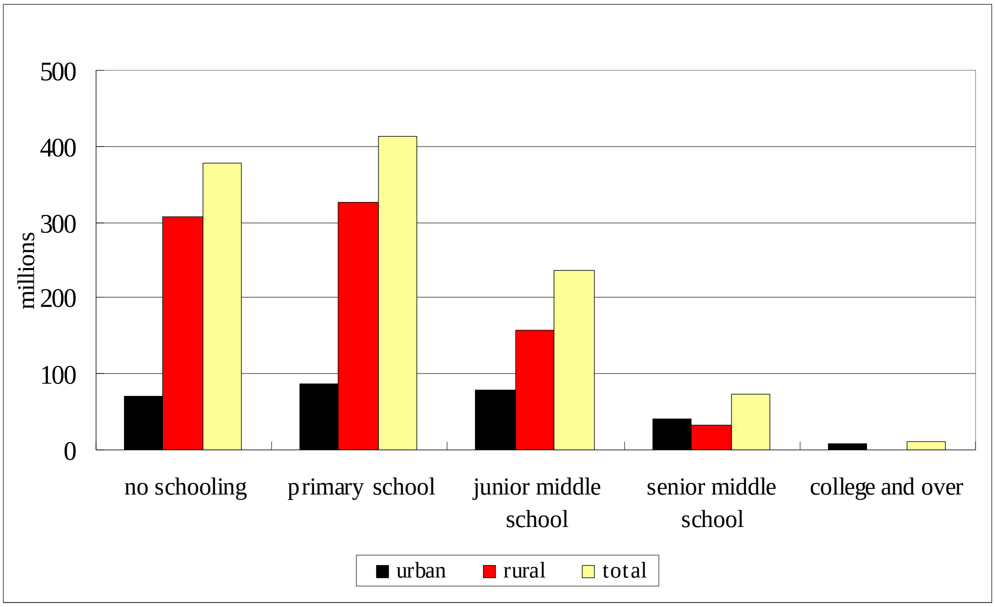


Figure 3.1.9 Population of different educational levels by urban and rural, 1988

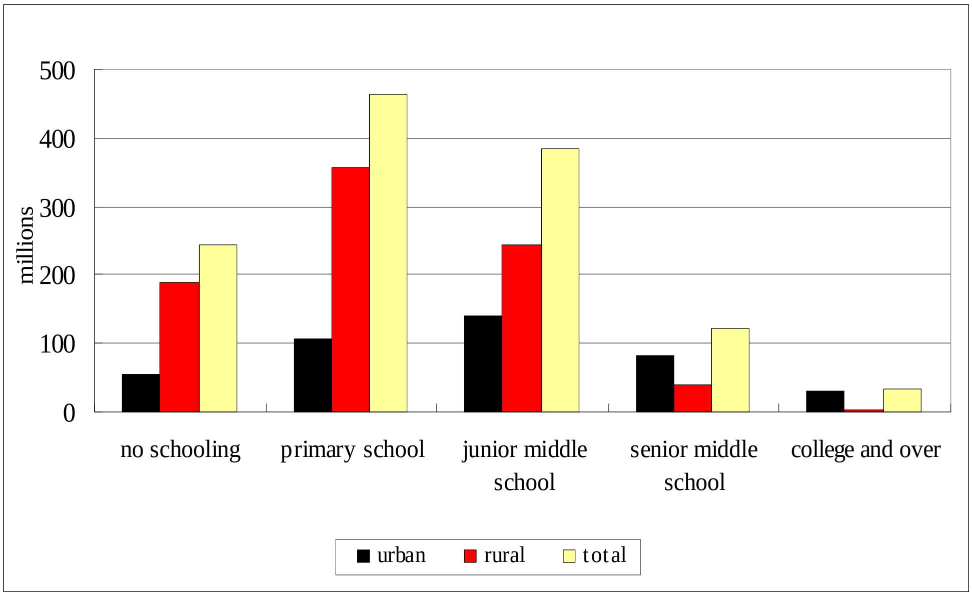


Figure 3.1.10 Population of different educational levels by urban and rural, 1998

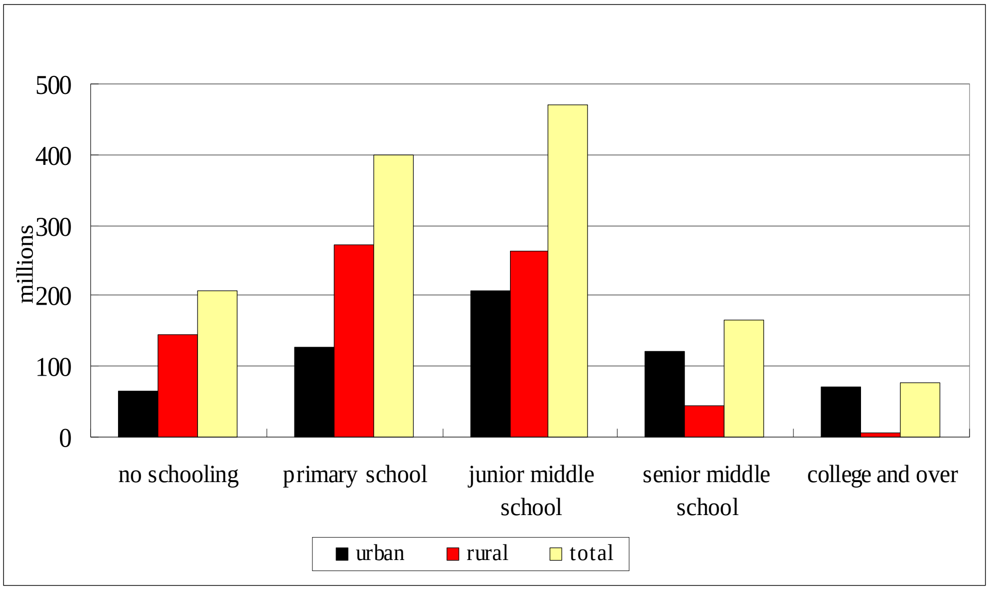


Figure 3.1.11 Population of different educational levels by urban and rural, 2007

Figures 3.1.8~11 disaggregate the data into rural and urban samples. Not surprisingly, most of the illiterate population resided in the rural area. However, the rural illiterate population fell from 349 million in 1982 to 144 million in 2007. Although the urban illiterate population changed slightly in absolute terms, its share in the urban population fell from nearly a quarter in 1982 to 10.86% in 2007. In the meantime, in the highest three levels of education (junior middle, senior middle, and college and over), urban growth outpaced rural growth. For example, the urban junior middle school population more than tripled from 58 million to 208 million, while the rural junior middle school population roughly doubled, from 123 million to 263 million. The comparison is more startling in the highest two education levels. The urban senior middle school population increased from 18 million to 122 million, while the rural senior middle school population only increased from 35 million to 44 million. The urban college and over population increased 14-fold, from 5 million to 71 million, while in rural areas, it grew 6-fold, but remained very small, at only 5 million individuals.

Note that during most of the sample period, the rural population far exceeded the urban population. Although both the urban and the rural distributions have improved, i.e. less skewed to the right, the improvement has certainly been more rapid and obvious in the urban area. One caveat, however, is that the result might be caused by better educated people migrating from rural to urban areas. We take special measures to control for that effect (See Appendix A).

3.2 Obtaining parameter estimates of the Mincer equation

One important component of the income approach is the estimation of future potential earnings for all individuals in the population. We conduct estimation and make projection based on the basic Mincer (1974) equation. It has been shown that there are significant differences in the structure of the earnings equation across gender and between the rural and urban population. To ensure our income estimates to be as accurate as possible, we estimate the parameters for the rural and urban population by gender and year using survey data in selected years and derive their imputed values for missing years over the period of 1985 to 2020.

3.2.1 Estimating the national parameters of mincer equation

We first estimate the basic Mincer equation:

$$\ln(inc) = \alpha + \beta \cdot e + \gamma \cdot exp + \delta \cdot exp^2 + u \tag{14}$$

where *ln inc* is the logarithm of earnings, *e* is years of schooling, e*xp* and exp^2 are, respectively, years of work experience and experience squared, and *u* is a random error. The coefficient *α* is an estimate of the average log earnings of individuals with zero years of schooling and work experience, *β* is an estimate of the return to an extra year of schooling, and *γ* and *δ* measure the return to investment in on-the-job training.

Equation (14) has been the workhorse widely adopted in empirical research on earnings determination. It has been estimated on a large number of data sets for numerous countries and time periods. Many studies have applied the model to Chinese data and found evidence consistent with the human capital theory. Notable studies include, among others, Liu (1998), Maurer-Fazio (1999), Li (2003), Fleisher and Wang (2004), Yang (2005), and Zhang *et al.* (2005). Following the convention of a large body of empirical literature, we estimate equation (14) by ordinary least squares.[11]

The data used for estimating the parameters of the earnings equation come from two well-known household surveys in China. The first is the annual Urban Household Survey (UHS) conducted by the National Statistical Bureau of China over the period of 1986-1997. We use this data set to estimate the parameters of equation (1) for each gender of the urban population by year, and then extract fitted estimates by applying linear or exponential time trends. We use the fitted time trends to generate the imputed parameters of the earnings equation for the urban population for the period 1985 through 2020.

[11] Griliches (1977) finds that accounting for the endogeneity of schooling and ability bias does not alter the estimates of earnings equation. Ashenfelter and Krueger (1994) also conclude that omitted ability variables do not cause an upward bias in the estimated parameters of equation (1).

The second data set we use is the China Health and Nutrition Survey (CHNS) for the years of 1989, 1991, 1993, 1997, and 2000. This survey covers both the urban and rural population. We use CHNS to obtain earnings-equation parameter estimates by year for each gender and separately for the rural and urban population. We calculate the urban-to-rural ratio for each of these parameters. We then use the ratio to fit a time trend model (i.e. interpolate and extrapolate), which is used to generate fitted values of the urban-to-rural ratio over the period 1985 to 2020. We use the fitted ratios along with the imputed parameters for the urban population to derive the imputed parameters for the rural population over the period 1985 to 2020.

3.2.1.1 Imputing the earnings equation parameters for the urban population

The UHS is a representative sample of the urban population. The sample size varies from year to year, ranging from a low of 4,934 respondents in 1986 to a high of 31,266 respondents in 1992. Individual earnings are annual wage incomes, which include basic wage, bonus, subsidies and other work-related incomes. Years of schooling are calculated using the information on the level of schooling completed: primary school equals 6 years of schooling, junior middle school 9 years, senior middle school 12 years, professional school 11 years, community college 15 years, and college and above 16 years. Assuming schooling begins at age 6, we approximate work experience by age minus years of schooling minus 6. As the minimum legal working age is 16 and the retirement ages are 60 and 55 for males and females respectively, we restrict our sample to include individuals who are currently employed and are between 16 and 60 years of age for male workers and between 16 and 55 for female workers. Self-employed and temporary job holders are excluded, so are those who failed to report wage income or educational attainment. Table B.2 in Appendix B contains means and standard deviations of these variables.

We use the UHS data to estimate the earnings equation for each gender by year. The estimates are reported in Table B.3 in Appendix B. They are by and large in line with the estimates reported in previous studies using the same or similar Chinese data. The constant term, which measures the base wage for the no-school no-experience population, clearly reveals the male advantage (Figure 3.2.1). Returns to schooling are positive and in general increasing over the sample years (Figure 3.2.2). Male return increased from a meager 1.7% in 1986 to 7.2% in 1997, while female return also increased from 4.2% in 1986 to 10.8% in 1997. Wang, Fleisher, Li, and Li (2009) also reports that female rates of return dominate male returns, and they offered an explanation. Rising returns to education have been a ubiquitous phenomenon in transitional economies when the Soviet-type wage grid was replaced by market wages (Fleisher, Sabirianova, Wang 2005). Earnings also increase with work experience but at a decreasing rate - a pattern found in most studies. Over time the earnings-experience profile shifts up for male (Figure 3.2.3) but fluctuates for females. For most recent years the male profile doesn’t curve downward as much as that of the female (Figure 3.2.4), and the male profile is much higher than the female profile, indicating uniformly higher return to experience for male than for female, *ceteris paribus*.

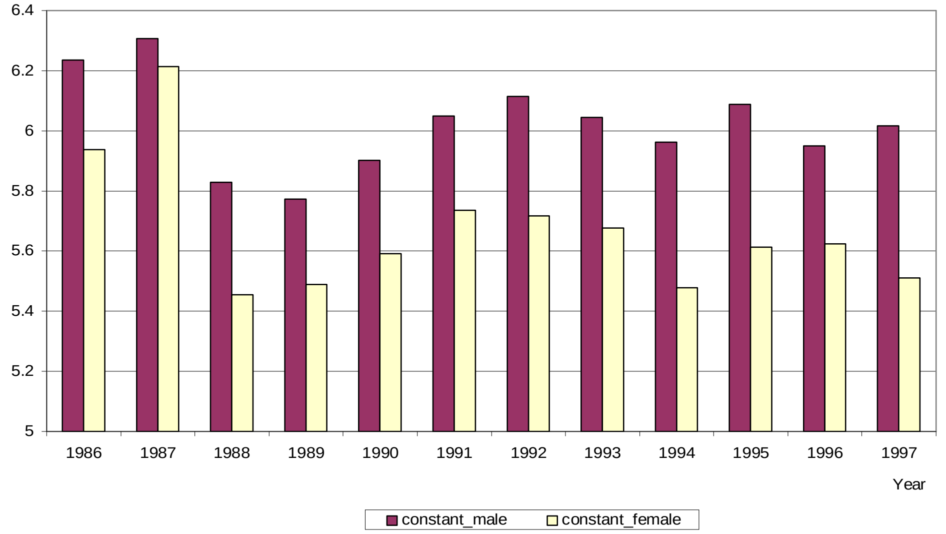


Figure 3.2.1 Constant term, zero-education zero-experience, UHS samples

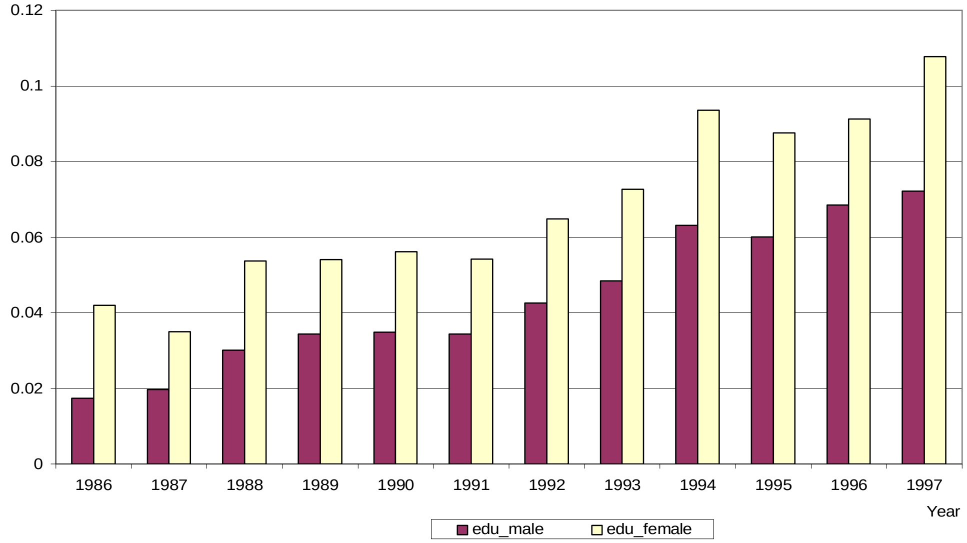


Figure 3.2.2 Return to education, UHS samples

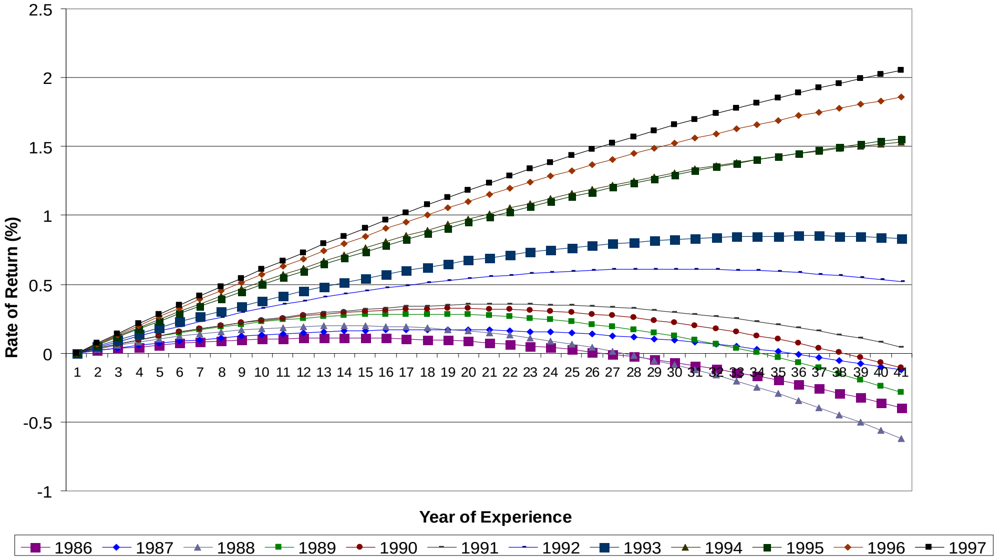


Figure 3.2.3 Return to experience, male, UHS samples

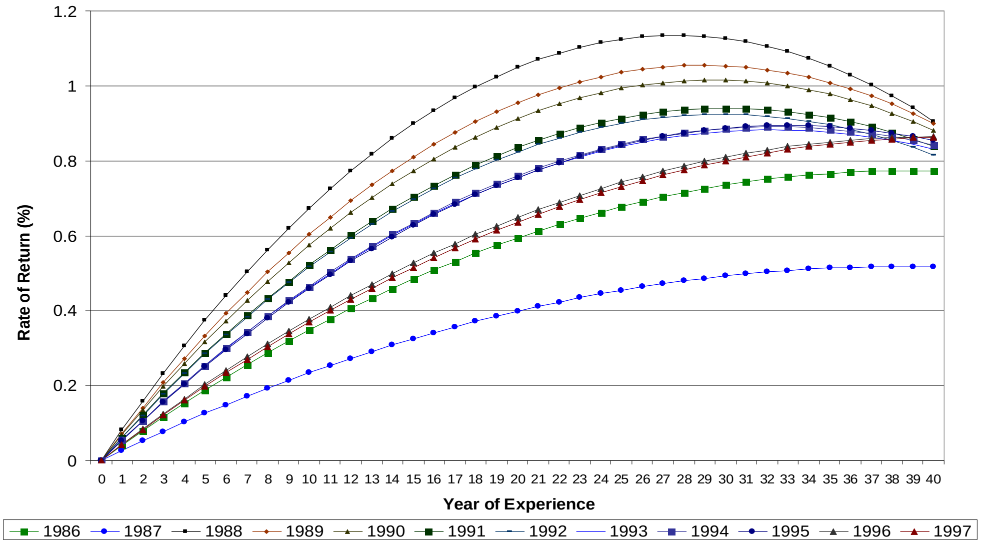


Figure 3.2.4 Return to experience, female, UHS samples

Figures B.1~8 in Appendix B show that when we plot each of the parameter estimates against time, they are generally trended. The large changes in the values of the estimated intercepts and coefficients on work experience and experience squared from 1986 and 1987 to 1988 are puzzling. We suspect that these changes may have been due to inconsistency in survey methodology adopted across the initial few years of the survey. We exclude these outliers from the time trend estimation of the parameters. For each parameter, we regress its estimates reported in Table B.3 (Appendix B) against time under two alternate specifications: a linear time trend model, and an exponential trend model where the logarithm of the parameter estimate is the dependent variable. The AIC values, a popular test for model selection, suggest that the linear time trend specification is appropriate for the intercept and the schooling parameter, while the exponential trend specification is suitable for the parameters associated with work experience and experience squared. As the coefficient on experience squared is negative, the dependent variable is defined as the log of the absolute value of the parameter estimates. Figures B.9~16 in Appendix B show the actual parameter estimates over the period 1988 to 1997 along with the fitted trend lines.

We use the fitted trend lines to generate imputed values of the parameters for each gender by year over the period 1985 to 2008. While there is some evidence that the pre-1997 trends of these parameters, particularly the one associated with schooling, continued after 1997 and up to 2008 (see e.g., Zhang *et. al.* 2005), it is unclear if the trends will extend beyond 2008. We therefore assume, probably rather conservatively, that the earnings equation parameters remain constant for the period 2009 to 2020 and are equal to the fitted values of their counterparts in 2008. Table 3.2.1

reports the imputed values of the parameters for the urban population by gender and year.

Table 3.2.1 Imputed parameters for the urban population,1985 to 2020

year	male				female			
	α	β	γ	δ	α	β	γ	δ
1985	5.81248	0.01089	0.08555	-0.00147	5.55553	0.02677	0.09859	-0.00209
1986	5.83390	0.01595	0.08061	-0.00134	5.56000	0.03301	0.09198	-0.00187
1987	5.85532	0.02101	0.07595	-0.00122	5.56447	0.03926	0.08581	-0.00167
1988	5.87673	0.02608	0.07156	-0.00111	5.56894	0.04550	0.08006	-0.00150
1989	5.89815	0.03114	0.06742	-0.00102	5.57342	0.05174	0.07469	-0.00134
1990	5.91956	0.03620	0.06353	-0.00093	5.57789	0.05798	0.06968	-0.00120
1991	5.94098	0.04126	0.05986	-0.00084	5.58236	0.06422	0.06501	-0.00107
1992	5.96239	0.04632	0.05640	-0.00077	5.58683	0.07046	0.06065	-0.00096
1993	5.98381	0.05138	0.05314	-0.00070	5.59130	0.07670	0.05658	-0.00086
1994	6.00522	0.05645	0.05007	-0.00064	5.59577	0.08295	0.05279	-0.00077
1995	6.02664	0.06151	0.04717	-0.00058	5.60024	0.08919	0.04925	-0.00069
1996	6.04805	0.06657	0.04445	-0.00053	5.60472	0.09543	0.04595	-0.00062
1997	6.06947	0.07163	0.04188	-0.00048	5.60919	0.10167	0.04287	-0.00055
1998	6.09088	0.07669	0.03946	-0.00044	5.61366	0.10791	0.03999	-0.00049
1999	6.11230	0.08176	0.03718	-0.00040	5.61813	0.11415	0.03731	-0.00044
2000	6.13372	0.08682	0.03503	-0.00037	5.62260	0.12040	0.03481	-0.00040
2001	6.15513	0.09188	0.03300	-0.00033	5.62707	0.12664	0.03248	-0.00035
2002	6.17655	0.09694	0.03110	-0.00030	5.63155	0.13288	0.03030	-0.00032
2003	6.19796	0.10200	0.02930	-0.00028	5.63602	0.13912	0.02827	-0.00028
2004	6.21938	0.10707	0.02761	-0.00025	5.64049	0.14536	0.02637	-0.00025
2005	6.24079	0.11213	0.02601	-0.00023	5.64496	0.15160	0.02460	-0.00023
2006	6.26221	0.11719	0.02451	-0.00021	5.64943	0.15785	0.02295	-0.00020
2007	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018
2008-2020	6.30504	0.12731	0.02176	-0.00017	5.65837	0.17033	0.01998	-0.00016

3.2.1.2 Imputing the earnings equation parameters for the rural population

The CHNS is an ongoing international collaborative project between the Carolina Population Center at the University of North Carolina at Chapel Hill and the National Institute of Nutrition and Food Safety at the Chinese Center for Disease Control and Prevention and was designed for evaluating the impact of social and economic transformation of the Chinese society on socioeconomic, demographic, and health behaviors of the urban and rural population. The survey also contains information on income, age and educational attainment, which we use to estimate the earnings equation by year for each gender and separately for the urban and rural population. For the urban sample, earnings contain wage income and subsidies from work.

The rural sample contains only household income, which includes family members' incomes from the collective or household productions or both in five distinct activities: gardening, farming, raising livestock, fishing, and small handicraft and family businesses. We allocate household income to each individual member according to his or her working hours as a share of the household's total. Years of schooling are calculated based on the reported grade or years completed (depending on the sample year). Work experience is approximated by age minus years of schooling minus 6. We restrict our sample to males between 16 and 60 years of age and females between 16 and 55 who reported information on education and income.

Table B.5 in Appendix B contains the summary statistics of the variables used.

We use the CHNS data to estimate equation (1) by gender and separately for the rural and urban samples for each of the sample year (i.e., 1989, 1991, 1993, 1997, and 2000). The parameter estimates, which are reported in Table B.6 in Appendix B, are then used to calculate the urban-to-rural ratio for each parameter by gender. We use the ratios to fit an exponential trend model, which is used to generate the fitted ratios for the period 1985 to 2008. We assume that the ratios remain constant for the period 2008 to 2020 and are equal to the fitted values of their counterparts in 2008. Table B.7 in Appendix B reports the fitted ratios. These fitted urban-to-rural ratios by themselves provide interesting insights. For example, in 1985, the urban no-schooling no-experience male cohort was on average paid 9.8% more than its rural counterpart, and by 2007 this gap has increased to 14.6%. In the meantime, the urban no-schooling no-experience female cohort was on average paid 6.7% more than its rural counterpart, and by 2007 the rural cohort was paid 1.8% more than the urban cohort. Return to education is always higher for rural male than for urban male. In 1985, the rate of return was 16% higher for rural male, and by 2007 it was 33% higher. For female, however, it is a different story. Return to education for urban female was 63% higher than rural female, but by 2007 the return to urban female was 22% less than rural female. The relation between urban and rural return to experience has also changed. All of these are not central to our current project, but nevertheless deserves attention in future research.

We use these ratios along with the imputed parameters for the urban population in Table 3.2.1 to impute parameters for the rural population which are presented in Table 3.2.2.

Table 3.2.2 Imputed parameters for the rural population, 1985 to 2020

year	male				female			
	α	β	γ	δ	α	β	γ	δ
1985	5.29358	0.01297	0.06773	-0.00093	5.20888	0.01646	0.12262	-0.00258
1986	5.30279	0.01919	0.06613	-0.00090	5.23264	0.02099	0.10967	-0.00219
1987	5.31194	0.02554	0.06456	-0.00088	5.25651	0.02580	0.09809	-0.00186
1988	5.32103	0.03201	0.06303	-0.00085	5.28047	0.03092	0.08773	-0.00157
1989	5.33007	0.03860	0.06154	-0.00083	5.30455	0.03635	0.07846	-0.00133
1990	5.33906	0.04532	0.06008	-0.00080	5.32873	0.04212	0.07017	-0.00113
1991	5.34799	0.05218	0.05866	-0.00078	5.35302	0.04823	0.06276	-0.00096
1992	5.35687	0.05916	0.05727	-0.00076	5.37741	0.05472	0.05613	-0.00081
1993	5.36569	0.06628	0.05591	-0.00074	5.40191	0.06158	0.05020	-0.00069
1994	5.37446	0.07354	0.05459	-0.00071	5.42653	0.06885	0.04490	-0.00058
1995	5.38317	0.08094	0.05330	-0.00069	5.45125	0.07654	0.04016	-0.00049
1996	5.39183	0.08847	0.05204	-0.00067	5.47607	0.08468	0.03592	-0.00042
1997	5.40043	0.09615	0.05080	-0.00066	5.50101	0.09327	0.03212	-0.00035
1998	5.40899	0.10397	0.04960	-0.00064	5.52606	0.10236	0.02873	-0.00030
1999	5.41748	0.11194	0.04843	-0.00062	5.55122	0.11195	0.02569	-0.00025
2000	5.42593	0.12005	0.04728	-0.00060	5.57649	0.12207	0.02298	-0.00022
2001	5.43432	0.12832	0.04616	-0.00058	5.60187	0.13276	0.02055	-0.00018
2002	5.44266	0.13674	0.04507	-0.00057	5.62736	0.14402	0.01838	-0.00015
2003	5.45095	0.14532	0.04400	-0.00055	5.65297	0.15590	0.01644	-0.00013
2004	5.45918	0.15405	0.04296	-0.00054	5.67869	0.16842	0.01470	-0.00011
2005	5.46736	0.16295	0.04194	-0.00052	5.70452	0.18161	0.01315	-0.00009
2006	5.47549	0.17200	0.04095	-0.00051	5.73047	0.19549	0.01176	-0.00008
2007	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007
2008-2020	5.49160	0.19061	0.03903	-0.00047	5.78271	0.22550	0.00941	-0.00006

3.2.2 Estimating the provincial parameters of Mincer equation

To estimate the parameters at the provincial level, we adopt Ordinary Least Square to estimate the extended Mincer equation:

$$\ln(income) = \beta_0 + \beta_1 \cdot bj + \beta_2 \cdot gs + \beta_3 \cdot gd + \beta_4 \cdot hn + \beta_5 \cdot js + \beta_6 \cdot \ln + \gamma_0 \cdot s + \gamma_1 \cdot s \cdot bj$$
$$+\gamma_2 \cdot s \cdot gs + \gamma_3 \cdot s \cdot gd + \gamma_4 \cdot s \cdot hn + \gamma_5 \cdot s \cdot js + \gamma_6 \cdot s \cdot \ln + \delta_0 \exp + \delta_1 \exp^2$$
$$+\mu \qquad (15)$$

where *ln(income)* is the logarithm of earnings, *s* is years of schooling, e*xp* and e*xp*^{2} are, respectively, years of work experience and experience squared, *bj*、*gs*、*gd*、*hn*、*js*、*ln* are dummy variables for Beijing, Gansu, Guangdong, Hunan[12], Jiangsu ,Liaoning, respectively, the model also includes the intersection of dummy variable and years of education, *u* is a random error.

The data sources for estimating the parameters of Mincer equation are different from provincial level and national level. The data used for estimating the provincial parameters of the earnings equation come from China Urban Household Survey, Chinese Household Income Project and China Health and Nutrition Survey. Firstly, we use the three data sets to estimate the parameters of the earnings equation for each gender of urban population by year. Secondly, by defining the number of regression sample as the weight, we add the weight into the results of three different data sets for the same year, and then extract fitted estimates by applying linear or

---

[12] Although we do not report the human capital results for Hunan province due to the lack of enough observation, we still use the data from Hunan in the estimation of earnings for each province.

exponential time trends. The final procedure is to use the fitted values to estimate parameters of the earnings equation for the period 1985 through 2008 (See the detailed approach in appendix B). The estimated approach for each province is the same as the national estimation.

3.2.2.1 Imputing the earnings equation parameters for the urban population

As the minimum legal working age is 16 and the retirement ages are 60 and 55 for males and females respectively, we restrict our sample to include individuals who are currently employed and are between 16 and 60 years of age for male workers and between 16 and 55 for female workers. Self-employed and temporary job holders are excluded, so are those who failed to report wage income or educational attainment.

Table B.2-3.4.1.1 in Appendix B contains estimated results of the intercept and the return rate to education. Taking Beijing as example, the constant term, which measures the base wage for the no-school no-experience population, clearly reveals the male advantage (Figure 3.2.5). Returns to schooling are positive and in general increasing over the sample years (Figure 3.2.6). Male return increased from less than 0.6% in 1986 to 10.1% in 2008, while female return also increased from less than 0.1% in 1986 to 13.3% in 1997.

Since we assume the same parameters of years of experience for male and female across the country, we have a uniform set of parameter results and fitted values. Table B.2-3.4.2.1 in Appendix B reports the results. As we can from the table, income increases with the rising experiences but at a decreasing rate, and the years of experience is higher for male than for female.

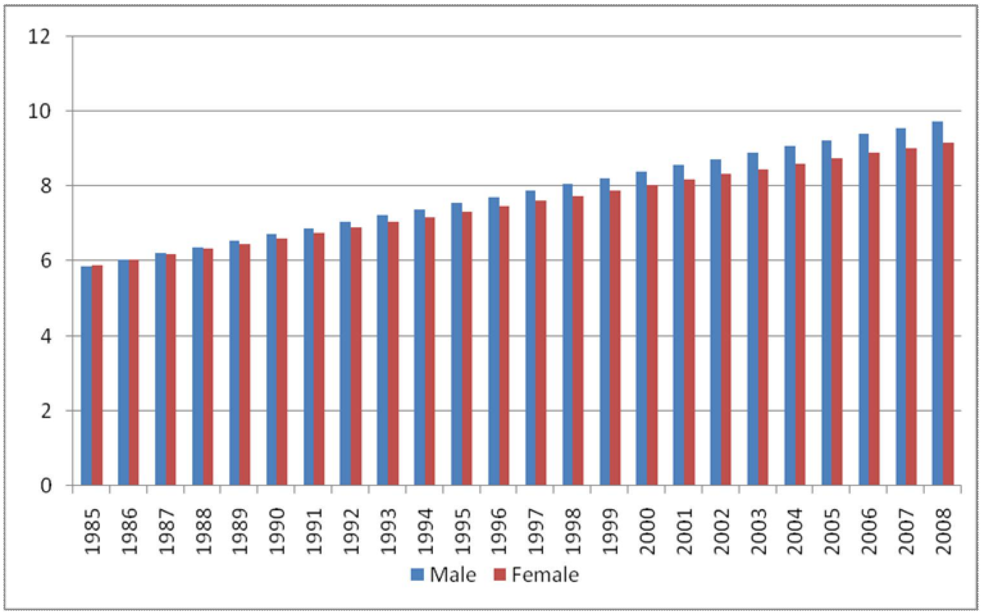


Figure 3.2.5 Constant term by gender, Beijing

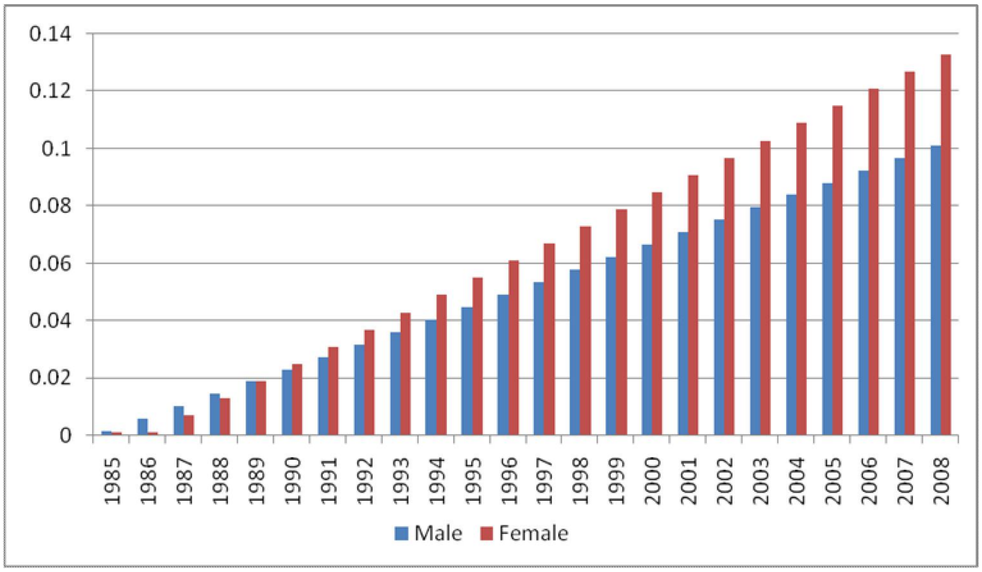


Figure 3.2.6 Returns to education by gender, Beijing

3.2.2.2 Imputing the earnings equation parameters for the rural population

The estimated approach towards the parameters of earning equations for rural area in each province is the same as the national estimation, so no more repeated words here. We use the CHNS data to estimate equation (15) by gender and separately for the rural and urban samples for each of the sample year (i.e., 1989, 1991, 1993, 1997, and 2000). The parameter estimates, which are reported in Table B.2-4.2.1, are then used to calculate the urban-to-rural ratio for each parameter by gender. We use the ratios to fit an exponential trend model, which is used to generate the fitted ratios for the period 1985 to 2008. Table B.2-4.2.2.1 and B.2- 4.2.2.2 in Appendix B report the fitted ratios of male and female separately. These fitted urban-to-rural ratios by themselves provide interesting insights. For example, in 1985, the urban no-schooling no-experience male cohort was on average paid 13.2% more than its rural counterpart, and by 2008 this gap has increased to 16.4%. In the meantime, the urban no-schooling no-experience female cohort was on average paid 3.6% more than its rural counterpart, and by 2008 this gap reduced to 11.8%. Return to education is always higher for rural male than for urban male. In 1985, the rate of return was 15% higher for rural male, and by 2008 it was 1% higher. For female, however, it is a different story. Return to education for urban female was 66% higher than rural female, but by 2008 the return to urban female was 28% less than rural female. The relation between urban and rural return to experience has also changed. All of these are not central to our current project, but nevertheless deserves attention in future research.

We use these ratios along with the estimated parameters for the urban population in to impute parameters for the rural population in each province which are presented in B.2-4.3 in Appendix B.

3.3 Growth rates of real income and the discount rate

To measure lifetime earnings for all individuals in the population, we need to project incomes for future years, discount these incomes back to the present, and weight income for each individual by the age- and gender-specific probability of survival. We use the imputed earnings equation parameters to estimate earnings for all individuals in a given year, and then derive earnings for future years until retirement assuming real earnings grow at a constant rate.[13] The main task of this section is to estimate the expected growth rate of real income and select an appropriate discount rate. Since the real income grew at fairly different rates in the past for the urban and rural population, we estimate them separately.

3.3.1 Growth rates of real income

To measure lifetime earnings for all individuals in the population, we need to project incomes for future years, discount these incomes back to the present. We use the following method to estimate the real income growth rate for urban and rural.[14]

---

[13] Mincer equation parameter estimates are used to calculate the cohort-wise labor income for a given year, it is not used to project future income.

[14] In China, there are also growth rates of real annual income in urban reported in the series of the *China Statistical Yearbook*, but this income only includes labor wage, who work in or

Assuming that the technology is labor-augmenting, we specify the aggregate production function as:

$$Y = (AL)^a K^b \tag{16}$$

where *Y* is output, *A* denotes a technology factor, *L* denotes labor input, and *K* physical capital input. The average product of labor or labor productivity is proportional to the marginal product of labor.[15] Because the marginal product of labor equals the real wage when the labor market is in equilibrium, labor productivity and the real wage are expected to grow at the same rate. This suggests that the growth rate of real output per employed worker can serve as a reasonable estimate for the growth rate of the real wage.

The labor productivity for the rural sector is calculated using real GDP of the primary industry divided by the number of workers in the primary industry; and for the urban sector using real GDP of the secondary and tertiary industries divided by the number of workers in these industries. The result shows that, for the 30-year period 1978-2007, labor productivity grew on average 4.11% and 6% per annum in the rural and urban sectors, respectively. Those growth rates will be used in the J-F calculation.[16]

---

get paid from the state-owned, urban collective, joint venture, joint-stock, foreign and Hong Kong, Macao and Taiwan invested in other units and its subsidiary bodies.This cannot reflect the overall income level in China, because Chinese enterprises have other ownership forms.

[15] The marginal product of labor is given by $\beta Q/L$, where Q/L is the average product of labor.

[16] Those rates are considerably higher than the growth rate of 1.32% (Jorgenson and Yun, 1990) used in OECD human capital calculation because the Chinese economy has grown much faster. Although the rate is based on 30-year moving average, it is still unclear whether it can represent long-run growth rate in China.

We use the same method to calculate the provincial income growth rates for Beijing, Liaoning, Jiangsu, Guangdong and Gansu, their growth rates are: 6.27%、4.97%、6.06%、5.57% and 4.82% for urban areas; 6.65%, 6.91%, 8.70%, 8.47%, and 7.10% for rural areas.

3.3.2 The discount rate

The discount rate that is used to value future incomes in present terms should reflect the rate of return one expects from investments over a long time horizon. We adopt the discount rate, 4.58%, used by Jorgenson and Fraumeni (1992a), in calculation. This discount rate was derived by Jorgenson and Yun (1990) based on the long-run rate of return for the private sector of the U.S. economy. As is the case for other calculations using discount rate, the result will be sensitive to the choice of discount rate. We also use alternative discount rates for the purpose of comparison, including the average interest rate on the 10-year government bonds issued to individual investors in China over the period 1996 to 2007, net of the average rate of inflation over the same period, 3.14%[17]; the average benchmark lending rate over 5 years in China from 1996 to 2008, 5.14%; [18]

---

[17] The details could be found in the *China Human Capital Index Analysis Report* 2009 Version. However, when the ideal discount rate should include the market risk, someone may question that coupon rate doesn't reflect it. We used the yield to maturity of the 10-year book-entry bonds issued to individual investors that are circulated in the stock exchange market and commercial banks as a comparison, found that the difference of the results are minor.

[18] The People's Bank of China set and adjust the benchmark lending rate, which play a key role in the money market. We here excluded the serious inflation period of 1993-1995, starting from 1996 to avoid the negative discount rates.

and the social discount rate based on the method from the World Bank, 8.14%.[19]

3.3.3 The deflators

In order to transfer the nominal human capital into the real human capital, we use the deflators. For the national human capital, we still use the CPI as the deflator like the last year, but for provincial estimates, we use three kinds of deflators to get the real human capital, they are: CPI for urban and rural; living cost index based on 1985 Beijing living cost; price index of fixed assets investment, to compare with the physical capital. (see details in appendix C.3)

3.4 Additional data imputations and assumptions for the J-F estimates

Besides annual population data by age, sex, and educational attainment, the Jorgenson-Fraumeni method requires additional information on the lifetime income, enrollment rate, growth rate of real wage, and discount rate. We briefly discuss how we construct these supplemental data sets in this section. Some parameters have to be set at values appropriate for China. Detailed information can be found in the appendixes.

---

[19] We calculated the average growth rate of individual consumption level over the period 1985 to 2008, based on World Bank's method. More details are available in *Where is the wealth of nations?* Human capital and economics growth in China, both from World Bank,"A Social Discount Rate for the United Kingdom" in *Environmental Economics: Essays in Ecological Economics and Sustainable Development*, ed. D. W. Pearce, 268–285. Cheltenham: Edward Elgar Publishing.

Following Jorgenson and Fraumeni, an individual may assume one of the following six statuses at any time: no school or work (age 0-5), school only (age 6-15), work and school (age 16-24), work only (25 to retirement), and retirement (age 60+ for male and 55+ for female). Each status implies a different pattern of age-income profile, therefore the method of computing lifetime income shall be different.

We first estimate a standard Mincer equation (i.e. with a regression of annual income on schooling years, work experience, and work experience squared) with microeconomic data sets (China Household Income Project, China Health and Nutrition Survey, and Urban Household Survey). We use annual employment rates by age, sex, and educational attainment (from China Population Statistical Yearbook and China Population Census) to convert annual income into annual market income. Then the lifetime income for each age/sex/education category can be calculated using the methodology described in the earlier section.

For the in-school population, we carefully derive the number of people in each education level with data on new enrollment, mortality rate, and attrition rate. We consider the following five categories of schooling: no schooling, primary school, junior middle school, senior middle school, and college and above or for six categories of schooling college and university and above. We compute lifetime income for every grade at each education level, taking into account how likely the individual will continue into the next grade and the next education level. For the five categories of schooling estimates college and above is the highest education level. For the six categories of schooling estimates college or university and above are the highest education levels. We do not allow for the possibility that one can go to college then followed by university.

As not all data is available by single year of age or by individual level of education, some additional imputations and assumptions are needed. Imputations having to do with creating data sets by single year of age and initial age of enrollment are described in Appendix A. Enrollment and grade advancement imputations and assumptions are described in this section.

The imputation of two components of the J-F human capital estimates is described in this section: 1) Number of years until an education category is completed, and 2) The probability of advancing to the next higher education category. A decision was made to assume that all students complete a grade level (if they continue) in the same number of years: 6 for primary, 3 for junior middle, and 3 for senior middle school. It is also assumed that no drop-outs return to school and that education continues without a break. These assumptions are also made by J-F. The probability of advancing to the next higher education level is estimated as the average ratio of the sum of all students of any age in a year who are initially enrolled to the sum of all students of any age initially enrolled in the next higher education level 'X' years later. "X" depends upon the number of years it takes to complete an education level. The imputations and assumptions allow for the appropriate discounting of a future higher income level.

In each case, advancing students are tracked from their age of initial enrollment, through individual grade levels, until they advance to the next higher level. The number of years discounted until they realize the higher level of lifetime income depends on the number of years it takes to advance given the current grade of enrollment.

Then, we treat the terminal education level as a probabilistic event, and therefore the lifetime income is a forecast based on the contemporary information set, except that the probability of advancing depends on initial enrollments at a higher education level in subsequent years. For instance, the lifetime income of a student who is in the first year of junior middle school, assuming she will live to finish junior middle school and goes onto senior middle school depends upon an adjusted lifetime income of someone who is currently three years older and whose educational attainment is senior middle school. The adjustments include those for three years of labor income (wage) growth and three years of discounting.

Chapter 4 Result discussions on the national level

4.1 Total human capital stock, GDP, and physical capital stock

Our main results are based on the J-F approach. The estimated total human capital stock at the national level for 1985-2008 is reported in Table 4.1.1. Columns 1 and 2 contain the total human capital measured in nominal terms, and columns 3 and 4 present the total human capital measured in real terms (in 1985 RMB). In this table, the real values are calculated using CPI.[20] Figure 4.1.1 shows the trend of human capital in both real and nominal values.

Before 2000, five education categories were reported by the National Bureau of Statistics of China. They are: no school, elementary school, junior middle school, senior middle school, and college and above. Starting from 2000, the college and above was further divided into two categories: three-year college, and four-year college and above.[21] To take advantage of this more detailed information on educational attainment, we create a separate human capital series starting from 2000. As can be seen from Figure 4.1.2, total human capital becomes larger with six education categories. This is because the lifetime incomes of graduates of four-year college and above are higher than those who graduated from three-year colleges.

---

[20] Because the total human capital is the sum of rural and urban human capital, we use CPI for rural and urban separately in the estimation.

[21] When we estimate Mincer equation to generate annual earnings, we assign 15 years of schooling for the category of three-year college; and assign 16 years of schooling for the category four-year college and above. Because we use the lower bound of schooling for this education category, the amount of human capital is underestimated.

Table 4.1.1 Nominal and real human capital, nominal GDP

(1985 as base year for real series, in trillions)

year	nominal human capital		real human capital		nominal GDP	ratio of human capital and GDP (current prices)
	five education categories	six education categories	five education categories	six education categories		
1985	19.30		19.30		0.90	21.40
1986	21.34		20.05		1.03	20.77
1987	24.11		21.09		1.21	19.99
1988	29.81		21.92		1.50	19.82
1989	36.44		22.72		1.70	21.44
1990	39.19		23.71		1.87	20.99
1991	42.39		24.75		2.18	19.46
1992	47.94		26.25		2.69	17.81
1993	59.80		28.48		3.53	16.92
1994	80.70		30.92		4.82	16.74
1995	98.89		32.33		6.08	16.27
1996	119.75		36.03		7.12	16.82
1997	138.58		40.44		7.90	17.55
1998	146.79		43.11		8.44	17.39
1999	158.50		47.11		8.97	17.67
2000	172.89	180.60	51.09	53.27	9.92	17.43
2001	186.07	194.83	54.51	56.96	10.97	16.97
2002	197.78	207.96	58.32	61.19	12.03	16.44
2003	215.53	227.80	62.75	66.19	13.58	15.87
2004	236.47	250.30	66.30	70.05	15.99	14.79
2005	256.91	275.60	70.76	75.76	18.32	14.02
2006	283.36	302.22	76.88	81.84	21.19	13.37
2007	322.38	344.91	83.45	89.12	24.95	12.92
2008	370.28	396.85	90.53	96.87	30.07	12.32

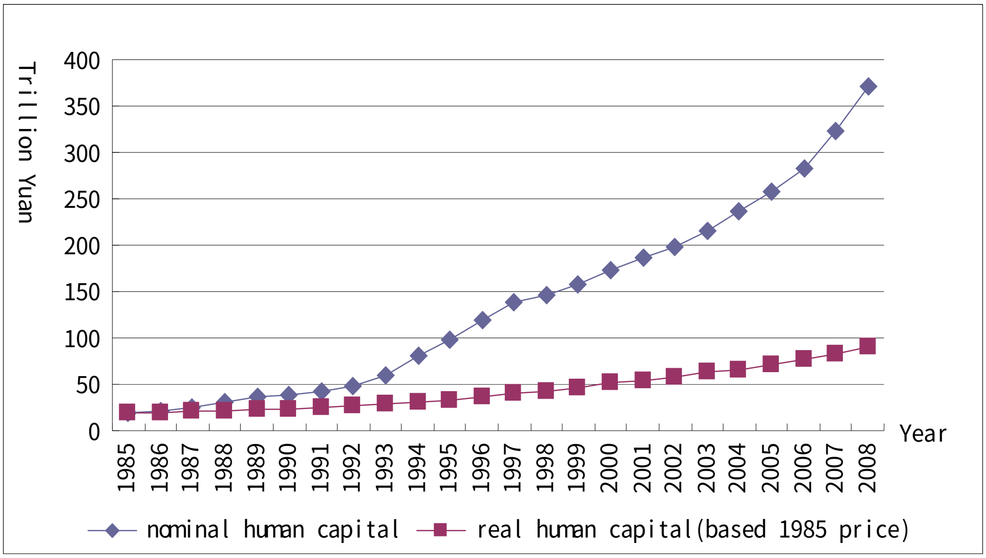


Figure 4.1.1 Nominal and real human capital, 1985-2008

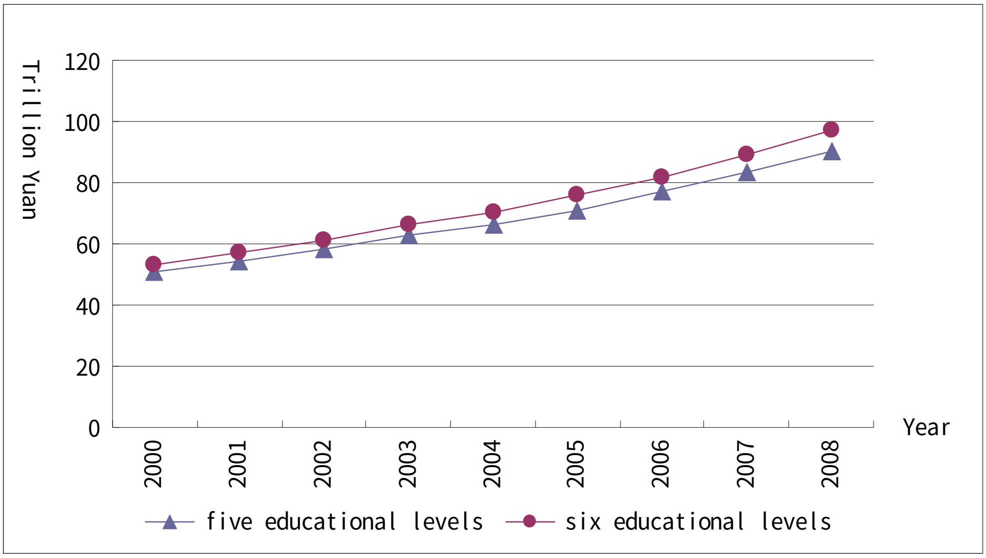


Figure 4.1.2 Real total human capital by different education categories, 2000-2008

In order to get a sense of the magnitude of the estimated total human capital in China, we also reported nominal GDP in Table 4.1.1. The ratio of estimated (market) human capital to GDP generally declines over time until 2005-7, when it is between 12 and 21. Jorgenson and Fraumeni (1992a)'s estimates of the ratio of total market human capital to GDP in the U.S. from 1947 to 1986 is between 18 and 22.

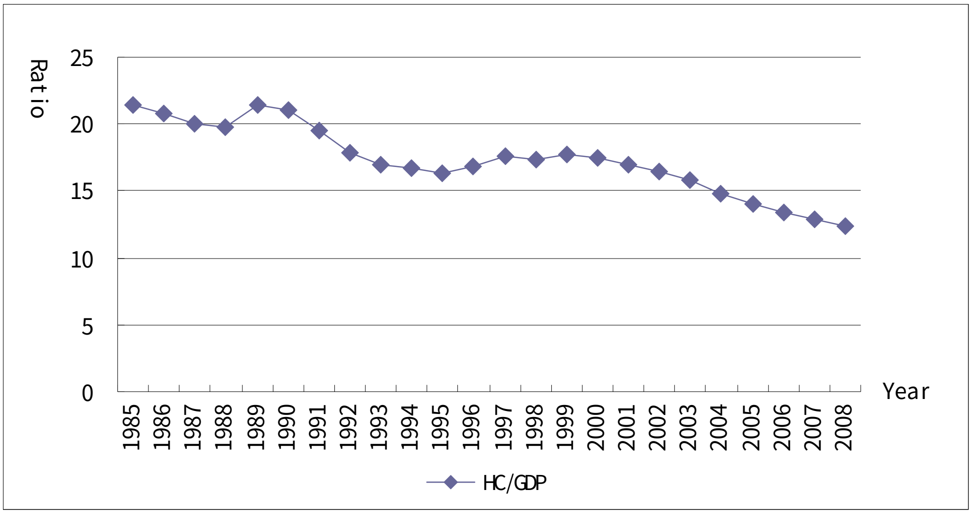


Figure 4.1.3 Ratio of nominal total human capital and nominal GDP

Table 4.1.2 Total human capital and physical capital (Zhang *et. al.* 2004), 1985-2000, in trillions

year	total human capital	total physical capital*	ratio of human capital to physical capital
	deflator for fixed capital formation(1985=100)		
1985	19.30	1.42	13.60
1986	20.06	1.57	12.74
1987	21.52	1.76	12.25
1988	23.44	1.95	12.01
1989	26.41	2.08	12.70
1990	26.92	2.20	12.21
1991	26.85	2.37	11.33
1992	26.87	2.61	10.30
1993	26.80	2.94	9.12
1994	32.77	3.34	9.81
1995	37.90	3.80	9.98

year	total human capital	total physical capital*	ratio of human capital to physical capital
	deflator for fixed capital formation(1985=100)		
1996	44.12	4.29	10.28
1997	50.21	4.79	10.47
1998	53.29	5.36	9.95
1999	57.77	5.92	9.76
2000	62.33	6.54	9.54

*. Use the deflator based on 1952 to convert to the deflator based on 1985 (See Table C.9).

Moreover, we also compare our human capital estimates with the estimated total physical capital stock in China. There are a few estimates of China's capital stock. In Table 4.1.2 the estimated capital stock is estimated by Zhang, Wu and Zhang (2004) published in Economic Research, a leading academic journal in China. In Table 4.1.3, we use the capital stock estimates reported in Holz (2006). In both tables, we use the same deflators reported in the paper to calculate the human capital stock, respectively.

As can be seen in Figure 4.1.4 and Figure 4.1.5, in both cases, the total human capital is much higher than total physical capital. More specifically, human capital is about 7-14 times of the amount of physical capital. This is not surprising, given that in most countries human capital accounts for over 60% of national wealth (which also include natural resources). On the other hand, the ratio of human capital to physical capital appears to be declining continuously, based on both estimates of physical capital. It is unclear whether such a trend indicates that the Chinese government has overly weighted toward physical capital investment relative to human capital investment.[22]

---

[22] Heckman (2005) and Liu (2007) also find over-investment of physical capital and under-investment of human capital in China during the reform period.

Table 4.1.3 Total human capital and midyear real original value of fixed assets of Holz (2006), 1985-2003, in trillions

year	total human capital	midyear real original value of fixed assets*	ratio of total human capital to fixed assets
1985	19.30	1.73	11.13
1986	20.06	1.95	10.28
1987	21.53	2.18	9.89
1988	23.45	2.43	9.66
1989	26.41	2.70	9.77
1990	26.93	2.97	9.06
1991	26.60	3.26	8.17
1992	26.10	3.58	7.28
1993	25.71	3.94	6.53
1994	31.43	4.32	7.27
1995	36.37	4.75	7.66
1996	42.35	5.24	8.09
1997	48.19	5.78	8.34
1998	51.14	6.35	8.06
1999	55.44	6.94	7.99
2000	59.82	7.56	7.91
2001	64.12	8.19	7.83
2002	68.02	8.87	7.67
2003	72.53	9.66	7.51

*. Scrap value deflated using deflator of earlier period (1985=100) (See Table C.9)

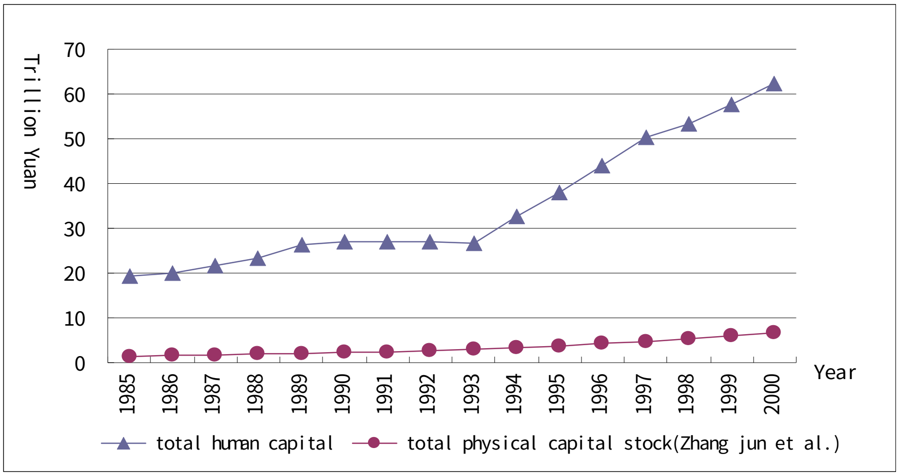


Figure 4.1.4 Total human capital and physical capital (Zhang *et. al.* 2004),1985-2000

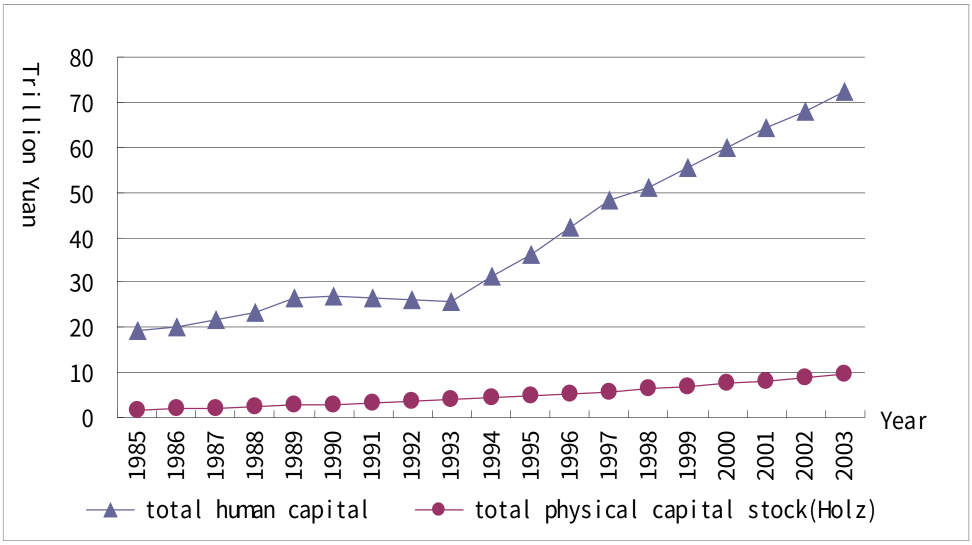


Figure 4.1.5 Total human capital and physical capital (Holz), 1985-2003

Table 4.1.4 shows the nominal human capital using the different discount rates. We can see that the discount rates influence the estimates greatly.

Table 4.1.4 1985-2008 nominal human capital using different discount rates

Unit: trillion RMB Yuan

Year	**Discount rate**			
	4.58%	**3.14%**	**8.14%**	**5.43%**
1985	19.30	26.98	9.86	13.54
1986	21.34	29.85	10.91	14.85
1987	24.11	33.70	12.35	16.59
1988	29.81	41.64	15.30	20.37
1989	36.44	50.76	18.81	24.92
1990	39.19	54.56	20.28	26.79
1991	42.39	58.89	22.05	28.81
1992	47.94	66.55	24.99	32.33
1993	59.80	82.85	31.30	40.17
1994	80.70	111.63	42.37	54.05
1995	98.89	136.55	52.10	66.20
1996	119.75	165.58	62.87	78.87

1997	138.58	191.59	72.69	90.01
1998	146.79	201.81	77.83	95.53
1999	158.50	217.59	84.22	102.36
2000	172.89	236.52	92.48	111.46
2001	186.07	254.24	99.92	119.61
2002	197.78	270.15	106.30	126.45
2003	215.53	294.59	115.68	137.00
2004	236.47	322.27	127.80	151.10
2005	256.91	349.81	139.37	164.75
2006	283.36	385.36	154.09	181.70
2007	322.38	437.55	176.13	207.56
2008	370.28	500.94	203.44	239.97

4.2 The trend of total human capital stock

In order to discuss the trend of the total human capital in China, we use CPI as deflator to calculate the real values. One reason is that other published deflators are not available for later years; and the other reason is that, as can be seen above, the results based on CPI are smaller than that based on capital deflators reported in those two studies. Thus, we give more conservative estimates of human capital in China.

From 1985 to 2008, the total human capital increased from RMB 19.30 trillion to 90.53 trillion, an increase of more than three-fold. The average annual growth for this period is 6.72% per year, considerably lower than economic growth.[23] Over the same period, the Chinese economy grew at an annual rate

[23] In calculating annual average growth rate in this report, we calculate annual growth rate using the difference of logarithm for every year, and then take average across years.

of 8.33%.[24] This helps explain the declining ratio of human capital to GDP. However, such a growth rate is much higher compared to that in other countries. For example, for 1970-2000, the annual average growth of human capital in Canada was 1.7% per year (Gu and Wang 2009). Moreover, the growth of human capital accelerated after 1994. The average annual growth for 1985-1994 is 5.24%, and for 1995-2008 is 7.67%. See the following Table 4.2.1.

Table 4.2.1 Real human capital by gender and location 1985-2008

Unit: trillion RMB Yuan

year	National	Male	Female	Urban	Rural
1985	19.30	11.12	8.18	7.72	11.58
1986	20.05	11.71	8.34	8.34	11.70
1987	21.09	12.39	8.70	9.14	11.96
1988	21.92	13.14	8.78	9.77	12.16
1989	22.72	13.73	8.99	10.36	12.36
1990	23.71	14.53	9.18	11.04	12.67
1991	24.75	15.31	9.44	11.81	12.95
1992	26.25	16.32	9.93	12.75	13.50
1993	28.48	17.84	10.64	14.05	14.43
1994	30.92	19.40	11.52	15.44	15.48
1995	32.33	20.35	11.97	16.34	15.99
1996	36.03	22.67	13.36	19.11	16.92
1997	40.44	25.44	15.00	22.42	18.02
1998	43.11	27.31	15.80	24.35	18.76
1999	47.11	29.74	17.37	27.41	19.70
2000	51.09	32.21	18.88	30.28	20.82
2001	54.51	34.26	20.25	32.93	21.58
2002	58.32	36.39	21.93	35.98	22.34

[24] The data come from “China Statistical Yearbook 2009”, Table 2-1, 2-5.

2003	62.75	38.87	23.88	39.39	23.37
2004	66.30	40.82	25.48	41.80	24.50
2005	70.76	43.42	27.34	44.57	26.18
2006	76.88	46.68	30.20	48.61	28.27
2007	83.45	50.24	33.21	52.70	30.76
2008	90.53	53.98	36.55	56.72	33.81

The results based on six education categories give similar trend (Figure 4.2.1). From 2000 to 2008, the total human capital increased from RMB 53.27 trillion to 96.88 trillion. The average annual growth rate for this period was 7.48%. The total human capital for male is higher than that for female (Figure 4.2.2). One reason is the earlier retirement age for women (age 55, vs. age 60 for men based on China labor law), and thus men have longer time to generate income in the market. The other reason is higher educational attainment for men. Moreover, the male-female income gap has been on rising. The results based on six education categories shows similar trends.

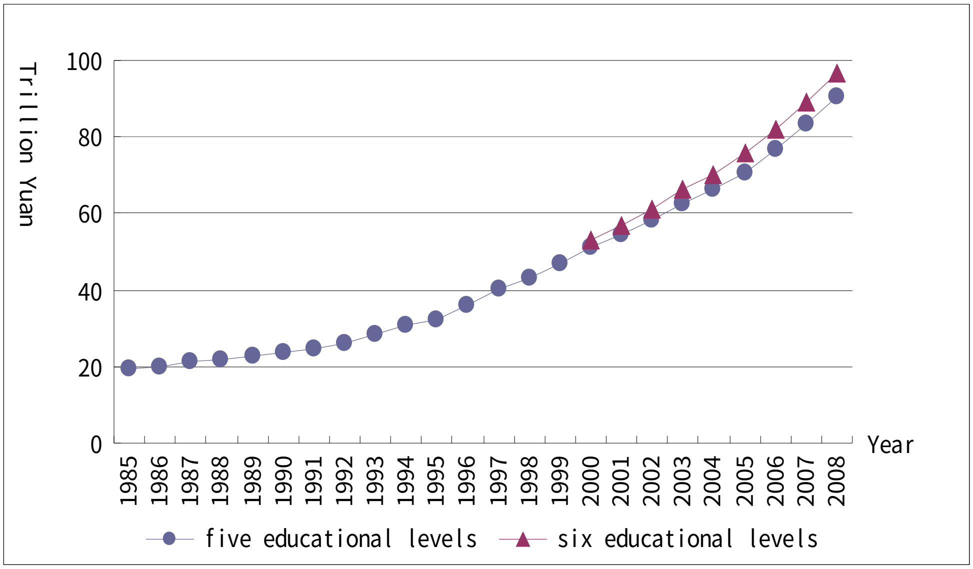


Figure 4.2.1 Total real human capital by education categories, 1985-2008

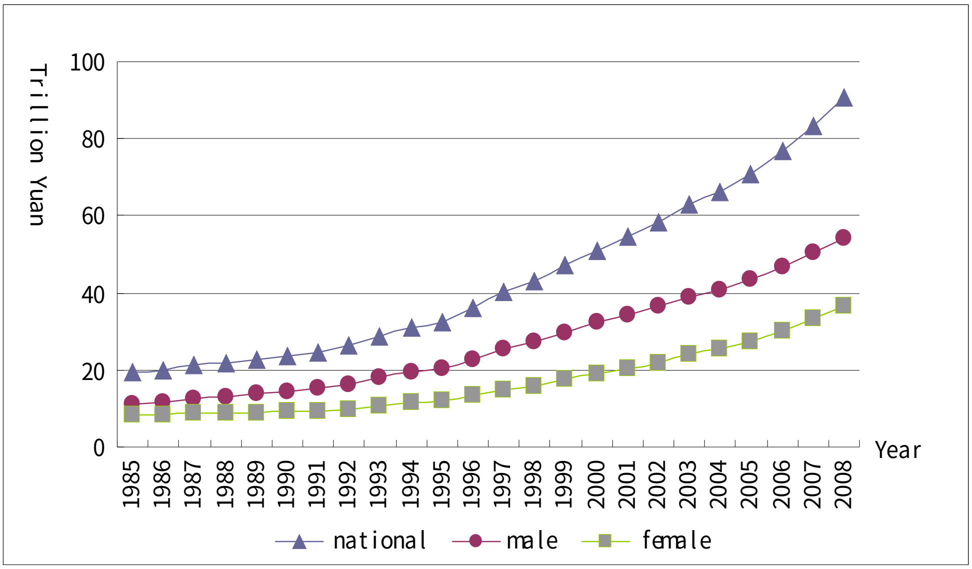


Figure 4.2.2 Total real human capital by gender, 1985-2008

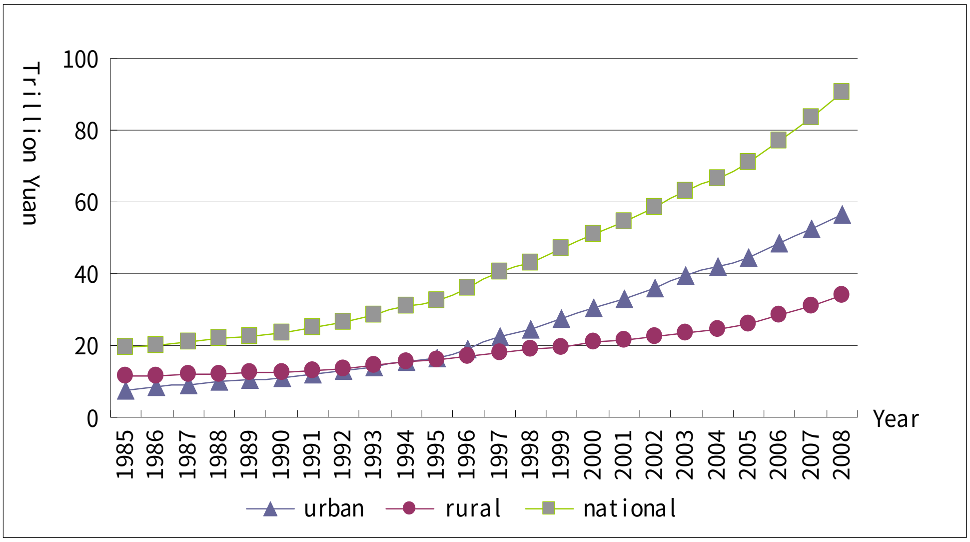


Figure 4.2.3 Total real human capital by urban and rural, 1985-2008

Figure 4.2.3 shows the total human capital for urban and rural China separately. Before 1995, the amount of total human capital in both areas was very close. In fact, rural human capital was even larger than that in the urban area until 1993. Since 1995, however, the human capital in the urban area has been rising much more rapidly. The total human capital for the rural area was 11.58 trillion in 1985 and 33.81 trillion in 2008; and for the urban area it was 7.72 trillion and 56.72 trillion, respectively. In this period, the annual growth rates of human capital were 4.66% and 8.67% for rural and urban areas, respectively. The urban-rural gap in the estimated human capital stock increased from 0.35 trillion in 1995 to 22.9 trillion in 2008, growing at an annual rate of 32.27%.

There are several reasons for such a trend. First, in early years, the rural population dominated, and thus had larger amount of human capital. For example, in 1985, there were 733 million people in rural areas, which were more than three times the urban population of 229 million. By 2008, however, the population in rural China reduced to 596 million, much closer to the urban population of 517 million. This change was, to a large extent, a result of the rapid urbanization during the course of economic transition as well as a large scale rural-urban migration.

The second reason is the education gap between the urban and rural population. In urban areas, the population with education at college or above accounted for 2.47% of the total population in 1985. This proportion increased to 13.54% by 2008. In rural areas, the corresponding figures were 0.074% in 1985 and 0.97% in 2008.

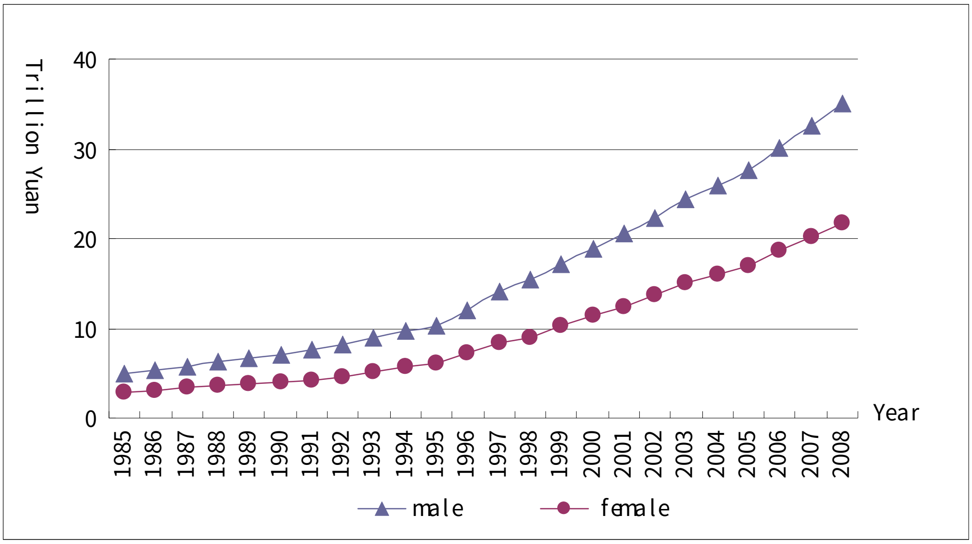


Figure 4.2.4 Total urban human capital by gender, 1985-2008

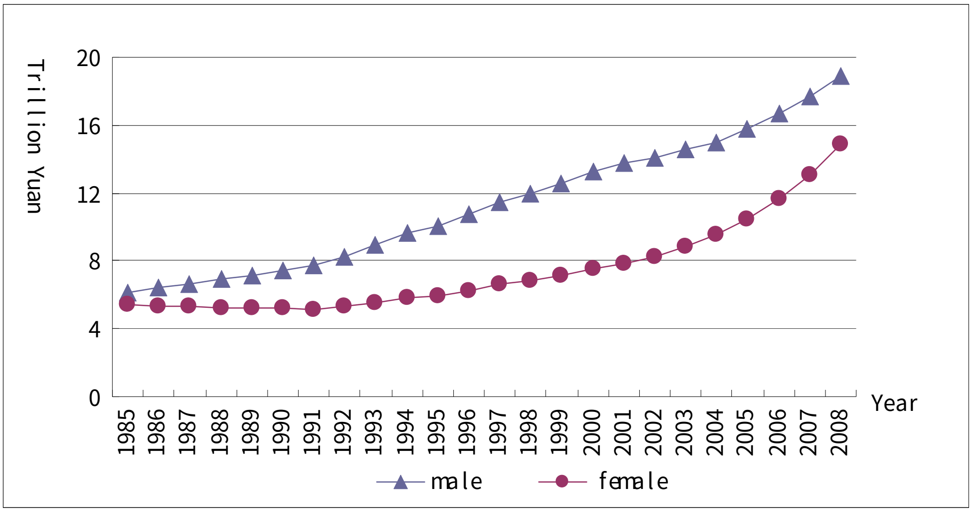


Figure 4.2.5 Total rural human capital by gender, 1985-2008

Figures 4.2.4 and 4.2.5 show the trends of male and female human capital estimates in urban and rural areas, respectively. Male and female human capital estimates in the urban area exhibit similar trend. But the gender gap seems to be widening. The gender-based human capital estimates for the rural population painted a somewhat different picture. In the later part of the period, the growth of human capital of males seems to have slowed down while that of females seems to have sped up, and therefore the gender gap became narrower. This result is probably caused by two factors: i) a disproportionate rural-to-urban migration in favor of men; and ii) an increase in education for women in rural areas. The reduction of gender gap in the rural area is consistent with the rising gender disparity in the urban area.

Table 4.2.2 Total human capital index, 1985-2008 (1985=100)

year	total human capital	male total human capital	female total human capital	urban total human capital	rural total human capital
1985	100	100	100	100	100
1986	103.88	105.32	101.91	108.06	101.09
1987	109.31	111.47	106.37	118.36	103.27
1988	113.60	118.20	107.36	126.48	105.01
1989	117.73	123.50	109.90	134.16	106.78
1990	122.88	130.72	112.23	142.99	109.47
1991	128.26	137.75	115.38	152.92	111.82
1992	136.03	146.81	121.39	165.18	116.59
1993	147.57	160.47	130.04	181.97	124.62
1994	160.22	174.52	140.80	199.97	133.71
1995	167.52	183.11	146.33	211.59	138.13
1996	186.71	203.91	163.34	247.53	146.15
1997	209.55	228.87	183.31	290.42	155.62
1998	223.41	245.68	193.17	315.40	162.07
1999	244.14	267.54	212.35	355.06	170.17

year	total human capital	male total human capital	female total human capital	urban total human capital	rural total human capital
2000	264.76	289.80	230.75	392.17	179.80
2001	282.49	308.21	247.54	426.53	186.44
2002	302.19	327.32	268.05	466.03	192.93
2003	325.20	349.70	291.90	510.17	201.84
2004	343.57	367.26	311.40	541.45	211.61
2005	366.66	390.57	334.18	577.31	226.18
2006	398.39	419.91	369.16	629.62	244.19
2007	432.45	451.98	405.92	682.56	265.66
2008	469.14	485.60	446.78	734.65	292.08

Finally we calculate human capital index using 1985 as the base year and set its value at 100. The results for each group are reported in Table 4.2.2. Figure 4.2.6 shows the index of total human capital, and Figures 4.2.7 and 4.2.8 show the index by gender for urban and rural areas, respectively.

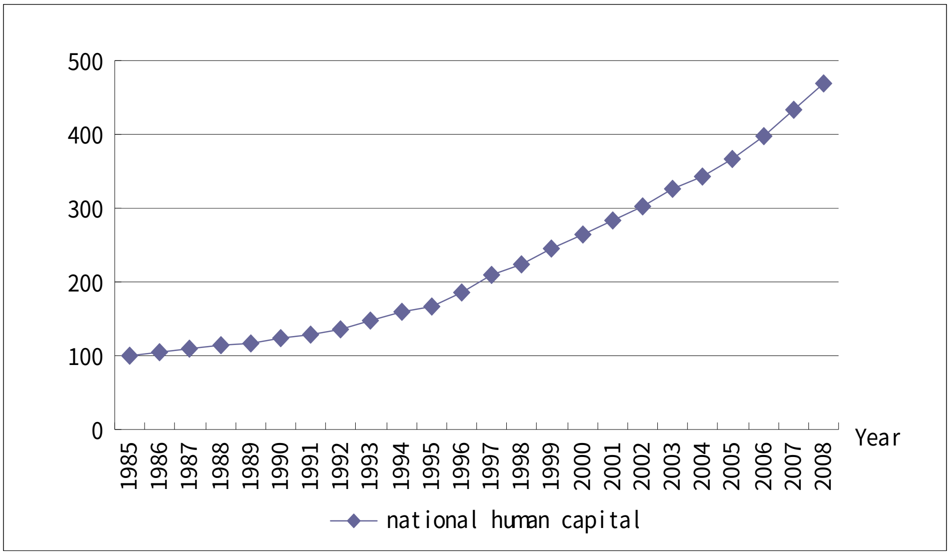


Figure 4.2.6 The index of total human capital, 1985-2008

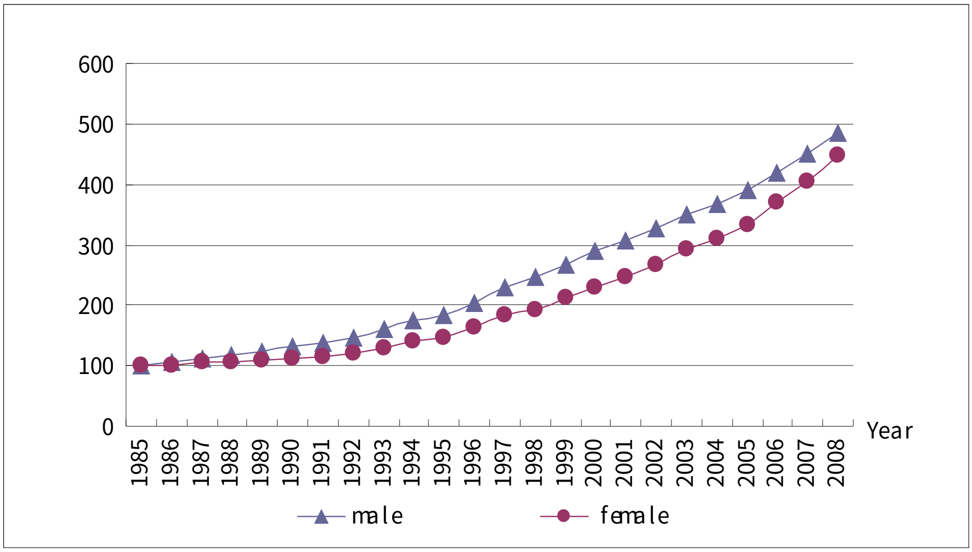


Figure 4.2.7 The index of total human capital by gender, 1985-2008

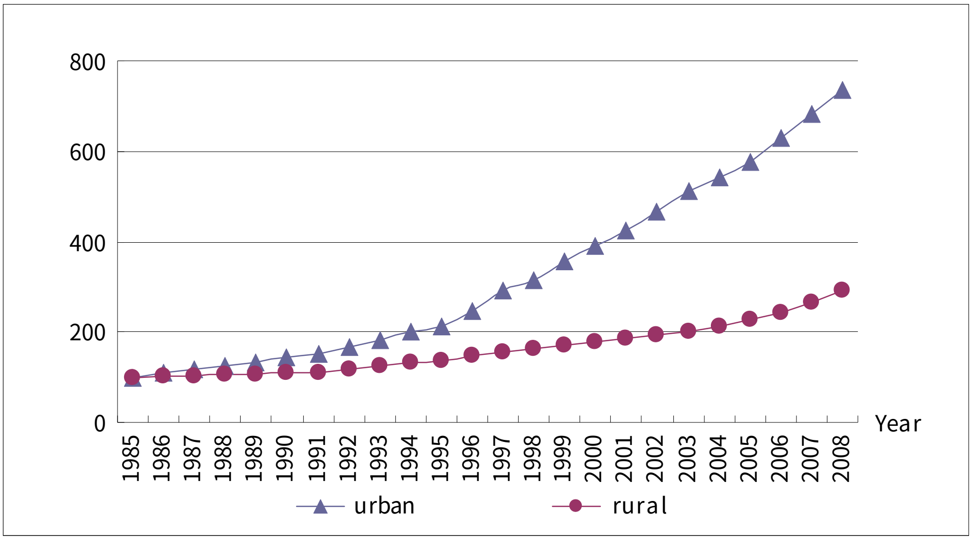


Figure 4.2.8 The index of total human capital by urban and rural, 1985-2008

4.3 Per capita human capital

The increase in the total human capital can be caused by population growth, demographic changes (e.g., the size of retirement group), rural-urban migration or urbanization (e.g., an individual can achieve higher value of human capital by moving from rural to urban area), higher educational attainment, higher rates of return to education, higher rates of return to on-the-job training, etc. In order to get further information on the dynamics of human capital in China, we calculate per capita human capital, i.e., the ratio of total human capital over non-retired population (Table 4.3.1).

Figures 4.3.1 and 4.3.2 show per capita human capital based on 5- and 6-education categories, respectively. Based on 5-education category, the per capita human capital was RMB 20,059 in 1985, RMB 30,073 in 1995, and RMB 81,282 in 2008. From 1985 to 2008, per capita human capital increased 3.1 times; while over the same period, per capita real GDP increased 5.8 times, much faster than the growth of per capita human capital. Per capita human capital has been increasing since 1985, and the growth accelerated from 1995. The average annual growth rate was 4.1% from 1985 to 1994, and 7.4% from 1995 to 2008. The growth rate in the later period is almost twice as high as that in the earlier period.

Table 4.3.1 Real per capita human capital and real per capita GDP (1985 yuan)

year	real per capita human capital					real per capita GDP
	national	urban	rural	male	female	
1985	20059	33742	15789	22027	17887	858
1986	20563	34842	15913	22921	17967	920
1987	21337	36491	16196	23961	18458	1010

1988	21827	37581	16329	24902	18424	1106
1989	22288	38627	16456	25551	18651	1134
1990	22932	40197	16689	26611	18816	1160
1991	23697	41829	16983	27804	19116	1250
1992	24924	44088	17668	29421	19920	1410
1993	26835	47427	18861	32000	21120	1589
1994	28939	50927	20228	34592	22693	1776
1995	30073	52724	20900	36210	23346	1949
1996	33165	57911	22369	39850	25820	2122
1997	36865	64020	24128	44189	28774	2295
1998	38975	65762	25496	46872	30186	2452
1999	42276	70244	27204	50602	32985	2616
2000	45545	73845	29243	54301	35717	2814
2001	48557	77193	31008	57899	38145	3025
2002	51877	81033	32842	61628	41090	3278
2003	55811	85394	35236	65962	44631	3584
2004	59077	88123	37811	69506	47627	3922
2005	63364	91820	41481	74403	51282	4306
2006	68887	98098	45560	79873	56811	4781
2007	74815	103914	50557	85818	62660	5376
2008	81282	109527	56739	92046	69313	5827

These growth rates are very high compared to those for Canada and the United States. Per capita human capital for Canada basically remained constant during 1980-2000 and even declined at an annual rate of 0.2% during 2000-2007 (Wu and Ambrose 2009). Per capita human capital in the United States also basically remained constant during 1994-2006 (Christian 2009). Such a huge difference is probably caused by the dramatic economic growth since 1978, rapid expansion of education, transition toward market-oriented system (so that human capital can realize much higher value), and rural-urban migration.

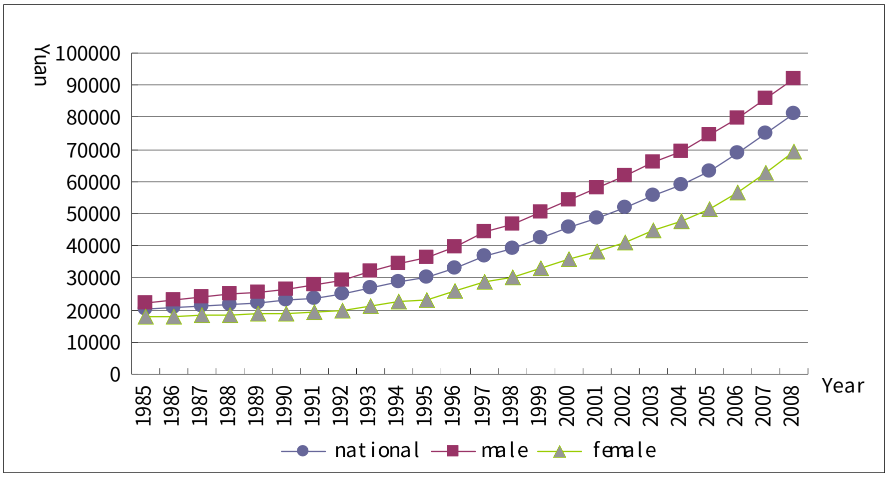


Figure 4.3.1 Real per capita human capital by gender, 1985-2008

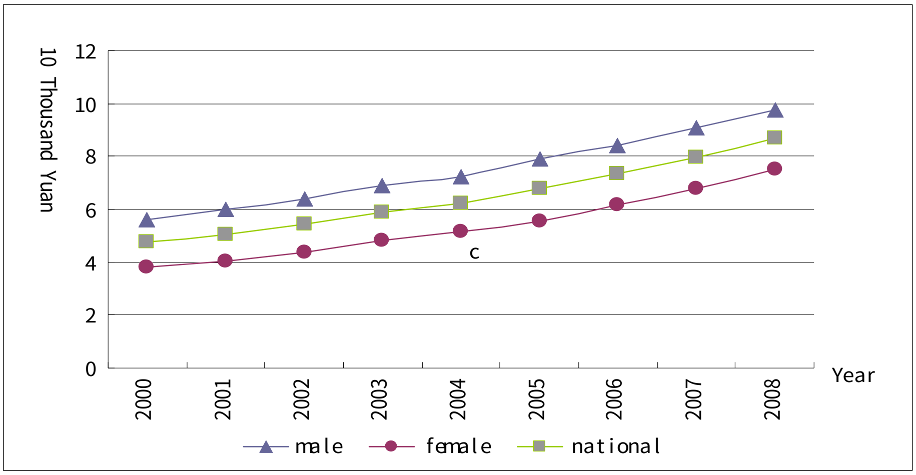


Figure 4.3.2 Real per capita human capital by gender, 2000-2008

Per capita human capital shows a similar trend for males and females. Specifically, the average annual growth rate for 1985-1994 was 5.0% for males and 2.6% for females; the average annual growth rate for 1995-2008 was 7.0% for males and 8.0% for females.

Clearly, the percentage point increase in the growth rates between the two periods is substantially greater for females than for males. In fact, from 1996 onward, the growth rate was lower for males than for females.

Figures 4.3.3 and 4.3.4 show per capita human capital for urban and rural areas based on two alternative classifications of education. Based on 5-education category, in 1985, per capita human capital is 33742 in the urban area and 15789 in the rural area; the corresponding numbers become 109527 and 56739, respectively, in 2008. The absolute size of the urban-rural gap has been on the rise. The annual growth rate was 5.12% for the urban area (4.57% for 1985-1994 and 5.47% for 1995-2008), and 5.56% for the rural area (2.75% for 1985-1994 and 7.37% for 1995-2008). Therefore, the urban-rural gap was widening for 1985-1994, while it has narrowed thereafter. The wide urban-rural gap raises concern for the increasing disparity between these two areas. Based on Fleisher, Li and Zhao (2009), human capital is a significant contributing factor to economic growth (total factor productivity). Therefore, such a trend in human capital can worsen the urban-rural inequality in China.

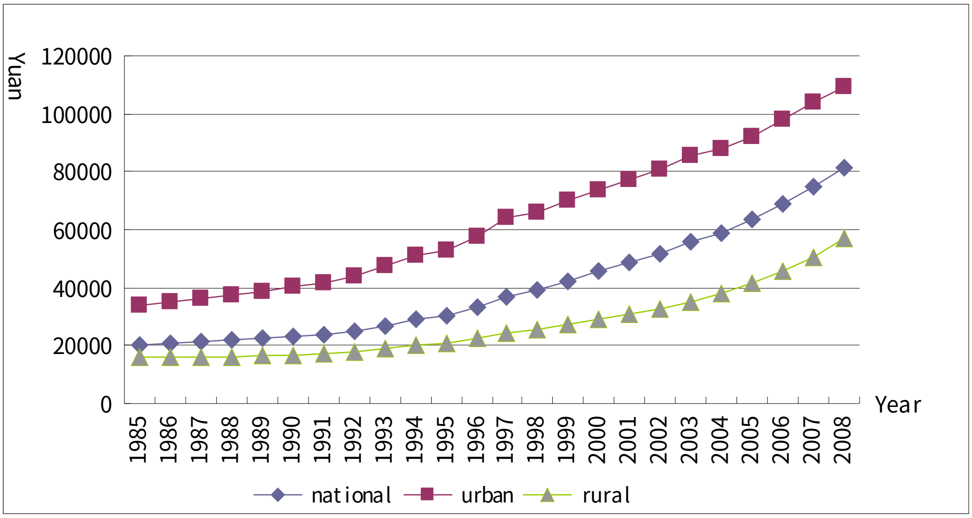


Figure 4.3.3 Real per capita human capital by urban and rural, 1985-2008

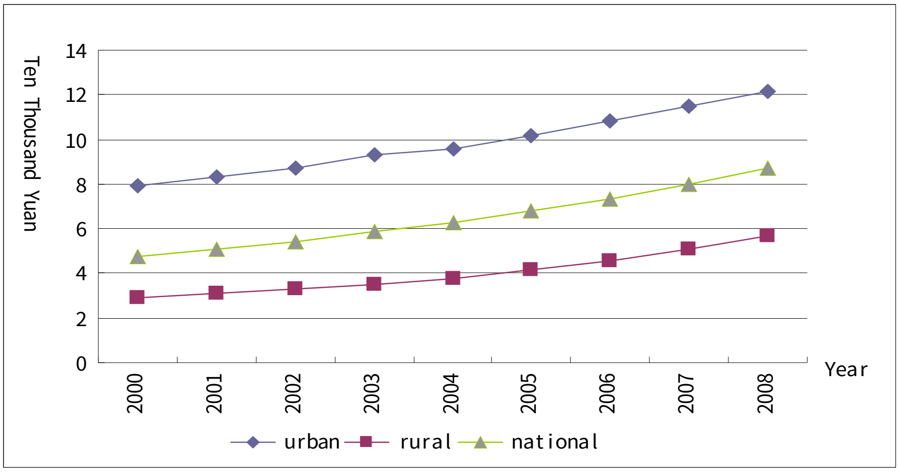


Figure 4.3.4 Real per capita human capital by urban and rural, 2000-2008

Figures 4.3.5 and 4.3.6 show the gender differences for urban and rural areas, respectively. The patterns are similar to that of total human capital. In particular, per capita human capital for males and females show similar trend in the urban area, but per capita human capital grew faster for females than males in the rural area in recent years. Although both male and female growth rates have increased, the female growth rate has increased much more than the male.

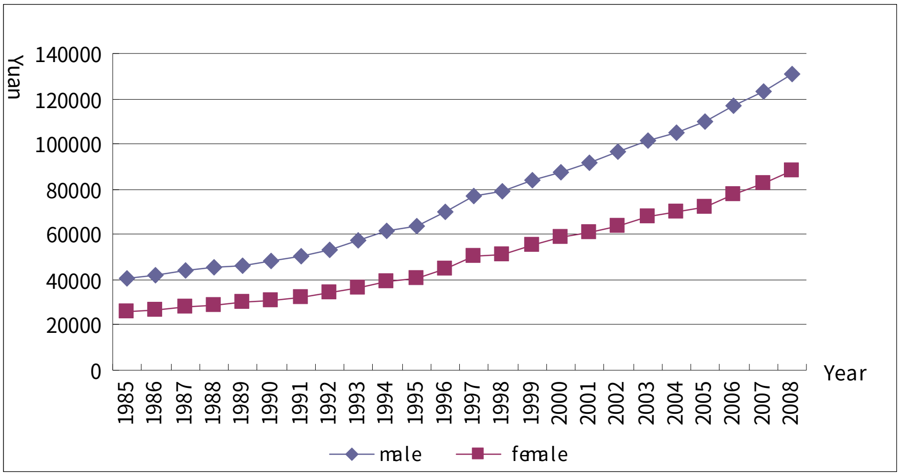


Figure 4.3.5 Urban real per capita human capital, 1985-2008

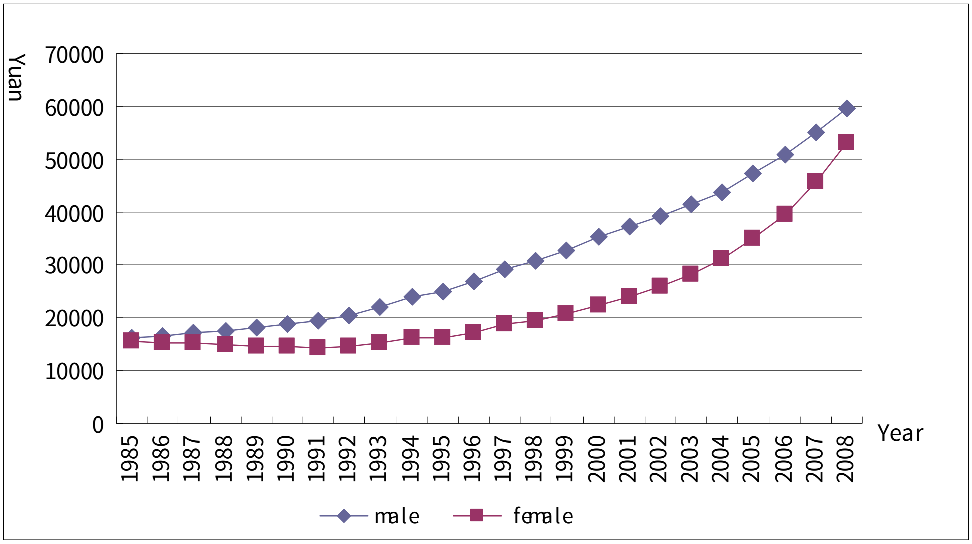


Figure 4.3.6 Rural real per capita human capital, 1985-2008

We also construct per capita human capital index with its corresponding value in 1985 set as 100 (Table 4.3.2). Figures 4.3.7and 4.3.8 show various per capita human capital indexes.

Table 4.3.2 Per capita human capital index 1985-2007 (1985=100)

year	average human capital	male average human capital	female average human capital	urban average human capital	rural average human capital
1985	100	100	100	100	100
1986	102.51	103.26	100.79	104.06	100.45
1987	106.37	108.15	102.58	108.78	103.20
1988	108.82	111.38	103.42	113.05	103.01
1989	111.11	114.48	104.22	116.00	104.27
1990	114.33	119.13	105.70	120.81	105.19
1991	118.14	123.96	107.57	126.22	106.87
1992	124.26	130.66	111.90	133.57	111.37
1993	133.78	140.56	119.46	145.27	118.08
1994	144.27	150.93	128.12	157.04	126.87

year	average human capital	male average human capital	female average human capital	urban average human capital	rural average human capital
1995	149.93	156.25	132.37	164.38	130.52
1996	165.34	171.63	141.68	180.91	144.35
1997	183.78	189.73	152.82	200.61	160.87
1998	194.30	194.90	161.49	212.79	168.76
1999	210.76	208.18	172.30	229.72	184.41
2000	227.06	218.85	185.22	246.52	199.68
2001	242.07	228.77	196.39	262.85	213.26
2002	258.62	240.15	208.01	279.78	229.72
2003	278.24	253.08	223.17	299.45	249.52
2004	294.52	261.16	239.48	315.54	266.27
2005	315.89	272.12	262.73	337.78	286.70
2006	343.43	290.73	288.56	362.61	317.61
2007	372.98	307.97	320.21	389.60	350.31
2008	405.22	324.60	359.37	417.87	387.51

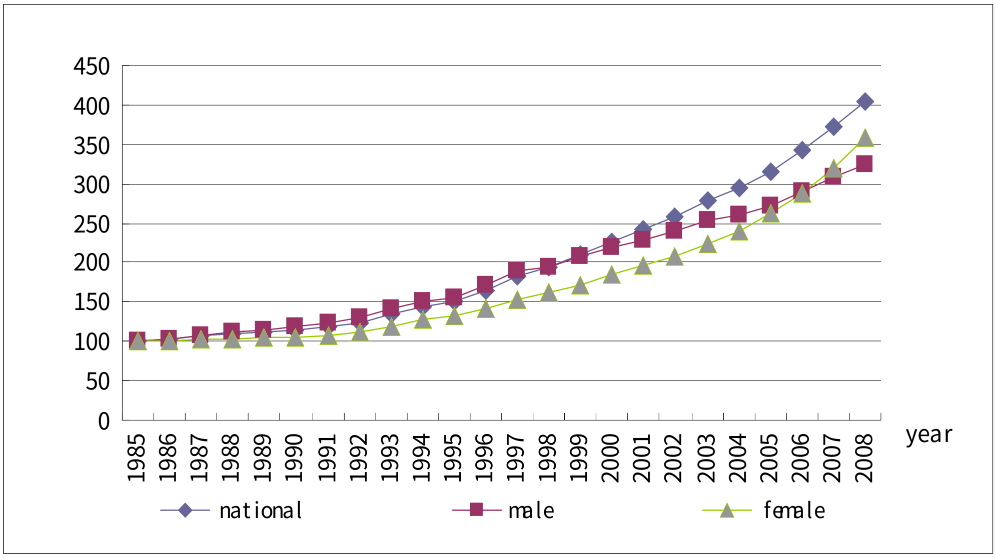


Figure 4.3.7 Real per capita human capital index by gender, 1985-2008

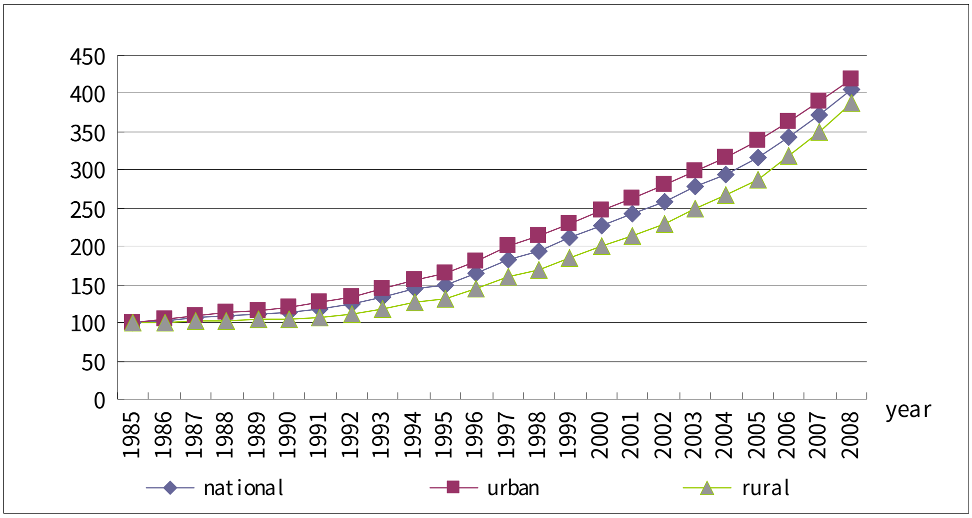


Figure 4.3.8 Real per capita human capital index by urban and rural, 1985-2008

4.4 Divisia indices

In order to discuss the trend of the total human capital in China, we construct real human capital by using Divisia quantity indices. Following the methodology outlined in Jorgenson, Ho and Stiroh (2005) the growth rate of aggregate human capital stock is calculated as a weighted sum of the growth rates of the number of individuals across different educational, age, gender and location categories:

$$d\ln K = \sum_s \sum_e \sum_a \sum_l \bar{v}_{s,e,a,l} \, d\ln L_{s,e,a,l} \tag{17}$$

where K denotes the volume indices of aggregate human capital stock, $L_{s,e,a,l}$ the number of individuals with gender s, educational level e, age a, and location l, and d denotes a first difference, or change between two consecutive periods, for example:

$$d\ln K = \ln K(t) - \ln K(t-1) \tag{18}$$

The weights are given by the average share of each category of population in the nominal value of aggregate human capital stock:

$$\bar{v}_{s,e,a,l} = \frac{1}{2}[v_{s,e,a,l}(t) + v_{s,e,a,l}(t-1)], v_{s,e,a,l} = \frac{Mi_{s,e,a,l}}{\sum_s \sum_e \sum_a \sum_l Mi_{s,e,a,l}} \quad (19)$$

Where $Mi_{s,e,a,l}$ is the lifetime income of different types of the individuals, cross-classified by gender, education, age and location.

Then we set the base year b[25], accumulate the annual human capital growth rate, and get the growth rate relative to the base year:

$$MItg(t) = \sum_b^t d \ln K \quad (20)$$

We get the human capital quantity of t year:

$$MIQ(t) = \frac{\exp[MItg(t)] \cdot MI(b)}{\exp[MItg(b)]} \quad (21)$$

Further, to examine the contribution to the compositional change of aggregate human capital stock from population characteristics such as gender, education, age, and location separately, we construct the partial indices of aggregate human capital stock corresponding to those characteristics. There are four orders partial indices based on our classification by gender, education, age, and location[26].

The first order partial index of the volume of aggregate human capital stock corresponding to one characteristic (e.g. education) is defined as follows:

$$d \ln K^e = \sum_e \bar{v}_e d \ln L_e \quad (22)$$

---

[25] In this paper we use 1985 as the base year.

[26] We also can call the aggregate index the fourth order index.

$$\bar{v}_e = \frac{1}{2}[v_e(y) + v_e(y-1)], v_e = \frac{Mi_e}{\sum_e Mi_e} \tag{23}$$

The second order partial index of the volume of aggregate human capital stock corresponding to two characteristics (e.g. education and age) is defined as follows:

$$d \ln K^{e,a} = \sum_e \sum_a \bar{v}_{e,a} d \ln L_{e,a} \tag{24}$$

$$\bar{v}_{e,a} = \frac{1}{2}[v_{e,a}(y) + v_{e,a}(y-1)], v_{e,a} = \frac{Mi_{e,a}}{\sum_e \sum_a Mi_{e,a}} \tag{25}$$

The third order indices are similarly defined. There are four first order indices, six second order indices and four third order indices. The following Table 4.4.1 only report the first order Divisia indices and the aggregate index.

Table 4.4.1 Divisia indices 1985-2008
(Base year: 1985, in trillions)

Year	Aggregate	By age	By education	By gender	By location
1985	19.30	19.30	19.30	19.30	19.30
1986	19.68	19.54	19.58	19.55	19.69
1987	20.07	19.79	19.87	19.82	20.12
1988	20.55	20.07	20.41	20.15	20.55
1989	20.95	20.30	20.95	20.46	20.96
1990	21.29	20.50	21.46	20.77	21.31
1991	21.47	20.56	21.80	20.97	21.63
1992	21.64	20.60	22.10	21.14	21.92
1993	21.81	20.59	22.43	21.29	22.20
1994	22.14	20.59	22.74	21.43	22.48
1995	22.40	20.57	23.11	21.54	22.73
1996	23.28	20.76	23.59	21.78	23.40

Year	Aggregate	By age	By education	By gender	By location
1997	24.19	20.92	24.11	22.00	24.07
1998	24.86	20.95	24.64	22.20	24.72
1999	25.42	20.90	25.18	22.38	25.35
2000	25.90	20.78	25.78	22.54	25.96
2001	25.93	20.46	26.00	22.54	26.39
2002	26.12	20.27	26.18	22.55	26.85
2003	26.57	20.10	26.31	22.55	27.28
2004	26.54	19.76	26.41	22.50	27.56
2005	26.27	19.32	26.48	22.38	27.72
2006	26.39	19.24	26.76	22.38	27.93
2007	26.64	19.19	27.02	22.38	28.17
2008	26.71	19.06	27.21	22.34	28.28

From 1986 to 2008, the aggregate Divisia index increases at the average growth rate of 1.41%. The growth rates of Divisia indices based on location and education level are significantly higher than that of the indices based on gender and age. From 1986 to 2008, the average annual growth rate of the Divisia indices based on gender and age are 0.64% and -0.05%, while location-based and education-based Divisia indices grow at the average annual growth rate of 1.66% and 1.49%. Taking into account the period of education improvement and rapid urbanization, this phenomenon is not surprising. Moreover, in recent years, accelerated aging also makes the age-based Divisia index a downward trend after 1999. See the following Figure 4.4.1.

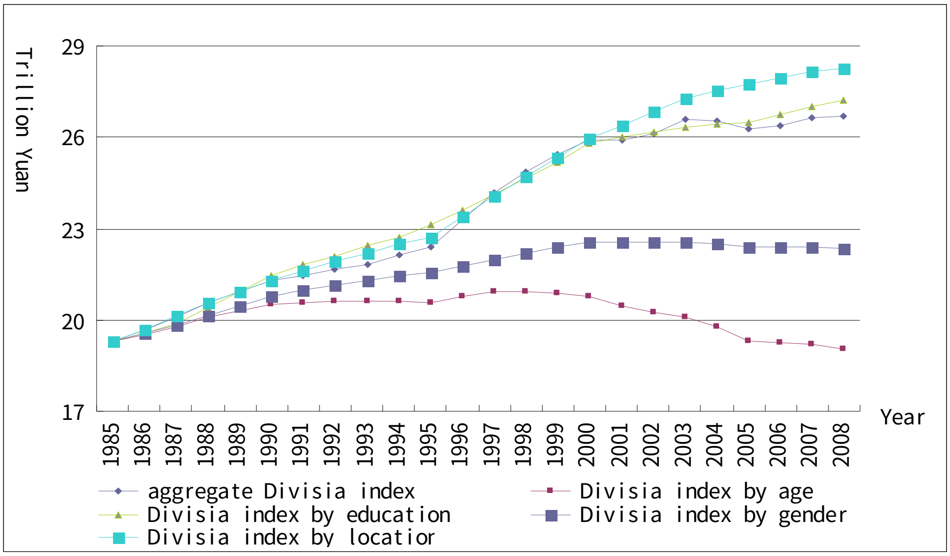


Figure 4.4.1 Divisia index, 1985-2008

4.5 Human capital in China 2009-2020: a projection

In order to understand future trend of human capital in China, we estimate human capital for 2009-2020. In particular, we forecast population in different age, gender and education groups using the perpetual inventory method, and then estimate human capital using the Jorgenson-Fraumeni method. For simplicity, we keep all other related data and parameters at their 2008 values.[27]

If we only project population in different age, gender and education groups for 2009 to 2020 while keeping other variables at their 2008 values, the change in human capital will mainly reflect the change in population composition. Figure 4.5.1 shows that results based on 5- and 6-education-categories.

[27] Due to data limitation, we use the average values of year 1995 and 2000 for age, gender and education based employment rates.

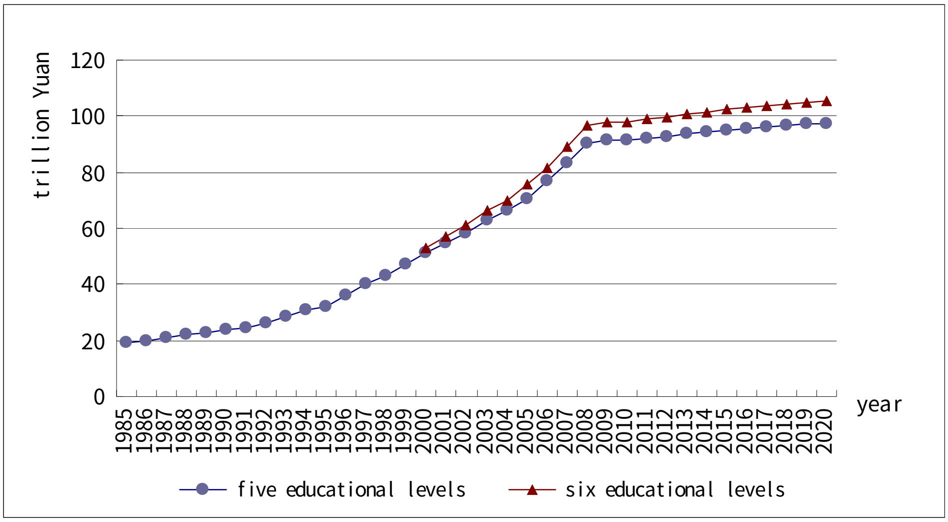


Figure 4.5.1 Total real human capital by education categories, 1985-2020

In both cases, the total human capital increases but at a much slower rate compared to that before 2008. The average annual growth rate is 0.62%, based on 5-education-category. This is much lower than the average annual growth of 6.72% for 1985-2008. There are several reasons for the slower growth. First, the return to education is kept at 2008 level, but was rising before that period. Return to education has a strong effect on lifetime earnings. Second, population growth will slow down in China due to the one-child policy. Third, it is expected that the growth of human capital will slow down when the economy gets closer to its steady state, including wage growth, returns to schooling, etc.

A similar pattern can be seen in male and female total human capital and per capita human capital (Figures 4.5.2 and 4.5.3). Interestingly the trends are quite different for urban and rural areas. As Figure 4.5.4 shows, urban human capital continues to increase throughout the entire period. However, the rural human capital declines. This is probably caused by the continuing declining of rural population, as a result of urbanization and rural-urban migration. However, the per capita human capital (Figure 4.5.5) in the rural area is quite flat and does not show a downward trend.

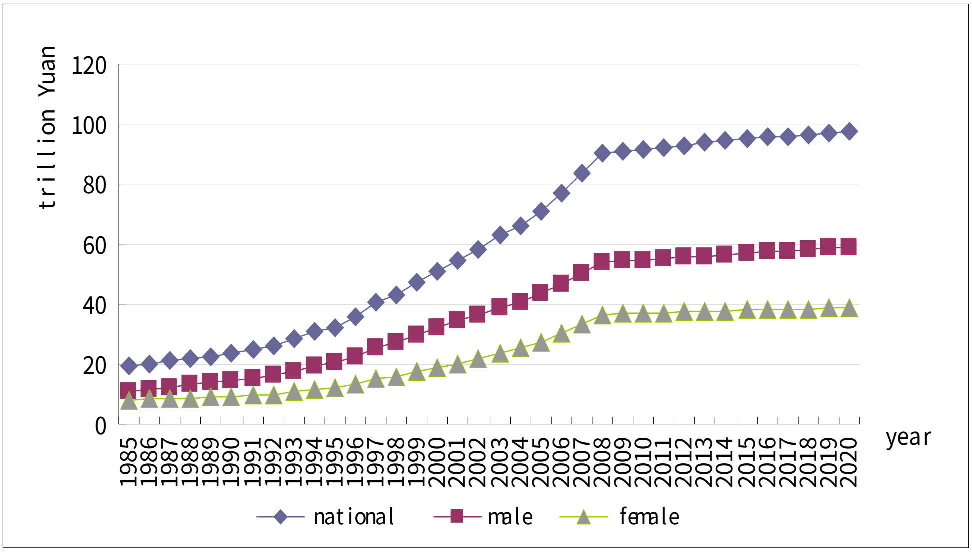


Figure 4.5.2 Real total human capital by gender, 1985-2020

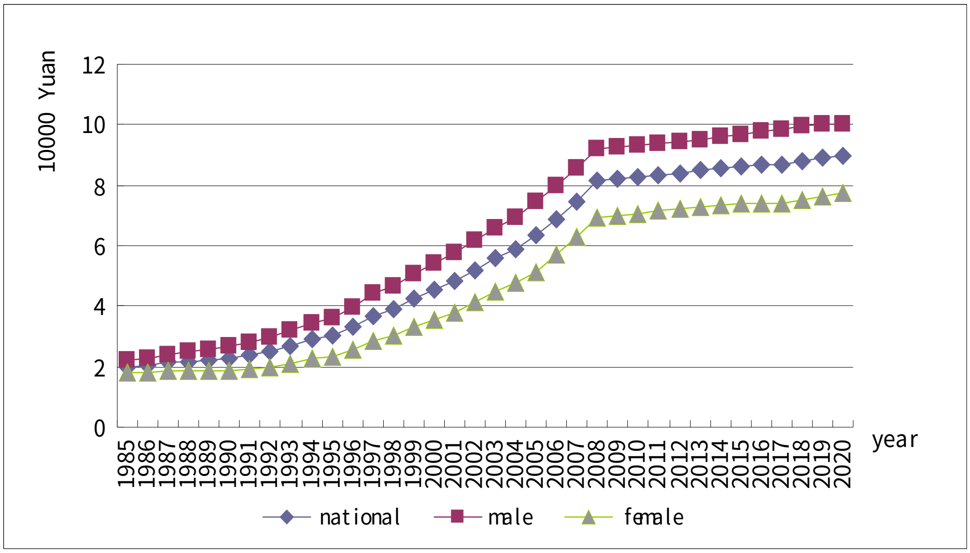


Figure 4.5.3 Real per capita human capital by gender, 1985-2020

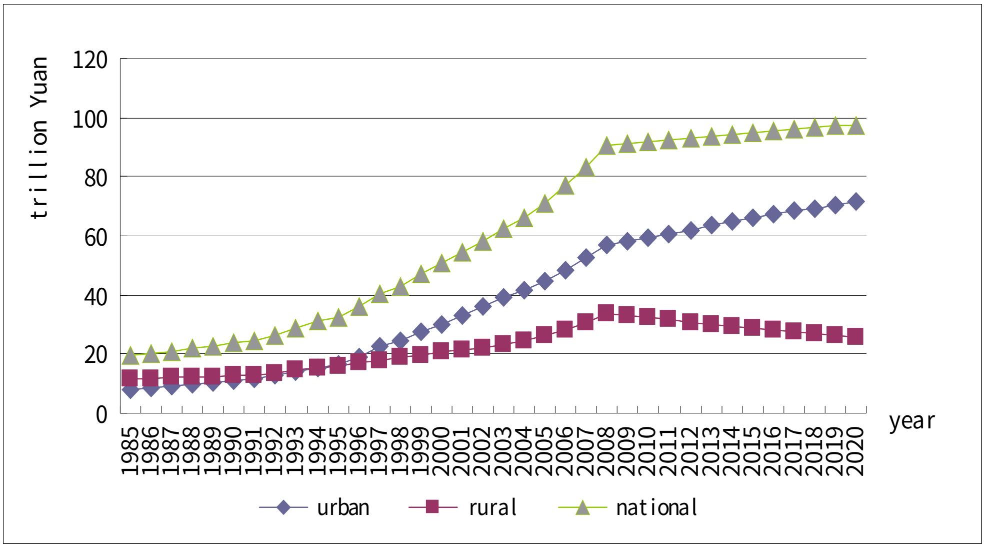


Figure 4.5.4 Real total human capital: urban, rural and national, 1985-2020

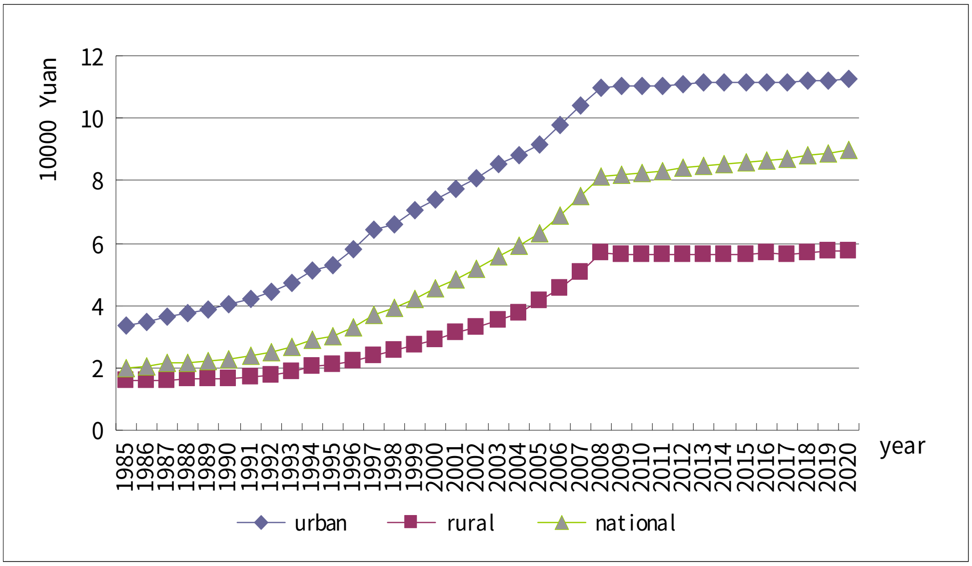


Figure 4.5.5 Per capita real human capital: urban, rural and national, 1985-2020

4.6 International comparison

A summary of international comparison of human capital estimates is reported in Table 4.6.1. China's total human capital is quite large, second only to the United States. However, China's per capita human capital is still very small. In 2001, the total human capital in China is 18 times of that in Australia and about 172 times of that in New Zealand. In 2006, China's total human capital is about 78 times of Norway's, and in 2007, China's total human capital is 11 times of Canada's. However, per capita human capital in China is one-fifth of that in Australia, one-fourth of that in Canada and one-sixth of that in US. The large gap in per capital human capital between China and these selected developed economies may suggest that it is necessary for China to invest more in human capital as it further develops.

Table 4.6.1 International comparison of human capital estimates

Currency unit: USD Dollars

	Canada	**Norway**	**New Zealand**	**U.S.**	**Australia**	**China**		
	2007	2006	2001	2006	2001	2001	2006	2007
Age Range	15-74	15-67	21-65	0-80	18-65	male 0-60, female 0-55		
Per capita human capital	54.85		32.32	about 70	35.56	7.84	11.55	13.05
Total human capital (trillions)	13.61	1.66	0.51	212	4.86	87.96	128.87	145.57
Ratio of human capital to GDP	11	8	6	>15	10	17	13.4	13

Note: the PPP exchange rates are from http://pwt.econ.upenn.edu/php_site/pwt_index.php

4.7 Conclusions

In this report, we presented our estimates of China's human capital for 1985-2008, using J-F lifetime income approach. We calculated total human capital at the national level, for urban and rural, and for male and female, as well as per capita human capital. We also constructed various human capital indexes, including Divisia quantity indexes. We projected the trend of human capital in one scenario for up to year 2020. Our main findings are summarized below.

First, for the period of 1985-2008, China's total human capital increased more than three times, with an annual growth rate of 6.72%. This growth rate is much higher compared to other countries. Moreover, the growth of human capital accelerated after 1994, and the average annual growth for 1995-2008 is 7.67%.

Second, the total human capital in urban area increased at a much higher rate than in rural area over the period 1985-2008. The annual average growth rates are 8.67% and 4.66% respectively for urban and rural areas. The total human capital in urban area surpassed that in rural area after 1994. The urban-rural gap has been widening rapidly, probably because of urbanization, large-scale rural-urban migration, and increase in educational attainment.

Third, per capita human capital also increased rapidly from 1985-2008, with a higher growth rate since 1995. Interestingly, before 1995 total human capital increased faster than per capita human capital on average, while since 1995, both have grown at a similar average annual rate. This result indicates that in recent years, the growth of human capital is mostly driven by factors such as increases in educational attainment, not by population growth.

Fourth, the gender gap in total human capital has been widening at the national level. However, the gender difference in per capita human capital appears to be narrowing down.

Fifth, the education-based and location-based Divisia indices grew at a much higher rate than the gender-based and age-based Divisia indices. This indicates the greater impact of education and urbanization on China's human capital accumulation.

On the other hand, our results also show that, compared to GDP and physical capital, human capital grew at a slower pace. More specifically, the ratio of human capital to GDP decreased from approximately 21 in 1985 to 12 in 2008; and the ratio of human capital to physical capital also declined from 11-14 in 1985 to 7-8 in 2003, these findings indicates that the Chinese government should invest more in human capital, especially compared to physical capital investment.

The gap in total human capital and per capita human capital between urban and rural areas has been increasing. Thus, in order to reduce urban-rural inequality, more investment in human capital should be directed to the rural area.

Finally, our projection to 2020 shows that, if we keep everything else at the 2008 level and only allow population to change, the growth of total human capital and per capita human capital will slow down after 2008. The amount of total human capital will even decline in rural China. Therefore, more active policies on human capital investment should be adopted in order to maintain the high speed growth.

Chapter 5 Results for Beijing

5.1 The trend of total human capital stock

The estimated human capital varies with discount rate. Based on four different discount rates, this report calculates the total human capital stocks measured in nominal terms. The results are reported in Table 5.1.1. Among the four different discount rates, 3.14% is the average interest rate of 10-year national bonds issued by Chinese government; 5.43% is the interest rate of long-term loans from commercial banks to enterprises; 4.58% is the discount rate used by OECD in the context of human capital estimation[28]; 8.14% is the social discount rate of China calculated by World Bank.

Table 5.1.1 Total human capital based on different discounts rates(Nominal)
Unit: 100 Million Yuan

Year	Discount rate 3.14%	Discount rate 4.58%	Discount rate 5.43%	Discount rate 8.14%
1985	4673.13	3226.78	2645.45	1537.25
1986	5430.39	3755.52	3081.98	1796.80
1987	6314.03	4398.41	3624.03	2136.31
1988	7791.65	5436.72	4484.11	2651.97
1989	9567.72	6700.47	5537.83	3294.61
1990	11768.57	8282.02	6863.71	4115.49
1991	13665.21	9679.87	8050.69	4873.24
1992	16209.08	11516.30	9593.32	5831.64
1993	19129.76	13644.40	11389.84	6962.79
1994	22603.36	16190.20	13544.75	8327.23
1995	26889.91	19346.30	16222.47	10031.73

[28] The analysis in this chapter is based on the discount rate 4.58% except additional illustration.

Year	Discount rate 3.14%	Discount rate 4.58%	Discount rate 5.43%	Discount rate 8.14%
1996	34183.93	24548.00	20557.60	12656.53
1997	42788.32	30831.70	25859.78	15970.02
1998	55956.80	40120.30	33549.80	20531.91
1999	67857.05	49048.70	41192.59	25492.31
2000	86859.85	62684.20	52591.25	32442.22
2001	106055.35	76806.40	64573.51	40084.24
2002	131704.94	95608.30	80484.21	50135.44
2003	161955.79	118036.00	99581.85	62409.85
2004	197559.14	144585.00	122269.14	77156.14
2005	245002.68	179494.00	151904.31	96122.80
2006	304250.74	223427.00	189334.83	120257.94
2007	381784.51	280437.00	237705.20	151146.57
2008	481414.83	354139.00	300433.78	191524.96

In order to discuss the trend of total human capital stock for Beijing, we often need to adjust the nominal value into real value by using adjustment index. It's obvious that different adjustment indexes have significant impact on the final estimated results. The real values of total human capital stock calculated by three different price indexes are reported in Table 5.1.2(all based on 1985). Column 1 uses CPI classified by rural and urban in Beijing as deflator, and thus the results exclude the inflation factor; Column 2 uses the living cost index. Based on the living cost of urban in Beijing, the real values are comparable between rural and urban; it's also the case for the comparison among various provinces. Column 3 uses index of fixed assets investment as deflator, comparing the human capital with the physical capital. The results show that the real value of total human capital adjusted by index of living cost is highest; the real values of total human capital adjusted by CPI and fixed asset investment respectively are very close although the latter one is slightly larger than the former.

Table 5.1.2 Real total human capital based on different indexes

Unit: 100 Million Yuan

Year	CPI	Living Cost index	Fixed Assets Investment Index
1985	3226.78	3226.78	3315.45
1986	3517.37	3755.52	3613.58
1987	3794.27	4399.33	3896.48
1988	3894.97	5434.82	3999.05
1989	4095.24	6694.90	4202.55
1990	4802.00	8273.17	4925.10
1991	5015.32	9011.67	5145.71
1992	5428.95	9555.58	5569.63
1993	5404.69	8942.62	5543.98
1994	5134.41	9131.77	5265.01
1995	5230.62	9580.26	5363.20
1996	5946.74	11234.87	6084.42
1997	7093.08	13739.74	7242.69
1998	9014.00	17737.23	9180.42
1999	10954.05	21706.19	11143.50
2000	13525.04	27465.80	13734.50
2001	16074.09	33452.91	16287.40
2002	20377.03	41476.15	20605.30
2003	25105.40	50103.50	25345.40
2004	30448.55	58848.21	30696.80
2005	37239.82	72541.38	37502.10
2006	45943.37	89937.01	46220.60
2007	56313.66	109810.80	56619.20
2008	67665.98	128660.45	67987.40

Calculated by income parameter of Beijing and discount rate valued 4.58%, the total human capital stocks for Beijing from 1985 to 2008 are reported in Table 5.1.3. Column 1 and column 2 contain the total human capital measured in nominal terms; column 3 and column 4 contain the total human capital measured in real terms (in 1985 RMB). In order to get a sense of the magnitude of the total human capital in Beijing, we also present the ratio of nominal GDP to nominal human capital stock in Table 5.1.3. The reason for calculating the ratio at nominal level is to avoid the differences between the real value of human capital stock and that of GDP caused by using different deflator indexes

Table 5.1.3 Nominal and real human capital, Nominal GDP

Unit: 100 Million Yuan

Year	Nominal human capital		Real human capital		Nominal GDP	Ratio of human capital to GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
1985	3226.78		3226.78		257.12	12.55
1986	3755.52		3517.37		284.86	13.18
1987	4398.41		3794.27		326.82	13.46
1988	5436.72		3894.97		410.22	13.25
1989	6700.47		4095.24		455.96	14.70
1990	8282.02		4802.00		500.82	16.54
1991	9679.87		5015.32		598.89	16.16
1992	11516.30		5428.95		709.1	16.24
1993	13644.40		5404.69		886.21	15.40
1994	16190.20		5134.41		1145.31	14.14
1995	19346.30		5230.62		1507.69	12.83
1996	24548.00		5946.74		1789.2	13.72
1997	30831.70		7093.08		2075.63	14.85
1998	40120.30		9014.00		2375.97	16.89
1999	49048.70		10954.10		2677.59	18.32
2000	62684.20	65776.5	13525.00	14192.30	3161	19.83
2001	76806.40	80784.7	16074.10	16906.70	3710.52	20.70
2002	95608.30	100872	20377.00	21498.90	4330.4	22.08
2003	118036.00	124829	25105.40	26550.20	5023.77	23.50
2004	144585.00	153256	30448.50	32274.50	6060.28	23.86
2005	179494.00	190836	37239.80	39593.10	6886.31	26.07
2006	223427.00	238295	45943.40	49000.70	7870.28	28.39
2007	280437.00	300613	56313.70	60365.10	9353.32	29.98
2008	354139.00	381324	67666.00	72860.40	10488.03	33.77

Note: 1.The real human capital is calculated by CPI. The following chapter is the same.

2. The ratio of nominal human capital to nominal GDP based on the contemporary price.

The trends of total human capital measured in nominal and real terms are presented in Figure 5.1.1.

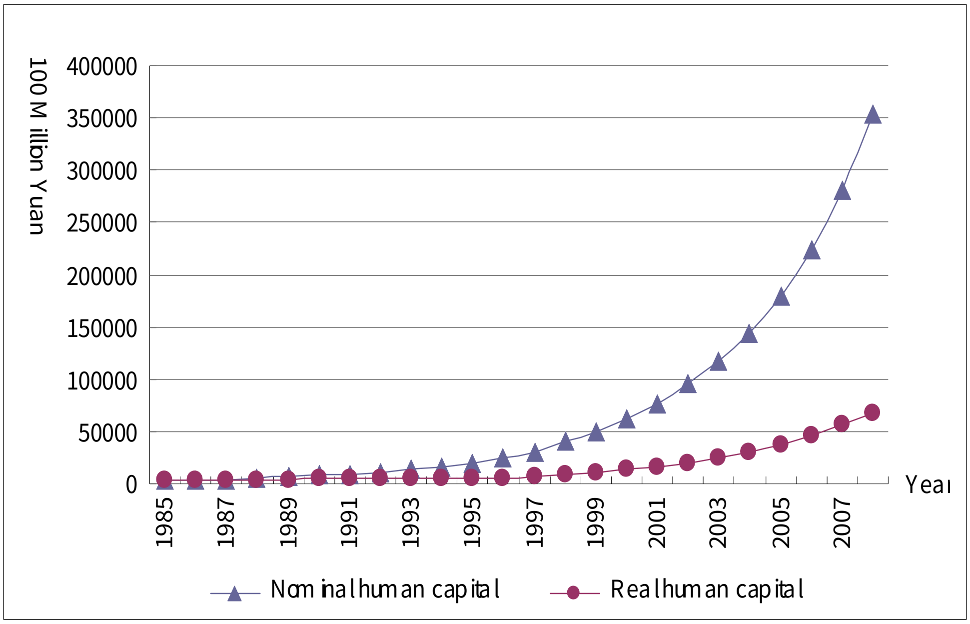


Figure 5.1.1 Nominal, Real human capital for Beijing

The level of annual human capital exhibits a rising trend and is much higher than that of GDP. The ratio of human capital to GDP measured at the nominal level reaches to 18.78, which indicates a faster growth in human capital relative to the growth of physical capital. Although there was a slightly decrease during 1992 to 1995, the ratio of human capital to GDP in Beijing from 1985 to 1997 increased at a considerable rate. After 1997, the rapid increase in this ratio reflected a higher growth rate of human capital in comparison with that of physical capital at this period.

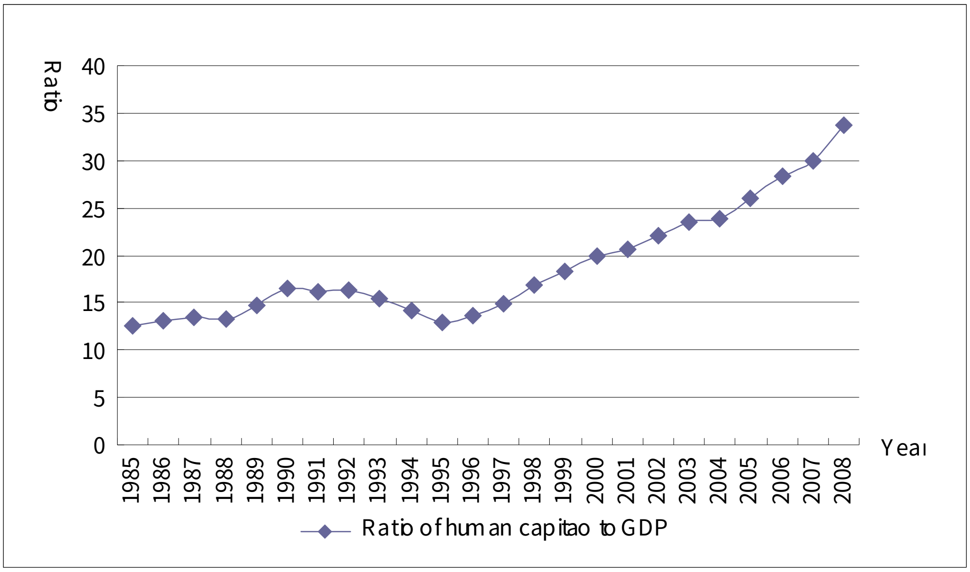


Figure 5.1.2 Ratio of nominal total human capital to nominal GDP for Beijing

Table 5.1.4 reports the total human capital stock for Beijing classified by gender and urban-rural. Before 1993, the growth rates of various human capital stocks were quite slow, the gender gap was fairly stable and the gap between rural and urban was relatively large. Starting from 1993, both the human capital of male and that of female increased by a significant level, and the gender gap appears to be expanding.

The results based on five education categories show that the total human capital for Beijing during 1985 to 2008 kept at a relatively rapid growth rate. More specifically, the total human capital for Beijing increased from RMB 0.32 trillion to RMB 6.77 trillion (calculated by 1985 comparable price), an increase of more than twenty-one-fold. The annual growth rate of total human capital at this period increased to 13.23%.[29]

[29] The annual growth rate here is the mean of the annual log growth rate.

The trend that the total human capital of male is higher than that of female is consistent with the national level. One reason is the earlier retirement age for female, male have longer time to generate income from market, and thus end up with a higher life income relative to female. [30]Moreover, male have higher educational attainment than female. Also the income gap between male and female keeps expanding, which directly results in the differences between them on the total human capital.

Table 5.1.4 Real human capital by gender and rural-urban

Unit: 100 Million Yuan

Year	Total	Male	Female	Urban	Rural
1985	3226.78	1813.90	1412.88	2715.25	511.53
1986	3517.37	2038.94	1478.43	2956.54	560.82
1987	3794.27	2232.37	1561.90	3192.49	601.78
1988	3894.97	2317.41	1577.55	3284.16	610.80
1989	4095.24	2466.79	1628.45	3468.87	626.37
1990	4802.00	2919.20	1882.80	4086.44	715.56
1991	5015.32	3077.20	1938.13	4259.30	756.02
1992	5428.95	3353.04	2075.92	4615.41	813.55
1993	5404.69	3353.48	2051.20	4602.06	802.63
1994	5134.41	3196.03	1938.38	4382.92	751.48
1995	5230.62	3282.53	1948.09	4466.63	763.99
1996	5946.74	3743.41	2203.33	5155.78	790.96
1997	7093.08	4580.61	2512.47	6233.60	859.47
1998	9014.00	5688.96	3325.03	8056.71	957.29
1999	10954.10	6954.45	3999.60	9865.69	1088.37

[30] To ensure the consistent of urban and rural, we define the working age of male and female in rural area as 60 and 55.

Year	Total	Male	Female	Urban	Rural
2000	13525.00	8497.63	5027.41	12327.09	1197.96
2001	16074.10	10158.40	5915.72	14854.49	1219.60
2002	20377.00	12832.50	7544.52	19066.06	1310.97
2003	25105.40	15742.20	9363.24	23737.25	1368.15
2004	30448.50	18971.90	11476.70	29031.35	1417.20
2005	37239.80	23123.90	14115.90	35753.92	1485.90
2006	45943.40	28454.80	17488.60	44364.84	1578.53
2007	56313.70	34812.90	21500.80	54583.68	1729.98
2008	67666.00	41800.60	25865.40	65831.47	1834.51

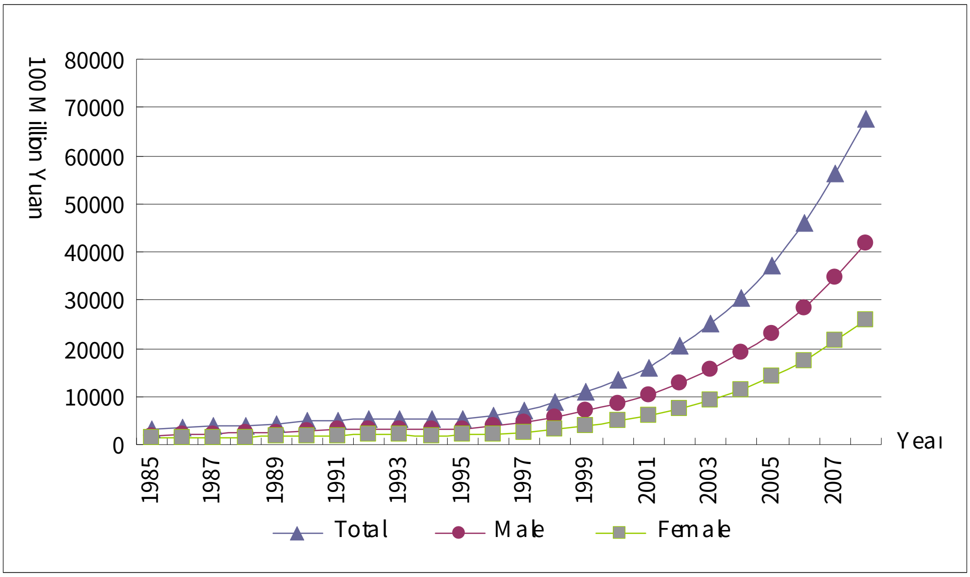


Figure5.1.3 Real human capital by gender (1985-2008)

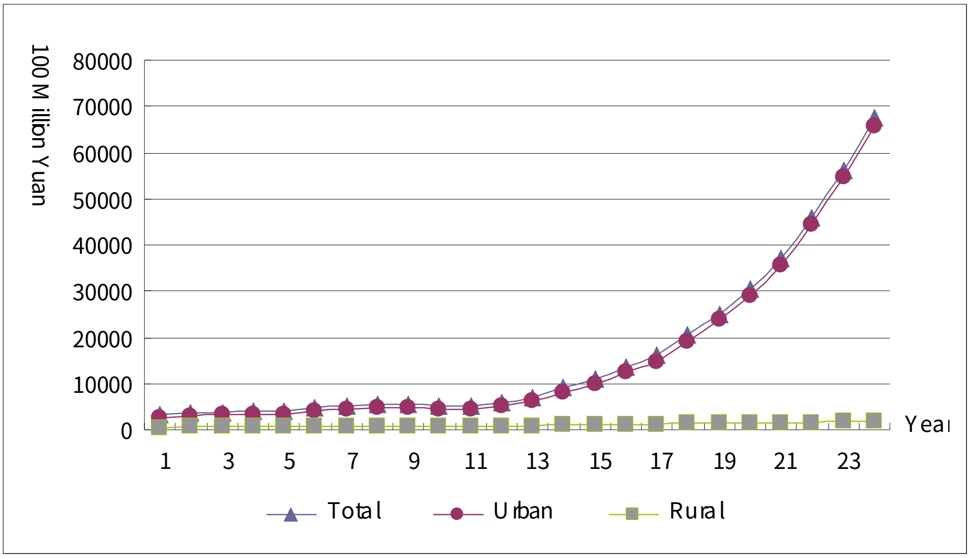


Figure 5.1.4 Real human capital by urban-rural (1985-2008)

Table 5.1.4 shows the total of human capital for urban and rural separately. Before 1994, the total human capital for urban was five times the amount of that for rural. Starting from 1995, however, the human capital in the urban area was rising much more rapidly while kept at low or even zero growth rates in the rural area, which resulted in a larger gap between rural and urban. Because of this, we could see from the figure that the human capital in urban changes almost simultaneously with the total of human capital. In 2008, the total human capital for urban was about 36 times the amount of that for rural in Beijing. From 1985 to 2008, total human capital for rural in Beijing increased from RMB 0.0551 trillion to RMB 0.18 trillion, the total human capital for urban in Beijing increased from RMB 0.27 trillion to RMB 6.58 trillion. During the same period, the annual growth rates of human capital were 5.55% and 13.86% for rural and urban areas respectively. The urban-rural gap in the estimated human capital stock increased from RMB 0.22 trillion in 1985 to RMB 6.4 trillion in 2008. Moreover, the gap exhibited a trend of further expansion as the urban area increases faster in the later period.

One reason that results in the gap between rural and urban is the rapid urbanization during the course of economic transition as well as a large scale rural-urban migration. Another reason is the education gap between the rural and urban population. On the national level, in urban areas, the population with education at college or above accounted for 2.47% of the total population in 1985. This proportion increased to 13.01% by 2007. While in rural areas, the corresponding figures were 0.074% in 1985 and 0.93% in 2007.

Table 5.1.5 reports a set of real indexes of total human capital for Beijing from 1985 to 2008 calculated using 1985 as the base year and setting its value at 100. Figure 5.1.5 shows the corresponding indexes of total human capital. It’s easy to see that the human capital has been rising much more rapidly since 1997.

Table 5.1.5 Total human capital index for Beijing (1985=100)

Year	Total human capital	male total human capital	female total human capital	urban total human capital	rural total human capital
1985	100	100	100	100	100
1986	109.01	112.41	104.64	108.89	109.64
1987	117.59	123.07	110.55	117.58	117.64
1988	120.71	127.76	111.65	120.95	119.41
1989	126.91	135.99	115.26	127.75	122.45
1990	148.82	160.93	133.26	150.5	139.89

1991	155.43	169.65	137.18	156.87	147.8
1992	168.25	184.85	146.93	169.98	159.04
1993	167.49	184.88	145.18	169.49	156.91
1994	159.12	176.2	137.19	161.42	146.91
1995	162.1	180.97	137.88	164.5	149.35
1996	184.29	206.37	155.95	189.88	154.63
1997	219.82	252.53	177.83	229.58	168.02
1998	279.35	313.63	235.34	296.72	187.14
1999	339.47	383.4	283.08	363.34	212.77
2000	419.15	468.47	355.83	453.99	234.19
2001	498.15	560.03	418.7	547.08	238.42
2002	631.5	707.45	533.98	702.18	256.28
2003	778.03	867.86	662.71	874.22	267.46
2004	943.62	1045.91	812.29	1069.2	277.05
2005	1154.08	1274.82	999.09	1316.78	290.48
2006	1423.81	1568.71	1237.79	1633.91	308.59
2007	1745.19	1919.22	1521.77	2010.26	338.2
2008	2097.01	2304.45	1830.68	2424.51	358.63

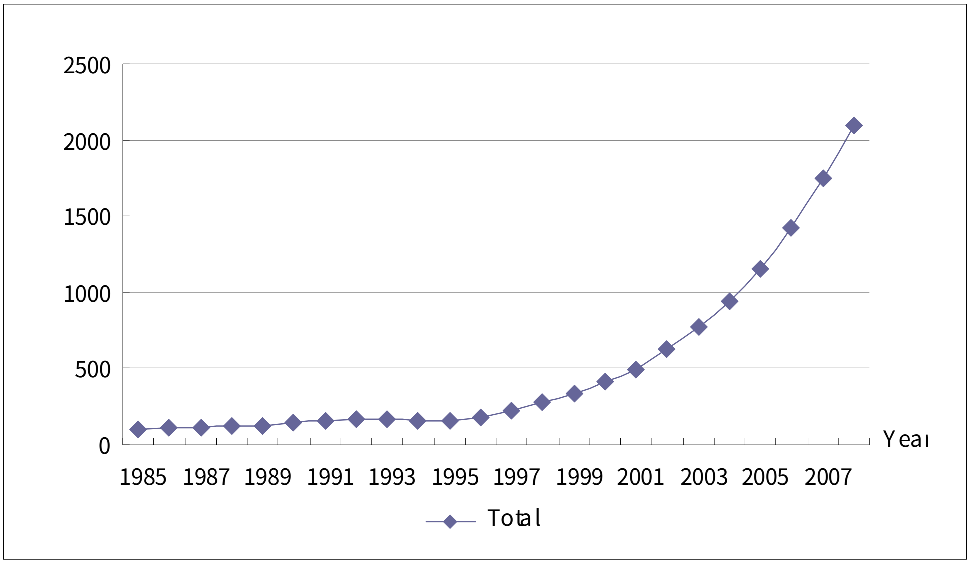


Figure 5.1.5 Total human capital index for Beijing, 1985-2008

5.2 Per capita human capital

The increase in the total human capital can be caused by population growth, demographic change, rural-urban migration or urbanization, higher educational attainment, higher rates of return to education, higher rates of return to on-the-job training, etc. In order to get further information on the dynamics of human capital, we calculate per capita human capital, defined as the ratio of total human capital over non-retired population. Although the per capita human capital is influenced by the age distribution of the population, the effect is relatively small in comparison with the number of population, and thus is able to serve as a better indicator of the average human capital.

Table 5.2.1 Nominal and real per capita human capital, per capita GDP

Unit: Yuan

Year	Nominal per capita human capital	Real per capita human capital	Per capita GDP	Ratio of nominal per capita human capital to nominal GDP
1985	41750.63	41750.63	2643	15.8
1986	47076.32	44090.99	2836	16.6
1987	53552.95	46197.15	3150	17
1988	61809.46	44281.41	3892	15.88
1989	71686.06	43813.59	4269	16.79
1990	83641.67	48496.29	4635	18.05
1991	97413.41	50471.71	5494	17.73
1992	115508.20	54452.13	6458	17.89
1993	136550.60	54089.02	8006	17.06
1994	161730.90	51289.82	10240	15.79

1995	191538.60	51785.95	12690	15.09
1996	235563.20	57065.05	14254	16.53
1997	286828.80	65987.32	16609	17.27
1998	362920.90	81538.91	19118	18.98
1999	431274.40	96316.52	21397	20.16
2000	535263.00	115491.00	24122	22.19
2001	641593.90	134273.20	26998	23.76
2002	780750.60	166401.60	30840	25.32
2003	943343.10	200641.40	34892	27.04
2004	1132309.00	238455.50	41099	27.55
2005	1379218.00	286148.30	45444	30.35
2006	1679971.00	345453.10	50467	33.29
2007	2056579.00	412975.10	58204	35.33
2008	2518646.00	481242.60	63029	39.96

Note: 1.The real human capital is calculated by CPI. The following chapter is the same.

2. The ratio of nominal human capital to nominal GDP based on the contemporary price.

Based on the five education categories, the per capita human capital measured at the nominal level in 1985, 1995 and 2008 were RMB 41750.63, RMB 191538.60, and RMB 2518646.005. From 1985 to 2008, per capita human capital measured in nominal term for Beijing increased 60.33 times; while over the same period, per capital real GDP increased 23.85 times, much lower than the growth of per capita human capital. The rapid growth of human capital was the result of dramatic economic growth since 1978, the rapid expansion of education, the transition towards market-orientated system and a large scale of rural-urban migration.

Table 5.2.2 Nominal and Real per capita human capital by urban-rural (1985-2008)

Unit: Yuan

Year	Nominal per capita human capital			Real per capita human capital		
	Total	Urban	Rural	Total	Urban	Rural
1985	41751	50075	22180	41751	50075	22180
1986	47076	55800	25807	44091	52262	24170
1987	53553	62888	29960	46197	54250	25845
1988	61809	71714	35469	44281	51377	25411
1989	71686	82478	41566	43814	50409	25405
1990	83642	95858	48410	48496	55579	28069
1991	97413	111655	56683	50472	57850	29368
1992	115508	132709	66563	54452	62561	31379
1993	136551	157273	77786	54089	62297	30812
1994	161731	186827	90685	51290	59248	28759
1995	191539	222401	105746	51786	60130	28590
1996	235563	274374	122560	57065	66467	29690
1997	286829	334834	140613	65987	77031	32349
1998	362921	426599	160849	81539	95846	36139
1999	431274	506023	184384	96317	113010	41178
2000	535263	630026	210092	115491	135938	45331
2001	641594	751673	230485	134273	157311	48236
2002	780751	910182	254471	166402	193987	54236
2003	943343	1093716	278650	200641	232625	59267
2004	1132309	1304841	305318	238456	274789	64298
2005	1379218	1579353	340618	286148	327671	70669
2006	1679971	1919202	373051	345453	394646	76711
2007	2056579	2353647	412775	412975	472628	82888
2008	2518646	2878446	459141	481243	549990	87729

Table 5.2.3 Nominal and Real per capita human capital by gender (1985-2008)

Unit: Yuan

Year	Nominal per capita human capital		Real per capita human capital		
	Total	Female	Total	Male	Female
1985	41750.63	39804.81	41750.63	43403	39804.81
1986	47076.32	42845.38	44090.99	47492	40128.36
1987	53552.95	47474.2	46197.15	50743	40953.35
1988	61809.46	53454.51	44281.41	49554	38295.77
1989	71686.06	60558.31	43813.59	49862	37012.44
1990	83641.67	69180.09	48496.29	56054	40111.32
1991	97413.41	79312.46	50471.71	58945	41093.27
1992	115508.2	92751.59	54452.13	64205	43724.36
1993	136550.6	108459.8	54089.02	64271	42961.99
1994	161730.9	127332.3	51289.82	61340	40380.98
1995	191538.6	148296.5	51785.95	62623	40094.66
1996	235563.2	182046.8	57065.05	69005	44100.75
1997	286828.8	216845.3	65987.32	80181	49887.05
1998	362920.9	286912.7	81538.91	96477	64461.83
1999	431274.4	339518.4	96316.52	114042	75824.64
2000	535263	430915.8	115491	134803	92976.54
2001	641593.9	506958.6	134273.2	158839	106096.6
2002	780750.6	616792.6	166401.6	197225	131457.2
2003	943343.1	746570.5	200641.4	237943	158789.5
2004	1132309	900237.5	238455.5	282512	189583.1
2005	1379218	1096682	286148.3	339549	227530.1
2006	1679971	1347544	345453.1	407191	277096.1
2007	2056579	1658632	412975.1	484815	333064.7
2008	2518646	2040229	481242.6	562922	389830.4

Table 5.2.2 and Table 5.2.3 present the trends of per capita human capital measured in real terms for Beijing classified by gender and urban-rural respectively. Based on this, the per capita human capital for urban is significantly

higher than that for rural. And the size of the difference expanded rapidly after 1997, partly due to the long-tem stagnant status in the rural area until 2002. Based on five-education category, in 1985, per capita human capital was RMB 55075 in the urban area and RMB 22180 in the rural area. The corresponding numbers became RMB 549990 and RMB 87729 in 2008, respectively. The ratio of urban to rural increased from 2.26 to 6.27, which indicates a rising size of urban-rural gap on per capita human capital. From 1985 to 2008, the annual growth rate was 10.42% for the urban area, and 5.98% for the rural area.

The trends of per capita human capital of male and female are similar to each other. Per capita human capital of male is higher than that of female and the gap exhibits a trend of further expansion. From1985 to 2008, the annual growth rate was 11.14% for male, and 9.92% for female.

The ratio of per capita human capital to per capita GDP measured in nominal term for Beijing is reported in Figure 5.2.1. The trend and level of the ratio is very similar to that of total human capital.

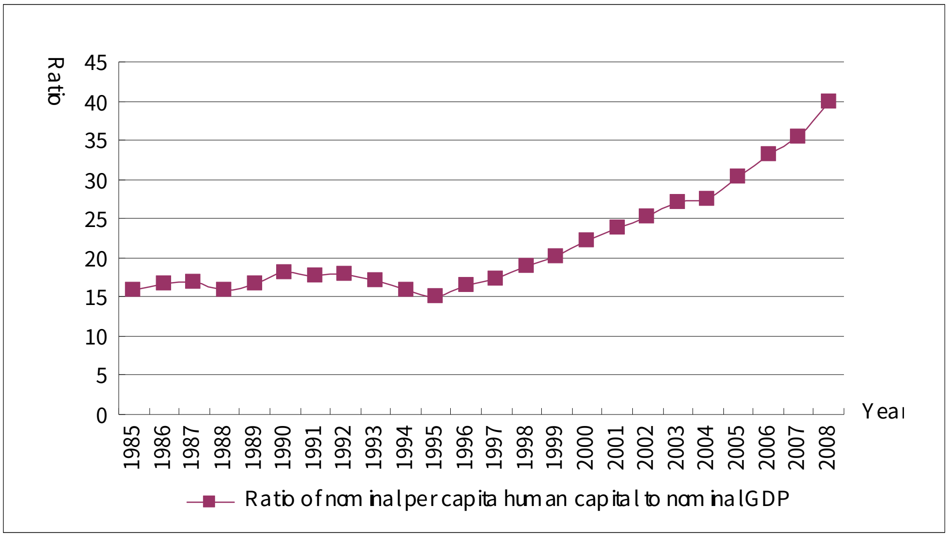


Figure 5.2.1 Ratio of nominal per capita human capital to nominal per capita GDP

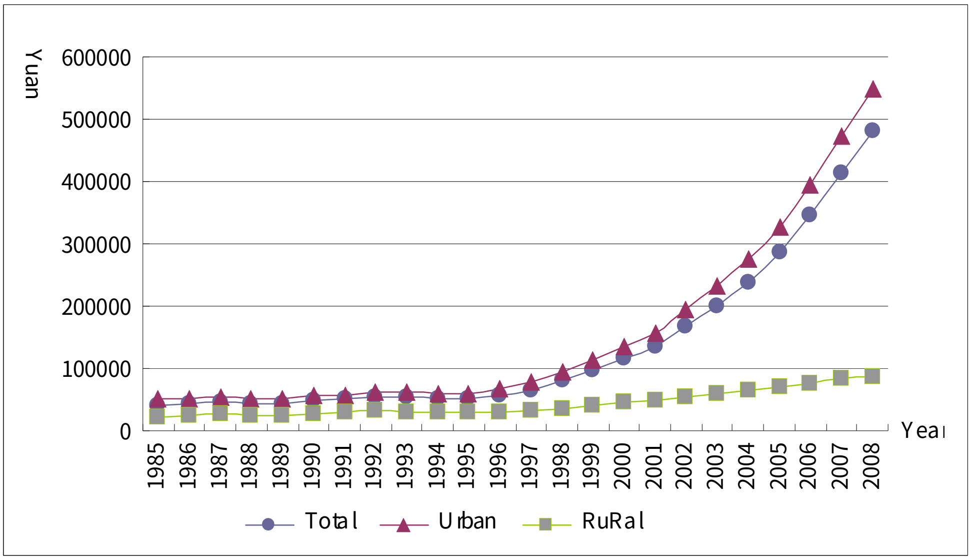


Figure 5.2.2 Per capita human capital by urban-rural 1985-2008

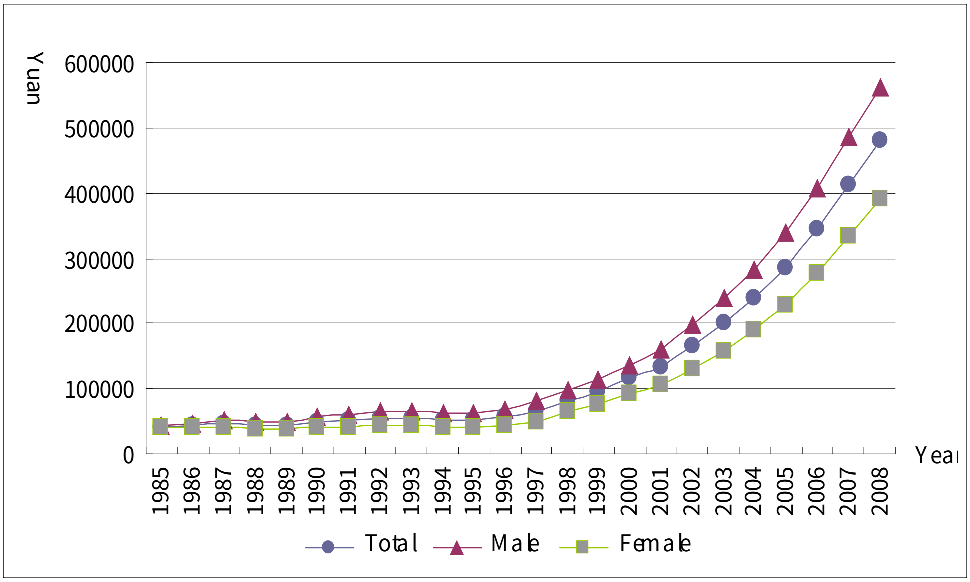


Figure 5.2.3 Per capita human capital by gender 1985-2008

Similarity, we construct a set of per capita human capital indexes with its corresponding value in 1985 set as 100. Figure 5.2.4 show various per capita human capital indexes for Beijing.

Table 5.2.4 Index of per capita human capital

Year	Total	Male	Female	Urban	Rural
1985	100.00	100.00	100.00	100.00	100.00
1986	105.61	109.42	100.81	104.37	108.97
1987	110.65	116.91	102.89	108.34	116.52
1988	106.06	114.17	96.21	102.60	114.57
1989	104.94	114.88	92.98	100.67	114.54
1990	116.16	129.15	100.77	110.99	126.55
1991	120.89	135.81	103.24	115.53	132.41
1992	130.42	147.93	109.85	124.93	141.47
1993	129.55	148.08	107.93	124.41	138.92
1994	122.85	141.33	101.45	118.32	129.66
1995	124.04	144.28	100.73	120.08	128.90
1996	136.68	158.99	110.79	132.73	133.86
1997	158.05	184.73	125.33	153.83	145.85
1998	195.30	222.28	161.94	191.40	162.94
1999	230.69	262.75	190.49	225.68	185.65
2000	276.62	310.58	233.58	271.47	204.38
2001	321.61	365.96	266.54	314.15	217.48
2002	398.56	454.40	330.25	387.39	244.53
2003	480.57	548.21	398.92	464.55	267.21
2004	571.14	650.90	476.28	548.75	289.89
2005	685.37	782.31	571.61	654.36	318.62
2006	827.42	938.16	696.14	788.11	345.86
2007	989.15	1117.00	836.74	943.84	373.71
2008	1152.66	1296.96	979.36	1098.33	395.53

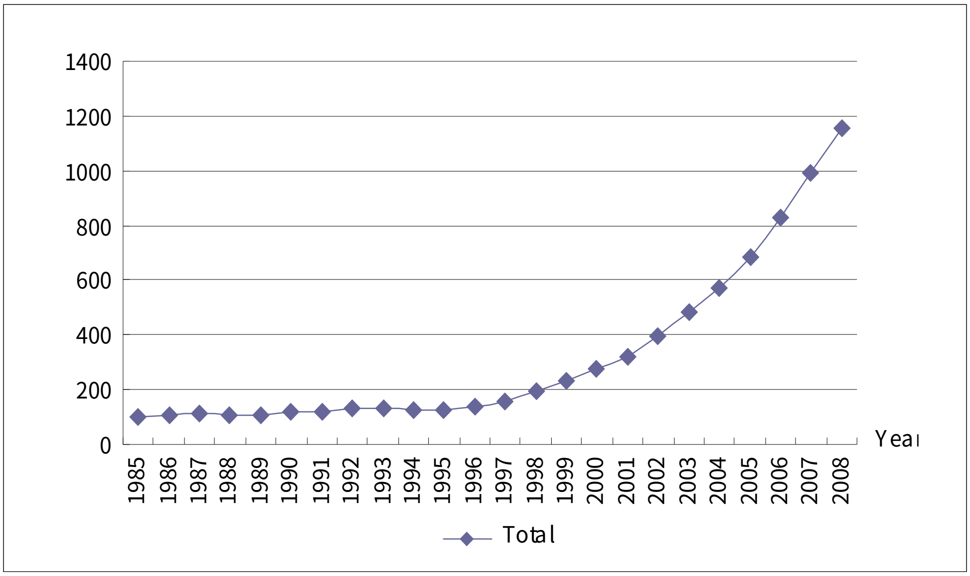


Figure5.2.4 Index of per capita human capital (1985-2008)

5.3 Active human capital

5.3.1 Active total human capital

The estimated approach of active human capital is the same as that of human capital we illustrated above. Based on the income parameter for Beijing and the discount rate valued at 4.58%, the total active human capital (non-retired population aged over 15) for Beijing is reported in Table 5.3.1. Column 1 and column 2 are active human capital stocks measured at nominal terms, column 3 and column 4 are active human capital stocks measured at real terms (in 1985 RMB). The real value in this table is calculated by using CPI as the deflator with respect to nominal value.

Table 5.3.1 Total active human capital and nominal GDP

Unit: 100 Million Yuan

Year	Nominal total human capital		Real total human capital		Nominal GDP	Ratio of nominal human capital to nominal GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
1985	1819.88		1819.88		257.1	7.08
1986	2131.83		1996.64		284.9	7.48
1987	2574.42		2220.81		326.8	7.88
1988	3228.54		2312.98		410.2	7.87
1989	4067.41		2485.95		456	8.92
1990	5164.89		2994.65		500.8	10.31
1991	6039.14		3128.99		598.9	10.08
1992	7164.80		3377.59		709.1	10.10
1993	8486.73		3361.68		886.2	9.58
1994	10025.24		3179.31		1145.3	8.75
1995	12023.60		3250.80		1507.7	7.97
1996	15130.50		3665.35		1789.2	8.46
1997	19827.90		4561.57		2075.6	9.55
1998	25768.30		5789.47		2376	10.85
1999	32967.74		7362.69		2677.6	12.31
2000	41894.16	42770.84	9039.29	9228.45	3161	13.25
2001	52092.52	53337.18	10901.95	11162.44	3710.5	14.04
2002	65848.52	67642.49	14034.32	14416.67	4330.4	15.21
2003	83563.83	86087.12	17773.35	18310.03	5023.8	16.63
2004	103865.48	107329.80	21873.27	22602.83	6060.3	17.14
2005	127862.60	132429.22	26527.84	27475.28	6886.3	18.57
2006	161158.00	167461.79	33138.98	34435.23	7861	20.50
2007	200897.12	209427.76	40341.51	42054.52	9353.3	21.48
2008	253382.73	265081.98	48414.33	50649.72	10488	24.16

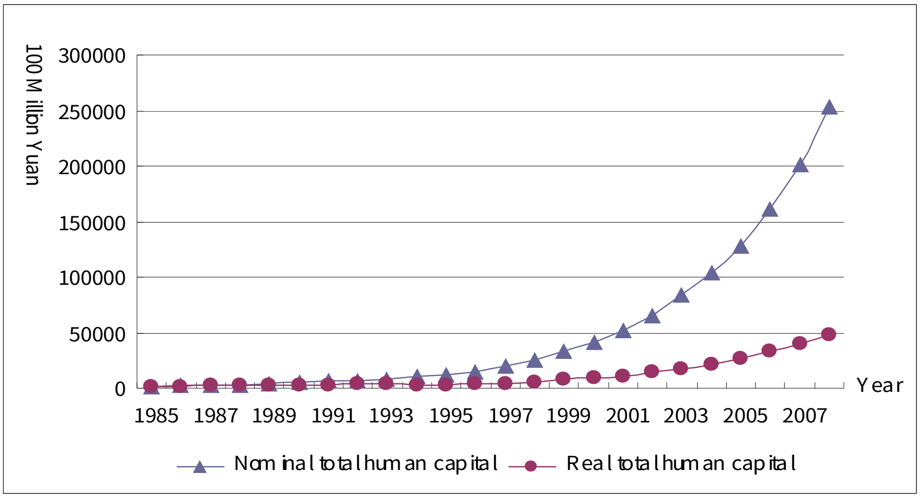


Figure 5.3.1 Nominal and Real total human capital

The trends of active human capital stock in both real and nominal terms for Beijing are presented in Figured 5.3.1. From 1985 to 2008, active human capital kept rising. Similar to the analysis of total human capital, we construct the ratio of nominal GDP to total active human capital stock measured in nominal term with the purpose of getting a sense of the magnitude of the total active human capital. The result is reported in Table 5.3.1.

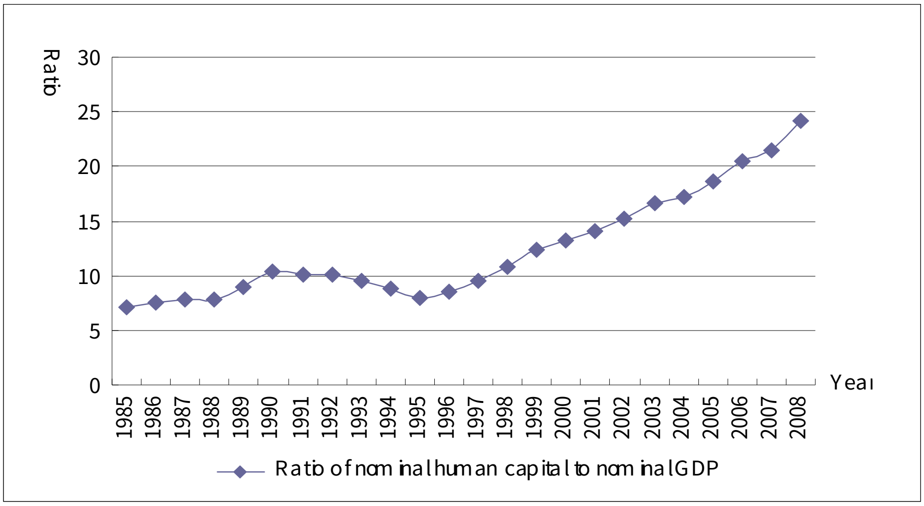


Figure 5.3.2 Ratio of nominal human capital to nominal GDP

The pattern of the ratio for active human capital is almost the same as that for total human capital. The ratio of active human capital to GDP appears to be rising from 1985 to 2008 and the trend was especially obvious after 1995 (See the Figure 5.3.2). Therefore, the active human capital increased at a higher rate than GDP.

The total active human capital by gender and urban-rural are reported in table 5.3.2 and 5.3.3, respectively. The total active human capital of male and female measured in real term are very close the trend with respect to trend, but the former one is larger than the latter one in terms of magnitude. In the rural area, the total human capital with a considerable growth rate is far small than that for the urban area. This has much to do with a relative-few rural population and a corresponding few active population in Beijing.

Table 5.3.2 Nominal and real active human capital by gender

Unit: 100 Million Yuan

Year	Nominal active human capital		Real active human capital	
	Male	Female	Male	Female
1985	1060.31	759.57	1060.31	759.57
1986	1281.53	850.30	1200.26	796.38
1987	1569.98	1004.44	1354.34	866.47
1988	1993.07	1235.46	1427.87	885.11
1989	2536.16	1531.25	1550.06	935.88
1990	3246.56	1918.32	1882.39	1112.26
1991	3799.41	2239.73	1968.55	1160.45
1992	4519.05	2645.75	2130.34	1247.24
1993	5353.30	3133.44	2120.49	1241.18
1994	6306.21	3719.03	1999.89	1179.42

1995	7602.64	4420.96	2055.51	1195.29
1996	9600.91	5529.59	2325.81	1339.54
1997	13052.75	6775.15	3002.89	1558.68
1998	16985.02	8783.28	3816.09	1973.37
1999	21792.51	11175.23	4866.92	2495.76
2000	27662.97	14231.19	5968.70	3070.59
2001	34071.36	18021.16	7130.48	3771.48
2002	42654.75	23193.77	9091.02	4943.30
2003	53727.41	29836.42	11427.38	6345.96
2004	66255.66	37609.82	13952.93	7920.34
2005	81430.28	46432.32	16894.46	9633.38
2006	102354.10	58803.92	21047.11	12091.87
2007	127207.63	73689.49	25544.16	14797.35
2008	160102.52	93280.23	30591.10	17823.23

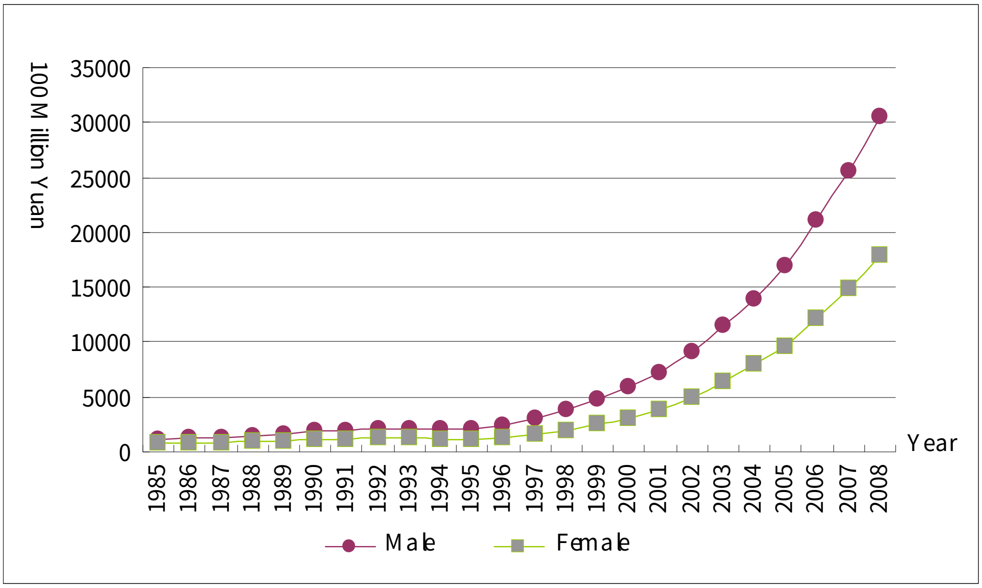


Figure 5.3.3 Real active human capital by gender, 1985-2008

Table 5.3.3 Nominal and real active human capital by urban-rural

Unit: 100 Million Yuan

Year	Nominal active human capital		Real active human capital	
	Urban	Rural	Urban	Rural
1985	1567.53	252.34	1567.53	252.34
1986	1831.92	299.91	1715.75	280.89
1987	2205.47	368.95	1902.53	318.27
1988	2777.53	451.01	1989.87	323.11
1989	3515.90	551.50	2148.87	337.07
1990	4472.69	692.20	2593.31	401.34
1991	5216.98	822.16	2703.02	425.97
1992	6186.59	978.22	2916.44	461.14
1993	7339.51	1147.22	2907.25	454.43
1994	8688.76	1336.47	2755.47	423.84
1995	10438.19	1585.41	2822.15	428.64
1996	13251.92	1878.58	3210.27	455.08
1997	17598.24	2229.66	4048.62	512.95
1998	23130.61	2637.69	5196.85	592.62
1999	29896.44	3071.30	6676.77	685.91
2000	38374.81	3519.35	8279.94	759.35
2001	48282.96	3809.56	10104.69	797.27
2002	61733.98	4114.53	13157.39	876.93
2003	79136.05	4427.78	16831.60	941.75
2004	99189.32	4676.16	20888.51	984.76
2005	122843.64	5018.97	25486.55	1041.29
2006	155554.01	5604.00	31986.63	1152.35
2007	194500.61	6396.50	39057.05	1284.46
2008	246196.59	7186.15	47041.26	1373.07

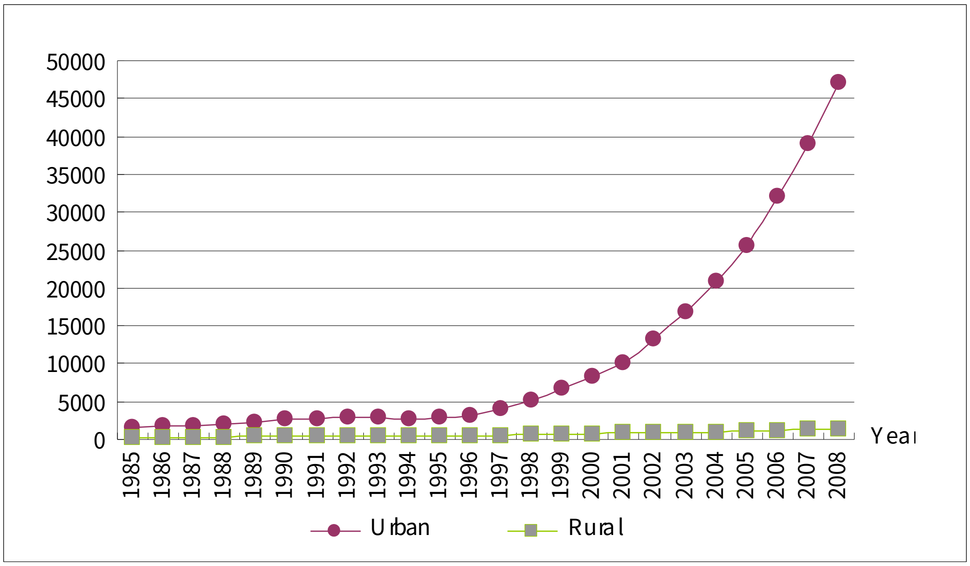


Figure 5.3.4 Real active human capital by urban-rural, 1985-2008

Similarity, we construct a set of total active human capital indexes with its corresponding value in 1985 set as 100. Table 5.3.4 shows various human capital indexes. Figure 5.3.5 presents the index total human capital for Beijing.

Table 5.3.4 Index of real active human capital （1985=100）

Year	Total	Male	Female	Urban	Rural
1985	100	100.00	100.00	100	100
1986	109.71	113.20	104.85	109.46	111.31
1987	122.03	127.73	114.07	121.37	126.13
1988	127.10	134.67	116.53	126.94	128.04
1989	136.60	146.19	123.21	137.09	133.58
1990	164.55	177.53	146.43	165.44	159.05
1991	171.93	185.66	152.78	172.44	168.81
1992	185.59	200.92	164.20	186.05	182.74
1993	184.72	199.99	163.41	185.47	180.08
1994	174.70	188.61	155.27	175.78	167.96

Year	Total	Male	Female	Urban	Rural
1995	178.63	193.86	157.36	180.04	169.86
1996	201.41	219.35	176.35	204.80	180.34
1997	250.65	283.21	205.21	258.28	203.27
1998	318.12	359.90	259.80	331.53	234.85
1999	404.57	459.01	328.58	425.94	271.82
2000	496.70	562.92	404.25	528.21	300.92
2001	599.05	672.49	496.53	644.62	315.94
2002	771.17	857.39	650.80	839.37	347.51
2003	976.62	1077.74	835.47	1073.76	373.20
2004	1201.91	1315.93	1042.74	1332.57	390.25
2005	1457.67	1593.35	1268.27	1625.90	412.65
2006	1820.94	1985.00	1591.93	2040.57	456.66
2007	2216.71	2409.13	1948.12	2491.62	509.01
2008	2660.31	2885.12	2346.49	3000.97	544.13

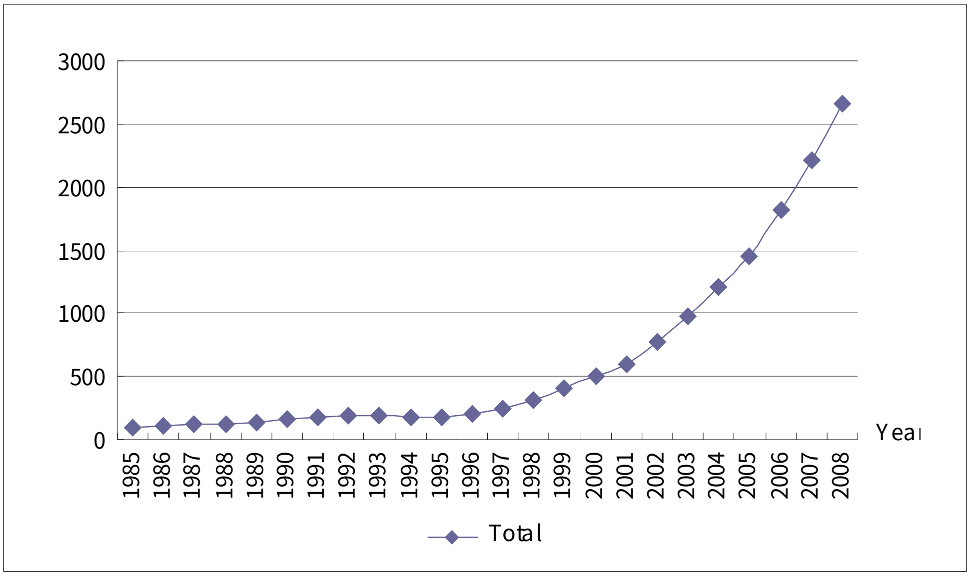


Figure 5.3.5 Index of real active human capital, 1985-2008

5.3.2 Active human capital per capita

Similar to the analysis of per capita human capital above, we calculate the active human capital per capita. Table 5.3.5 shows that the active human capital per capita both in real and nominal values kept increasing; and the ratio of active human capital per capita to GDP measured in nominal terms exhibited the same trend.

Table 5.3.5 Nominal and real active human capital per capita, Nominal GDP per capita

Unit: Yuan

Year	Nominal active human capital per capita		Real active human capital per capita		Nominal GDP per capita	Ratio of human capital to GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
1985	33022.08		33022.08		2643	12.49
1986	37198.07		34839.17		2836	13.12
1987	42701.30		36836.04		3150	13.56
1988	49595.16		35530.86		3892	12.74
1989	57977.82		35435.28		4269	13.58
1990	68066.49		39465.64		4635	14.69
1991	79485.88		41183.13		5494	14.47
1992	93879.22		44255.94		6458	14.54
1993	110771.45		43877.64		8006	13.84
1994	131175.89		41599.90		10240	12.81
1995	156714.11		42370.50		12690	12.35
1996	190387.30		46121.21		14254	13.36
1997	236224.72		54345.44		16609	14.22
1998	289973.25		65149.45		19118	15.17
1999	353622.94		78974.61		21397	16.53
2000	431457.75	440486.41	93093.47	95041.54	24122	17.89

Year	Nominal active human capital per capita		Real active human capital per capita		Nominal GDP per capita	Ratio of human capital to GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
2001	519590.19	532004.88	108740.14	111338.30	26998	19.25
2002	634435.44	651720.00	135217.45	138901.30	30840	20.57
2003	776049.75	799483.31	165059.48	170043.61	34892	22.24
2004	940271.31	971633.00	198013.89	204618.42	41099	22.88
2005	1136729.13	1177327.38	235838.83	244261.81	45444	25.01
2006	1390459.38	1444847.88	285920.66	297104.59	50467	27.55
2007	1685638.50	1757215.38	338487.72	352860.84	58204	28.96
2008	2057181.13	2152165.75	393069.59	411218.47	63029	32.64

Table 5.3.6 and Table 5.3.7report the active human capital per capita classified by rural-urban and gender separately. The active human capital per capita was much smaller in rural area than in urban area. And the active human capital per capita was smaller for female than for male. More specifically, the number for urban was about 34.26 times that for rural, the number for male was about 1.72 times that for female. This result indicates a huge gap between urban and rural and a relative small difference male and female.

Table 5.3.6 Nominal and real active human capital per capita by urban-rural

Unit: Yuan

Year	Nominal		Real	
	Urban	Rural	Urban	Rural
1985	39036	16874	39036	16874
1986	43560	19660	40797	18413
1987	49682	23209	42858	20021

1988	56992	27564	40830	19747
1989	66022	32632	40352	19944
1990	77129	38692	44720	22434
1991	90131	45434	46699	23540
1992	106651	53421	50277	25183
1993	126154	62228	49971	24649
1994	150004	72233	47571	22907
1995	180610	83755	48831	22645
1996	219642	98159	53208	23779
1997	273072	114393	62823	26317
1998	335104	132954	75289	29871
1999	408458	153296	91221	34236
2000	498366	175111	107530	37783
2001	599509	193189	125466	40431
2002	731106	212621	155821	45316
2003	891419	234235	189598	49820
2004	1074954	257069	226377	54137
2005	1292450	287855	268146	59722
2006	1578664	322672	324621	66351
2007	1917642	360272	385076	72345
2008	2337208	402992	446575	77001

Table 5.3.7 Nominal and real active human capital per capita by gender

Unit: Yuan

Year	Nominal		Real	
	Male	Female	Male	Female
1985	35266	30329	35266	30329
1986	41182	32465	38570	30406
1987	48106	36323	41498	31334
1988	57053	40958	40874	29343
1989	67860	46711	41475	28549
1990	80836	53708	46869	31141

Year	Nominal		Real	
	Male	Female	Male	Female
1991	94825	62371	49131	32316
1992	112802	72971	53177	34399
1993	133718	85659	52967	33930
1994	158801	101296	50361	32124
1995	191089	119688	51664	32360
1996	232583	144781	56343	35073
1997	291647	172918	67096	39781
1998	356783	212885	80160	47830
1999	433669	260028	96851	58072
2000	525488	320114	113382	69069
2001	632965	388147	132467	81232
2002	771421	478252	164413	101930
2003	942412	588862	200443	125246
2004	1139424	718912	239954	151397
2005	1381530	867233	286628	179926
2006	1678697	1070517	345191	220131
2007	2025326	1307174	406699	262489
2008	2460269	1605659	470088	306796

Finally we calculate a set of total human capital indexes using 1985 as the base year and setting its value at 100. Table 5.3.8 reports the results.

Table 5.3.8 Index of real active human capital per capita（1985=100）

Year	Total	Male	Female	Urban	Rural
1985	100.00	100.00	100.00	100.00	100.00
1986	105.50	109.37	100.25	104.51	109.12
1987	111.55	117.67	103.31	109.79	118.65
1988	107.60	115.90	96.75	104.60	117.03
1989	107.31	117.61	94.13	103.37	118.19
1990	119.51	132.90	102.68	114.56	132.95

1991	124.71	139.32	106.55	119.63	139.50
1992	134.02	150.79	113.42	128.80	149.24
1993	132.87	150.19	111.87	128.01	146.08
1994	125.98	142.80	105.92	121.86	135.75
1995	128.31	146.50	106.70	125.09	134.20
1996	139.67	159.77	115.64	136.30	140.92
1997	164.57	190.26	131.17	160.94	155.96
1998	197.29	227.30	157.70	192.87	177.02
1999	239.16	274.63	191.47	233.68	202.89
2000	281.91	321.51	227.74	275.46	223.91
2001	329.30	375.63	267.84	321.41	239.61
2002	409.48	466.21	336.08	399.17	268.56
2003	499.85	568.38	412.96	485.70	295.25
2004	599.64	680.42	499.19	579.92	320.83
2005	714.19	812.77	593.25	686.92	353.93
2006	865.85	978.83	725.82	831.59	393.21
2007	1025.03	1153.25	865.48	986.46	428.74
2008	1190.32	1333.00	1011.57	1144.01	456.33

Chapter 6 Results for Liaoning

6.1 The trend of total human capital stock

Based on four different discount rates, this report calculates the total human capital stocks measured in nominal terms. The trend of total human capital doesn't change with different discount rates although the total human capital does. The results are reported in Table 6.1.1. The four different discount rates: 3.14% is the average interest rate on 10-year national bonds issued by the Chinese government; 5.43% is the interest rate on long-term loans made by commercial banks to enterprises; 4.58% is the discount rate used by OECD in the context of human capital estimation[31]; 8.14% is the social discount rate of China calculated by the World Bank.

Table 6.1.1 Total human capital based on different discounts rates (Nominal)

Unit: 100 Million Yuan

Year	Discount rate 3.14%	Discount rate 4.58%	Discount rate 5.43%	Discount rate 8.14%
1985	15811.06	10948.86	8982.46	5209.63
1986	17866.44	12429.56	10224.09	5974.29
1987	20083.01	14067.84	11616.37	6862.20
1988	22398.23	15767.91	13060.48	7792.74
1989	24982.43	17679.01	14689.70	8852.36
1990	27453.46	19618.53	16391.55	10036.22
1991	30985.98	22190.89	18564.15	11409.79
1992	35221.90	25278.79	21173.65	13061.75
1993	40597.26	29104.38	24364.42	15012.31

[31] The analysis in this chapter is based on the discount rate 4.58%, unless otherwise indicated.

1994	46450.94	33325.99	27910.33	17219.86
1995	53382.71	38318.67	32101.37	19826.40
1996	62763.60	45019.96	37696.12	23243.36
1997	71117.72	51332.01	43124.07	26822.76
1998	80590.10	58512.03	49308.11	30916.16
1999	96148.61	69595.07	58541.26	36511.26
2000	113916.65	82776.72	69764.44	43712.24
2001	133399.27	96563.89	81221.06	50634.28
2002	150701.76	109450.96	92224.83	57770.43
2003	171153.36	124502.96	105003.35	65954.18
2004	197323.25	143564.87	121079.89	76029.12
2005	223211.17	162623.39	137290.61	86530.68
2006	270188.93	196904.96	166233.71	104715.10
2007	322624.94	235206.94	198591.61	125086.16
2008	381141.61	278450.91	235354.62	148626.45

We derive the total human capital stock in real terms by adjusting the total human capital in nominal terms using three different price indexes. The results are reported in Table 6.1.2 (all with1985 as the base year). Column 1 uses the rural and urban CPI as the deflator. Column 2 uses the cost of living index as the deflator. Based on the cost living indexes, the real human capital stocks in rural and urban Liaoning are fairly comparable. Column 3 uses the price index of fixed asset investment as deflator. The real human capital derived using the cost of living index the highest, while the real human capital stocks derived suing the CPI and the price index of fixed asset investment are very comparable. The result also indicates that the difference in human capital between Liaoning and Beijing is partly due to the differences in the cost living between these two areas.

Table 6.1.2 Real total human capital based on different indexes

Unit: 100 Million Yuan

Year	CPI	Living Cost index	Fixed Assets Investment Index
1985	10948.86	12126.49	10948.86
1986	11667.84	12930.97	11455.82
1987	12143.50	13470.76	11663.00
1988	11510.74	12732.47	11645.36
1989	10903.25	12090.01	13179.40
1990	11707.70	12969.87	13914.08
1991	12553.41	13930.57	14545.73
1992	13430.58	14946.35	13705.38
1993	13442.29	14995.22	11568.54
1994	12366.08	13818.43	11283.28
1995	12250.81	13689.46	12367.65
1996	13319.03	14859.72	14217.75
1997	14671.75	16358.24	15846.69
1998	16766.22	18669.54	18099.43
1999	20046.30	22326.98	21527.73
2000	23736.36	26338.96	25326.59
2001	27520.22	30408.96	29427.24
2002	31422.72	34589.97	33122.63
2003	34857.81	38367.88	36758.78
2004	38740.03	42447.71	40441.47
2005	43225.84	47188.32	44566.74
2006	51620.35	56194.99	52851.67
2007	58724.63	63766.84	60529.62
2008	66461.22	72032.04	65675.27

Table 6.1.3 reports the total human capital estimates for Liaoning from 1985 to 2008. Columns 1 and 2 contain the total human capital measured in nominal terms. Columns 3 and 4 contain the total human capital measured in real terms (in 1985 prices).

Table 6.1.3 Nominal and real human capital, Nominal GDP

Unit: 100 Million Yuan

Year	Nominal human capital		Real human capital		Nominal GDP	Ratio of human capital to GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
1985	10948.86		10948.86		518.6	21.11
1986	12429.56		11667.84		605.3	20.53
1987	14067.84		12143.50		719.1	19.56
1988	15767.91		11510.74		881	17.90
1989	17679.01		10903.25		1003.8	17.61
1990	19618.53		11707.70		1062.7	18.46
1991	22190.89		12553.41		1200.1	18.49
1992	25278.79		13430.58		1472.9	17.16
1993	29104.38		13442.29		2010.8	14.47
1994	33325.99		12366.08		2461.8	13.54
1995	38318.67		12250.81		2793.4	13.72
1996	45019.96		13319.03		3157.7	14.26
1997	51332.01		14671.75		3582.5	14.33
1998	58512.03		16766.22		3881.7	15.07
1999	69595.07		20046.30		4171.7	16.68
2000	82776.72	86822.51747	23736.36	24778.46	4669.1	17.73
2001	96563.89	101889.2701	27520.22	28918.71	5033.08	19.19
2002	109450.96	113959.764	31422.72	32614.12	5458.22	20.05
2003	124502.96	131003.182	34857.81	36576.82	6002.54	20.74
2004	143564.87	152552.2681	38740.03	41069.80	8009.01	17.93
2005	162623.39	174545.8561	43225.84	46308.61	8009.01	20.31
2006	196904.96	212875.65	51620.35	55718.39	9251.15	21.28
2007	235206.94	255044.721	58724.63	63600.98	11023.49	21.34
2008	278450.91	302284.3072	66461.22	72079.74	13461.57	20.68

In order to get a sense of the magnitude of the total human capital, we also present the ratio of nominal GDP to nominal human capital stock in Table 6.1.3. The reason for calculating the ratio at the nominal level is to avoid the differences between the real value of human capital stock and that of GDP caused by using different deflator indexes

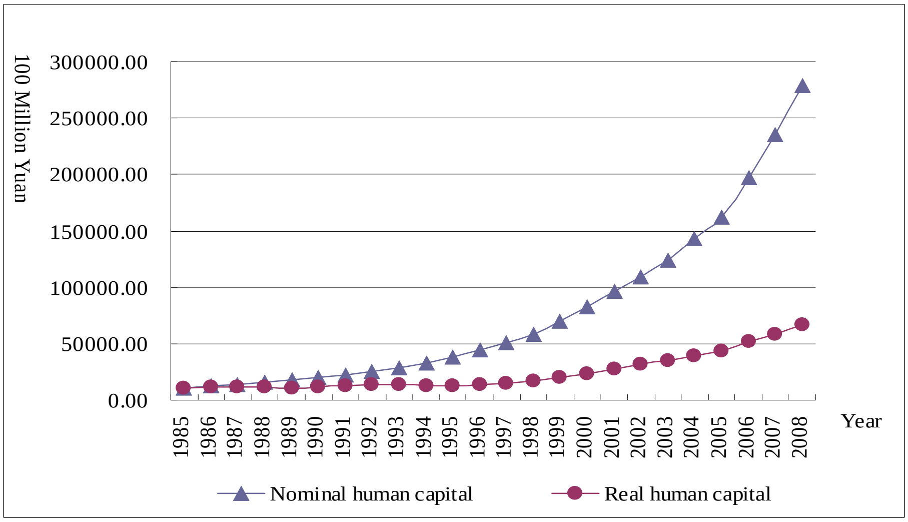


Figure 6.1.1 Nominal, Real human capital

For any given year, the human capital is much higher than GDP. The ratio of nominal human capital to nominal GDP declined from 1985 to 1997. It began to increase after 1997 from 14.33 to 20.68 in 2008. The overall trend is by no means smooth.

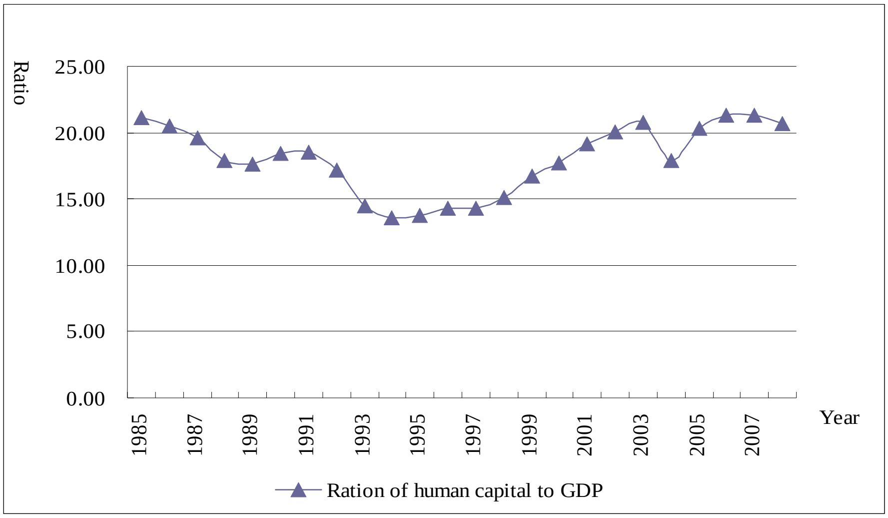


Figure 6.1.2 Ratio of nominal total human capital to nominal GDP

Table 6.1.4 reports the total human capital stock for Liaoning for male and female populations, and for the urban and rural populations. The results based on five education categories show that the total human capital for Liaoning increased from RMB 1.09 trillion in 1985 to RMB 6.65 trillion in 2008 (calculated by 1985 comparable price), an increase of more than 500%. The annual growth rate of the total human capital over this period was 7.84%.[32] This indicates a rapid growth of human capital for Liaoning. Before 1997, the growth rates of various human capital stocks were quite low, the gender gap was fairly stable and the gap between rural and urban areas was relatively large. Starting from 1997, both the human capital of male and female populations increased significantly, and the gender gap further expanded. In 2007 and 2008, the human capital of females exceeded that of the males in Liaoning. Moreover, the human capital for the urban population increased dramatically while the human capital for the rural population stagnated and even started to decline in the later period.

Consistent with what observed at the national level, the total human capital grew faster for males than for females. One obvious explanation is that males retire at older age than females and therefore have longer time to engage in income-generating activities. As a result, the life-time income is higher for males than for females[33] Moreover, males tend to have higher educational attainments than females, and income is positively related to education. However, the human capital of females in Liaoning increased

[32] The annual growth rate here is the mean of the annual log growth rate.

[33] To ensure the consistent of urban and rural, we define the working age of male and female in rural area as 60 and 55.

at an incredible rate of 9.55%, much higher than the 6.55% for males. One possible driving force is the higher return to education for females than that for males. (See the details in appendix B)

Table 6.1.4 Real human capital by gender and rural-urban

Unit: 100 Million Yuan

Year	Total	Male	Female	Urban	Rural
1985	10948.86	7139.41	3809.45	8319.12	2629.73
1986	11667.84	7604.21	4063.62	8827.86	2839.98
1987	12143.50	7895.67	4247.83	9111.98	3031.52
1988	11510.74	7397.14	4113.60	8595.13	2915.60
1989	10903.25	6931.19	3972.07	8211.22	2692.03
1990	11707.70	7345.89	4361.81	8873.99	2833.71
1991	12553.41	7899.09	4654.32	9374.22	3179.19
1992	13430.58	8478.12	4952.46	9788.48	3642.10
1993	13442.29	8451.43	4990.86	9615.77	3826.52
1994	12366.08	7778.05	4588.04	8698.04	3668.04
1995	12250.81	7705.70	4545.11	8614.21	3636.60
1996	13319.03	8324.26	4994.77	9491.95	3827.09
1997	14671.75	9142.14	5529.60	10523.21	4148.53
1998	16766.22	10266.90	6499.32	12164.94	4601.28
1999	20046.30	11983.39	8062.91	15020.77	5025.53
2000	23736.36	13865.54	9870.82	18294.90	5441.46
2001	27520.22	15899.89	11620.33	21926.77	5593.45
2002	31422.72	17543.03	13879.69	25652.57	5770.15
2003	34857.81	19121.25	15736.57	29297.23	5560.58
2004	38740.03	20858.92	17881.11	33572.43	5167.60
2005	43225.84	22686.02	20539.82	38409.78	4816.06
2006	51620.35	26352.43	25267.92	46689.78	4930.57
2007	58724.63	29143.10	29581.52	53973.31	4751.32
2008	66461.22	32209.54	34251.68	61827.06	4634.16

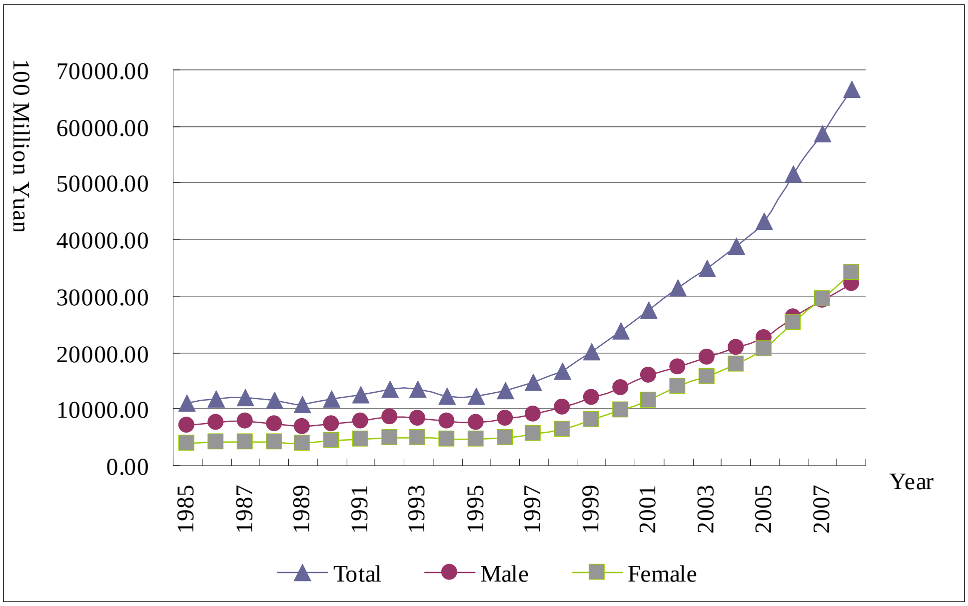


Figure 6.1.3 Real human capital by gender (1985-2008)

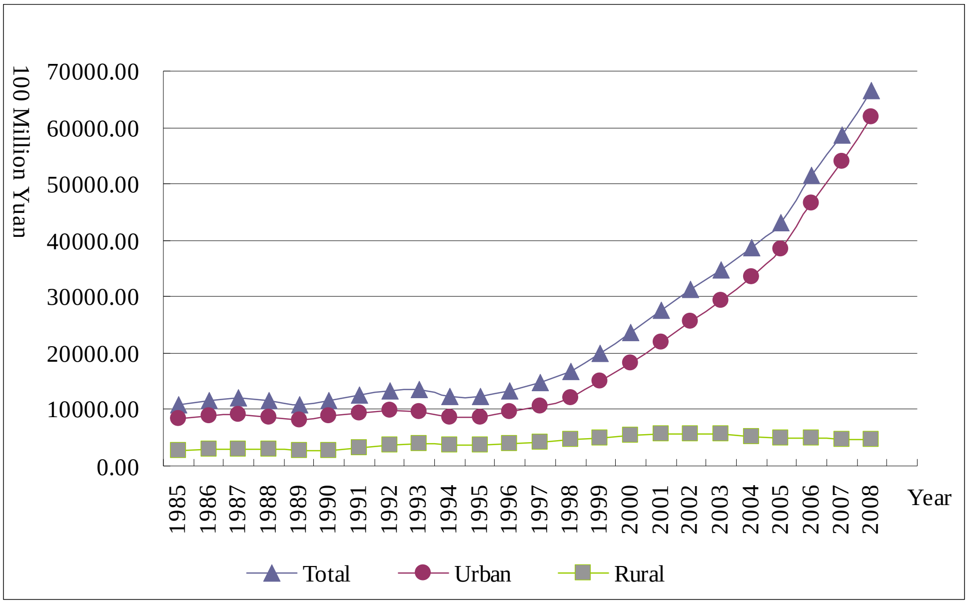


Figure 6.1.4 Real human capital by urban-rural (1985-2008)

Figure 6.1.4 shows the total of human capital for urban and rural separately. Before 2002, the total human capital for the urban population was three times the amount of that for the rural population. During the period 1988 to 1999, the urban-to-rural ratio was lower than three. But starting from 2000, the ratio increases because human capital in the urban area increased much more rapidly than in rural area where the growth rates were low or even near zero As a result, urban-rural gap in human capital widened. In 2008, the total human capital for the urban population was about 13.3 times as large as that for the rural population in Liaoning. From 1985 to 2008, total human capital for rural Liaoning increased from RMB 0.26 trillion to RMB 0.46 trillion, while the total human capital for urban Liaoning increased from RMB 0.83 trillion to RMB 6.18 trillion. During the same period, the annual growth rates of human capital were 2.46% and 8.72% for rural and urban areas respectively. The urban-rural gap in the estimated human capital stock increased from RMB 0.57 trillion in 1985 to RMB 5.72 trillion in 2008. Moreover, the gap exhibited a trend of further expansion as the human capital in the urban area increased at a faster pace in the later period.

Rapid urbanization during the course of economic transition as well as a large scale rural-urban migration may have been the main driving forces for behind the widening urban-rural gap. Persistent urban-rural inequality in education is another contributing factor.

Table 6.1.5 reports a set of real indexes of total human capital for Liaoning from 1985 to 2008 calculated using 1985 as the base year. Figure 6.1.5 shows the corresponding indexes of the total human capital. It is evident that the total human capital has been rising much more rapidly since 1997.

Table 6.1.5 Total human capital index (1985=100)

Year	Total human capital	Male total human capital	Female total human capital	Urban total human capital	Rural total human capital
1985	100	100	100	100	100
1986	106.57	106.51	106.67	106.12	107.99
1987	110.91	110.59	111.51	109.53	115.28
1988	105.13	103.61	107.98	103.32	110.87
1989	99.58	97.08	104.27	98.70	102.37
1990	106.93	102.89	114.50	106.67	107.76
1991	114.65	110.64	122.18	112.68	120.89
1992	122.67	118.75	130.00	117.66	138.50
1993	122.77	118.38	131.01	115.59	145.51
1994	112.94	108.95	120.44	104.55	139.48
1995	111.89	107.93	119.31	103.55	138.29
1996	121.65	116.60	131.12	114.10	145.53
1997	134.00	128.05	145.15	126.49	157.75
1998	153.13	143.81	170.61	146.23	174.97
1999	183.09	167.85	211.66	180.56	191.10
2000	216.79	194.21	259.11	219.91	206.92
2001	251.35	222.71	305.04	263.57	212.70
2002	287.00	245.72	364.35	308.36	219.42
2003	318.37	267.83	413.09	352.17	211.45
2004	353.83	292.17	469.39	403.56	196.51
2005	394.80	317.76	539.18	461.70	183.14
2006	471.47	369.11	663.30	561.23	187.49
2007	536.35	408.20	776.53	648.79	180.68
2008	607.02	451.15	899.12	743.19	176.22

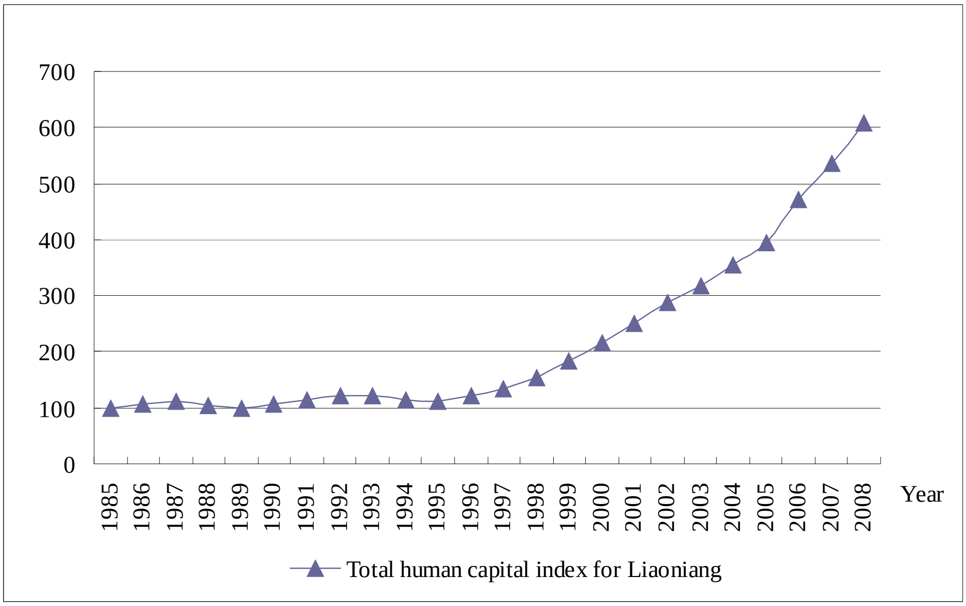


Figure 6.1.5 Total human capital index, 1985-2008

6.2 Per capita human capital

In order to get further information on the dynamics of human capital, we calculate per capita human capital, which is defined as the ratio of the total human capital to the population. Although the per capita human capital is sensitive to the age distribution of the population, it is a good indicator of the average human capital level.

Table 6.2.1 Nominal and real per capita human capital, per capita GDP

Unit: Yuan

Year	Nominal per capita human capital	Real per capita human capital	Per capita GDP	Ratio of nominal per capita human capital to nominal GDP
1985	32437.63	32437.63	1413	22.96
1986	36614.89	34371.00	1633	22.42
1987	41104.46	35481.78	1917	21.44
1988	45711.61	33369.95	2285	20.01

1989	50893.06	31387.50	2574	19.77
1990	56312.01	33605.17	2698	20.87
1991	63496.82	35920.23	3027	20.98
1992	72160.26	38338.62	3693	19.54
1993	82742.22	38215.73	5015	16.50
1994	94440.88	35043.63	6103	15.47
1995	108119.07	34566.61	6880	15.71
1996	126557.59	37441.73	7730	16.37
1997	143896.03	41128.45	8725	16.49
1998	163809.80	46938.57	9415	17.40
1999	194592.41	56050.77	10086	19.29
2000	229746.47	65880.17	11177	20.56
2001	270357.31	77050.47	12015	22.50
2002	309740.03	88924.52	13000	23.83
2003	356751.72	99881.84	14270	25.00
2004	415714.31	112177.75	15835	26.25
2005	478028.75	127061.64	18632	25.66
2006	570990.38	149690.08	21788	26.21
2007	683113.63	170554.45	25729	26.55
2008	812830.63	194008.06	31259	26.00

Table 6.2.2 Nominal and Real per capita human capital by urban-rural

Unit: Yuan

Year	**Nominal per capita human capital**			**Real per capita human capital**		
	Total	**Urban**	**Rural**	**Total**	**Urban**	**Rural**
1985	32437.63	53702	14400	32437.63	53702	14400
1986	36614.89	58839	16665	34371.00	54974	15876
1987	41104.46	64241	19143	35481.78	54672	17266
1988	45711.61	69567	21763	33369.95	49739	16938
1989	50893.06	75647	24646	31387.50	45931	15967
1990	56312.01	81898	27685	33605.17	48237	17234
1991	63496.82	91683	32157	35920.23	50948	19212
1992	72160.26	103551	37473	38338.62	53229	21885

Year	Nominal per capita human capital			Real per capita human capital		
	Total	Urban	Rural	Total	Urban	Rural
1993	82742.22	118536	43388	38215.73	52201	22839
1994	94440.88	135088	49977	35043.63	47182	21765
1995	108119.07	154999	57084	34566.61	46632	21431
1996	126557.59	182141	64673	37441.73	50649	22737
1997	143896.03	206633	72314	41128.45	55353	24898
1998	163809.80	235322	80140	46938.57	63165	27953
1999	194592.41	282928	88436	56050.77	76948	30938
2000	229746.47	337556	96316	65880.17	91805	33795
2001	270357.31	396908	103486	77050.47	107947	36310
2002	309740.03	451217	110746	88924.52	124208	39297
2003	356751.72	516296	116664	99881.84	139734	39910
2004	415714.31	597144	121802	112177.75	157224	39204
2005	478028.75	679765	125654	127061.64	177544	38884
2006	570990.38	802380	135321	149690.08	207301	41218
2007	683113.63	947225	146886	170554.45	233963	41816
2008	812830.63	1110627	160055	194008.06	262816	43181

Table 6.2.3 Nominal and Real per capita human capital by gender

Unit: Yuan

Year	Nominal per capita human capital			Real per capita human capital		
	Total	Male	Female	Total	Male	Female
1985	32437.63	38798.60	24813.44	29705.71	36230.03	22209.98
1986	36614.89	44435.68	27528.12	31318.22	38727.35	23061.92
1987	41104.46	50401.69	30556.93	32147.77	40108.12	23484.2
1988	45711.61	56409.04	34013.92	30092.86	37835.46	21997.95
1989	50893.06	63189.32	37940.75	28133.28	35706.64	20533.59
1990	56312.01	70597.70	41956.30	29887.17	38407	21758.39

1991	63496.82	79093.97	47524.10	31877.05	40717.55	23293.73
1992	72160.26	89491.72	54113.68	33937.26	43159.57	24847.94
1993	82742.22	101514.56	62933.15	33753.63	42473.95	25045.96
1994	94440.88	114967.75	72439.02	30862.95	38541.51	23070.8
1995	108119.07	130728.58	83593.30	30368.90	37666.94	22859.83
1996	126557.59	151815.81	99125.41	32834.84	40453.32	24991.01
1997	143896.03	171789.17	113535.38	35989.55	44181.26	27545.63
1998	163809.80	191828.42	133282.80	40993.50	49468.54	32262.22
1999	194592.41	222012.83	164666.03	48860.42	57520.71	39926.24
2000	229746.47	255055.36	201915.09	57399.35	65774.27	48690.63
2001	270357.31	299024.88	239275.94	66368.63	76107.2	56479.93
2002	309740.03	332584.34	285237.09	75626.73	84732.91	66582.55
2003	356751.72	378456.47	333689.09	83769.19	93201.66	74595.93
2004	415714.31	435125.41	395255.22	92848.85	102420.7	83721.55
2005	478028.75	491651.34	463880.94	103183.95	112670.4	94404.9
2006	570990.38	570046.19	571975.94	120667.47	128350.6	113576.9
2007	683113.63	661951.06	705297.56	136397.08	141247.1	131934
2008	812830.63	767116.19	861056.38	153819.38	155736.1	152059.4

Based on the five education categories, the per capita human capital measured in nominal terms in 1985, 1995 and 2008 were RMB 32437.63, RMB 108119.07, and RMB 812830.63, respectively. From 1985 to 2008, per capita human capital measured in nominal terms for Liaoning increased 25 times; while over the same period, per capita real GDP increased 22 times. Starting from 1985, the total human capital and the per capita human capital increased dramatically. Especially after 1996, per capita human capital increased further accelerated. The rapid growth of human capital was the result of dramatic economic growth since 1978, the rapid expansion of education, the transition towards a market-orientated system and a large scale of rural-urban migration.

The ratio of per capita human capital to per capita GDP measured in nominal term for Liaoning is reported in Figure 6.2.1. The trend and level of the ratio is very similar to that of total human capital. As we can see, the level of human capital for Liaoning is influenced to a large extent by the population structure.

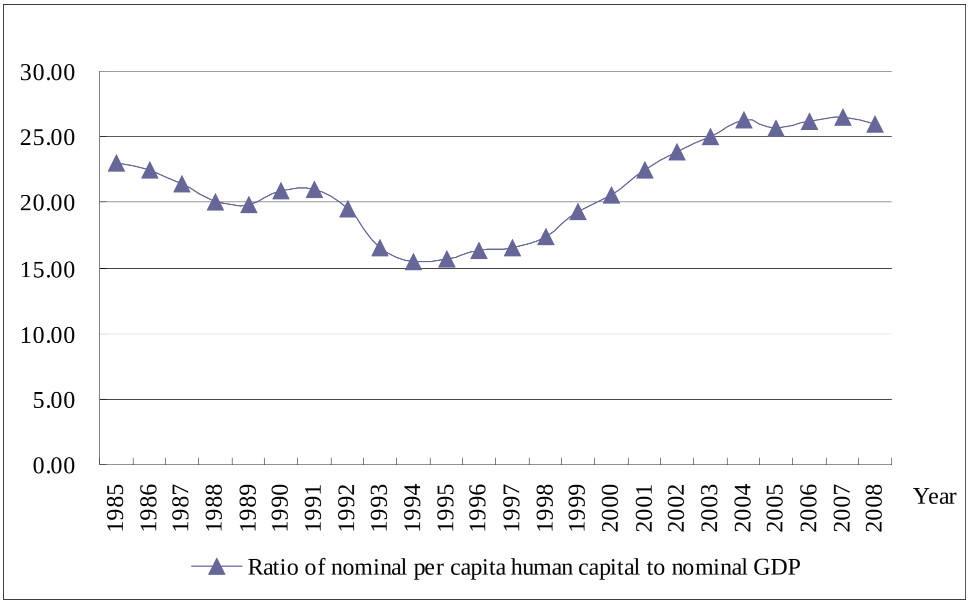


Figure 6.2.1 Ratio of nominal per capita human capital to nominal per capita GDP

Figure 6.2.2 and Figure 6.2.3 present the trends of per capita human capital measured in real terms for Liaoning by gender and separately for the urban and rural areas. As Figure 6.2.2 shows, the per capita human capital is significantly higher for the urban population than for the rural population, and the urban-rural gap expanded rapidly after 1997, partly due to the long-tem stagnant status in the rural area. Based on five-education category, in 1985, per capita human capital was RMB 53702 in the urban area and RMB 14400 in the rural area. The corresponding numbers became RMB 262816 and RMB 43181 in 2008, respectively. The urban-rural ratio increased from 3.73 to 6.09, which indicates a rising size of urban-rural gap on per capita human capital. From 1985 to 2008, the annual growth rates were 6.90% for the urban area and 4.77% for the rural area.

The trends of per capita human capital of male and female populations are similar. Per capita human capital of males is higher than that of females. From1985 to 2008, the annual growth rates of human capital were 6.75% for males and 9.19% for females.

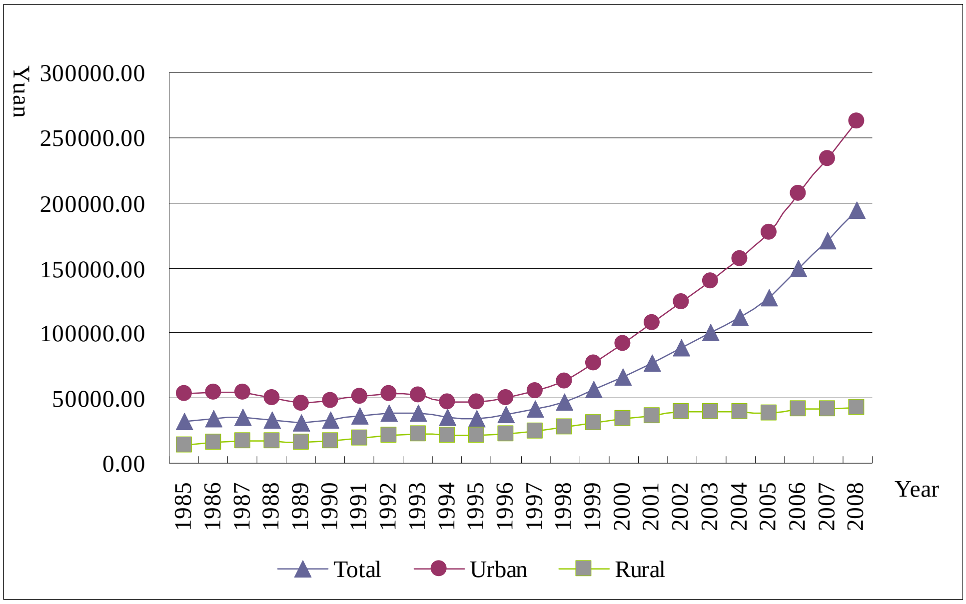


Figure6.2.2 Per capita human capital by urban-rural 1985-2008

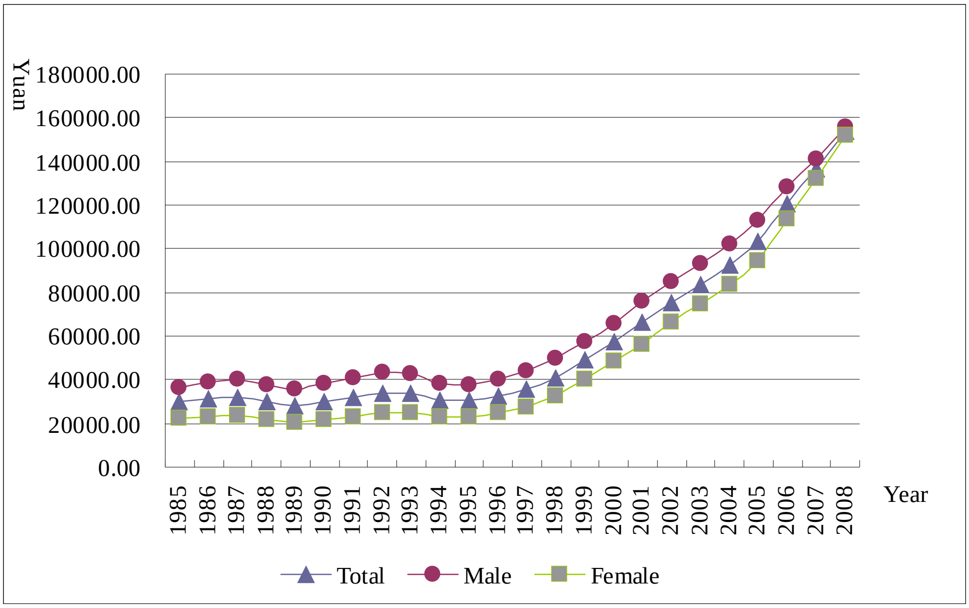


Figure 6.2.3 Per capita human capital by gender 1985-2008

Similarly, we construct a set of per capita human capital indexes with its corresponding value in 1985 set as 100. Table 6.2.4 shows per capita human capital indexes for Liaoning. According to this index, human capital grew at a higher rate for females than for males in Liaoning.

Table 6.2.4 Index of per capita human capital (1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100.00	100.00	100.00	100.00	100.00
1986	105.43	106.89	103.84	102.37	110.25
1987	108.22	110.70	105.74	101.81	119.90
1988	101.30	104.43	99.05	92.62	117.63
1989	94.71	98.56	92.45	85.53	110.88
1990	100.61	106.01	97.97	89.82	119.68
1991	107.31	112.39	104.88	94.87	133.42
1992	114.24	119.13	111.88	99.12	151.98
1993	113.63	117.23	112.77	97.20	158.60

1994	103.90	106.38	103.88	87.86	151.15
1995	102.23	103.97	102.93	86.83	148.83
1996	110.53	111.66	112.52	94.31	157.90
1997	121.15	121.95	124.02	103.07	172.90
1998	138.00	136.54	145.26	117.62	194.12
1999	164.48	158.77	179.77	143.29	214.85
2000	193.23	181.55	219.23	170.95	234.69
2001	223.42	210.07	254.30	201.01	252.15
2002	254.59	233.87	299.79	231.29	272.90
2003	282.00	257.25	335.87	260.20	277.15
2004	312.56	282.70	376.95	292.77	272.25
2005	347.35	310.99	425.06	330.61	270.03
2006	406.21	354.27	511.38	386.02	286.24
2007	459.16	389.86	594.03	435.67	290.39
2008	517.81	429.85	684.64	489.40	299.87

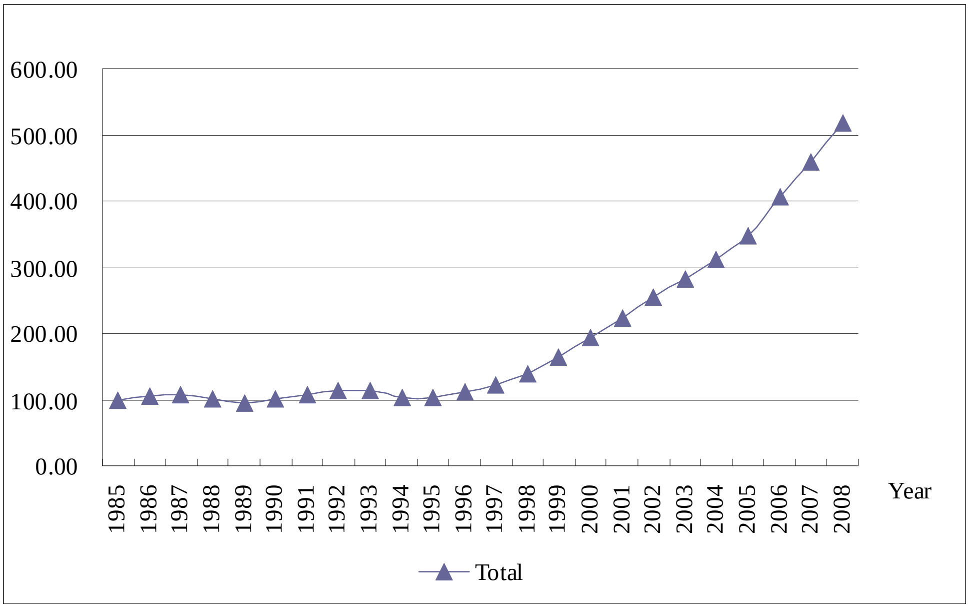


Figure 6.2.4 Index of per capita human capital

6.3 Active human capital

6.3.1 Active total human capital

The active human capital is estimated following the same approach used for that of human capital illustrated above, but the estimation is based on the non-retired population aged over 15, instead of the whole population. Table 6.3.1 reports the total active human capital for Liaoning. Columns 1 and 2 contain active human capital stocks measured in nominal terms. Columns 3 and 4 contain active human capital stocks measured in real terms (in 1985 prices). The real active human capital is calculated using the CPI as the deflator.

Table 6.3.1 Total active human capital and nominal GDP

Unit: 100 Million Yuan

Year	Nominal total human capital		Real total human capital		Nominal GDP	Ratio of nominal human capital to nominal GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
1985	6311.29		6311.29		518.6	13.87
1986	7378.18		6926.49		605.3	13.47
1987	8674.46		7485.60		719.1	12.98
1988	9764.29		7127.89		881	11.69
1989	11009.96		6790.84		1003.8	11.36
1990	12563.96		7497.76		1062.7	12.04
1991	14108.42		7981.23		1200.1	11.82
1992	15957.26		8478.01		1472.9	10.75
1993	17884.08		8265.95		2010.8	8.72
1994	20162.50		7492.91		2461.8	7.95
1995	23061.25		7392.39		2793.4	7.94
1996	26784.89		7951.41		3157.7	8.13
1997	31142.04		8927.70		3582.5	8.32

1998	36495.85		10475.02		3881.7	8.97
1999	42020.24		12138.02		4171.7	9.60
2000	51405.99	51988.06	14753.66	14911.01	4669.1	10.53
2001	57976.30	58720.47	16546.45	16747.95	5033.08	11.11
2002	66325.44	67178.85	19044.01	19278.24	5458.22	11.79
2003	76032.35	77229.94	21284.66	21609.28	6002.54	12.36
2004	87937.21	89598.38	23721.23	24159.18	8009.01	10.76
2005	99341.09	101314.87	26408.61	26924.85	8009.01	12.26
2006	122339.15	125286.36	32072.10	32834.63	9251.15	13.09
2007	147494.16	151747.06	36822.30	37874.05	11023.49	13.27
2008	177347.69	183311.83	42322.55	43735.51	13461.57	13.08

Figure 6.3.1 presents the trends of the active human capital in both real and nominal terms for Liaoning. As we can see, the active human capital for Liaoning increased continuously from 1985 to 2008, which corresponds to the rapid economic growth experienced by the province during this period.

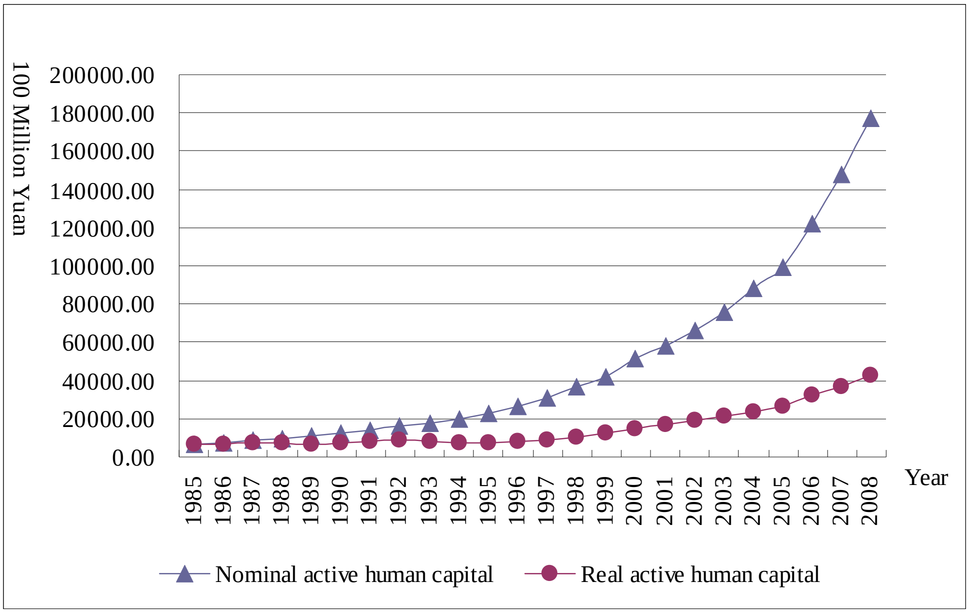


Figure 6.3.1 Nominal and Real total active human capital

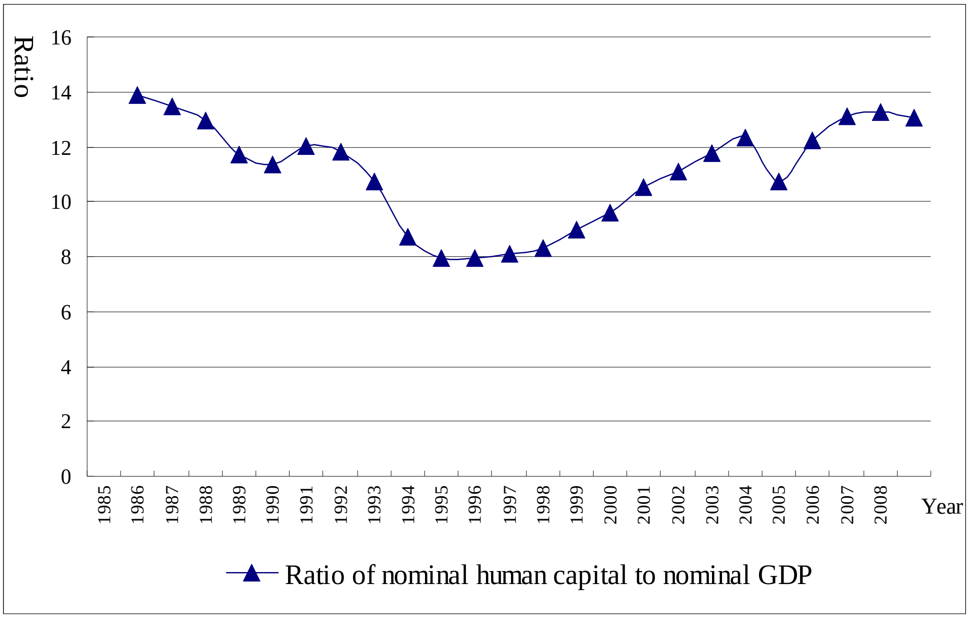


Figure 6.3.2 Ratio of nominal human capital to nominal GDP

Similar to the analysis of total human capital, we construct the ratio of the active human capital to GDP, both in nominal terms, to get a sense of the magnitude of the total active human capital. The ratio is reported in Table 6.3.1. Compared to the ratio of nominal human capital to nominal GDP, the ratio of total active human capital to nominal GDP is more volatile. But these two ratios still moved in similar pattern.

The total active human capitals by gender and separately for urban and rural areas are reported in Tables 6.3.2 and 6.3.3, respectively. From 1985 to 2008, the nominal active human capital for male and female populations both increased. When we remove the influence of inflation using the CPI, the total active human capital for male and female populations became smaller, but the rising trend remains evident. Meanwhile, the total active human capital of males is higher than that for females in the earlier period.

Table 6.3.2 Nominal and real active human capital by gender

Unit: 100 Million Yuan

Year	Nominal active human capital			Real active human capital		
	Total	Male	Female	Total	Male	Female
1985	6311.29	4179.97	2131.32	6311.29	4179.97	2131.32
1986	7378.18	4910.48	2467.70	6926.49	4606.11	2320.38
1987	8674.46	5789.78	2884.67	7485.60	4984.17	2501.43
1988	9764.29	6379.98	3384.32	7127.89	4642.41	2485.49
1989	11009.96	7061.54	3948.42	6790.84	4346.15	2444.69
1990	12563.96	7927.27	4636.68	7497.76	4723.36	2774.40
1991	14108.42	8917.96	5190.46	7981.23	5036.95	2944.29
1992	15957.26	10115.88	5841.38	8478.01	5363.79	3114.22
1993	17884.08	11337.64	6546.44	8265.95	5231.48	3034.47
1994	20162.50	12744.16	7418.35	7492.91	4732.69	2760.22
1995	23061.25	14525.37	8535.87	7392.39	4658.95	2733.44
1996	26784.89	16854.23	9930.66	7951.41	5009.73	2941.68
1997	31142.04	19566.94	11575.10	8927.70	5619.90	3307.79
1998	36495.85	22771.97	13723.88	10475.02	6552.49	3922.53
1999	42020.24	25792.94	16227.29	12138.02	7474.88	4663.14
2000	51405.99	31140.68	20265.31	14753.66	8967.58	5786.08
2001	57976.30	34657.76	23318.55	16546.45	9922.31	6624.14
2002	66325.44	38838.53	27486.91	19044.01	11183.95	7860.07
2003	76032.35	43770.05	32262.30	21284.66	12278.65	9006.01
2004	87937.21	49818.56	38118.65	23721.23	13453.76	10267.47
2005	99341.09	54964.01	44377.09	26408.61	14619.96	11788.65
2006	122339.15	65621.75	56717.41	32072.10	17208.78	14863.32
2007	147494.16	76656.18	70837.97	36822.30	19137.68	17684.62
2008	177347.69	89616.57	87731.11	42322.55	21380.42	20942.13

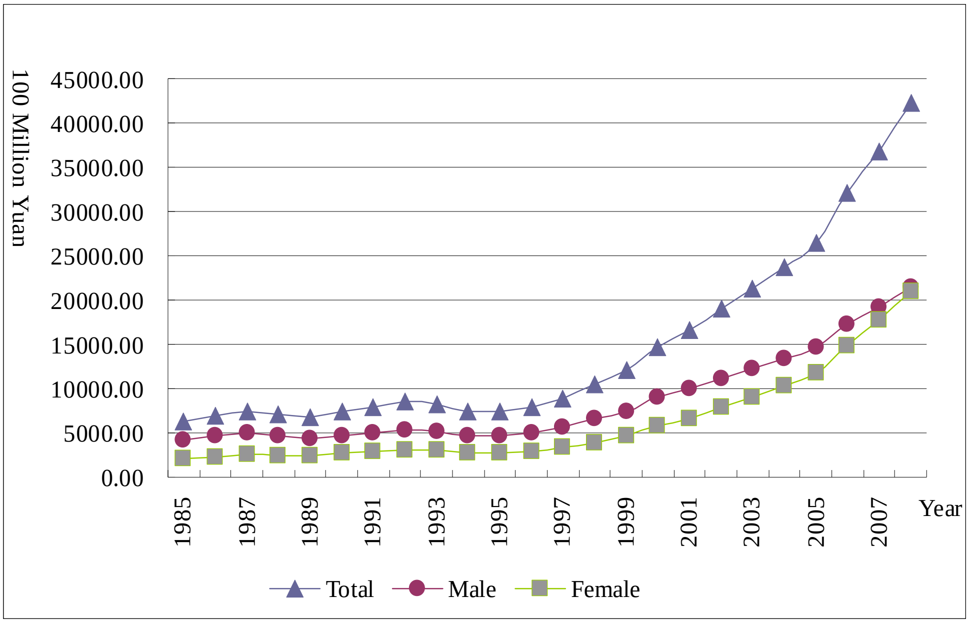


Figure 6.3.3 Real active human capital by gender

Table 6.3.3 Nominal and real active human capital by urban-rural

Unit: 100 Million Yuan

Year	Nominal		Real	
	Urban	Rural	Urban	Rural
1985	4717.99	1593.30	4717.99	1593.30
1986	5583.17	1795.01	5216.42	1710.07
1987	6646.63	2027.82	5656.62	1828.98
1988	7446.63	2317.66	5324.14	1803.75
1989	8406.79	2603.17	5104.39	1686.45
1990	9648.73	2915.22	5682.97	1814.79
1991	10723.20	3385.23	5958.82	2022.42
1992	12021.40	3935.86	6179.40	2298.61
1993	13348.44	4535.64	5878.41	2387.53
1994	14935.59	5226.92	5216.53	2276.38
1995	16970.22	6091.03	5105.58	2286.81
1996	19938.56	6846.33	5544.48	2406.93
1997	23483.30	7658.74	6290.76	2636.94
1998	28051.68	8444.17	7529.63	2945.39
1999	32904.49	9115.75	8949.00	3189.02

2000	41611.41	9794.58	11317.02	3436.64
2001	48107.26	9869.04	13083.69	3462.76
2002	56441.47	9883.96	15536.80	3507.21
2003	66141.75	9890.60	17901.12	3383.54
2004	78240.55	9696.66	20600.16	3121.07
2005	89763.47	9577.62	23444.77	2963.84
2006	112285.60	10053.56	29009.82	3062.27
2007	137104.96	10389.20	33864.65	2957.65
2008	166623.20	10724.48	39429.24	2893.30

The total active human capital grew at a higher rate in the urban area than in the rural area. As we can see from Table 6.3.4, the growth trend of the active human capital for the rural area is relatively flat while that for the urban area is much steeper. The urban-rural gap in the active human capital was widened over time.

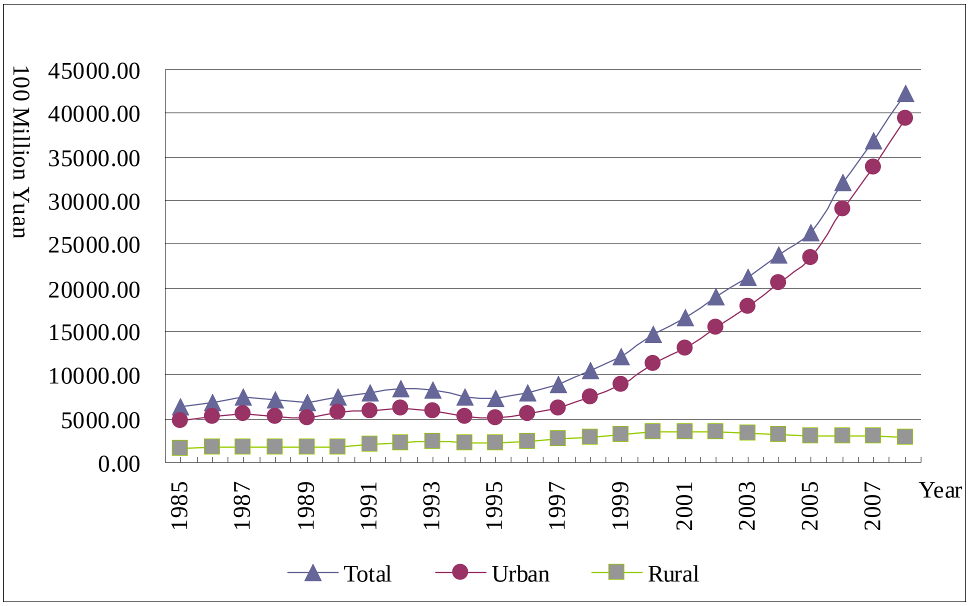


Figure 6.3.4 Real active human capital by urban-rural

Table 6.3.2 and Table 6.3.3 further highlight the significant differences in the active human capital between urban and rural areas, and between male and female populations. The active human capital is higher for males than for females even though the active human capital grew at a faster pace for females. Moreover, the active human capital is much higher in the urban area than in the rural areas in terms of levels as well as rates of growth, which reflects unevenness in development across urban and rural sectors. This is consistent with the fact that the urban economy is the main driver of economic development in Liaoning.

Table 6.3.4 shows human capital indexes calculated with 1985 as the base year. These indexes suggest that the active human capital in Liaoning has been rising over the period 1985 to 2008.

Table 6.3.4 Index of real active human capital （1985=100）

Year	Total	Male	Female	Urban	Rural
1985	100	100.00	100.00	100	100
1986	109.75	110.19	108.87	110.56	107.33
1987	118.61	119.24	117.37	119.89	114.79
1988	112.94	111.06	116.62	112.85	113.21
1989	107.60	103.98	114.70	108.19	105.85
1990	118.80	113.00	130.17	120.45	113.90
1991	126.46	120.50	138.14	126.30	126.93
1992	134.33	128.32	146.12	130.98	144.27
1993	130.97	125.16	142.38	124.60	149.85
1994	118.72	113.22	129.51	110.57	142.87
1995	117.13	111.46	128.25	108.22	143.53
1996	125.99	119.85	138.02	117.52	151.07
1997	141.46	134.45	155.20	133.34	165.50
1998	165.97	156.76	184.04	159.59	184.86

1999	192.32	178.83	218.79	189.68	200.15
2000	233.77	214.54	271.48	239.87	215.69
2001	262.17	237.38	310.80	277.32	217.33
2002	301.75	267.56	368.79	329.31	220.12
2003	337.25	293.75	422.56	379.42	212.36
2004	375.85	321.86	481.74	436.63	195.89
2005	418.43	349.76	553.12	496.92	186.02
2006	508.17	411.70	697.38	614.88	192.20
2007	583.44	457.84	829.75	717.78	185.63
2008	670.58	511.50	982.59	835.72	181.59

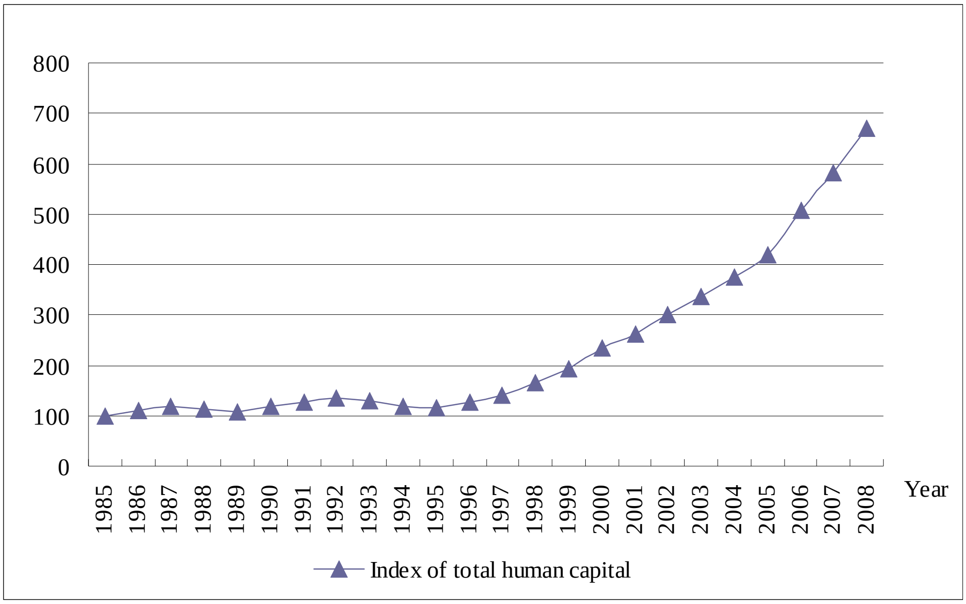


Figure 6.3.5 Index of real active human capital

6.3.2 Active human capital per capita

Table 6.3.5 shows that the active per capita human capitals both in real and nominal terms increased continuously throughout the period under study, and were much larger than per capita GDP.

Table 6.3.5 Nominal and real active human capital per capita, Nominal GDP per capita

Unit: Yuan

Year	Nominal active human capital per capita		Real active human capital per capita		Nominal GDP per capita	Ratio of human capital to GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
1985	26891.83		26891.83		1413	19.03
1986	30974.84		29078.55		1633	18.97
1987	35544.73		30673.23		1917	18.54
1988	38975.15		28451.70		2285	17.06
1989	43006.54		26526.05		2574	16.71
1990	47769.66		28507.39		2698	17.71
1991	53767.73		30416.79		3027	17.76
1992	60930.86		32372.25		3693	16.50
1993	68588.95		31701.53		5015	13.68
1994	77462.16		28786.93		6103	12.69
1995	87925.95		28185.08		6880	12.78
1996	101059.06		30000.57		7730	13.07
1997	115724.27		33175.46		8725	13.26
1998	133374.58		38281.09		9415	14.17
1999	152289.66		43990.59		10086	15.10
2000	182120.61	184182.75	52269.10	52826.58	11177	16.29
2001	205787.06	208428.48	58731.68	59446.88	12015	17.13
2002	235785.72	238819.59	67701.13	68533.80	13000	18.14
2003	269828.19	274078.25	75536.29	76688.30	14270	18.91
2004	313091.84	319006.28	84457.12	86016.41	15835	19.77
2005	355356.13	362416.56	94467.05	96313.71	18632	19.07
2006	428191.66	438506.97	112253.55	114922.43	21788	19.65
2007	514868.00	529713.88	128538.13	132209.55	25729	20.01
2008	620049.06	640901.06	147969.53	152909.58	31259	19.84

Table 6.3.6 and Table 6.3.7 report the active human capital per capita for rural and urban areas and by gender. The active human capital per capita was much smaller in the rural area than in the urban area. And the active human capital per capita was smaller for females than for males. These results are in line with what we observed regarding the total human capital: there was a significant difference in human capital between urban and rural areas, and between male and female populations in Liaoning province.

Table 6.3.6 Nominal and real active human capital per capita by urban-rural

Unit: Yuan

Year	Nominal		Real	
	Urban	Rural	Urban	Rural
1985	42873	12783	42873	12783
1986	47886	14761	44741	14062
1987	53306	16990	45366	15324
1988	57113	19291	40834	15014
1989	61641	21761	37427	14098
1990	67105	24451	39524	15221
1991	74844	28418	41590	16978
1992	84176	33053	43269	19303
1993	94325	38042	41539	20025
1994	106289	43641	37123	19006
1995	120798	50010	36343	18776
1996	139064	56272	38671	19783
1997	159972	62618	42854	21560
1998	185489	68986	49789	24063
1999	213013	75057	57933	26258
2000	258300	80836	70250	28363
2001	291339	84637	79235	29697
2002	333204	88325	91722	31341
2003	380476	91630	102975	31346

Year	Nominal		Real	
	Urban	Rural	Urban	Rural
2004	440427	93942	115961	30237
2005	497262	96706	129877	29926
2006	593576	104135	153355	31719
2007	705973	112604	174374	32057
2008	839223	122597	198591	33075

Table 6.3.7 Nominal and real active human capital per capita by gender

Unit: Yuan

Year	Nominal active human capital per capita		Real active human capital per capita	
	Male	Female	Male	Female
1985	32323.17	20226.30	32323.17	20226.30
1986	37808.72	22781.11	35465.20	21421.05
1987	44031.77	25629.60	37905.02	22224.59
1988	48569.52	28399.41	35341.73	20856.92
1989	53998.28	31528.52	33234.22	19521.10
1990	60530.31	35113.75	36066.19	21010.63
1991	67612.74	39774.23	38188.29	22561.93
1992	76107.37	45290.66	40354.77	24145.83
1993	84897.27	51466.77	39173.77	23856.38
1994	94804.46	58939.99	35206.71	21930.38
1995	106480.13	67816.94	34153.01	21717.03
1996	122196.26	78123.82	36321.48	23141.97
1997	139560.00	89798.36	40083.62	25661.51
1998	159534.14	104847.44	45904.92	29967.26
1999	179576.17	122663.81	52041.75	35249.20
2000	210516.31	150852.95	60622.34	43071.02
2001	236831.02	172232.44	67803.31	48926.40
2002	267928.88	201609.97	77152.82	57651.76
2003	303425.69	234587.70	85118.89	65485.10
2004	348307.94	276548.94	94062.38	74489.95
2005	388680.44	321243.00	103385.70	85337.30
2006	452380.22	403245.31	118633.09	105674.15
2007	525590.25	503747.22	131216.80	125759.91
2008	613062.75	627351.81	146262.44	149753.97

Finally we calculate a set of total active human capital indexes using 1985 as the base year. Table 6.3.8 reports the results.

Table 6.3.8 Index of real active human capital per capita（1985=100）

Year	Total	Male	Female	Urban	Rural
1985	100.00	100.00	100.00	100.00	100.00
1986	104.66	109.72	105.91	104.36	110.01
1987	108.22	117.27	109.88	105.81	119.88
1988	97.13	109.34	103.12	95.24	117.45
1989	89.77	102.82	96.51	87.30	110.29
1990	96.03	111.58	103.88	92.19	119.07
1991	102.16	118.15	111.55	97.01	132.82
1992	106.21	124.85	119.38	100.92	151.01
1993	102.30	121.19	117.95	96.89	156.65
1994	91.75	108.92	108.43	86.59	148.68
1995	88.23	105.66	107.37	84.77	146.88
1996	92.90	112.37	114.42	90.20	154.76
1997	103.03	124.01	126.87	99.96	168.66
1998	119.05	142.02	148.16	116.13	188.24
1999	137.53	161.00	174.27	135.13	205.41
2000	163.59	187.55	212.95	163.86	221.88
2001	184.75	209.77	241.89	184.81	232.32
2002	214.42	238.69	285.03	213.94	245.18
2003	244.01	263.34	323.76	240.19	245.22
2004	274.49	291.01	368.28	270.48	236.54
2005	308.71	319.85	421.91	302.93	234.11
2006	366.86	367.02	522.46	357.70	248.13
2007	422.11	405.95	621.76	406.72	250.78
2008	481.39	452.50	740.39	463.21	258.74

Chapter 7 Results for Jiangsu

7.1 The trend of total human capital stock

Table 7.1.1 reports total nominal human capital stocks for Jiangsu based on four different discount rates. Among the four different discount rates, 3.14% is the average interest rate of 10-year national bonds issued by the Chinese government; 5.43% is the interest rate of long-term loans from commercial banks to enterprises; 4.58% is the discount rate used by the OECD in the context of human capital estimation[34]; 8.14% is the social discount rate of China calculated by the World Bank.

Table 7.1.1 Total human capital based on different discount rates (Nominal)

Unit: 100 Million Yuan

Year	Discount rate 3.14%	Discount rate 4.58%	Discount rate 5.43%	Discount rate 8.14%
1985	26835.68	18244.67	14812.03	8335.80
1986	31301.50	21320.12	17329.62	9791.88
1987	34669.32	23790.12	19421.80	11117.83
1988	40696.63	27991.73	22882.87	13150.74
1989	47922.65	32980.54	26971.30	15520.57
1990	57457.96	39463.76	32243.57	18521.29
1991	67354.23	46337.61	37896.66	21833.52
1992	78112.19	53802.82	44032.61	25423.73
1993	90144.48	62128.59	50859.97	29383.71
1994	102141.46	70709.63	58027.51	33758.03
1995	119651.18	83104.59	68313.75	39906.33
1996	140813.29	97359.00	79832.51	46327.09
1997	172032.95	118430.35	96857.51	55762.18

[34] The analysis in this chapter is based on the discount rate of 4.58% except declared otherwise.

1998	197733.37	136571.89	111888.67	64707.72
1999	239886.46	165373.25	135318.19	77942.70
2000	297118.71	206042.67	169114.64	98149.46
2001	340442.34	235702.48	193300.50	111970.89
2002	385161.13	267534.06	219791.18	127905.41
2003	449204.93	311547.57	255699.49	148314.92
2004	504158.70	350307.22	287827.57	167513.89
2005	573205.92	398436.65	327518.90	191036.54
2006	672131.43	467862.53	384864.05	224865.91
2007	788970.14	549857.95	452603.07	264877.49
2008	925784.23	645690.83	531709.23	311541.87

In order to discuss the real growth of total human capital stock, we need to adjust the nominal value into real value by a price index. The real values of total human capital stock calculated by three different price indexes are reported in Table 7.1.2 (base year is 1985 in all three cases). Column 1 uses rural and urban CPI; Column 2 uses the living cost index. Aligned on the urban living cost of in Beijing, the real values are comparable between rural and urban as well as cross provinces. Column 3 uses index of fixed assets investment, treating the human capital with the physical capital. As we can see from the table, the real value of total human capital adjusted by the index of fixed asset investment is the highest; the real value of total human capital adjusted by CPI is the lowest while the real value adjusted by living cost lies in the middle.

Table 7.1.2 Real total human capital based on different price indexes

Unit: 100 Million Yuan

Year	CPI	Living Cost index	Fixed Assets Investment Index
1985	18244.67	21489.51	18244.67
1986	19922.69	23365.25	22162.29
1987	20378.85	24009.22	22410.60
1988	19657.81	23112.99	23853.40

Year	CPI	Living Cost index	Fixed Assets Investment Index
1989	19746.76	23158.61	29470.88
1990	22894.68	26845.11	34799.63
1991	25635.41	30020.11	39101.51
1992	27899.39	32681.85	40500.40
1993	27277.28	31931.80	33694.30
1994	25116.54	29407.29	33462.53
1995	25390.94	29592.87	36618.53
1996	27203.42	31673.35	41569.26
1997	32298.03	37291.65	50973.86
1998	37255.77	42877.21	59738.01
1999	45320.53	51707.92	73587.02
2000	55834.10	63010.55	90686.36
2001	63378.79	71265.14	102917.31
2002	72523.87	81164.00	114863.59
2003	83328.51	92772.14	128245.87
2004	89977.94	99833.39	131858.94
2005	100009.68	110566.07	148681.79
2006	115290.28	127025.65	172518.73
2007	129758.92	142528.03	193282.69
2008	144283.78	158329.50	206260.73

Calculated by the Mincer models of Jiangsu and discount rate valued 4.58%, the total human capital stocks for Jiangsu from 1985 to 2008 are reported in table 7.1.3. Column 1 and column 2 contain the total human capital measured in nominal terms; column 3 and column 4 contain the total human capital measured in real terms (price in 1985). In order to get a sense of the magnitude of the total human capital, we also present the ratio of nominal GDP to nominal human capital stock in Table 7.1.3.

Table 7.1.3 Nominal and real human capital, Nominal GDP

Unit: 100 Million Yuan

Year	**Nominal human capital**		**Real human capital**		**Nominal GDP**	**Ratio of human capital to GDP**
	Five-education category	**Six-education category**	**Five-education category**	**Six-education category**		
1985	18244.67		18244.67		651.82	27.99
1986	21320.12		19922.69		744.94	28.62
1987	23790.12		20378.85		922.33	25.79
1988	27991.73		19657.81		1208.85	23.16
1989	32980.54		19746.76		1321.85	24.95
1990	39463.76		22894.68		1416.5	27.86
1991	46337.61		25635.41		1601.38	28.94
1992	53802.82		27899.39		2136.02	25.19
1993	62128.59		27277.28		2998.16	20.72
1994	70709.63		25116.54		4057.39	17.43
1995	83104.59		25390.94		5155.25	16.12
1996	97359.00		27203.42		6004.21	16.22
1997	118430.35		32298.03		6680.34	17.73
1998	136571.89		37255.77		7199.95	18.97
1999	165373.25		45320.53		7697.82	21.48
2000	206042.67	221271.5561	55834.10	59743.33	8553.69	24.09
2001	235702.48	250792.3889	63378.79	67234.61	9456.84	24.92
2002	267534.06	281730.6866	72523.87	76206.02	10606.85	25.22
2003	311547.57	331064.2371	83328.51	88361.66	12442.87	25.04
2004	350307.22	373982.7673	89977.94	95877.74	15003.6	23.35
2005	398436.65	426318.286	100009.68	106826.44	18305.66	21.77
2006	467862.53	503320.0452	115290.28	123819.09	21645.08	21.62
2007	549857.95	592396.3247	129758.92	139581.57	25741.15	21.36
2008	645690.83	692036.2944	144283.78	154424.80	30312.61	21.30

Figure 7.1.1 shows the trends of total human capital measured in both real and nominal terms.

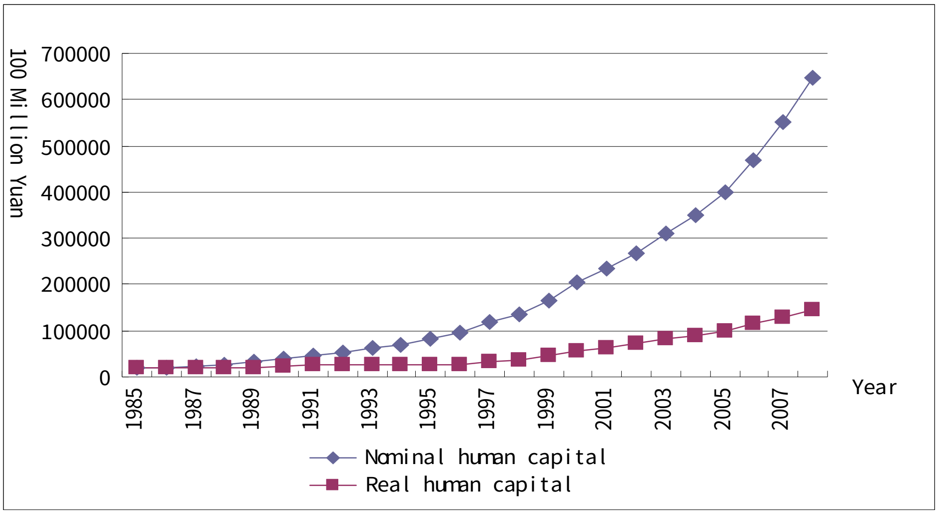


Figure 7.1.1 Nominal, Real human capital for Jiangsu

As we can see from Figure 7.1.2, the ratio of nominal human capital to nominal GDP declined slightly between 1985 to 1989 and again between 1990 to 1998, but went up and reached the highest point at 25 in 2003.This has much to do with both human capital and GDP. During the declining period, the growth rate of human capital stock is lower than that of GDP, and this is reversed over the rising period.

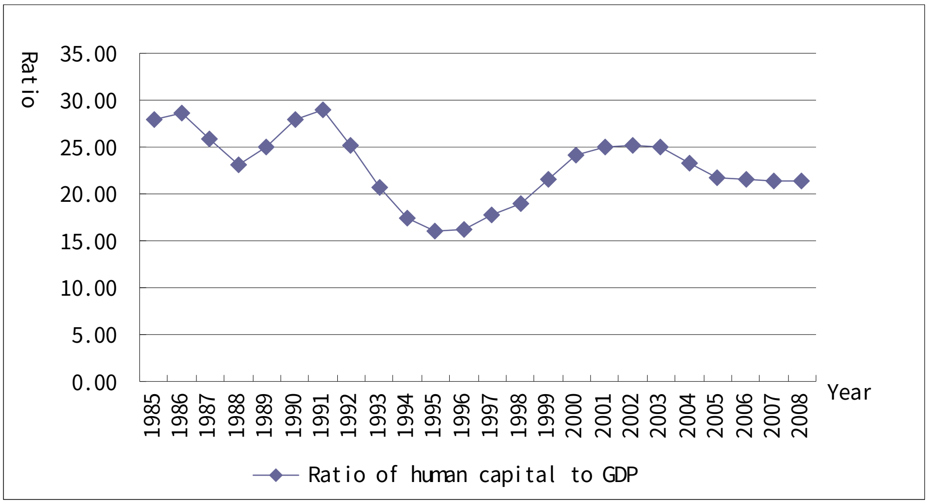


Figure 7.1.2 Ratio of nominal total human capital to nominal GDP for Jiangsu

Table 7.1.4 reports the total human capital stock for Jiangsu classified by gender and urban-rural. The results based on five education categories show that the total human capital for Jiangsu increased from RMB 1.82 trillion to RMB 14 trillion (calculated by 1985 comparable price), an increase of about eight-fold. The annual growth rate of total human capital at this period increased to 8.99%.[35] This indicates a rapid growth of human capital for Jiangsu. Before 1997, the growth rates of various human capital stocks were quite low, the gender gap was fairly stable and the gap between rural and urban was relatively large. Starting from 1997, both the human capital of male and female increased by a significant amount, and the gender gap appears to be expanding. Moreover, the human capital for urban increased dramatically while the human capital for rural remained stable and even started to decline in the later period.

The trend that the total human capital of male is higher than that of female is consistent with the national results. One reason is the earlier retirement age for female, male have longer time to generate income from market, and thus end up with a higher life income relative to female. 36Moreover, male on average have higher educational attainment than female. Last but not least the income gap between male and female keeps expanding, which directly results in the differences in human capital.

Table 7.1.4 Real human capital by gender and rural-urban

Unit: 100 Million Yuan

Year	Total	Male	Female	Urban	Rural
1985	18244.67	10243.99	8000.69	8700.87	9543.80
1986	19922.69	11465.78	8456.91	9965.36	9957.33

[35] The annual growth rate here is the mean of the annual log growth rates.

[36] To ensure the consistent of urban and rural, we define the working age of male and female in rural area as 60 and 55.

Year	Total	Male	Female	Urban	Rural
1987	20378.85	11851.86	8526.99	9685.29	10693.57
1988	19657.81	11641.32	8016.49	9551.03	10106.78
1989	19746.76	11834.61	7912.15	9901.82	9844.95
1990	22894.68	13951.49	8943.19	11511.09	11383.60
1991	25635.41	15806.02	9829.39	13073.32	12562.09
1992	27899.39	17454.33	10445.05	14173.79	13725.59
1993	27277.28	17262.30	10014.98	13970.08	13307.19
1994	25116.54	15899.04	9217.50	12823.52	12293.02
1995	25390.94	16124.72	9266.23	13639.60	11751.35
1996	27203.42	17374.63	9828.79	14774.68	12428.74
1997	32298.03	21012.53	11285.50	19099.33	13198.70
1998	37255.77	24258.37	12997.40	22718.09	14537.68
1999	45320.53	29463.80	15856.73	29853.99	15466.54
2000	55834.10	36990.06	18844.05	40209.02	15625.08
2001	63378.79	42143.96	21234.83	46928.67	16450.11
2002	72523.87	48308.83	24215.04	55602.04	16921.82
2003	83328.51	55158.22	28170.29	66211.24	17117.27
2004	89977.94	59320.13	30657.80	73196.10	16781.84
2005	100009.68	66030.42	33979.25	83323.99	16685.69
2006	115290.28	75939.60	39350.68	98200.67	17089.61
2007	129758.92	85347.08	44411.84	112747.24	17011.68
2008	144283.78	95138.00	49145.78	127417.38	16866.41

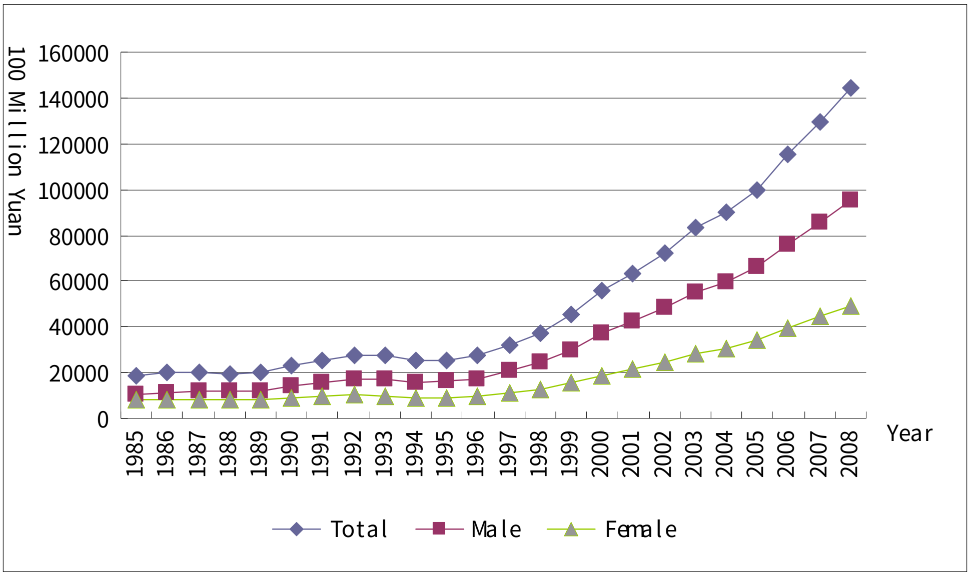


Figure7.1.3 Real human capital by gender (1985-2008)

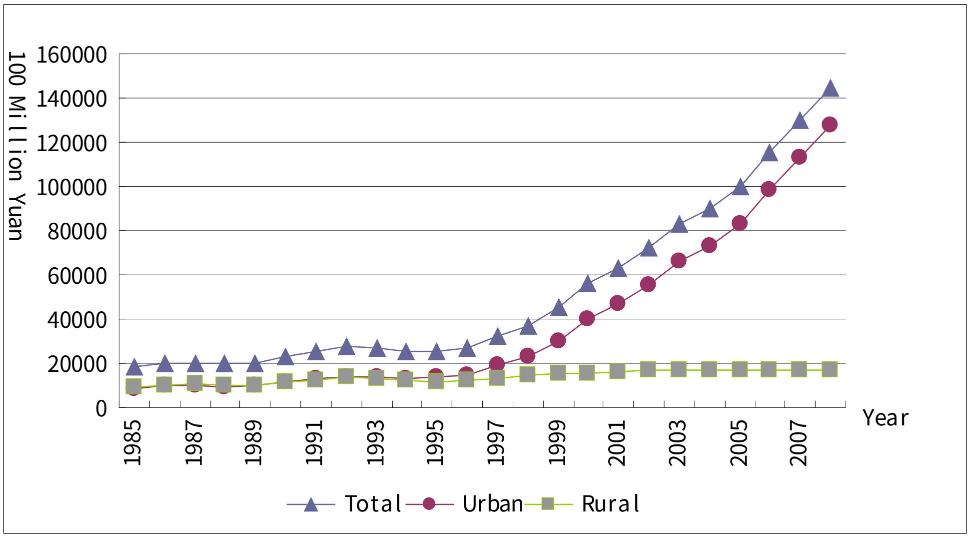


Figure 7.1.4 Real human capital by urban-rural (1985-2008)

Figure 7.1.4 shows the trend of total of human capital for urban and rural separately. The total human capital remained almost constant before 1997. Starting from 1998, however, the human capital in the urban area rose rapidly while in the rural area it remained low with zero growth. This results in an expanding gap between rural and urban. In 2008, the total human capital for urban was about 7.55 times the amount for rural in Jiangsu. From 1985 to 2008, total human capital for rural in Jiangsu increased from RMB 0.95 trillion to RMB 1.69 trillion, the total human capital for urban in Jiangsu increased from RMB 0.87 trillion to RMB 12.74 trillion. During the same period, the annual growth rates of human capital were 2.48% and 11.76% for rural and urban areas respectively. The gap between urban and rural exhibits a trend of further expansion as the urban area increases faster in the later period. One reason that results in the gap between rural and urban is the rapid urbanization during the course of economic transition as well as a large scale rural-urban migration. Another reason is the education gap between the rural and urban population.

Table 7.1.5 reports a set of real indexes of total human capital for Jiangsu from 1985 to 2008 calculated by using 1985 as the base year.. It's easy to see that the human capital for Jiangsu has been rising much more rapidly since 1997.

Table 7.1.5 Total human capital index for Jiangsu (1985=100)

Year	Total human capital	Male total human capital	Female total human capital	Urban total human capital	Rural total human capital
1985	100	100	100	100	100
1986	109.20	111.93	105.70	114.53	104.33
1987	111.70	115.70	106.58	111.31	112.05
1988	107.75	113.64	100.20	109.77	105.90
1989	108.23	115.53	98.89	113.80	103.16
1990	125.49	136.19	111.78	132.30	119.28
1991	140.51	154.30	122.86	150.25	131.63
1992	152.92	170.39	130.55	162.90	143.82
1993	149.51	168.51	125.18	160.56	139.43
1994	137.67	155.20	115.21	147.38	128.81
1995	139.17	157.41	115.82	156.76	123.13
1996	149.10	169.61	122.85	169.81	130.23
1997	177.03	205.12	141.06	219.51	138.30

1998	204.20	236.81	162.45	261.10	152.33
1999	248.40	287.62	198.19	343.11	162.06
2000	306.03	361.09	235.53	462.13	163.72
2001	347.38	411.40	265.41	539.36	172.36
2002	397.51	471.58	302.66	639.04	177.31
2003	456.73	538.44	352.10	760.97	179.35
2004	493.17	579.07	383.19	841.25	175.84
2005	548.16	644.58	424.70	957.65	174.83
2006	631.91	741.31	491.84	1128.63	179.07
2007	711.22	833.14	555.10	1295.82	178.25
2008	790.83	928.72	614.27	1464.42	176.73

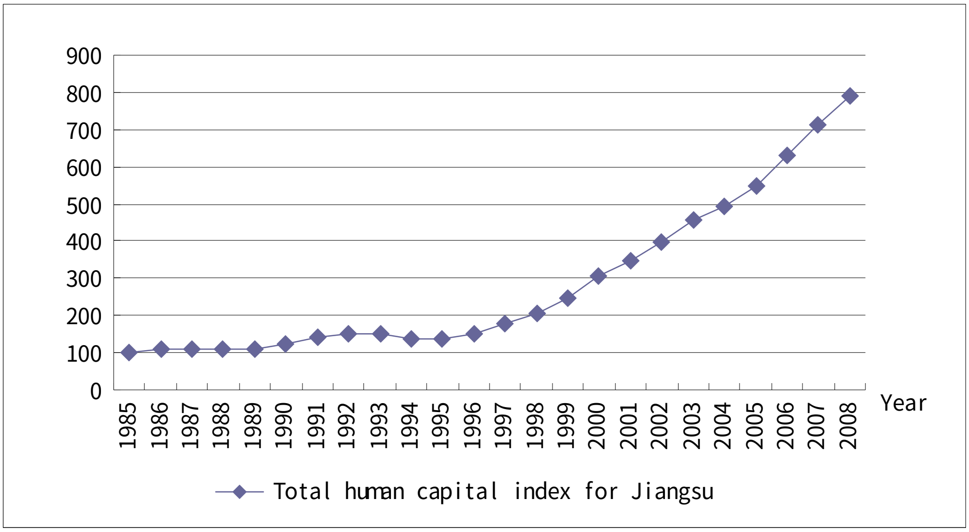


Figure 7.1.5 Total human capital index for Jiangsu, 1985-2008

7.2 Per capita human capital

In order to get further information on the dynamics of human capital, we calculate per capita human capital, defined as the ratio of total human capital over non-retired population. Although the per capita human capital is influenced by the age distribution of the population, the effect is relatively small in comparison with the number of population, and thus per capita human capital is able to serve as a better indicator of the average human capital.

Table 7.2.1 Nominal and real per capita human capital, per capita GDP

Unit: Yuan

Year	Nominal per capita human capital	Real per capita human capital	Per capita GDP	Ratio of nominal per capita human capital to nominal GDP
1985	32829.63	32829.63	1172.89	50.37
1986	38254.46	35747.06	1336.64	51.35
1987	42403.92	36323.62	1643.98	45.97
1988	49183.16	34539.96	2124.02	40.69
1989	57053.90	34160.45	2286.70	43.16
1990	65940.69	38255.13	2366.85	46.55
1991	76652.48	42406.54	2649.03	47.87
1992	88431.13	45855.85	3510.79	41.40
1993	101657.98	44632.47	4905.74	33.91
1994	115436.74	41003.92	6623.88	28.45
1995	135351.92	41354.07	8396.32	26.26
1996	157874.80	44112.35	9736.27	26.29
1997	191369.61	52189.85	10794.65	28.65
1998	220105.91	60043.21	11603.79	30.57
1999	266017.50	72902.09	12382.63	34.56
2000	326544.69	88488.13	13556.23	38.18
2001	373181.69	100346.00	14972.77	39.46
2002	423130.13	114703.27	16775.72	39.89
2003	492256.81	131662.16	19660.20	39.56
2004	553640.56	142205.00	23712.33	36.90
2005	629979.56	158128.16	28943.60	34.41
2006	737343.31	181695.53	34112.28	34.07
2007	863802.38	203845.50	40438.20	33.56
2008	1016080.56	227049.75	47700.93	33.52

Table 7.2.2 Nominal and Real per capita human capital by urban-rural

Unit: Yuan

Year	Nominal per capita human capital			Real per capita human capital		
	Total	Urban	Rural	Total	Urban	Rural
1985	32830	94985	20563	32830	94985	20563
1986	38254	103445	23575	35747	97288	21889
1987	42404	109291	27151	36324	92964	23407
1988	49183	120767	31266	34540	83827	22203
1989	57054	135122	36061	34160	80830	21611
1990	65941	153611	41723	38255	88863	24275
1991	76652	171928	47522	42407	92358	27134
1992	88431	196299	54300	45856	96923	29698
1993	101658	225851	61718	44632	93937	28776
1994	115437	252232	69843	41004	83746	26758
1995	135352	281961	79531	41354	80560	26427
1996	157875	335201	89872	44112	86433	27883
1997	191370	398443	100790	52190	101416	30657
1998	220106	446811	112466	60043	113727	34554
1999	266018	520550	124490	72902	134390	38713
2000	326545	582500	138328	88488	150384	42973
2001	373182	664128	150287	100346	171287	45998
2002	423130	739325	160415	114703	193781	49000
2003	492257	850637	170135	131662	221008	51356
2004	553641	951455	178579	142205	238382	51528
2005	629980	1062894	188996	158128	261081	53256
2006	737343	1233992	201986	181696	298335	55965
2007	863802	1434065	215936	203846	333026	57086
2008	1016081	1676204	231957	227050	369308	58069

Based on the five education categories, the per capita human capital measured at the nominal level in 1985, 1995 and 2008 were RMB 32830, RMB 135352, and RMB 1016081. From 1985 to 2008, the nominal per capital human capital for Jiangsu increased almost 30 times. The rapid growth of human capital was the result of dramatic economic growth since 1978, the rapid expansion of education, the transition towards market-orientated system and a large scale of rural-urban migration.

Table 7.2.3 Nominal and Real per capita human capital by gender

Unit: Yuan

Year	Nominal per capita human capital			Real per capita human capital		
	Total	Male	Female	Total	Male	Female
1985	32830	34993	30422	32830	34993	30422
1986	38254	41666	34439	35747	38966	32147
1987	42404	46728	37564	36324	39999	32210
1988	49183	55207	42440	34540	38727	29853
1989	57054	64886	48327	34160	38847	28939
1990	65941	76260	54442	38255	44232	31595
1991	76652	90088	61767	42407	49746	34275
1992	88431	105723	69345	45856	54680	36117
1993	101658	123203	77997	44632	53966	34383
1994	115437	140702	88038	41004	49891	31367
1995	135352	166532	102035	41354	50840	31218
1996	157875	195474	117811	44112	54615	32921
1997	191370	239570	139193	52190	65320	37976
1998	220106	275582	160056	60043	75214	43622
1999	266018	331832	194530	72902	91030	53212
2000	326545	412482	231831	88488	111814	62780
2001	373182	474715	262035	100346	127680	70424
2002	423130	540579	295209	114703	146555	80012
2003	492257	627135	346411	131662	167750	92639
2004	553641	703509	392009	142205	180681	100709
2005	629980	803134	443857	158128	201531	111475
2006	737343	936224	522752	181696	230597	128931
2007	863802	1093230	615248	203846	257835	145355
2008	1016081	1285327	722462	227050	286997	161676

The ratio of per capita human capital to per capita GDP measured in nominal term for Jiangsu is reported in Figure 7.2.1. The trend and level of the ratio is very similar to that of total human capital.

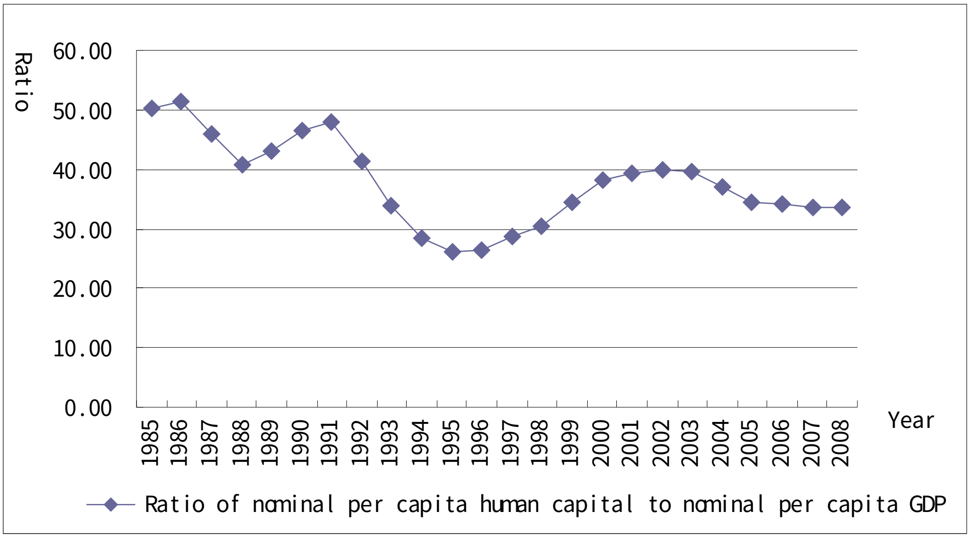


Figure 7.2.1 Ratio of nominal per capita human capital to nominal per capita GDP

Table 7.2.2 and Table 7.2.3 present the trends of per capita human capital measured in real terms for Jiangsu classified by gender and urban-rural respectively. As we can see, per capita human capital is significantly higher for urban than for rural. And the size of the difference expanded rapidly after 1997, partly due to the slow growth in the rural area. Based on five-education category, in 1985, per capita human capital was RMB 94985 in the urban area and RMB 20563 in the rural area. The corresponding numbers became RMB 369308 and RMB 58069 in 2008, respectively. The ratio of urban to rural increased from 4.62 to 6.36, which indicates a rising size of urban-rural gap on per capita human capital. From 1985 to 2008, the annual growth rate was 5.9% for the urban area, and 4.51% for the rural area.

The trends of per capita human capital of male and female are similar to each other. Per capita human capital of male is higher than that of female. From1985 to 2008, the annual growth rate was 9.15% for male, and 7.26% for female.

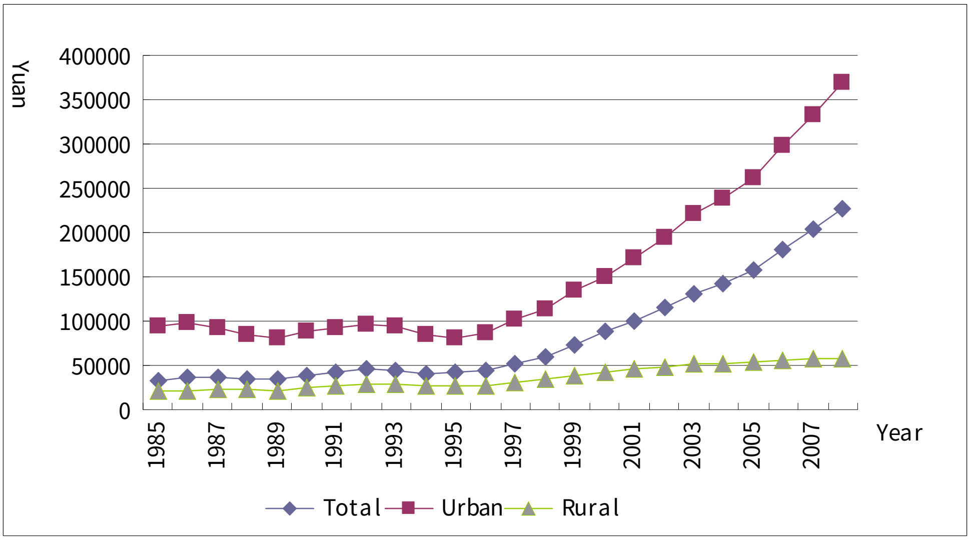


Figure 7.2.2 Per capita human capital by urban-rural, 1985-2008

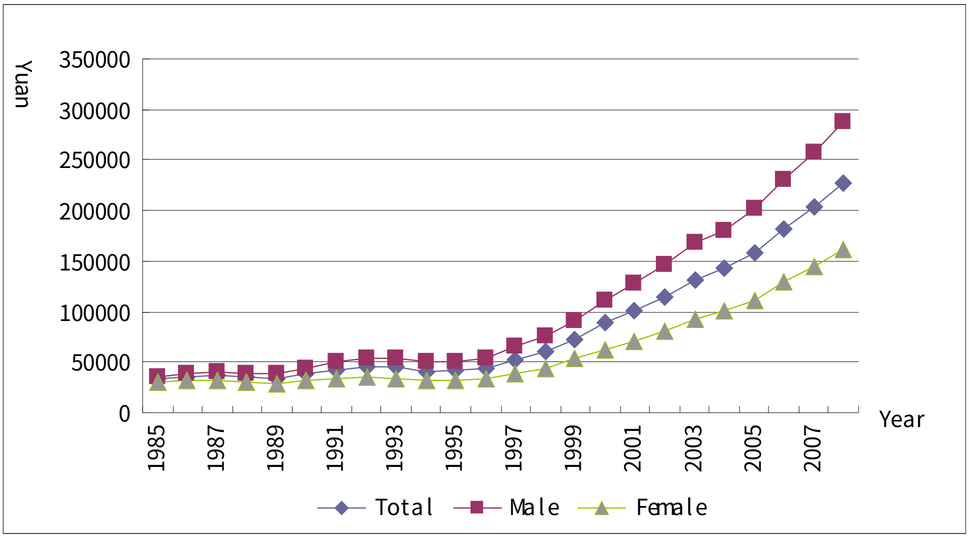


Figure 7.2.3 Per capita human capital by gender 1985-2008

Similarity, we construct a set of per capita human capital indexes with 1985 as the base year. Table 7.2.4 shows various per capita human capital indexes for Jiangsu.

Table 7.2.4 Index of per capita human capital(1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100.00	100.00	100.00	100.00	100.00
1986	108.89	111.35	105.67	102.42	106.45
1987	110.64	114.31	105.88	97.87	113.83
1988	105.21	110.67	98.13	88.25	107.98
1989	104.05	111.01	95.12	85.10	105.10
1990	116.53	126.40	103.86	93.55	118.05
1991	129.17	142.16	112.67	97.23	131.96
1992	139.68	156.26	118.72	102.04	144.42
1993	135.95	154.22	113.02	98.90	139.94
1994	124.90	142.57	103.11	88.17	130.13
1995	125.97	145.29	102.62	84.81	128.52
1996	134.37	156.08	108.21	91.00	135.60
1997	158.97	186.67	124.83	106.77	149.09
1998	182.89	214.94	143.39	119.73	168.04
1999	222.06	260.14	174.91	141.49	188.27
2000	269.54	319.54	206.36	158.32	208.98
2001	305.66	364.88	231.49	180.33	223.69
2002	349.39	418.82	263.01	204.01	238.29
2003	401.05	479.39	304.52	232.68	249.75
2004	433.16	516.34	331.04	250.97	250.59
2005	481.66	575.92	366.43	274.87	258.99
2006	553.45	658.99	423.81	314.09	272.16
2007	620.92	736.83	477.80	350.61	277.62
2008	691.60	820.16	531.45	388.81	282.40

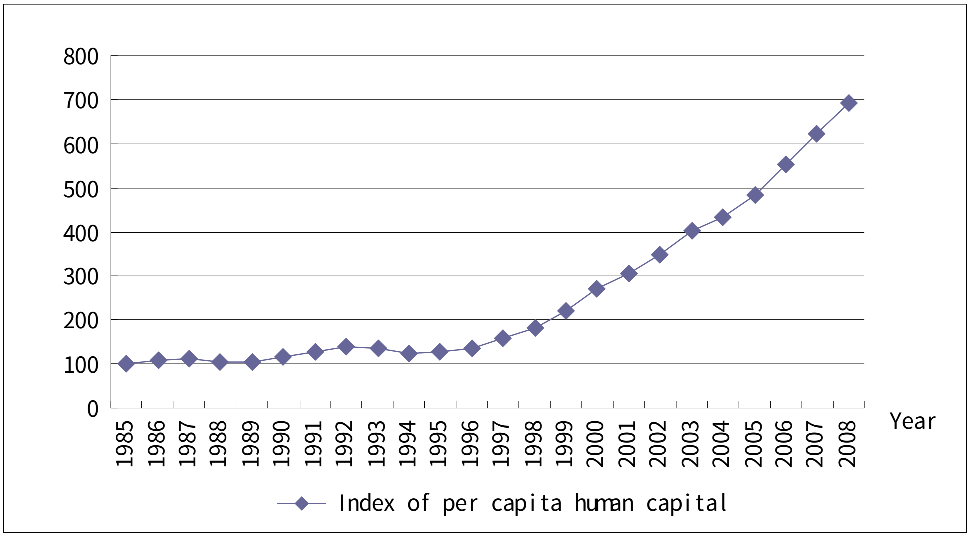


Figure7.2.4 Index of per capita human capital, 1985-2008

7.3 Active human capital

7.3.1 Active total human capital

Based on the income parameter of Jiangsu and the discount rate valued 4.58%，the total active human capital (non-retired population aged over 15) for Jiangsu is reported in Table 7.3.1. Column 1 and column 2 contain active human capital stocks measured in nominal terms. Column 3 and column 4 contain active human capital stocks measured in real terms (1985 price). The real value in this table is calculated using.

Table7.3.1 Total active human capital and nominal GDP

Unit: 100 Million Yuan

Year	Nominal total human capital		Real total human capital		Nominal GDP	Ratio of nominal human capital to nominal GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
1985	9496.69		9496.69		651.82	14.57
1986	11380.90		10631.02		744.94	15.28

1987	13349.39		11437.77		922.33	14.47
1988	15620.79		10978.18		1208.85	12.92
1989	18854.72		11289.43		1321.85	14.26
1990	22178.59		12868.23		1416.5	15.66
1991	25959.26		14381.36		1601.38	16.21
1992	30030.05		15615.50		2136.02	14.06
1993	34101.34		15029.60		2998.16	11.37
1994	39248.05		13988.77		4057.39	9.67
1995	46522.83		14229.18		5155.25	9.02
1996	51802.84		14547.93		6004.21	8.63
1997	61058.09		16768.62		6680.34	9.14
1998	71084.42		19512.47		7199.95	9.87
1999	84118.68		23197.65		7697.82	10.93
2000	109735.40	112652.29	29781.30	30534.94	8553.69	12.83
2001	121405.78	124652.18	32695.29	33533.24	9456.84	12.84
2002	139688.22	143857.16	37878.58	38972.00	10606.85	13.17
2003	158114.80	163642.63	42317.86	43754.96	12442.87	12.71
2004	179801.70	186736.75	46172.57	47911.16	15003.6	11.98
2005	205341.74	213214.40	51496.98	53432.05	18305.66	11.22
2006	250383.53	261814.16	61655.99	64421.15	21645.08	11.57
2007	301663.51	316666.03	71154.06	74639.81	25741.15	11.72
2008	360216.14	378107.87	80458.71	84402.44	30312.61	11.88

Figure 7.3.1 presents the trends of active human capital in both real and nominal terms for Jiangsu. As we can see, the active human capital for Jiangsu increased continuously from 1985 to 2008. After 1999, the growth rate increased much more rapidly, which corresponds to the rapid economic growth during this period for Jiangsu province.

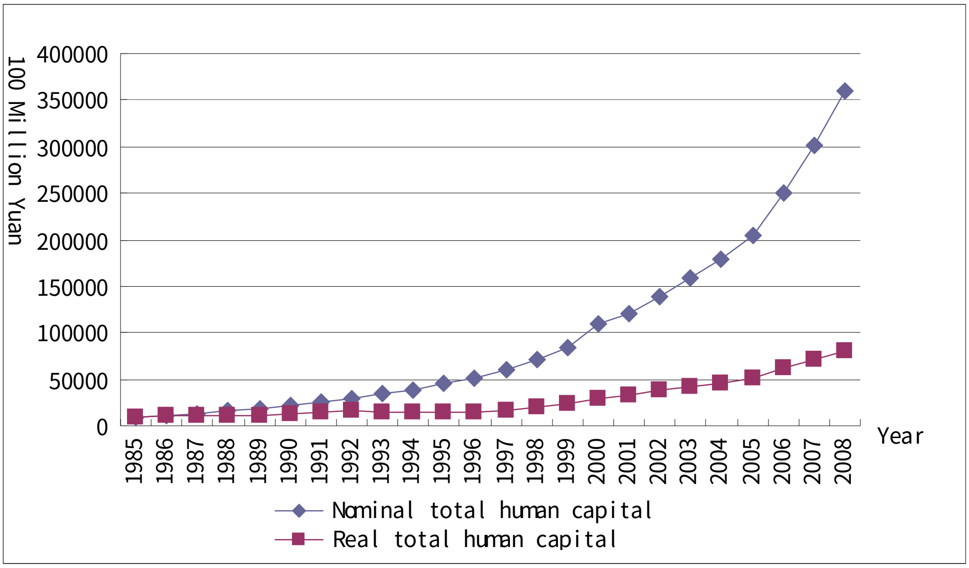


Figure 7.3.1 Nominal and Real total active human capital

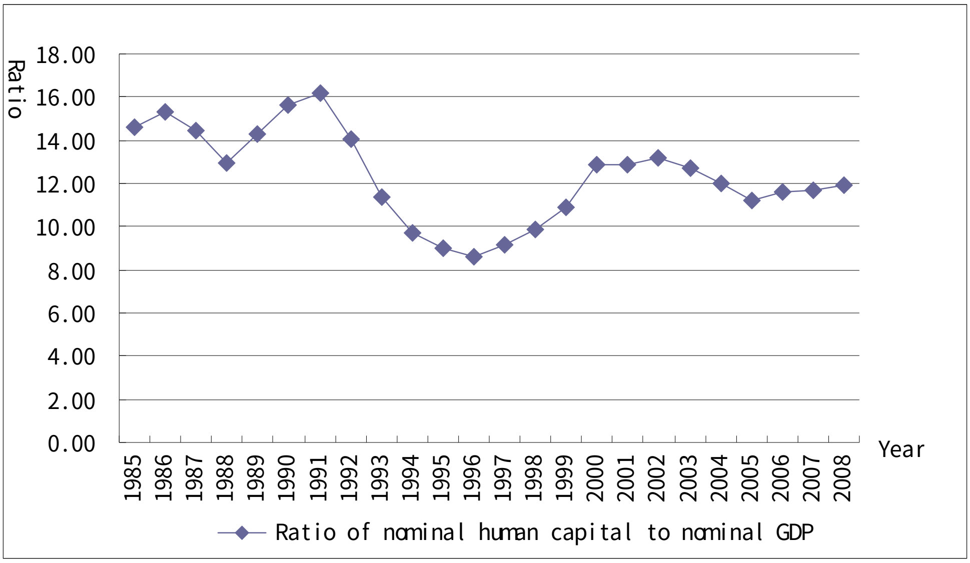


Figure 7.3.2 Ratio of nominal human capital to nominal GDP

Similar to the analysis of total human capital, we construct the ratio of nominal GDP to total active human capital stock measured in nominal term with the purpose of getting a sense of the relative magnitude. The result is reported in Table 7.3.1. As we can see from the table, the total active human capital is far above the total GDP for Jiangsu. Meanwhile, the growth rate of active human capital and that of GDP are relatively stable except a substantial decline in the ratio of nominal human capital to nominal GDP during 1991 to 1996.

The total active human capital by gender and urban-rural are reported in table 7.3.2 and 7.3.3, respectively. From 1985 to 2008, the nominal active human capital for male and female appeared to be increasing continuously. If we get rid of the influence of inflation by using CPI, the total active human capital for male and female declines correspondingly, but the rising trend still holds. Meanwhile, the total active human capital of male is higher than that for female in earlier period.

Table 7.3.2 Nominal and Real active human capital by gender

Unit: 100 Million Yuan

Year	Nominal active human capital		Real active human capital	
	Male	Female	Male	Female
1985	5319.56	4177.13	5319.56	4177.13
1986	6536.08	4844.81	6110.33	4520.69
1987	7785.76	5563.63	6665.99	4771.78
1988	9300.71	6320.08	6529.08	4449.10
1989	11481.98	7372.74	6874.40	4415.03
1990	13759.09	8419.50	7981.39	4886.84
1991	16297.85	9661.41	9011.50	5369.87
1992	19034.84	10995.21	9872.58	5742.92
1993	21726.55	12374.79	9555.09	5474.51
1994	25040.26	14207.79	8909.61	5079.17
1995	29694.65	16828.17	9075.75	5153.43
1996	33438.46	18364.37	9389.13	5158.80
1997	40234.27	20823.82	11044.42	5724.20
1998	46721.07	24363.36	12831.51	6680.95
1999	55486.89	28631.78	15312.58	7885.07
2000	72834.30	36901.09	19775.93	10005.37

Year	Nominal active human capital		Real active human capital	
	Male	Female	Male	Female
2001	80469.88	40935.90	21681.79	11013.50
2002	92571.29	47116.93	25108.55	12770.03
2003	103459.34	54655.46	27700.16	14617.71
2004	116603.77	63197.93	29949.72	16222.84
2005	132835.82	72505.92	33311.66	18185.33
2006	161348.95	89034.57	39716.46	21939.53
2007	193983.46	107680.05	45724.39	25429.67
2008	231524.91	128691.24	51665.24	28793.48

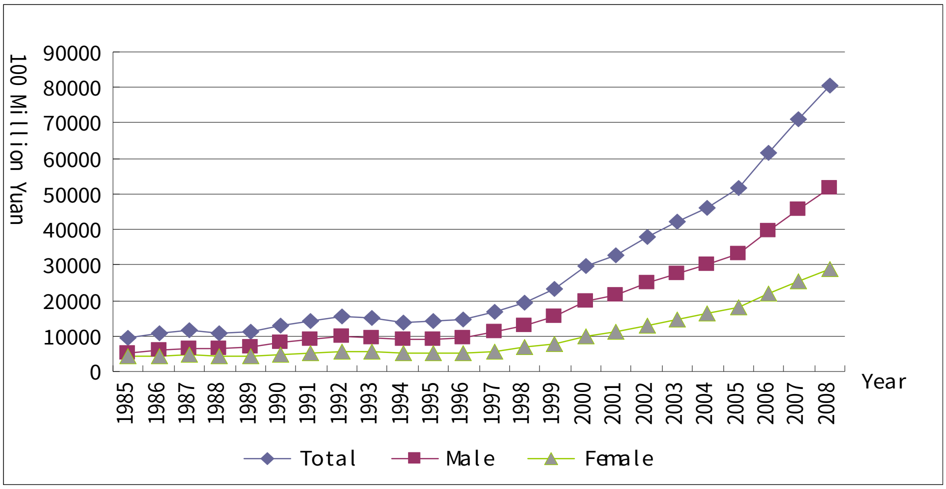


Figure 7.3.3 Real active human capital by gender

Table 7.3.3 Nominal and real active human capital by urban-rural

Unit: 100 Million Yuan

Year	Nominal active human capital		Real active human capital	
	Urban	Rural	Urban	Rural
1985	4303.63	5193.06	4303.63	5193.06
1986	5329.47	6051.42	5012.24	5618.77
1987	6167.22	7182.17	5245.87	6191.90
1988	7171.14	8449.66	4977.66	6000.52
1989	9129.09	9725.62	5461.04	5828.39

1990	10751.25	11427.35	6219.48	6648.75
1991	13045.18	12914.09	7007.69	7373.67
1992	15205.27	14824.78	7507.60	8107.89
1993	17292.15	16809.19	7192.26	7837.34
1994	20506.44	18741.61	6808.55	7180.22
1995	26401.10	20121.72	7543.17	6686.01
1996	29084.47	22718.37	7499.55	7048.38
1997	36329.01	24729.08	9246.85	7521.77
1998	44157.30	26927.12	11239.39	8273.07
1999	56075.07	28043.61	14476.90	8720.75
2000	82093.89	27641.51	21194.17	8587.12
2001	92681.47	28724.30	23903.66	8791.63
2002	110497.53	29190.69	28962.03	8916.54
2003	128681.46	29433.34	33433.37	8884.49
2004	150220.71	29580.98	37637.06	8535.50
2005	176065.37	29276.37	43247.37	8249.62
2006	218601.50	31782.02	52850.02	8805.97
2007	267430.25	34233.26	62103.96	9050.10
2008	323759.61	36456.54	71332.08	9126.64

In the rural area, the total active human capital is far smaller than that for the urban area although both of them exhibit a rising trend. As we can see from Table 7.3.4, the growth trend of active human capital for rural is relatively flat while that for urban is much steeper.

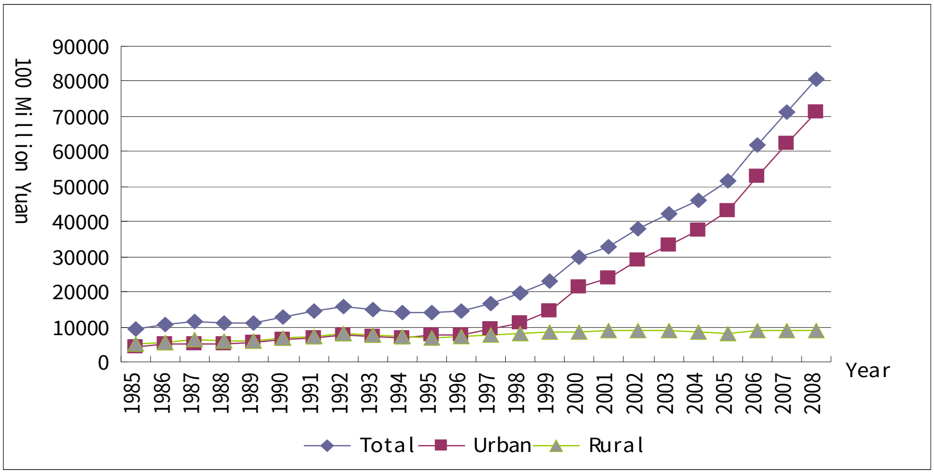


Figure 7.3.4 Real active human capital by urban-rural

From Table 7.3.2 and Table 7.3.3, we see the significant difference between urban and rural, male and female. The male human capital is higher than female although their growth rates are very similar. Moreover, the active human capital is much higher in urban area than in rural in terms of stock and growth rate, which reflects the unbalanced development between urban and rural. Nowadays, urban economy is the main driving force of the economy development for Jiangsu.

Similarity, we construct a set of total active human capital indexes with 1985 as the base year. Table 6.3.4 shows various human capital indexes. The index of human capital for Jiangsu exhibits a rising trend from 1985 to 2008.

Table 7.3.4 Index of real active human capital （1985=100）

Year	Total	Male	Female	Urban	Rural
1985	100	100.00	100.00	100	100
1986	111.94	114.87	108.22	116.47	108.20
1987	120.44	125.31	114.24	121.89	119.23
1988	115.60	122.74	106.51	115.66	115.55
1989	118.88	129.23	105.70	126.89	112.23
1990	135.50	150.04	116.99	144.52	128.03
1991	151.44	169.40	128.55	162.83	141.99
1992	164.43	185.59	137.48	174.45	156.13
1993	158.26	179.62	131.06	167.12	150.92
1994	147.30	167.49	121.59	158.20	138.27
1995	149.83	170.61	123.37	175.27	128.75
1996	153.19	176.50	123.50	174.26	135.73
1997	176.57	207.62	137.04	214.86	144.84
1998	205.47	241.21	159.94	261.16	159.31
1999	244.27	287.85	188.77	336.39	167.93
2000	313.60	371.76	239.53	492.47	165.36
2001	344.28	407.59	263.66	555.43	169.30

2002	398.86	472.00	305.71	672.97	171.70
2003	445.61	520.72	349.95	776.86	171.08
2004	486.20	563.01	388.37	874.54	164.36
2005	542.26	626.21	435.35	1004.90	158.86
2006	649.24	746.61	525.23	1228.03	169.57
2007	749.25	859.55	608.78	1443.06	174.27
2008	847.23	971.23	689.31	1657.49	175.75

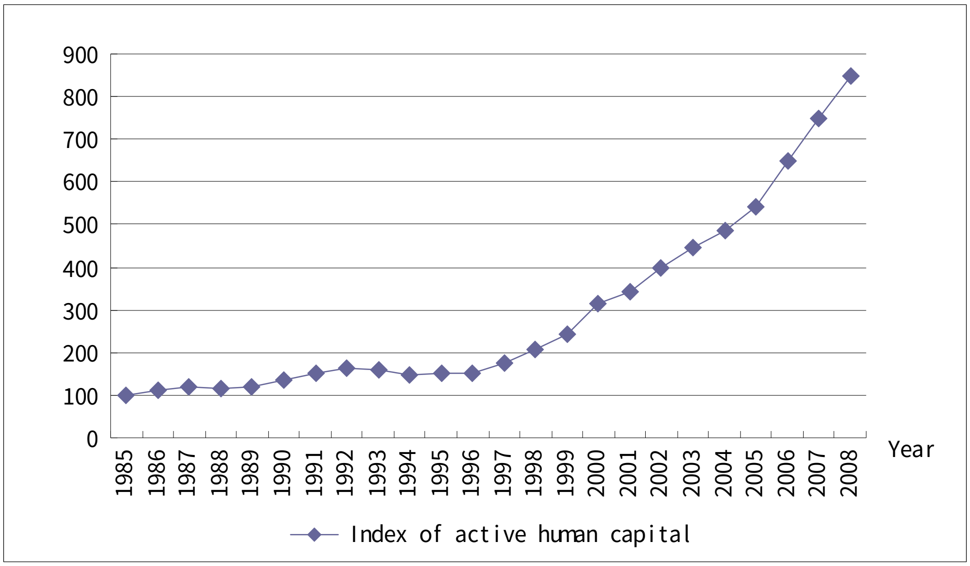


Figure 7.3.5 Index of real active human capital

7.3.2 Active human capital per capita

Similar to the analysis of per capita human capital above, we calculate the active human capital per capita. Table 7.3.5 shows that the active per capita human capital both in real and nominal values increase continuously, much larger than per capita GDP.

Table 7.3.5 Nominal and real human capital per capita, Nominal GDP per capita

Unit: Yuan

Year	Nominal active human capital per capita		Real active human capital per capita		Nominal GDP per capita	Ratio of human capital to GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
1985	25090.48		25090.48		1172.891	21.39
1986	29274.82		27345.93		1336.638	21.90
1987	33351.05		28575.23		1643.977	20.29
1988	38153.40		26813.93		2124.022	17.96
1989	45129.99		27021.99		2286.703	19.74
1990	51825.97		30069.92		2366.855	21.90
1991	59813.43		33136.48		2649.031	22.58
1992	68354.85		35544.22		3510.795	19.47
1993	77150.73		34002.89		4905.742	15.73
1994	88063.32		31387.49		6623.877	13.29
1995	103640.02		31698.69		8396.323	12.34
1996	115946.02		32561.43		9736.269	11.91
1997	135760.77		37284.51		10794.65	12.58
1998	155847.00		42779.55		11603.79	13.43
1999	182238.42		50256.41		12382.63	14.72
2000	229840.67	235950.13	62376.89	63955.41	13556.23	16.95
2001	254956.64	261774.22	68661.33	70421.05	14972.77	17.03
2002	292667.06	301401.56	79361.10	81651.99	16775.72	17.45
2003	331971.69	343577.69	88848.95	91866.21	19660.2	16.89
2004	376826.56	391361.00	96767.98	100411.71	23712.33	15.89
2005	429046.16	445495.53	107599.09	111642.27	28943.6	14.82
2006	512214.63	535598.50	126130.91	131787.64	34112.28	15.02
2007	607119.88	637313.56	143202.75	150218.08	40438.2	15.01
2008	719524.31	755262.63	160714.63	168592.13	47700.93	15.08

Table 7.3.6 and Table 7.3.7 report the active human capital per capita classified by rural-urban and gender separately. The active human capital per capita was much smaller in rural area than in urban area. And the active human capital per capita was smaller for female than for male. This reinforces the conclusion obtained from the total human capital that there is a significant difference between urban and rural, male and female in Jiangsu.

Table 7.3.6 Nominal and real active human capital per capita by urban-rural

Unit: Yuan

Year	Nominal		Real	
	Urban	Rural	Urban	Rural
1985	65143	16621	65143	16621
1986	71241	19275	67001	17897
1987	77811	22374	66186	19289
1988	84402	26043	58585	18494
1989	96927	30054	57982	18011
1990	108635	34736	62844	20210
1991	120878	39604	64934	22613
1992	136734	45181	67512	24710
1993	154700	50901	64344	23733
1994	175369	57009	58226	21841
1995	199167	63610	56905	21136
1996	224213	71652	57814	22230
1997	258197	80018	65719	24339
1998	292354	88264	74413	27118
1999	329726	96198	85125	29915
2000	388120	103945	100201	32292
2001	431217	109949	111216	33652
2002	491097	115702	128719	35342
2003	553096	120810	143703	36467

Year	Nominal		Real	
	Urban	Rural	Urban	Rural
2004	623518	125225	156219	36133
2005	690072	131014	169504	36918
2006	820462	142912	198358	39597
2007	968321	155114	224868	41007
2008	1144282	167467	252113	41924

Table 7.3.7 Nominal and real active human capital per capita by gender

Unit: Yuan

Year	Nominal		Real	
	Male	Female	Male	Female
1985	26715.17	23286.95	26715.17	23286.95
1986	31918.66	26332.30	29839.54	24570.62
1987	36925.77	29371.93	31615.01	25191.56
1988	43043.04	32688.71	30216.12	23011.63
1989	51976.35	37448.05	31118.86	22425.11
1990	60728.18	41810.03	35227.28	24267.35
1991	71291.59	47038.05	39418.94	26144.03
1992	82733.01	52545.74	42910.14	27445.22
1993	94533.78	58321.89	41574.86	25801.15
1994	108864.98	65878.13	38735.39	23550.87
1995	129292.67	76764.37	39516.49	23508.17
1996	145933.78	84375.88	40976.49	23702.31
1997	173239.89	95740.95	47554.83	26317.97
1998	198582.06	110319.63	54538.75	30251.99
1999	232728.31	128297.77	64225.45	35332.64
2000	292778.88	161371.16	79495.16	43754.20
2001	325848.03	178582.50	87796.45	48046.30
2002	375004.38	204465.00	101714.21	55415.83
2003	422398.84	236238.44	113092.88	63182.42
2004	476978.28	271604.53	122512.05	69720.59
2005	543502.06	309598.53	136295.73	77650.91
2006	644901.63	373101.19	158744.19	91938.07
2007	761013.13	445005.38	179380.55	105092.24
2008	898378.88	529774.81	200475.00	118532.24

Finally we calculate a set of total human capital indexes using 1985 as the base year. Table 7.3.8 reports the results.

Table 7.3.8 Index of real active human capital per capita（1985=100）

Year	Total	Male	Female	Urban	Rural
1985	100.00	100.00	100.00	100.00	100.00
1986	108.99	111.70	105.51	102.85	107.68
1987	113.89	118.34	108.18	101.60	116.05
1988	106.87	113.10	98.82	89.93	111.27
1989	107.70	116.48	96.30	89.01	108.36
1990	119.85	131.86	104.21	96.47	121.59
1991	132.07	147.55	112.27	99.68	136.05
1992	141.66	160.62	117.86	103.64	148.67
1993	135.52	155.62	110.80	98.77	142.79
1994	125.10	144.99	101.13	89.38	131.41
1995	126.34	147.92	100.95	87.35	127.16
1996	129.78	153.38	101.78	88.75	133.75
1997	148.60	178.01	113.02	100.88	146.44
1998	170.50	204.15	129.91	114.23	163.16
1999	200.30	240.41	151.73	130.67	179.98
2000	248.61	297.57	187.89	153.82	194.28
2001	273.65	328.64	206.32	170.73	202.47
2002	316.30	380.74	237.97	197.59	212.63
2003	354.11	423.33	271.32	220.60	219.40
2004	385.68	458.59	299.40	239.81	217.39
2005	428.84	510.18	333.45	260.20	222.12
2006	502.70	594.21	394.81	304.50	238.23
2007	570.75	671.46	451.29	345.19	246.72
2008	640.54	750.42	509.01	387.01	252.24

Chapter 8 Results for Guangdong

This report calculates the total human capital, per capita human capital and active human capital from 1988 to 2008[37] for Guangdong.

8.1 The trend of total human capital stock

This report calculates the total nominal human capital stocks based on four different discount rates. The results are reported in Table 8.1.1. Among the four different discount rates, 3.14% is the average interest rate of 10-year national bonds issued by the Chinese government; 5.43% is the interest rate of long-term loans from commercial banks to enterprises; 4.58% is the discount rate used by the OECD in the context of human capital estimation38; 8.14% is the social discount rate of China calculated by the World Bank.

Table 8.1.1 Total human capital based on different discounts rates (Nominal)

Unit: 100 Million Yuan

Year	Discount rate 3.14%	Discount rate 4.58%	Discount rate 5.43%	Discount rate 8.14%
1988	69846.36	46839.39	37733.96	20763.81
1989	83335.16	56059.33	45238.53	25009.49
1990	103443.32	69659.56	56249.48	31159.70
1991	121588.69	82020.56	66299.43	36847.54
1992	145875.86	98462.90	79621.73	44315.79
1993	173530.76	117347.50	94994.64	53044.01
1994	205465.64	139225.06	112839.33	63240.26

[37] The administrative division of Guangdong Province included Hainan Province before 1988. Therefore, the human capital estimation for Guangdong starts from 1988.

[38] The analysis in this chapter is based on the discount rate 4.58% except additional illustration.

1995	252901.05	171491.19	139042.54	78002.68
1996	316747.36	214955.23	174284.84	97596.50
1997	404475.11	275036.62	223176.32	125083.45
1998	498551.42	341113.39	277712.31	156994.81
1999	634251.07	435331.68	355010.38	201558.94
2000	802312.64	553055.43	452061.08	258288.16
2001	983540.21	676186.73	551924.06	314179.35
2002	1227568.93	841453.05	685566.24	388014.10
2003	1495356.45	1025528.80	835682.27	473003.24
2004	1806910.19	1240452.74	1011423.36	573545.61
2005	2181382.52	1500165.64	1224531.67	696998.70
2006	2693554.01	1854452.79	1514693.70	863775.05
2007	3284280.63	2265103.01	1852034.53	1059551.32
2008	3984402.24	2754180.66	2255020.74	1295737.78

In order to discuss the real growth of total human capital stock, we need to adjust the nominal value into real value by using a price index. The real values of total human capital stock calculated by three different price indexes are reported in Table 8.1.2(1985 is the base year in all cases). Column 1 uses CPI classified by rural and urban in Guangdong; Column 2 uses the living cost index. Aligned on the urban living cost in Beijing, the real values are comparable between rural and urban as well as cross provinces. Column 3 uses index of fixed assets investment, treating the human capital with the physical capital. The results show that the real value of total human capital adjusted by index of living cost is the lowest; which indicates that the human capital differences between Guangdong and another province is partly due to the differences of living cost in these two provinces. The real value of total human capital adjusted by fixed asset investment is the highest.

Table 8.1.2 Real total human capital based on different indexes

Unit: 100 Million Yuan

Year	CPI	Living Cost index	Fixed Assets Investment Index
1988	30834.67	26739.81	36487.10
1989	30240.67	26235.68	41694.64
1990	38551.78	33429.85	48778.70
1991	44693.73	38811.88	57044.50
1992	49852.51	43318.60	57959.81
1993	48857.17	42457.19	58794.60
1994	47714.17	41377.74	66788.27
1995	51593.19	44323.95	74938.06
1996	60392.87	51675.23	93201.29
1997	75663.26	64169.39	117635.61
1998	95370.33	80313.98	145854.59
1999	123654.83	103335.28	192374.77
2000	155000.97	127845.22	239101.35
2001	190724.80	156606.52	291750.96
2002	240410.67	196465.83	364150.06
2003	290763.88	236679.77	434257.64
2004	342062.33	277176.62	493671.68
2005	404943.36	326670.98	587918.70
2006	491421.77	395125.79	721712.71
2007	578535.66	463745.70	860867.98
2008	666341.53	532689.23	963765.16

Calculated by income parameter of Guangdong and discount rate valued 4.58%, the total human capital stocks for Guangdong from 1988 to 2008 are reported in Table 8.1.3. Column 1 and column 2 contain the total human capital measured in nominal terms; column 3 and column 4 contain the total human capital measured in real terms (in 1985 RMB). In order to get a sense of the magnitude of the total human capital in Guangdong, we also present the ratio of nominal GDP to nominal human capital stock in Table 8.1.3. The reason for calculating the ratio at the nominal level is to avoid the complication between the real value of human capital stock and that of real GDP that is caused by using different deflator indexes

Table 8.1.3 Nominal and real human capital, Nominal GDP

Unit: 100 Million Yuan

Year	Nominal human capital		Real human capital		Nominal GDP	Ratio of human capital to GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
1988	46839.39		30834.67		1155.37	40.54
1989	56059.33		30240.67		1381.39	40.58
1990	69659.56		38551.78		1559.03	44.68
1991	82020.56		44693.73		1893.3	43.32
1992	98462.90		49852.51		2447.54	40.23
1993	117347.50		48857.17		3469.28	33.82
1994	139225.06		47714.17		4619.02	30.14
1995	171491.19		51593.19		5933.05	28.90
1996	214955.23		60392.87		6834.97	31.45
1997	275036.62		75663.26		7774.53	35.38
1998	341113.39		95370.33		8530.88	39.99
1999	435331.68		123654.83		9250.68	47.06
2000	553055.43	583228.0375	155000.97	163357.07	10741.25	51.49
2001	676186.73	722942.4848	190724.80	203778.06	12039.25	56.17
2002	841453.05	908225.109	240410.67	259315.76	13502.42	62.32
2003	1025528.80	1111181.691	290763.88	314844.36	15844.64	64.72
2004	1240452.74	1349722.749	342062.33	372003.31	18864.62	65.76
2005	1500165.64	1639410.156	404943.36	442346.82	22366.54	67.07
2006	1854452.79	2040851.019	491421.77	540601.91	26204.47	70.77
2007	2265103.01	2505746.667	578535.66	639760.42	31084.4	72.87
2008	2754180.66	3056050.425	666341.53	739140.13	35696.46	77.16

The trends of total human capital measured in nominal and real terms are presented in Figure 8.1.1.

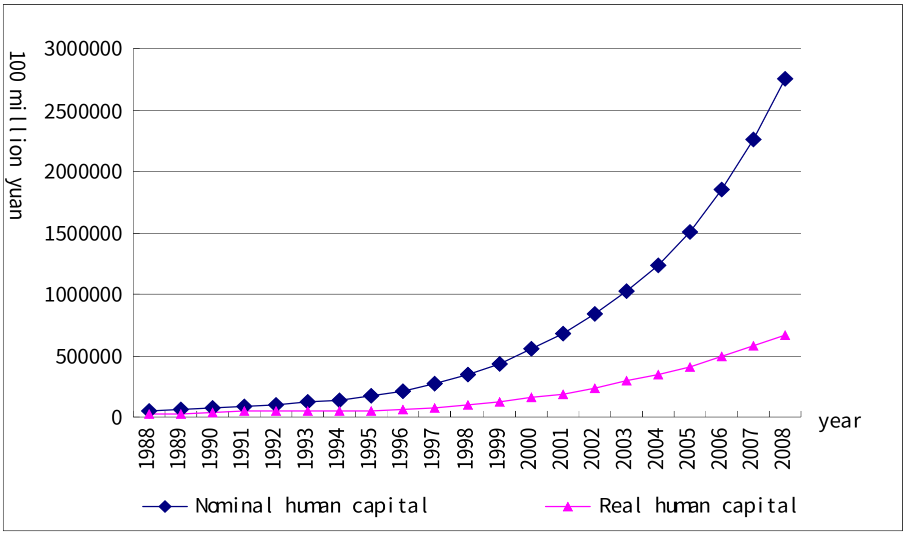


Figure 8.1.1 Nominal, Real human capital for Guangdong

The ratio of nominal human capital to nominal GDP from 1988 to 1995 exhibited a slightly decreasing trend, and started increase from 28.9 in 1995 to the record point of 77.16 in 2008.This has much to do with both human capital and GDP. During the declining period, the growth rate of human capital stock is lower than that of GDP, and the former is higher than the later over the rising period.

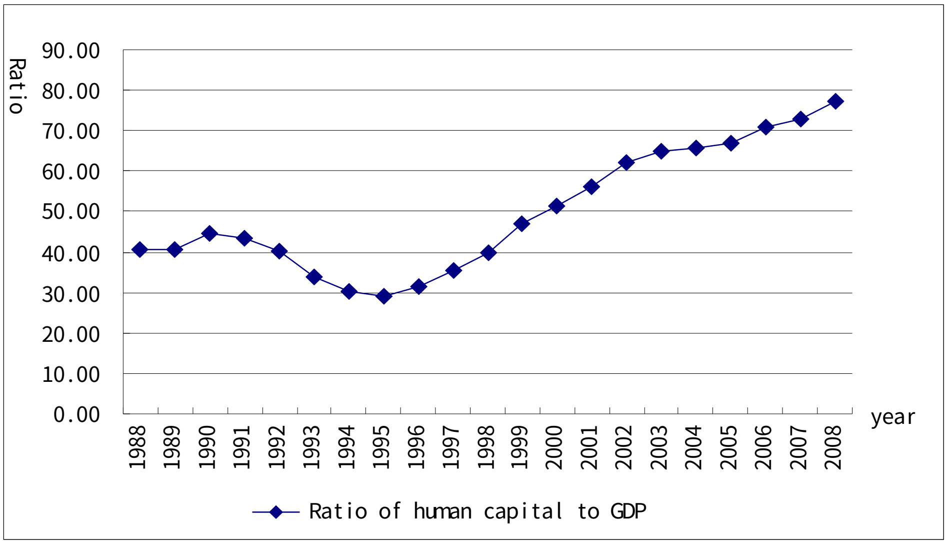


Figure 8.1.2 Ratio of nominal total human capital to nominal GDP

Table 8.1.4 reports the total human capital stock for Guangdong classified by gender and urban-rural. Before 1997, the growth rates of various human capital stocks are quite low, the gender gap was fairly stable and the gap between rural and urban was relatively small. Starting from 1997, both the human capital of male and female increased by a significant amount, and the gender gap appears to be expanding. The human capital in urban area kept rising while that in the rural area was stable, which might be caused by the acceleration of urbanization.

The results based on five education categories show that the total human capital for Guangdong increased from RMB 3.08 trillion in 1988 to RMB 66.63 trillion in 2008 (calculated by 1985 comparable price), an increase of more than twenty-fold. The annual growth rate of total human capital at this period increased to 11.76%.[39]

The trend that the total human capital of male is higher than that of female is consistent with the national results. One reason is the earlier retirement age for female, male have longer time to generate income from market, and thus end up with a higher life income relative to female.[40] Moreover, male have higher educational attainment than female. Last but not least the income gap between male and female keeps expanding, which directly results in the differences in human capital.

Table 8.1.4 Real human capital by gender and rural-urban

Unit: 100 Million Yuan

Year	Total	Male	Female	Urban	Rural
1988	30834.67	18493.16	12341.51	21403.54	9431.13
1989	30240.67	18213.50	12027.18	20934.65	9306.03
1990	38551.78	23312.49	15239.29	26764.32	11787.46

[39] The annual growth rate here is the mean of the annual log growth rate.

[40] To ensure the consistent of urban and rural, we define the working age of male and female in rural area as 60 and 55.

Year	Total	Male	Female	Urban	Rural
1991	44693.73	27262.51	17431.22	30812.18	13881.56
1992	49852.51	30735.16	19117.35	34248.38	15604.13
1993	48857.17	30415.75	18441.43	33585.81	15271.37
1994	47714.17	29921.22	17792.95	33130.93	14583.23
1995	51593.19	32758.15	18835.04	37538.43	14054.76
1996	60392.87	38530.65	21862.22	44773.86	15619.01
1997	75663.26	48557.57	27105.68	58431.21	17232.05
1998	95370.33	61584.04	33786.29	75971.71	19398.61
1999	123654.83	79977.51	43677.33	101744.85	21909.99
2000	155000.97	99968.51	55032.46	131109.60	23891.37
2001	190724.80	123884.43	66840.36	164114.43	26610.37
2002	240410.67	156329.77	84080.89	210665.42	29745.25
2003	290763.88	189836.93	100926.93	258545.37	32218.50
2004	342062.33	223588.01	118474.30	309206.96	32855.36
2005	404943.36	265755.02	139188.33	371912.21	33031.13
2006	491421.77	322972.15	168449.58	456693.06	34728.70
2007	578535.66	381476.31	197059.35	542970.69	35564.97
2008	666341.53	441531.36	224810.19	630831.79	35509.72

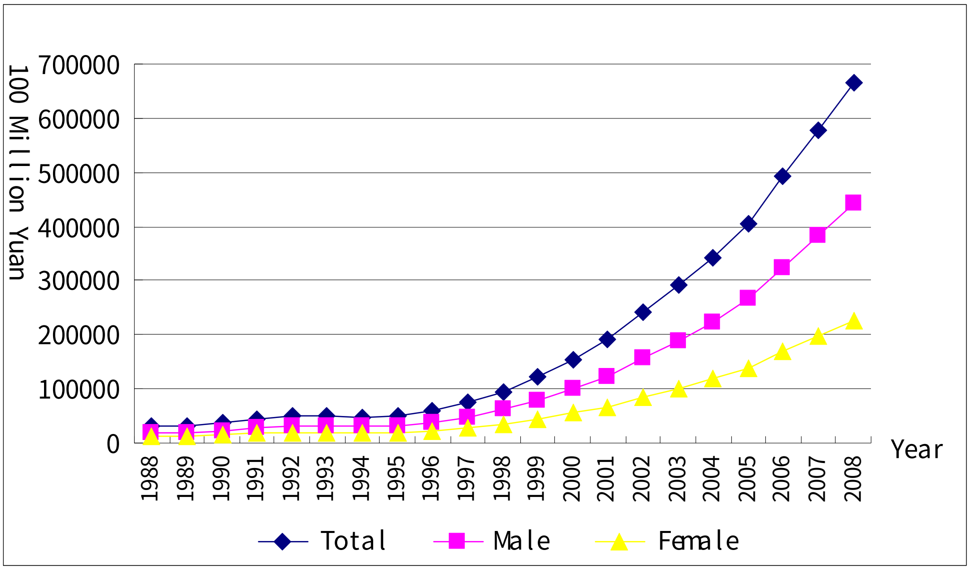


Figure8.1.3 Real human capital by gender, 1988-2008

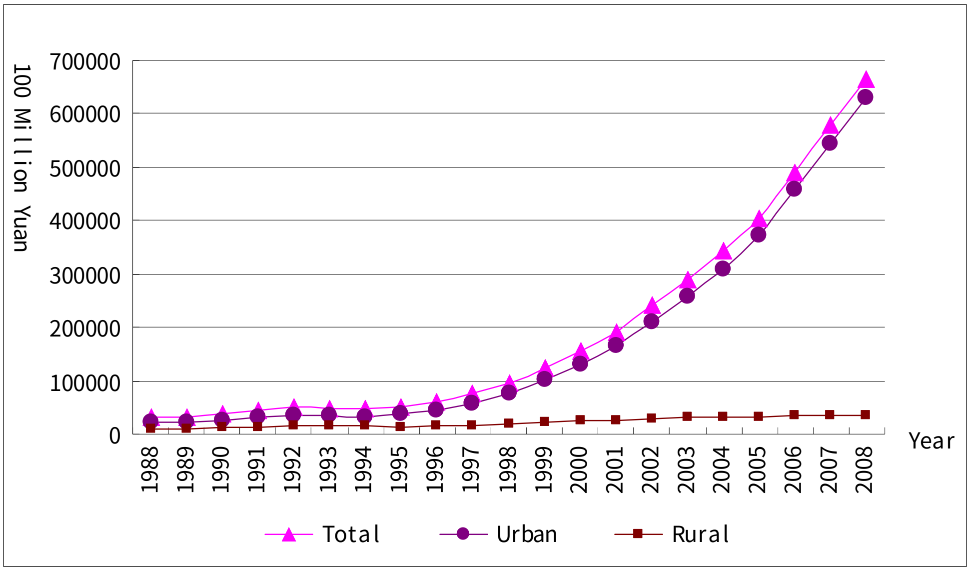


Figure 8.1.4 Real human capital by urban-rural, 1988-2008

Table 8.1.4 shows the total human capital for urban and rural separately. Before 1997, the total human capital for urban was less than three times the amount of rural. Starting from 1995, however, the human capital in the urban area was rising much more rapidly while in the rural area it was low or even at zero growth rate. This results in a larger gap between rural and urban. In 2008, the total human capital for urban is about 17.8 times the amount of rural Guangdong. From 1988 to 2008, total human capital for rural in Guangdong increased from RMB 0.94 trillion to RMB 3.55 trillion, the total human capital for urban in Guangdong increased from RMB 2.14 trillion to RMB 63.08 trillion. During the same period, the annual growth rates of human capital were 10% and 12% for rural and urban areas respectively. The urban-rural gap in the estimated human capital stock increased from RMB 1.20 trillion in 1988 to RMB 59.53 trillion in 2008. Moreover, the gap exhibits a trend of further expansion as the urban area increases faster in the later period.

One reason that results in the gap between rural and urban is the rapid urbanization during the course of economic transition as well as a large scale rural-urban migration. This is quite obvious in Guangdong where a huge population was freed from the farmland as a result of rapid economic development. Another reason is the education gap between the rural and urban population.

Table 8.1.5 reports a set of real indexes of total human capital for Guangdong from 1988 to 2008 calculated by using 1988 as the base year. Figure 8.1.5 shows the corresponding indexes of total human capital.

Table 8.1.5 Total human capital index for Guangdong (1988=100)

Year	Total human capital	Male total human capital	Female total human capital	Urban total human capital	Rural total human capital
1988	100.00	100.00	100.00	100.00	100.00
1989	98.07	98.49	97.45	97.81	98.67
1990	125.03	126.06	123.48	125.05	124.98
1991	144.95	147.42	141.24	143.96	147.19
1992	161.68	166.20	154.90	160.01	165.45
1993	158.45	164.47	149.43	156.92	161.93
1994	154.74	161.80	144.17	154.79	154.63
1995	167.32	177.14	152.62	175.38	149.03
1996	195.86	208.35	177.14	209.19	165.61
1997	245.38	262.57	219.63	273.00	182.71
1998	309.30	333.01	273.76	354.95	205.69
1999	401.03	432.47	353.91	475.36	232.32
2000	502.68	540.57	445.91	612.56	253.32
2001	618.54	669.89	541.59	766.76	282.15
2002	779.68	845.34	681.29	984.26	315.39
2003	942.98	1026.53	817.78	1207.96	341.62
2004	1109.34	1209.03	959.97	1444.65	348.37
2005	1313.27	1437.05	1127.81	1737.62	350.24
2006	1593.73	1746.44	1364.90	2133.73	368.23
2007	1876.25	2062.80	1596.72	2536.83	377.10
2008	2161.01	2387.54	1821.58	2947.33	376.52

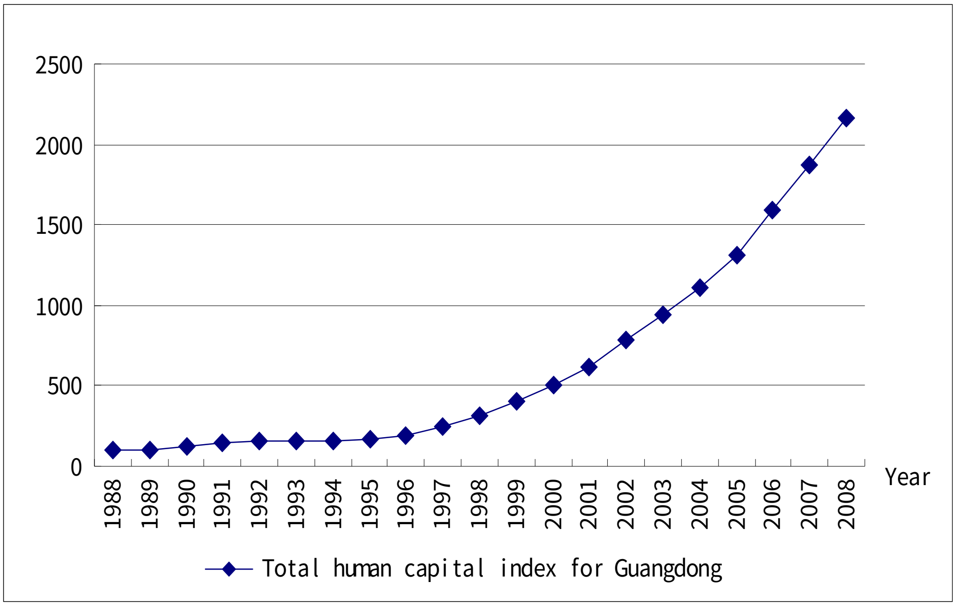


Figure 8.1.5 Total human capital index for Guangdong, 1988-2008

8.2 Per capita human capital

The increase in the total human capital can be caused by population growth, demographic change, rural-urban migration or urbanization, higher educational attainment, higher rates of return to education, higher rates of return to on-the-job training, etc. In order to get further information on the dynamics of human capital, we calculate per capita human capital, defined as the ratio of total human capital over non-retired population. Although the per capita human capital is affected by the age distribution of the population, the effect is relatively small in comparison with the number of population, and thus is able to serve as a better indicator of the average human capital.

Table 8.2.1 Nominal and real per capita human capital, per capita GDP

Unit: Yuan

Year	Nominal per capita human capital	Real per capita human capital	Per capita GDP	Ratio of nominal per capita human capital to nominal GDP
1988	87368	57515	1926	45.36
1989	102129	55093	2251	45.37
1990	120589	66738	2484	48.55
1991	141826	77282	2941	48.22
1992	168512	85319	3699	45.56
1993	198661	82712	5085	39.07
1994	233677	80084	6530	35.79
1995	285479	85887	8129	35.12
1996	350574	98496	9139	38.36
1997	438777	120709	10130	43.31
1998	533751	149229	10819	49.33
1999	661282	187836	11415	57.93
2000	814708	228333	12736	63.97
2001	989802	279183	13849	71.47
2002	1219896	348535	15361	79.42
2003	1475500	418342	17795	82.92
2004	1773961	489181	20870	85.00
2005	2136627	576745	24435	87.44
2006	2599013	688727	28332	91.73
2007	3138934	801723	33151	94.69
2008	3775660	913477	37589	100.45

Table 8.2.2 Nominal and Real per capita human capital by urban-rural

Unit: Yuan

Year	Nominal per capita human capital			Real per capita human capital		
	Total	Urban	Rural	Total	Urban	Rural
1988	87368	171716	40807	57515	112247	27302
1989	102129	197795	48415	55093	106065	26473

1990	120589	230808	57328	66738	127056	32118
1991	141826	267613	67942	77282	143986	38102
1992	168512	313781	80846	85319	155741	42821
1993	198661	365326	95381	82712	148611	41874
1994	233677	425369	111716	80084	143008	40050
1995	285479	497773	130285	85887	147971	40501
1996	350574	611794	153197	98496	169665	44721
1997	438777	738534	178586	120709	200611	51353
1998	533751	862333	206630	149229	238281	60572
1999	661282	1033046	237376	187836	290096	71232
2000	814708	1231492	270441	228333	341037	81154
2001	989802	1486341	307049	279183	414941	92513
2002	1219896	1822023	346016	348535	515849	105709
2003	1475500	2186183	385851	418342	614602	117428
2004	1773961	2608121	420004	489181	714626	123251
2005	2136627	3115145	448592	576745	836756	128202
2006	2599013	3754422	489081	688727	990552	137554
2007	3138934	4487962	531889	801723	1141790	144531
2008	3775660	5337650	577576	913477	1287176	148349

Table 8.2.3 Nominal and Real per capita human capital by gender

Unit: Yuan

Year	Nominal per capita human capital			Real per capita human capital		
	Total	Male	Female	Total	Male	Female
1988	87368	96786	76231	57515	63666	50241
1989	102129	114922	87376	55093	61954	47180
1990	120589	137804	101219	66738	76221	56067
1991	141826	163942	117056	77282	89231	63900
1992	168512	197323	136375	85319	99758	69212
1993	198661	235401	157869	82712	97869	65883
1994	233677	279614	182991	80084	95735	62815
1995	285479	346707	218325	85887	104252	65744

Year	Nominal per capita human capital			Real per capita human capital		
	Total	Male	Female	Total	Male	Female
1996	350574	427934	265797	98496	120183	74730
1997	438777	539502	328746	120709	148380	90481
1998	533751	660617	395314	149229	184671	110554
1999	661282	819421	488602	187836	232746	138795
2000	814708	1010353	602733	228333	283183	168904
2001	989802	1233636	724434	279183	347968	204323
2002	1219896	1523153	890340	348535	435192	254363
2003	1475500	1851178	1067861	418342	524849	302775
2004	1773961	2229217	1280397	489181	614685	353115
2005	2136627	2703184	1525879	576745	729622	411944
2006	2599013	3288225	1853804	688727	871277	491345
2007	3138934	3978656	2228197	801723	1016063	569257
2008	3775660	4800007	2660184	913477	1161126	643795

From 1988 to 2008, per capital nominal human capital for Guangdong increased 43 times; while over the same period, per capital real GDP increased 20 times, much lower than the growth of per capita human capital. During the recent twenty years, rapid economic growth has also brought about a dramatic increase in human capital. Moreover, the rapid expansion of education, the transition towards a market-orientated system and a large scale rural-urban migration also contributed to the rapid growth of human capital. One unique and important reason is the migration of talented person to Guangdong due to its economic prosperity.

The ratio of per capita human capital to per capita GDP measured in nominal term for Guangdong is reported in Figure 8.2.1. The trend and level of the ratio is very similar to that of total human capital.

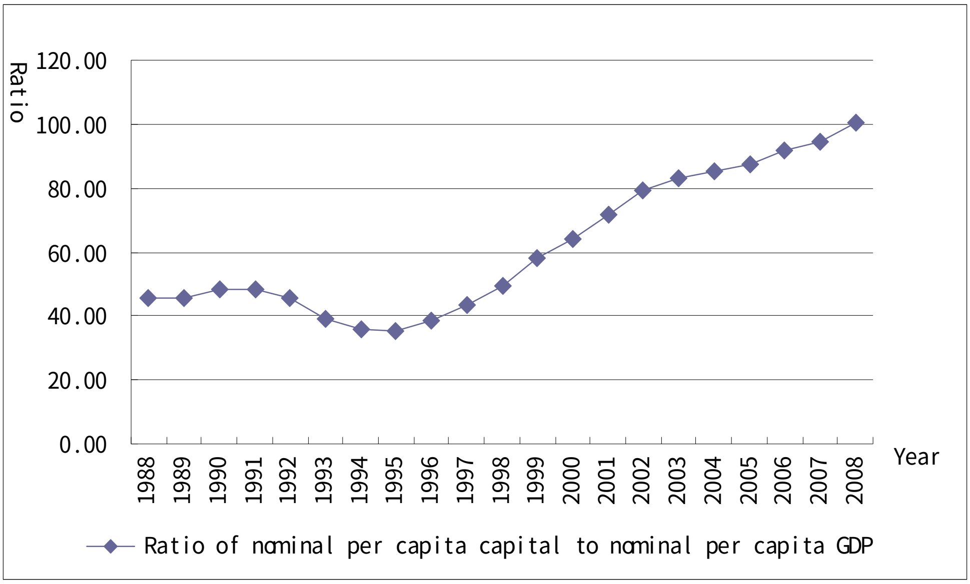


Figure 8.2.1 Ratio of nominal per capita human capital to nominal per capita GDP

Table 8.2.2 and Table 8.2.3 present the trends of per capita real human capital for Guangdong classified by gender and urban-rural respectively. Per capita human capital for urban is significantly higher than that of rural. And the size of the difference expanded rapidly after 1997, partly due to the slow growth in the rural are. For per capita human capital, the ratio of urban to rural increased from 4.11 in 1988 to 6.88 in 2008, which indicates a rising urban-rural gap of per capita human capital.

The trends of per capita human capital of male and female are similar to each other. Per capita human capital of male is higher than that of female but the difference does not change significantly over time. From 1988 to 1998, the annual growth rate was 11.50% for male, and11.11% for female. From 1998 to 2008, the corresponding figures are 11.31% and 12.57%.

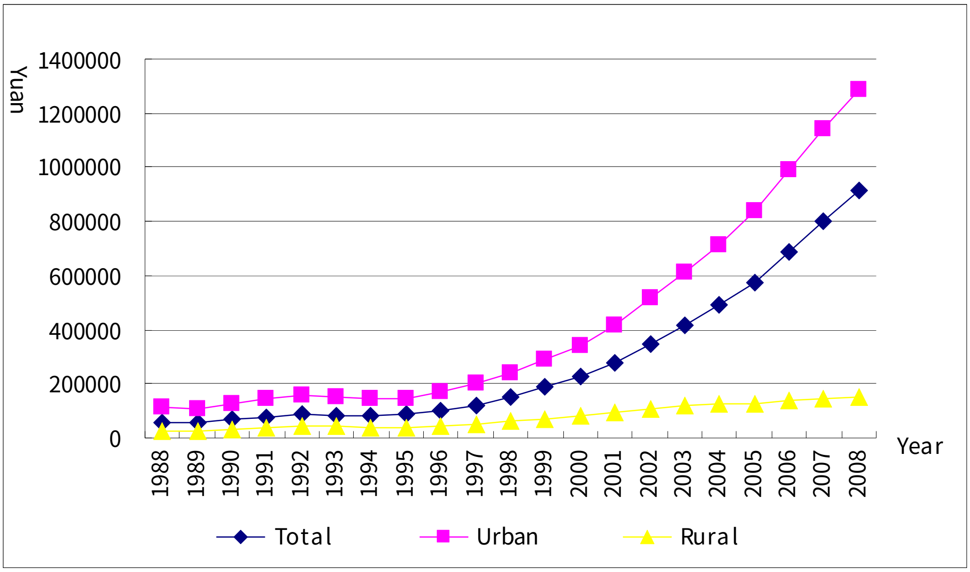


Figure 8.2.2 Per capita human capital by urban-rural, 1988-2008

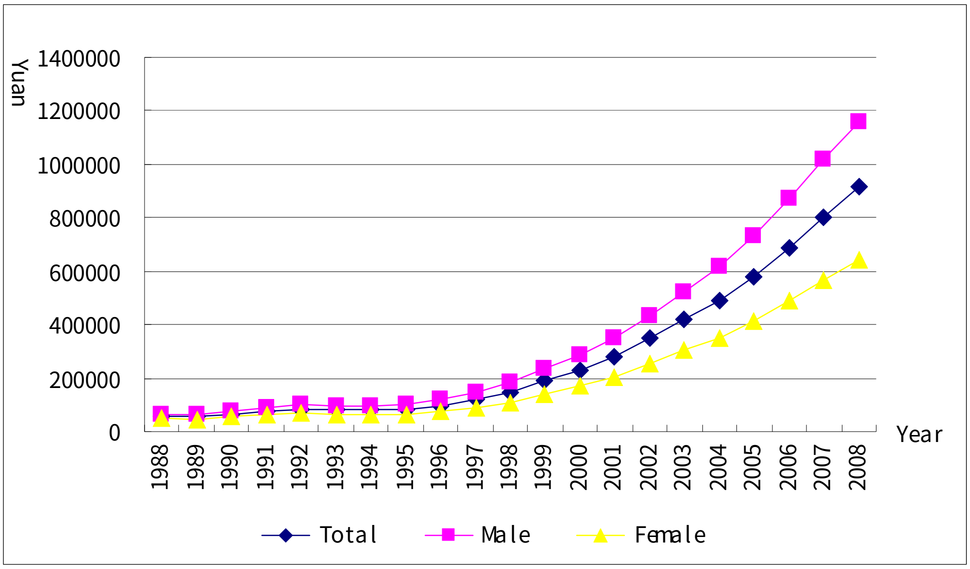


Figure 8.2.3 Per capita human capital by gender, 1988-2008

Similarity, we construct a set of per capita human capital indexes with 1985 as the base year. Table 8.2.4 shows various per capita human capital indexes for Guangdong. Figure 8.2.4 reports the index of total human capital for Guangdong.

Table 8.2.4 Index of per capita human capital

Year	Total	Male	Female	Urban	Rural
1988	100.00	100.00	100.00	100.00	100.00
1989	95.79	97.31	93.91	94.49	96.96
1990	116.04	119.72	111.59	113.19	117.64
1991	134.37	140.16	127.19	128.28	139.56
1992	148.34	156.69	137.76	138.75	156.84
1993	143.81	153.72	131.13	132.40	153.37
1994	139.24	150.37	125.03	127.40	146.69
1995	149.33	163.75	130.86	131.83	148.34
1996	171.25	188.77	148.74	151.15	163.80
1997	209.87	233.06	180.09	178.72	188.09
1998	259.46	290.06	220.05	212.28	221.86
1999	326.59	365.57	276.26	258.44	260.90
2000	397.00	444.79	336.19	303.83	297.25
2001	485.41	546.55	406.69	369.67	338.85
2002	605.99	683.56	506.29	459.57	387.18
2003	727.37	824.38	602.64	547.54	430.11
2004	850.53	965.49	702.84	636.65	451.44
2005	1002.78	1146.02	819.93	745.46	469.57
2006	1197.48	1368.51	977.97	882.48	503.82
2007	1393.94	1595.93	1133.05	1017.21	529.38
2008	1588.25	1823.78	1281.41	1146.74	543.36

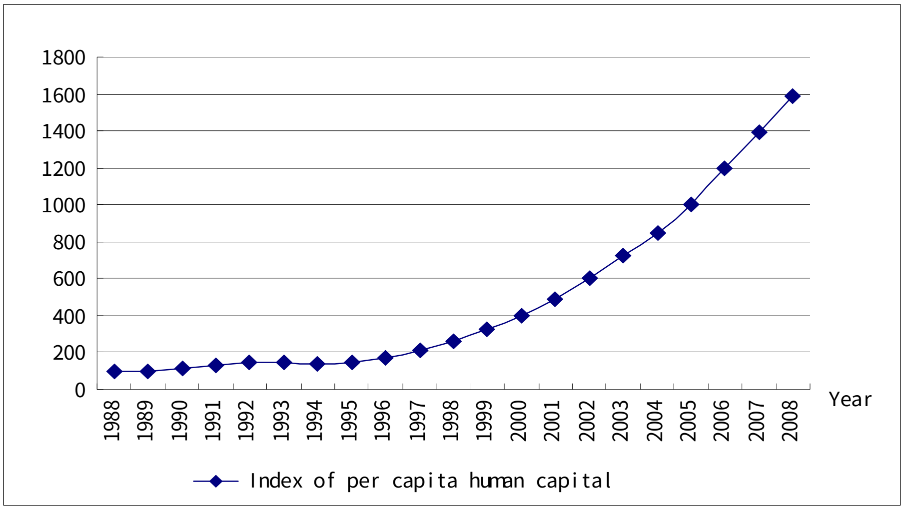


Figure 8.2.4 Index of per capita human capital, 1988-2008

8.3 Active human capital

8.3.1 Active total human capital

Table 8.3.1 Total active human capital and nominal GDP

Unit: 100 Million Yuan

Year	Nominal total human capital		Real total human capital		Nominal GDP	Ratio of nominal human capital to nominal GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
1988	23338.73		15369.81		1155.37	20.20
1989	28489.02		15370.17		1381.39	20.62
1990	35644.39		19726.84		1559.03	22.86
1991	41489.21		22609.65		1893.3	21.91
1992	48961.48		24791.26		2447.54	20.00
1993	56634.60		23581.99		3469.28	16.32
1994	65298.43		22383.19		4619.02	14.14
1995	81229.19		24436.13		5933.05	13.69
1996	102939.19		28918.91		6834.97	15.06
1997	135723.84		37327.31		7774.53	17.46
1998	178104.81		49760.94		8530.88	20.88
1999	235255.76		66769.67		9250.68	25.43
2000	307964.90	311429.15	86239.64	87199.38	10741.25	28.67
2001	364543.95	369605.76	102733.25	104146.82	12039.25	30.28
2002	447072.25	454953.85	127601.72	129833.78	13502.42	33.11
2003	545307.50	555844.10	154417.64	157380.69	15844.64	34.42
2004	658091.16	671984.21	181304.49	185112.17	18864.62	34.88
2005	791719.09	807409.06	213624.54	217840.18	22366.54	35.40
2006	981319.33	1004583.46	259992.72	266132.30	26204.47	37.45
2007	1205750.24	1238505.75	307945.55	316281.08	31084.4	38.79
2008	1482699.21	1526785.04	358731.61	369365.47	35696.46	41.54

Based on the income parameter for Guangdong and the discount rate of 4.58%，the total active human capital (non-retired population aged over 15) for Guangdong is reported in Table 8.3.1. Column 1 and column 2 are active human capital stocks measured in nominal terms, column 3 and column 4 are active human capital stocks measured in real terms (in 1985 RMB). The real value in this table is calculated using the CPI.

The trends of active human capital stock in both real and nominal terms for Guangdong are presented in Figured 8.3.1. From 1988 to 2008, the active human capital kept rising.

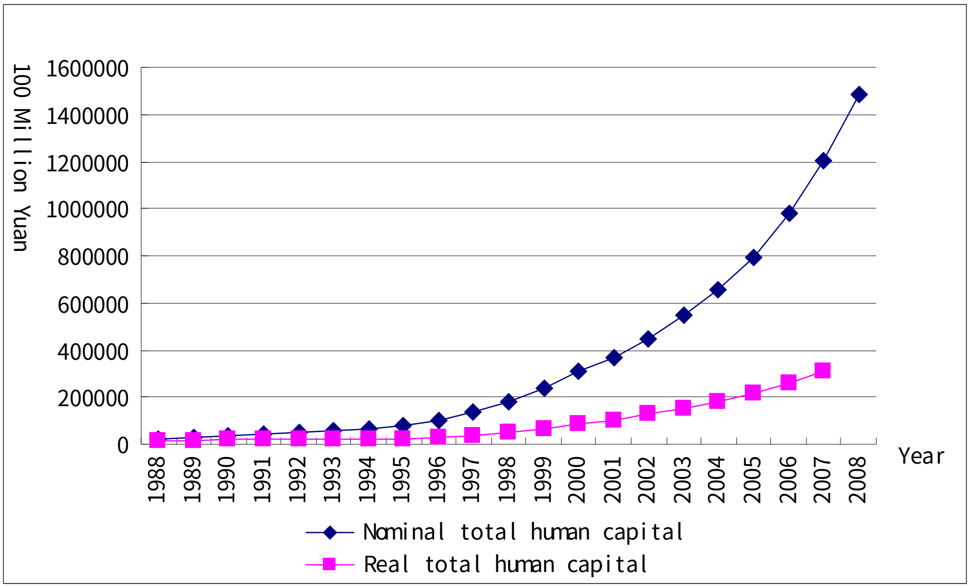


Figure 8.3.1 Nominal and Real total human capital

Similar to the analysis of total human capital, we construct the ratio of nominal GDP to total active human capital stock measured in nominal term with the purpose of getting a sense of the relative magnitude. The result is reported it in Table 8.3.1. The ratio of active human capital to GDP appears to be rising from 1988 to 2008. As the economy develops and the education system improves, the active human capital grows at an average rate of 25.86%, higher than the GDP growth rate.

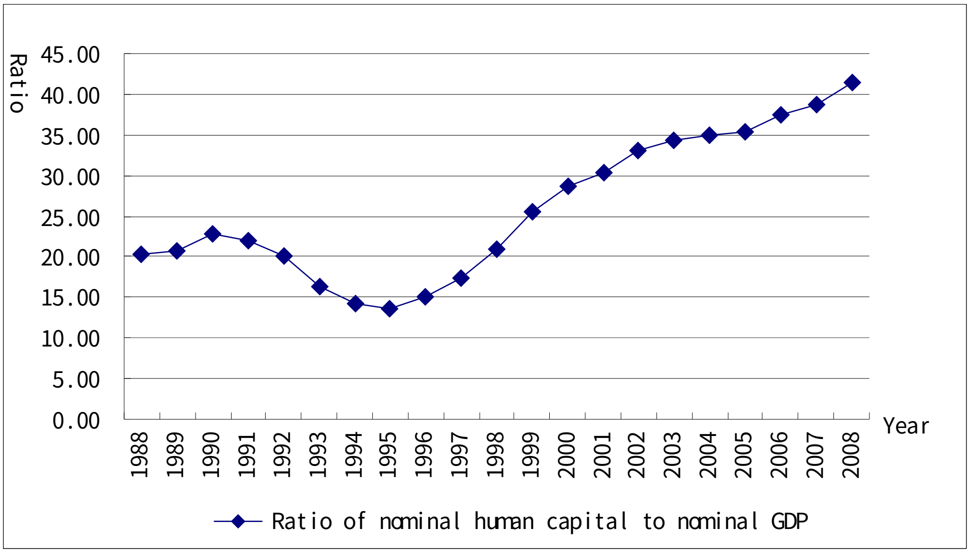


Figure 8.3.2 Ratio of nominal human capital to nominal GDP

The total active human capital by gender and urban-rural are reported in Table 8.3.2 and 8.3.3, respectively. From 1988 to 2008, the nominal active human capital for male and female appeared to be increasing continuously. If we get rid of inflation by using CPI, the total active human capital for male and female shifts downward correspondingly, but the rising trend still holds. Meanwhile, the total active human capital of male is higher than that for female, and the gap appears to be widening.

Table8.3.2 Nominal and Real active human capital by gender

Unit: 100 Million Yuan

Year	Nominal active human capital		Real active human capital	
	Male	Female	Male	Female
1988	14135.17	9203.55	9304.00	6065.81
1989	17328.04	11160.99	9344.20	6025.97
1990	21769.40	13874.99	12042.07	7684.76
1991	25558.49	15930.72	13914.48	8695.17
1992	30459.62	18501.86	15403.46	9387.81
1993	35489.73	21144.87	14760.03	8821.97
1994	41093.41	24205.02	14075.67	8307.52

1995	51406.64	29822.55	15459.74	8976.39
1996	66104.45	36834.73	18566.11	10352.80
1997	87691.51	48032.33	24114.37	13212.95
1998	115006.37	63098.44	32132.15	17628.79
1999	151695.18	83560.57	43058.24	23711.43
2000	198697.22	109267.69	55650.55	30589.08
2001	237230.67	127313.28	66861.40	35871.84
2002	291161.83	155910.43	83108.38	44493.32
2003	355286.49	190020.97	100610.59	53807.06
2004	429279.05	228812.10	118261.23	63043.26
2005	519975.33	271743.78	140285.71	73338.83
2006	646138.49	335180.80	171162.16	88830.57
2007	796174.28	409575.92	203299.93	104645.64
2008	983274.96	499424.21	237846.46	120885.17

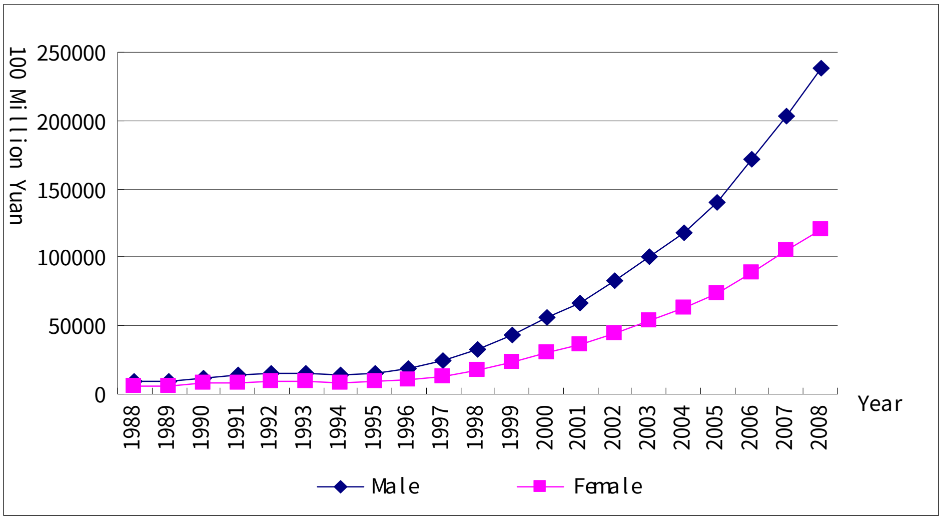


Figure8.3.3 Real active human capital by gender

In the rural area, the total active human capital growth rate is much smaller than that for the urban area although both of them exhibit a rising trend. As we can see from Table 8.3.4, the growth trend of active human capital for rural is relatively flat while that for urban is much steeper.

Table 8.3.3 Nominal and real active human capital by urban-rural

Unit: 100 Million Yuan

Year	Nominal active human capital		Real active human capital	
	Urban	Rural	Urban	Rural
1988	15939.56	7399.16	10419.29	4950.52
1989	19647.03	8842.00	10535.45	4834.72
1990	24866.81	10777.57	13688.80	6038.04
1991	28888.59	12600.62	15543.18	7066.48
1992	34261.04	14700.44	17004.98	7786.28
1993	39772.20	16862.39	16178.99	7403.00
1994	46013.38	19285.05	15469.56	6913.63
1995	59939.49	21289.70	17817.93	6618.19
1996	77483.19	25456.00	21487.86	7431.05
1997	106820.78	28903.07	29016.10	8311.21
1998	145607.93	32496.88	40234.67	9526.27
1999	198608.56	36647.21	55772.55	10997.12
2000	266721.03	41243.88	73863.15	12376.49
2001	320987.30	43556.65	89609.81	13123.44
2002	401186.56	45885.70	113583.52	14018.19
2003	497250.22	48057.29	139792.08	14625.56
2004	607335.39	50755.77	166410.08	14894.41
2005	735734.52	55984.59	197624.85	15999.69
2006	918993.23	62326.10	242463.51	17529.22
2007	1137126.98	68623.25	289298.47	18647.08
2008	1407633.08	75066.10	339451.13	19280.50

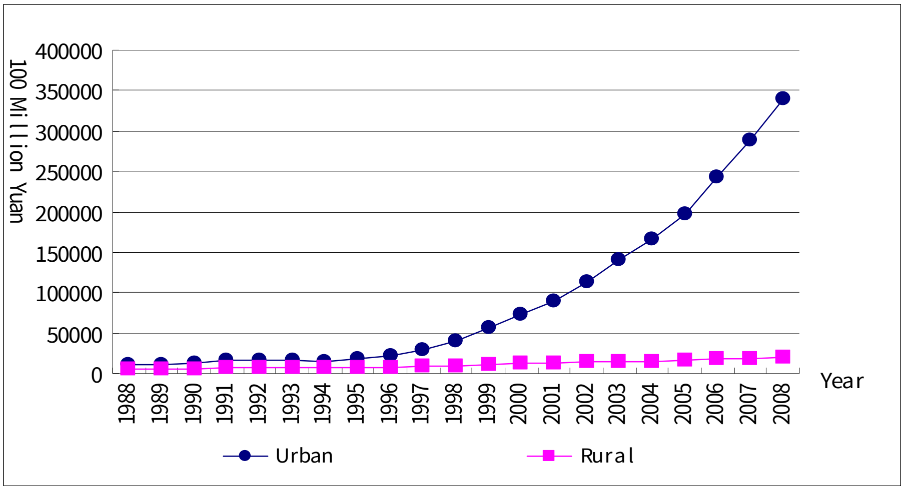


Figure 8.3.4 Real active human capital by urban-rural

From Table 8.3.2 and Table 8.3.3, we see the significant difference between urban and rural, male and female. The male human capital is higher than female. Moreover, the active human capital is much higher in urban area than in rural, which reflects the unbalanced development between urban and rural. Nowadays, urban economy is the main driving force of the economic development for Guangdong..

Similarly, we construct a set of total active human capital indexes with 1988 as the base year. Table 8.3.4 shows various human capital indexes. The index of human capital for Guangdong exhibits a rising trend from 1988 to 2008.

Table 8.3.4 Index of real active human capital （1988=100）

Year	Total	Male	Female	Urban	Rural
1988	100.00	100.00	100.00	100.00	100.00
1989	100.00	100.43	99.34	101.11	97.66
1990	128.35	129.43	126.69	131.38	121.97
1991	147.10	149.55	143.35	149.18	142.74
1992	161.30	165.56	154.77	163.21	157.28
1993	153.43	158.64	145.44	155.28	149.54
1994	145.63	151.29	136.96	148.47	139.65
1995	158.99	166.16	147.98	171.01	133.69
1996	188.15	199.55	170.67	206.23	150.11
1997	242.86	259.18	217.83	278.48	167.89
1998	323.76	345.36	290.63	386.16	192.43
1999	434.42	462.79	390.90	535.28	222.14
2000	561.10	598.14	504.29	708.91	250.00
2001	668.41	718.63	591.38	860.04	265.09
2002	830.21	893.25	733.51	1090.13	283.17
2003	1004.68	1081.37	887.05	1341.67	295.43
2004	1179.61	1271.08	1039.32	1597.13	300.87
2005	1389.90	1507.80	1209.05	1896.72	323.19
2006	1691.58	1839.66	1464.45	2327.06	354.09
2007	2003.57	2185.08	1725.17	2776.57	376.67
2008	2334.00	2556.39	1992.89	3257.91	389.46

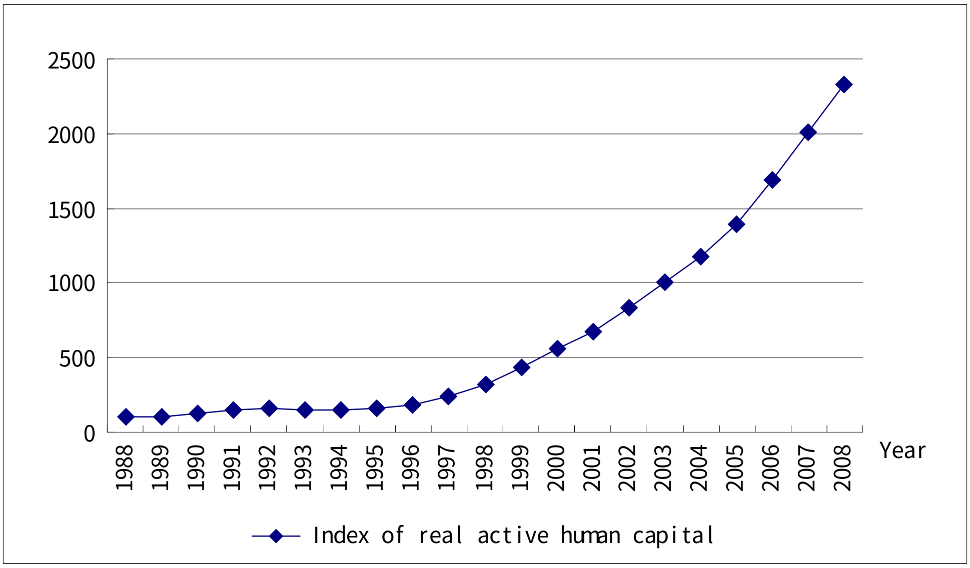


Figure 8.3.5 Index of real active human capital

8.3.2 Active human capital per capita

Similar to the analysis of per capita human capital above, we calculate the active human capital per capita. Table 8.3.5 shows that the active human capital per capita both in real and nominal values kept increasing; and the ratio of active human capital per capita to nominal GDP exhibited the same trend.

Table 8.3.5 Nominal and real active human capital per capita, Nominal GDP per capita

Unit: Yuan

Year	Nominal active human capital per capita		Real active human capital per capita		Nominal GDP per capita	Ratio of human capital to GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
1988	67166		44232		3325	20.20
1989	79954		43136		3877	20.62
1990	95197		52685		4164	22.86
1991	110841		60403		5058	21.91

1992	130271		65962		6512	20.00
1993	150835		62806		9240	16.32
1994	174229		59723		12324	14.14
1995	213431		64206		15589	13.69
1996	263741		74093		17512	15.06
1997	333564		91738		19107	17.46
1998	417689		116699		20007	20.88
1999	518094		147044		20372	25.43
2000	632893	640013	177230	179202	22074	28.67
2001	747551	757931	210670	213568	24688	30.28
2002	905428	921390	258424	262944	27346	33.11
2003	1092276	1113381	309306	315241	31738	34.42
2004	1302450	1329946	358826	366362	37336	34.88
2005	1526742	1556998	411951	420080	43131	35.40
2006	1839042	1882640	487240	498745	49109	37.45
2007	2209352	2269372	564263	579537	56957	38.79
2008	2659053	2738116	643345	662415	64018	41.54

Table 8.3.6 and Table 8.3.7 report the active human capital per capita classified by rural-urban and gender separately. The active human capital per capita was much smaller in rural area than in urban area. And the active human capital per capita was smaller for female than for male.

Table 8.3.6 Nominal and real active human capital per capita by urban-rural

Unit: Yuan

Year	**Nominal**		**Real**	
	Urban	**Rural**	**Urban**	**Rural**
1988	119900	34489	78376	23075
1989	140494	40845	75338	22334
1990	164515	48270	90563	27043
1991	188302	57043	101314	31990
1992	217779	67272	108091	35631

Year	Nominal		Real	
	Urban	Rural	Urban	Rural
1993	248546	78265	101106	34360
1994	283951	90651	95464	32498
1995	336613	105124	100063	32679
1996	417850	124254	115879	36272
1997	512765	145558	139284	41856
1998	622835	168708	172103	49456
1999	748835	194049	210285	58230
2000	888613	221213	246084	66382
2001	1042593	242281	291060	72998
2002	1255383	263414	355423	80474
2003	1505136	284580	423139	86608
2004	1788936	306170	490169	89846
2005	2099848	332860	564038	95127
2006	2515528	370382	663687	104170
2007	3004980	410097	764502	111436
2008	3594543	452202	866825	116147

Table 8.3.7 Nominal and real active human capital per capita by gender

Unit: Yuan

Year	Nominal		Real	
	Male	Female	Male	Female
1988	73936	58884	48666	38809
1989	89790	68332	48419	36893
1990	109215	79239	60414	43887
1991	128903	90498	70177	49395
1992	153796	104065	77775	52803
1993	180376	118313	75018	49362
1994	210624	134710	72145	46234
1995	261391	162148	78609	48806
1996	326506	196092	91703	55114
1997	415943	244982	114381	67391
1998	522595	305803	146010	85437
1999	650180	378502	184552	107405
2000	796523	460768	223088	128990

2001	949210	535545	267527	150895
2002	1154611	645335	329569	184164
2003	1398211	775156	395948	219496
2004	1670870	921320	460305	253846
2005	1971991	1066132	532029	287730
2006	2376969	1280437	629659	339345
2007	2857967	1533030	729770	391685
2008	3444695	1835052	833245	444173

Finally we calculate a set of total human capital indexes using 1985 as the base year. Table 8.3.8 reports the results.

Table 8.3.8 Index of real active human capital per capita（1988=100）

Year	Total	Male	Female	Urban	Rural
1989	97.52	99.49	95.06	96.12	96.79
1990	119.11	124.14	113.09	115.55	117.20
1991	136.56	144.20	127.28	129.27	138.63
1992	149.13	159.81	136.06	137.91	154.41
1993	141.99	154.15	127.19	129.00	148.91
1994	135.02	148.25	119.13	121.80	140.84
1995	145.16	161.53	125.76	127.67	141.62
1996	167.51	188.43	142.01	147.85	157.19
1997	207.40	235.03	173.65	177.71	181.39
1998	263.83	300.03	220.15	219.59	214.33
1999	332.44	379.22	276.75	268.30	252.35
2000	400.68	458.41	332.37	313.98	287.68
2001	476.28	549.72	388.81	371.36	316.35
2002	584.24	677.21	474.54	453.48	348.75
2003	699.28	813.60	565.58	539.88	375.33
2004	811.23	945.85	654.09	625.41	389.37
2005	931.34	1093.23	741.40	719.66	412.25
2006	1101.55	1293.84	874.40	846.80	451.44
2007	1275.68	1499.55	1009.26	975.43	482.93
2008	1454.47	1712.18	1144.51	1105.98	503.35

Chapter 9 Results for Gansu

9.1 The trend of total human capital stock

Based on four different discount rates, this report calculates the total human capital stock measured in nominal terms. The results are reported in Table 9.1.1. We use four different discount rates: the average interest rate of 10-year national bonds issued by Chinese government (3.14%), the discount rate used by OECD in the context of human capital estimation (4.58%),[41] the interest rate of long-term loans from commercial banks to enterprises (5.43%) and the social discount rate of China calculated by World Bank (8.14%).

Table 9.1.1 Total human capital based on different discounts rates (Nominal)

Unit: 100 Million Yuan

Year	Discount rate 3.14%	Discount rate 4.58%	Discount rate 5.43%	Discount rate 8.14%
1985	4607.64	3277.84	2730.78	1657.11
1986	5250.87	3739.04	3116.93	1895.19
1987	5972.29	4264.72	3560.52	2173.72
1988	6756.42	4851.34	4062.56	2500.85
1989	7723.00	5560.56	4663.85	2884.34
1990	8897.74	6433.13	5408.75	3368.77
1991	10121.74	7346.12	6189.41	3877.68
1992	11541.86	8403.24	7092.98	4467.62
1993	13293.93	9690.96	8185.23	5164.25
1994	15204.14	11110.30	9396.81	5951.74
1995	17549.58	12838.63	10866.04	6897.40
1996	20234.72	14829.50	12563.07	7995.04

[41] The analysis in this chapter is based on the discount rate 4.58% except additional illustration.

1997	23884.11	17464.06	14775.08	9366.23
1998	27861.68	20369.33	17231.24	10920.50
1999	33237.02	24203.45	20429.84	12870.71
2000	38919.45	28406.22	24004.06	15161.71
2001	43935.34	32206.28	27282.32	17355.03
2002	51771.45	37895.17	32075.57	20360.28
2003	60073.28	43987.90	37239.99	23653.17
2004	67453.95	49660.94	42172.48	27025.97
2005	74564.10	55222.50	47059.51	30477.15
2006	85839.98	63497.18	54078.08	34969.51
2007	96899.79	71699.16	61077.02	39526.95
2008	110121.78	81479.16	69409.25	44925.88

The real values of total human capital stock calculated by three different price indexes are reported in Table 9.1.2(all based on 1985). Column 1 uses CPI classified by rural and urban in Gansu as deflator, and thus the results exclude the inflation factor. Column 2 uses the living cost index. Based on the living cost of urban in Beijing, the real values are comparable between rural and urban, which is also the case for the comparison among various provinces. Column 3 uses index of fixed assets investment as deflator, comparing the human capital with the physical capital. The results show that the real value of total human capital adjusted by index of living cost is the highest. The trends of total human capital adjusted by CPI and fixed asset investment respectively are very close.

Table 9.1.2 Real total human capital based on different indexes

Unit: 100 Million Yuan

Year	CPI	Living Cost Index	Fixed Assets Investment Index
1985	3277.83	3997.22	3277.83
1986	3510.62	4280.44	3738.98
1987	3726.53	4547.11	4078.14

Year	CPI	Living Cost Index	Fixed Assets Investment Index
1988	3586.31	4388.30	4274.48
1989	3487.78	4271.18	4550.13
1990	3905.87	4783.47	4758.49
1991	4245.89	5205.77	4664.28
1992	4547.64	5581.26	4544.57
1993	4539.19	5566.64	4153.02
1994	4196.27	5148.16	4228.44
1995	4052.78	4968.69	4466.42
1996	4255.66	5216.51	4917.96
1997	4867.76	5949.47	5639.47
1998	5732.58	6989.06	6557.93
1999	6963.73	8450.59	7715.20
2000	8195.90	9901.60	8765.49
2001	8924.71	10739.43	9743.39
2002	10504.21	12542.78	11441.59
2003	12063.36	14314.63	13059.21
2004	13327.20	15709.51	13975.81
2005	14589.06	17097.26	15212.51
2006	16593.46	19342.43	16803.06
2007	17792.76	20650.11	18456.80
2008	18725.70	21643.53	19663.25

Calculated by the income parameter of Gansu and discount rate 4.58%, the total human capital stock for Gansu from 1985 to 2008 are reported in Table 9.1.3. Column 1 and column 2 contain the total human capital measured in nominal terms; column 3 and column 4 contain the total human capital measured in real terms (in 1985 RMB).

Table 9.1.3 Nominal and real human capital, Nominal GDP

Unit: 100 Million Yuan

Year	Nominal human capital		Real human capital		Nominal GDP	Ratio of human capital to GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
1985	3277.84		3277.83		123.39	26.56
1986	3739.04		3510.62		140.74	26.57
1987	4264.72		3726.53		159.52	26.73
1988	4851.34		3586.31		191.84	25.29
1989	5560.56		3487.78		216.84	25.64
1990	6433.13		3905.87		242.8	26.50
1991	7346.12		4245.89		271.39	27.07
1992	8403.24		4547.64		317.79	26.44
1993	9690.96		4539.19		372.24	26.03
1994	11110.30		4196.27		453.6079	24.49
1995	12838.63		4052.78		557.7636	23.02
1996	14829.50		4255.66		722.5207	20.52
1997	17464.06		4867.76		793.5691	22.01
1998	20369.33		5732.58		887.6744	22.95
1999	24203.45		6963.73		956.3229	25.31
2000	28406.22	28915.22769	8195.90	8340.24	1052.88	26.98
2001	32206.28	32853.54807	8924.71	9102.73	1125.373	28.62
2002	37895.17	38758.72965	10504.21	10743.38	1232.03	30.76
2003	43987.90	45121.56221	12063.36	12374.46	1399.834	31.42
2004	49660.94	51034.69724	13327.20	13699.65	1688.491	29.41
2005	55222.50	56811.49641	14589.06	15014.60	1933.98	28.55
2006	63497.18	65528.02034	16593.46	17130.86	2277.35	27.88
2007	71699.16	74178.62029	17792.76	18416.35	2703.98	26.52
2008	81479.16	84532.44322	18725.70	19436.34	3176.11	25.65

The trends of total human capital measured in nominal and real terms are presented in Figure 9.1.1. In order to get a sense of the magnitude of the total human capital in Gansu, we also present the ratio of nominal GDP to nominal human capital stock in Table 9.1.3. The reason for calculating the ratio at nominal level is to avoid the differences between the real value of human capital stock and that of GDP caused by using different deflator indexes.

The level of annual human capital exhibits a rising trend and is much higher than that of GDP. The ratio of human capital to GDP measured at the nominal level reaches to 26.29, which indicates a faster growth in human capital than the growth in physical capital. There was a slightly decrease from 1985 to 1997.

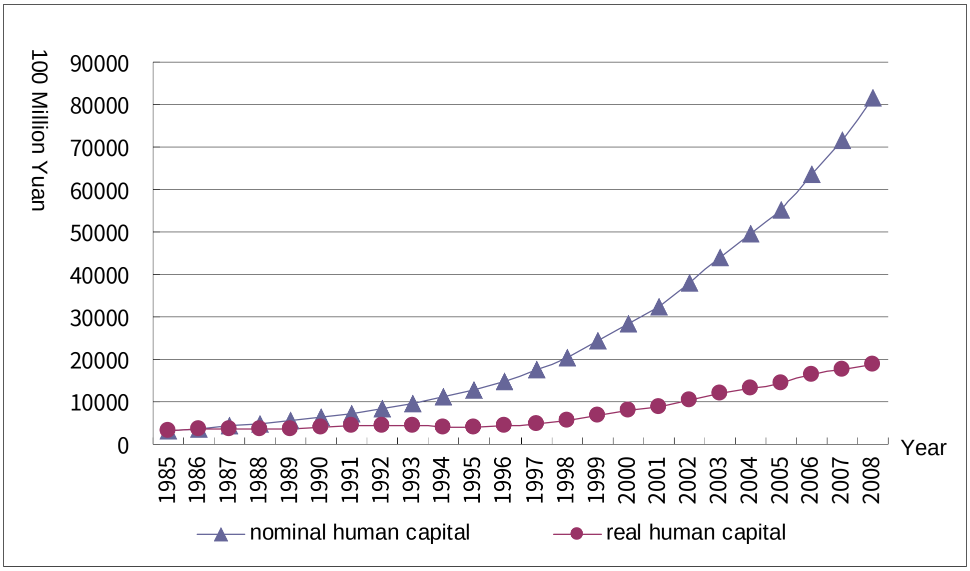


Figure 9.1.1 Nominal and real human capital for Gansu

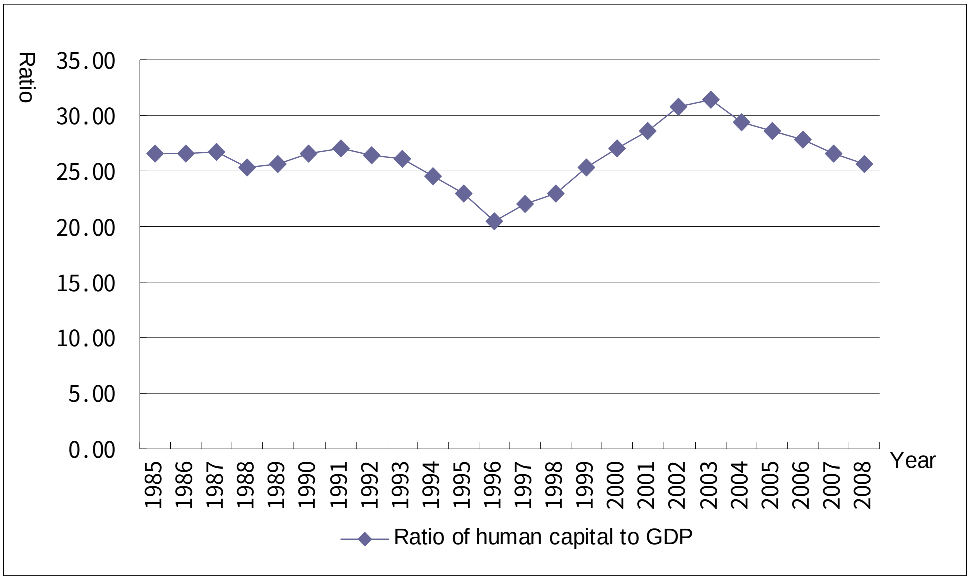


Figure 9.1.2 Ratio of nominal total human capital to nominal GDP for Gansu

Table 9.1.4 reports the total human capital stock for Gansu classified by gender and geography. Before 1997, the growth rates of various human capital stock was quite slow, the gender gap was fairly stable and the gap between rural and urban was relatively small. Starting from 1997, both the human capital of male and female increased by a significant amount, and the gender gap appears to be expanding. The urban human capital increased rapidly while rural human capital was relatively stable. This might be a result of urban-rural migration, slow economy development in rural area or the lack of investment on human capital.

Table 9.1.4 Real human capital by gender and rural-urban

Unit: 100 Million Yuan

Year	Total	Male	Female	Urban	Rural
1985	3277.83	1768.36	1509.47	1651.36	1626.47
1986	3510.62	1941.96	1568.66	1771.84	1738.78
1987	3726.53	2114.56	1611.97	1864.30	1862.23
1988	3586.31	2071.18	1515.14	1734.73	1851.58

Year	Total	Male	Female	Urban	Rural
1989	3487.78	2047.39	1440.40	1670.39	1817.39
1990	3905.87	2336.41	1569.46	1869.19	2036.68
1991	4245.89	2574.22	1671.67	2003.47	2242.42
1992	4547.64	2804.80	1742.85	2119.14	2428.50
1993	4539.19	2844.83	1694.37	2135.79	2403.40
1994	4196.27	2665.29	1530.98	1964.43	2231.84
1995	4052.78	2606.49	1446.29	1913.86	2138.92
1996	4255.66	2778.54	1477.12	2014.06	2241.59
1997	4867.76	3220.66	1647.11	2387.66	2480.11
1998	5732.58	3797.49	1935.09	2896.07	2836.51
1999	6963.73	4636.75	2326.99	3708.93	3254.80
2000	8195.90	5464.87	2731.03	4579.24	3616.66
2001	8924.71	5970.23	2954.48	5192.77	3731.94
2002	10504.21	7064.60	3439.61	6582.58	3921.63
2003	12063.36	8073.36	3990.00	7994.44	4068.92
2004	13327.20	8911.61	4415.59	9339.03	3988.17
2005	14589.06	9795.21	4793.85	10705.48	3883.58
2006	16593.46	11180.34	5413.11	12678.59	3914.87
2007	17792.76	12025.80	5766.96	14031.80	3760.96
2008	18725.70	12719.24	6006.46	15199.70	3526.00

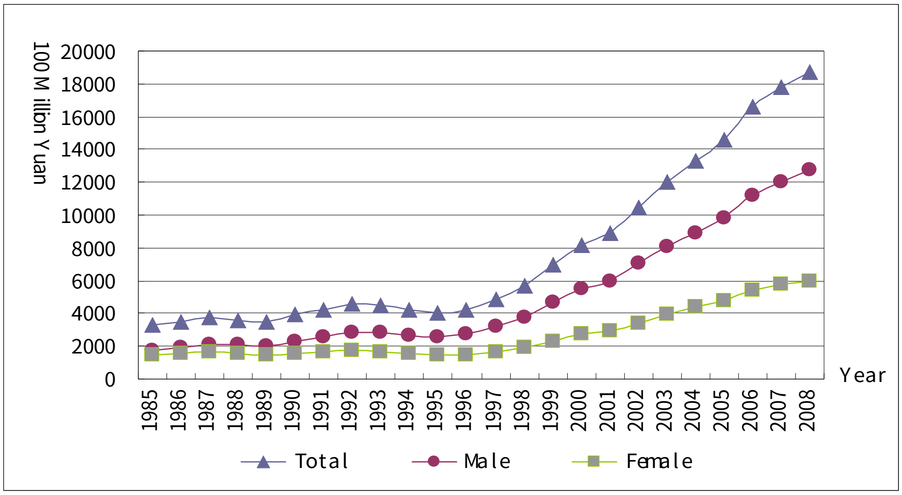


Figure9.1.3 Real human capital by gender, 1985-2008

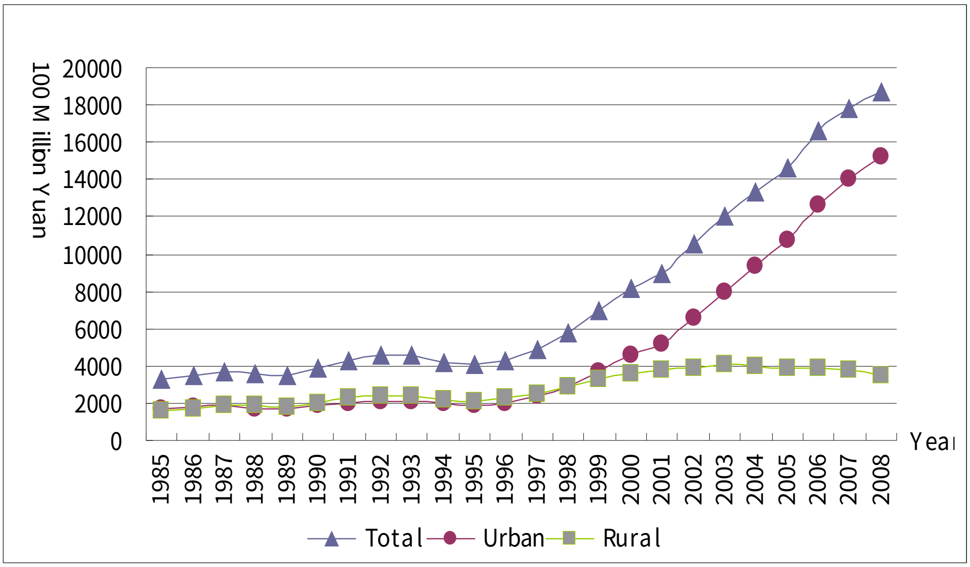


Figure 9.1.4 Real human capital by urban-rural, 1985-2008

Table 9.1.4 shows the total of human capital for urban and rural separately. Before 1997, the difference between urban and rural was insignificant. The urban human capital was even smaller than rural human capital because of the larger rural population relative to urban in Gansu. Starting from 1998, however, the human capital in the urban area was rising much more rapidly and then resulted in a larger gap between rural and urban. In 2008, the total human capital for urban was about 4.3 times the amount of that for rural in Gansu.

Table 9.1.5 reports a set of real indexes of total human capital for Gansu from 1985 to 2008 calculated by using 1985 as the base year whose value is set at 100. Figure 9.1.5 shows the corresponding indexes of total human capital. Apparently, the human capital in Gansu also increased rapidly especially in the later period.

Table 9.1.5 Total human capital index for Gansu (1985=100)

Year	Total human capital	Male total human capital	Female total human capital	Urban total human capital	Rural total human capital
1985	100	100	100	100	100
1986	107.10	109.82	103.92	107.30	106.90
1987	113.69	119.58	106.79	112.90	114.50
1988	109.41	117.12	100.38	105.05	113.84
1989	106.41	115.78	95.42	101.15	111.74
1990	119.16	132.12	103.97	113.19	125.22
1991	129.53	145.57	110.75	121.32	137.87
1992	138.74	158.61	115.46	128.33	149.31
1993	138.48	160.87	112.25	129.34	147.77
1994	128.02	150.72	101.43	118.96	137.22
1995	123.64	147.40	95.81	115.90	131.51
1996	129.83	157.13	97.86	121.96	137.82
1997	148.51	182.13	109.12	144.59	152.48
1998	174.89	214.75	128.20	175.38	174.40
1999	212.45	262.21	154.16	224.60	200.11
2000	250.04	309.04	180.93	277.30	222.36
2001	272.28	337.61	195.73	314.46	229.45
2002	320.46	399.50	227.87	398.62	241.11
2003	368.03	456.55	264.33	484.11	250.17
2004	406.59	503.95	292.53	565.54	245.20
2005	445.08	553.92	317.59	648.28	238.77
2006	506.23	632.24	358.61	767.77	240.70
2007	542.82	680.05	382.05	849.71	231.23
2008	571.28	719.27	397.92	920.44	216.79

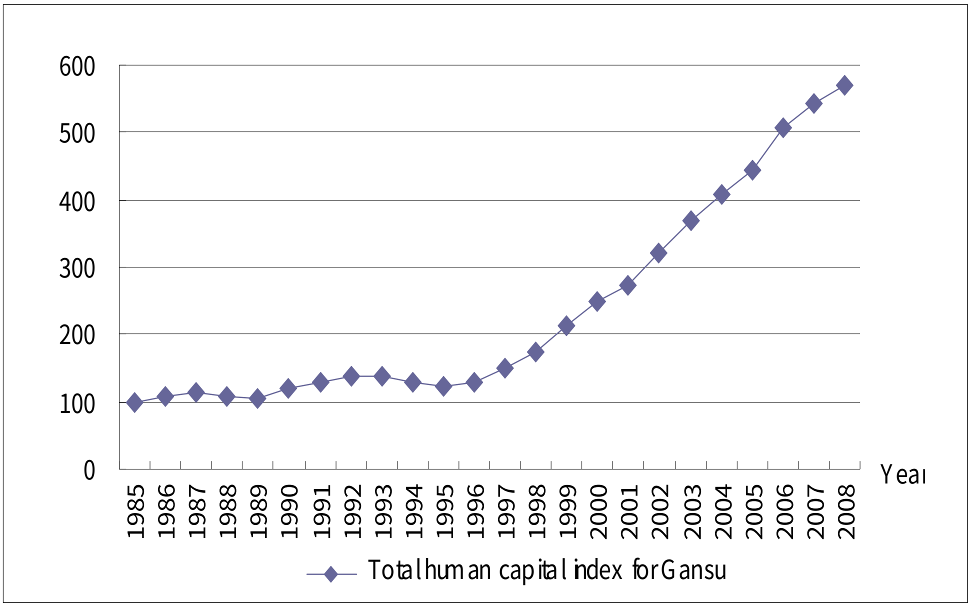


Figure 9.1.5 Total human capital index for Gansu, 1985-2008

9.2 Per capita human capital

The increase in the total human capital can be caused by population growth, demographic changes, rural-urban migration or urbanization, higher educational attainment, higher rates of return to education, higher rates of return to on-the-job training, and so forth. In order to get further information on the dynamics of human capital, we calculate per capita human capital, which is defined as the ratio of total human capital over non-retired population. Although the per capita human capital is influenced by the age distribution of the population, the effect is relatively small in comparison with the number of population, and thus is able to serve as a better indicator of the average human capital.

Table 9.2.1 Nominal and real per capita human capital, per capita GDP

Unit: Yuan

Year	Nominal per capita human capital	Real per capita human capital	Per capita GDP	Ratio of nominal per capita human capital to nominal GDP
1985	16521.85	16521.78	608.00	27.17
1986	18781.97	17634.58	684.00	27.46
1987	21290.42	18603.66	764.00	27.87
1988	24015.15	17753.02	905.00	26.54
1989	27239.12	17085.34	1007.00	27.05
1990	30763.41	18677.96	1099.00	27.99
1991	34716.54	20065.37	1204.00	28.83
1992	39328.30	21283.59	1384.00	28.42
1993	44874.48	21018.96	1600.00	28.05
1994	50727.96	19159.54	1920.65	26.41
1995	57616.54	18187.87	2316.20	24.88
1996	65974.68	18932.91	2946.17	22.39
1997	76998.96	21461.96	3199.19	24.07
1998	89189.63	25100.82	3541.08	25.19
1999	105309.22	30299.21	3778.47	27.87
2000	123153.91	35532.98	4129.38	29.82
2001	139162.59	38563.47	4385.59	31.73
2002	163087.08	45206.34	4768.08	34.20
2003	189271.83	51906.41	5429.40	34.86
2004	213627.13	57329.78	6566.15	32.53
2005	241541.45	63812.09	7476.53	32.31
2006	277855.88	72610.94	8757.00	31.73
2007	313630.31	77830.05	10346.00	30.31
2008	356140.75	81848.95	12110.00	29.41

Table 9.2.2 Nominal and real per capita human capital by urban-rural

Unit: Yuan

Year	Nominal per capita human capital			Real per capita human capital		
	Total	Urban	Rural	Total	Urban	Rural
1985	16522	41644	10246	16522	41644	10246
1986	18782	45176	11731	17635	42219	11067
1987	21290	49394	13430	18604	42585	11897
1988	24015	54464	15399	17753	38936	11759
1989	27239	60870	17628	17085	36816	11447
1990	30763	67916	20178	18678	40311	12514
1991	34717	75380	23000	20065	42328	13651
1992	39328	83951	26318	21284	43934	14680
1993	44874	95464	29929	21019	43366	14417
1994	50728	107378	33892	19160	39149	13219
1995	57617	122112	38419	18188	37444	12456
1996	65975	139864	43847	18933	38881	12959
1997	76999	167683	49582	21462	45347	14241
1998	89190	198369	55833	25101	54186	16215
1999	105309	242841	62717	30299	68246	18547
2000	123154	292239	69815	35533	82788	20626
2001	139163	332768	76285	38563	91526	21363
2002	163087	392738	82222	45206	108781	22820
2003	189272	455582	88234	51906	125065	24150
2004	213627	514982	91804	57330	139552	24091
2005	241541	578929	95526	63812	155022	24338
2006	277856	668501	99337	72611	176885	24960
2007	313630	763540	102293	77830	192046	24179
2008	356141	874781	105170	81849	203732	22870

Table 9.2.3 Nominal and real per capita human capital by gender

Unit: Yuan

Year	Nominal per capita human capital			Real per capita human capital		
	Total	Male	Female	Total	Male	Female
1985	16522	17178	15814	16522	17177	15815
1986	18782	19929	17532	17635	18703	16470
1987	21290	23075	19325	18604	20140	16911
1988	24015	26463	21305	17753	19512	15806
1989	27239	30417	23699	17085	19031	14917
1990	30763	34935	26106	18678	21182	15883
1991	34717	40025	28812	20065	23101	16688
1992	39328	46119	31775	21284	24929	17229
1993	44874	53470	35321	21019	25025	16566
1994	50728	61200	39071	19160	23102	14771
1995	57617	70438	43381	18188	22232	13697
1996	65975	81642	48476	18933	23429	13911
1997	76999	96360	55284	21462	26861	15407
1998	89190	111776	63892	25101	31473	17963
1999	105309	132045	75077	30299	38016	21574
2000	123154	154789	87453	35533	44687	25202
2001	139163	177526	96881	38563	49204	26836
2002	163087	211116	111152	45206	58520	30810
2003	189272	246428	128816	51906	67580	35328
2004	213627	281633	143623	57330	75576	38547
2005	241541	322972	159426	63812	85330	42113
2006	277856	372334	182339	72611	97316	47635
2007	313630	420879	204863	77830	104474	50809
2008	356141	479307	230741	81849	110200	52984

Based on the five education categories, the per capita human capital measured at the nominal level in 1985, 1995 and 2008 were RMB 3277, RMB 12839, and RMB 81479. From 1985 to 2008, per capital human capital measured in nominal terms for Gansu increased by 23.86 times, while over the same period, per capital real GDP increased by 24.74 times, higher than the growth of per capita human capital. On the one hand, the growth of human capital was rapid, resulting from dramatic economic growth since 1978 - the rapid expansion of education, the transition towards market-orientated system and a large scale of rural-urban migration. On the other hand, the growth of human capital in Gansu was relatively slow in comparison with the growth of physical capital.

The ratio of per capita human capital to per capita GDP measured in nominal term for Gansu is reported in Table 9.2.1.

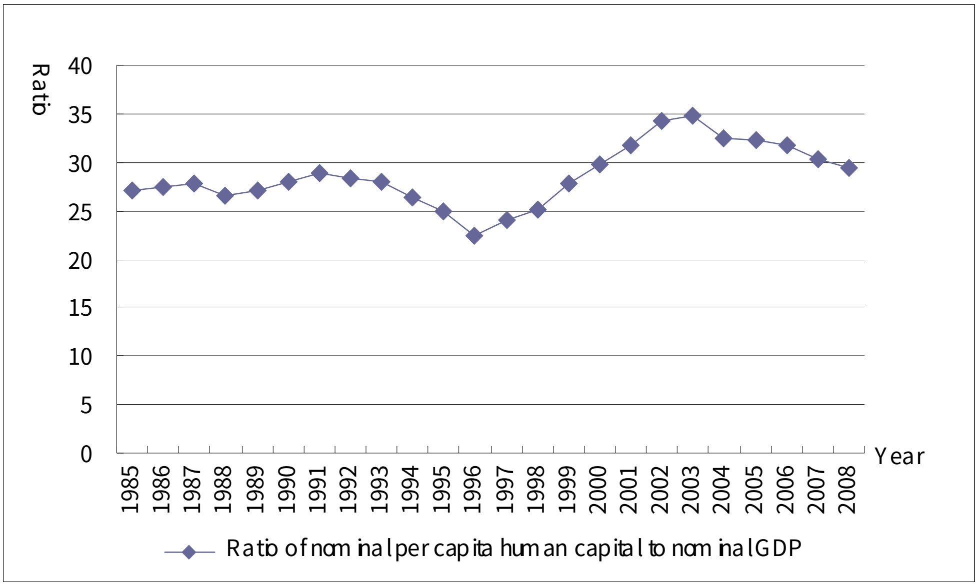


Figure9.2.1 Ratio of nominal per capita human capital to nominal per capita GDP

Table 9.2.2 and Table 9.2.3 present the trends of per capita human capital measured in real terms for Gansu classified by gender and urban-rural respectively. It can be seen that the per capita human capital for urban is significantly higher than that for rural. And the size of the difference expanded rapidly after 1997.

The ratio of urban to rural increased from 4.06 in 1985 to 8.91 in 2008, which indicates a rising size of urban-rural gap on per capita human capital.

The trends of per capita human capital of male and female are similar to each other. Per capita human capital of male is higher than that of female and the gap exhibits a trend of further expansion. From1985 to 2008, the ratio of male to female increased from 1.09 to 2.08. The annual growth rates were 8.08% and 5.26%, respectively.

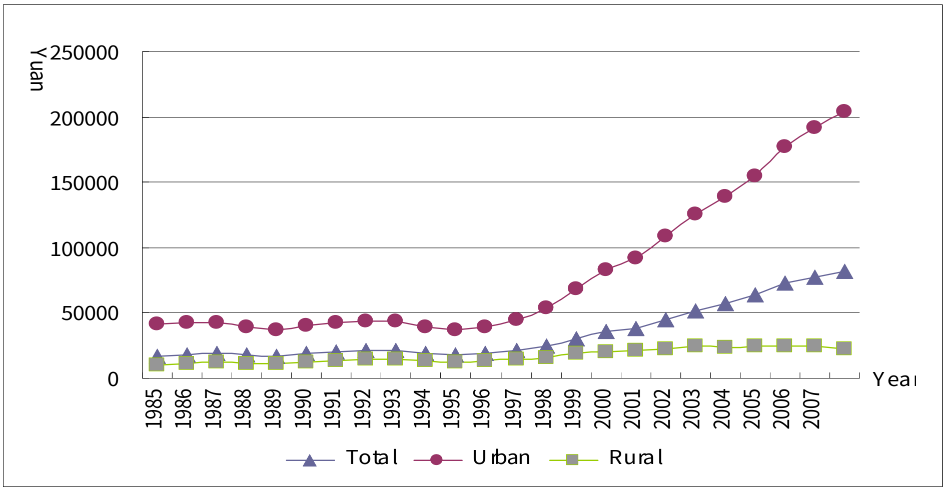


Figure 9.2.2 Per capita human capital by urban-rural, 1985-2008

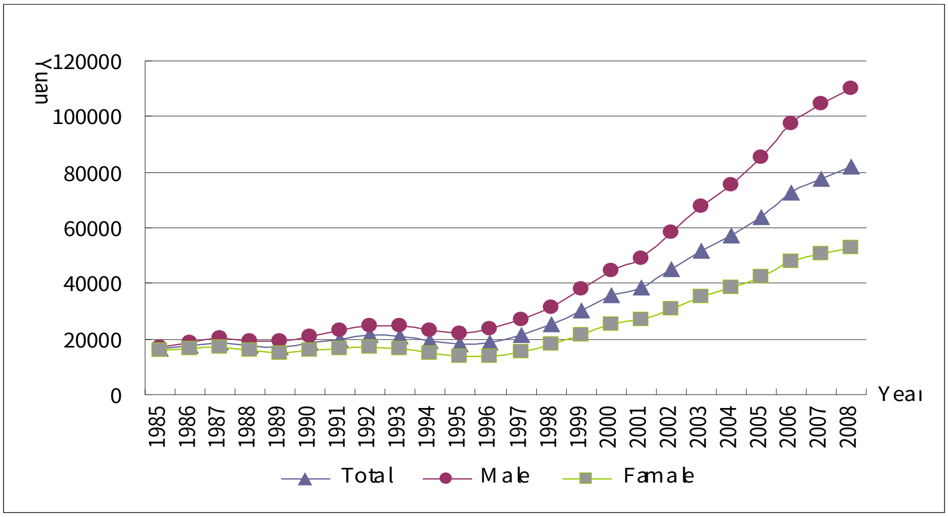


Figure 9.2.3 Per capita human capital by gender, 1985-2008

Similarity, we construct a set of per capita human capital indexes. The corresponding value in 1985 is set as 100. Table 9.2.4 shows various per capita human capital indexes for Gansu.

Table 9.2.4 Index of per capita human capital (1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100.00	100.00	100.00	100.00	100.00
1986	106.74	108.88	104.14	101.38	108.01
1987	112.60	117.25	106.93	102.26	116.11
1988	107.45	113.59	99.94	93.50	114.77
1989	103.41	110.79	94.32	88.41	111.72
1990	113.05	123.31	100.43	96.80	122.14
1991	121.45	134.49	105.52	101.64	133.23
1992	128.82	145.13	108.94	105.50	143.28
1993	127.22	145.69	104.75	104.14	140.71
1994	115.97	134.49	93.40	94.01	129.02
1995	110.08	129.43	86.61	89.91	121.57
1996	114.59	136.40	87.96	93.37	126.48
1997	129.90	156.37	97.42	108.89	138.99
1998	151.93	183.23	113.59	130.12	158.26
1999	183.39	221.31	136.41	163.88	181.02
2000	215.07	260.15	159.36	198.80	201.31
2001	233.41	286.45	169.69	219.78	208.50
2002	273.62	340.68	194.82	261.22	222.72
2003	314.17	393.43	223.39	300.32	235.70
2004	347.00	439.98	243.74	335.11	235.13
2005	386.23	496.76	266.29	372.26	237.54
2006	439.49	566.53	301.21	424.76	243.61
2007	471.08	608.20	321.28	461.16	235.98
2008	495.40	641.54	335.03	489.22	223.21

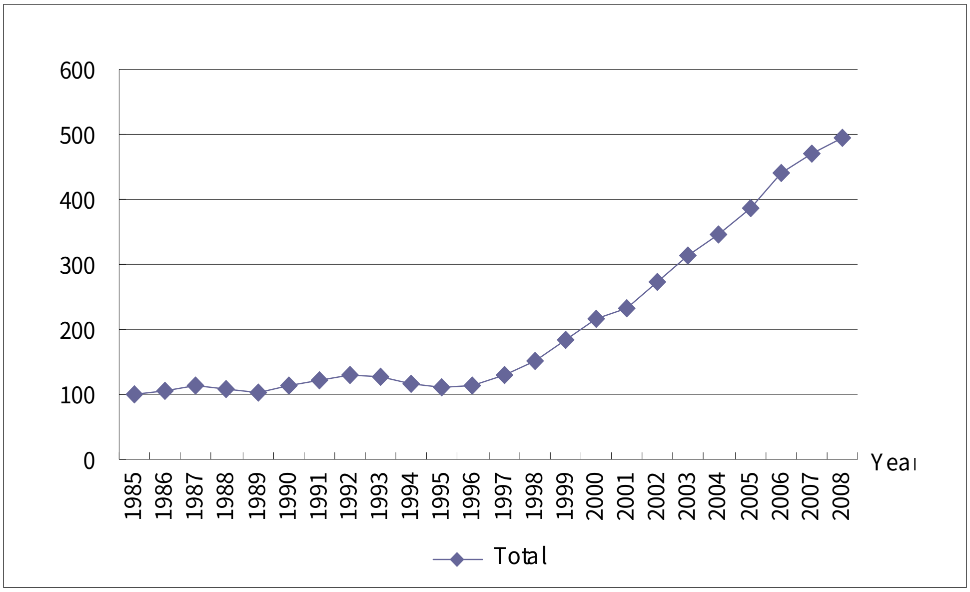


Figure9.2.4 Index of per capita human capital, 1985-2008

9.3 Active human capital

9.3.1 Active total human capital

The estimated approach of active human capital is the same as that of human capital we illustrate above. Based on the income parameter for Gansu and the discount rate valued at 4.58%， the total active human capital (non-retired population aged over 15) for Gansu is reported in Table 9.3.1. Column 1 and column 2 are for active human capital stock measured in nominal terms, column 3 and column 4 are for active human capital stock measured in real terms (in 1985 RMB). The real value in this table is calculated by using CPI as deflator with respect to nominal value.

Table 9.3.1 Total active human capital and nominal GDP

Unit: 100 Million Yuan

Year	Nominal total human capital		Real total human capital		Nominal GDP	Ratio of nominal human capital to nominal GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
1985	1856.81		1856.80		123.39	15.05
1986	2130.20		2000.35		140.74	15.14
1987	2463.64		2154.05		159.52	15.44
1988	2925.69		2164.37		191.84	15.25
1989	3463.91		2173.03		216.84	15.97
1990	4112.40		2496.51		242.8	16.94
1991	4715.32		2724.60		271.39	17.37
1992	5375.93		2907.74		317.79	16.92
1993	6168.11		2886.67		372.24	16.57
1994	6968.16		2629.46		453.60789	15.36
1995	7908.86		2495.08		557.76355	14.18
1996	9023.14		2587.75		722.52072	12.49
1997	10341.76		2882.52		793.5691	13.03
1998	11875.76		3343.37		887.67437	13.38
1999	13531.69		3897.51		956.32292	14.15
2000	16072.07	16162.41	4639.73	4665.42	1052.88	15.26
2001	18452.43	18576.79	5114.32	5148.53	1125.3728	16.40
2002	21247.69	21417.89	5889.88	5937.00	1232.0302	17.25
2003	24590.36	24809.07	6743.47	6803.44	1399.8344	17.57
2004	28322.60	28618.97	7599.10	7679.52	1688.4909	16.77
2005	32101.89	32439.79	8480.72	8571.21	1933.98	16.60
2006	36994.06	37474.65	9667.99	9795.15	2277.35	16.24
2007	42222.07	42874.06	10478.34	10642.26	2703.98	15.61
2008	48380.56	49252.84	11118.51	11321.31	3176.11	15.23

The trends of active human capital stock in both real and nominal terms for Gansu are presented in Figured 9.3.1. From 1985 to 2008, the active human capital kept rising.

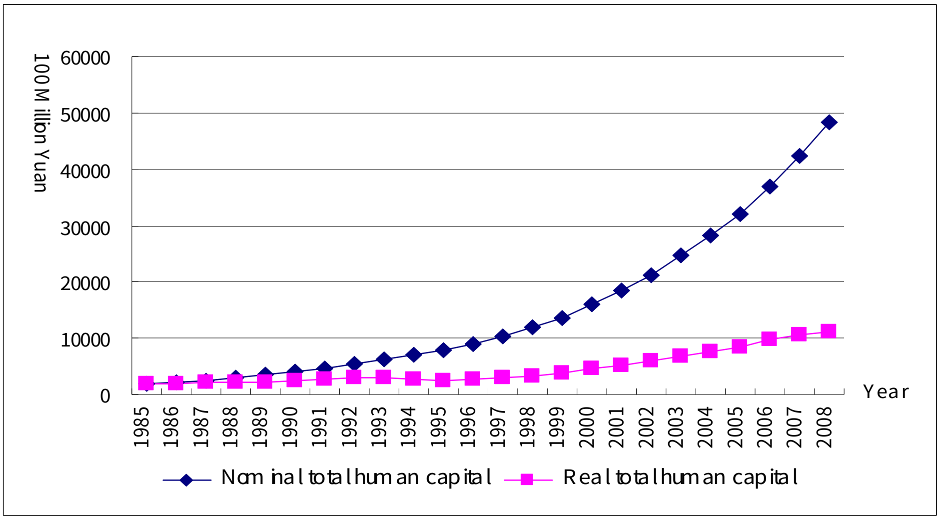


Figure 9.3.1 Nominal and real total human capital

Similar to the analysis of total human capital, we construct the ratio of nominal GDP to total active human capital stock measured in nominal term with the purpose of getting a sense of the magnitude of the total active human capital. The result is reported in Table 9.3.1. Moreover, as we can see from Figure 9.3.2, the active human capital in Gansu is much larger than its corresponding gross domestic products.

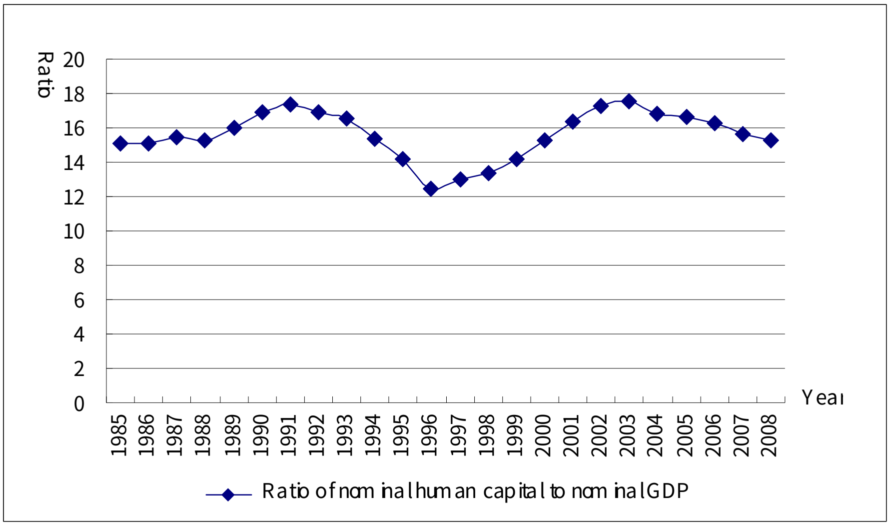


Figure 9.3.2 Ratio of nominal human capital to nominal GDP

The total active human capital by gender and urban-rural are reported in Table 9.3.2 and 9.3.3, respectively. From 1985 to 2008, the nominal active human capital for male and female appeared to be increasing continuously. If we get rid of the influence of inflation by using CPI, the total active human capital for male and female declines correspondingly, but the rising trend still holds. Meanwhile, the total active human capital of male is higher than that for female. (See the Figure 9.3.3). In the rural area, the total active human capital with a considerable growth rate is far smaller than that for the urban area, though both of them exhibit a rising trend. As we can see from Figure 9.3.4, the growth trend of active human capital for rural is relatively flat while that for urban is much steeper.

Table 9.3.2 Nominal and real active human capital by gender

Unit: 100 Million Yuan

Year	Nominal active human capital		Real active human capital	
	Male	Female	Male	Female
1985	1015.77	841.04	1015.75	841.05
1986	1197.25	932.95	1123.76	876.59
1987	1417.87	1045.77	1238.28	915.77
1988	1722.71	1202.98	1271.14	893.23
1989	2084.52	1379.38	1304.43	868.60
1990	2531.19	1581.21	1534.47	962.04
1991	2943.58	1771.73	1698.56	1026.04
1992	3408.35	1967.58	1841.50	1066.24
1993	3982.78	2185.33	1862.57	1024.10
1994	4548.97	2419.19	1715.84	913.62
1995	5224.86	2684.00	1648.29	846.79
1996	6044.68	2978.46	1733.84	853.91
1997	7066.43	3275.33	1969.77	912.75
1998	8109.32	3766.44	2284.22	1059.15
1999	9337.38	4194.31	2690.69	1206.83
2000	11138.28	4933.79	3216.84	1422.89
2001	12772.87	5679.56	3540.62	1573.70

Year	Nominal active human capital		Real active human capital	
	Male	Female	Male	Female
2002	14680.61	6567.08	4069.50	1820.38
2003	16969.29	7621.07	4653.55	2089.92
2004	19484.92	8837.68	5228.30	2370.81
2005	22097.70	10004.19	5839.45	2641.27
2006	25441.06	11553.00	6651.06	3016.92
2007	29067.56	13154.51	7217.40	3260.95
2008	33382.56	14998.00	7677.12	3441.40

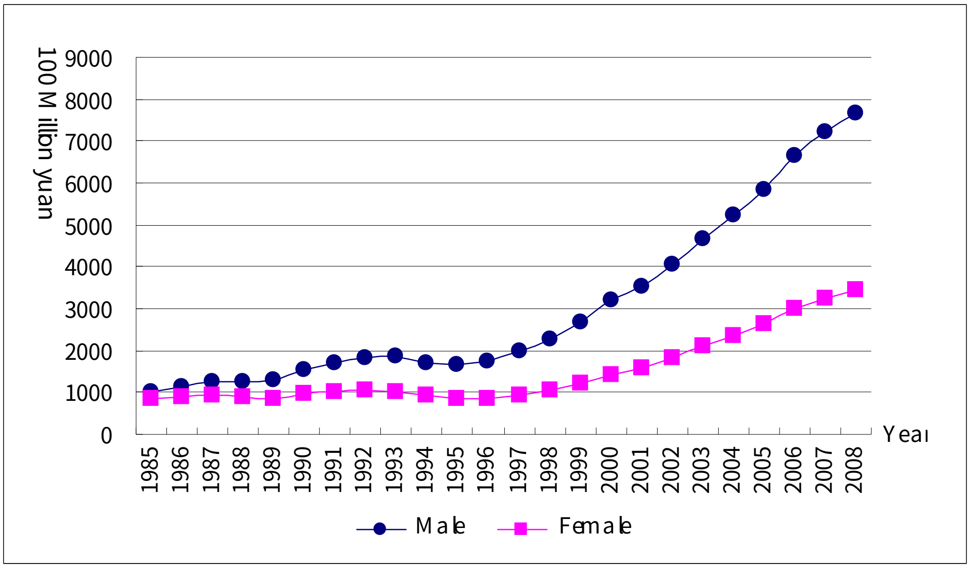


Figure 9.3.3 Real active human capital by gender

Table 9.3.3 Nominal and real active human capital by urban-rural

Unit: 100 Million Yuan

Year	Nominal active human capital		Real active human capital	
	Urban	Rural	Urban	Rural
1985	911.83	944.98	911.83	944.97
1986	1047.47	1082.73	978.91	1021.45
1987	1193.88	1269.76	1029.29	1124.76
1988	1430.95	1494.74	1022.96	1141.41

1989	1712.63	1751.27	1035.84	1137.19
1990	2025.58	2086.82	1202.27	1294.24
1991	2313.42	2401.90	1299.04	1425.57
1992	2636.63	2739.30	1379.82	1527.92
1993	3081.50	3086.61	1399.84	1486.84
1994	3471.99	3496.18	1265.87	1363.59
1995	3931.23	3977.63	1205.45	1289.64
1996	4502.04	4521.10	1251.54	1336.21
1997	5231.10	5110.66	1414.66	1467.86
1998	6114.63	5761.13	1670.25	1673.12
1999	7091.33	6440.36	1992.91	1904.61
2000	8936.26	7135.81	2531.54	2108.19
2001	10625.67	7826.76	2922.52	2191.80
2002	12963.72	8283.97	3590.72	2299.16
2003	15951.30	8639.05	4378.90	2364.57
2004	19464.00	8858.60	5274.42	2324.69
2005	23228.00	8873.89	6219.83	2260.89
2006	27953.21	9040.85	7396.38	2271.61
2007	32890.64	9331.43	8272.66	2205.69
2008	38724.82	9655.73	9018.82	2099.69

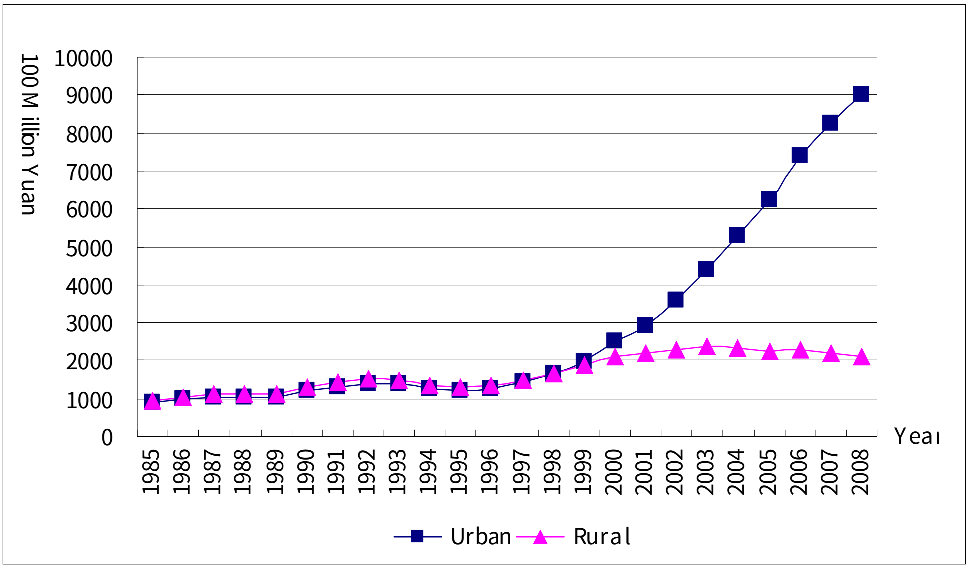


Figure 9.3.4 Real active human capital by urban-rural

From Table 9.3.2 and Table 9.3.3, we can see the significant difference between urban and rural, male and female. The human capital of the male is higher than the female although their growth rates are very close. Moreover, the active human capital is much higher in urban area than in rural in terms of stock and growth rate, which reflects the unbalance development between urban and rural areas. Nowadays, urban economy is the main drive of the economy development for Gansu. At an inferior position, rural economy contributes little to the economy development of Gansu province.

Similarity, we construct a set of total active human capital indexes. The corresponding value in 1985 is set as 100. Table 9.3.4 shows various human capital indexes. Figure 9.3.5 presents the index total human capital for Gansu.

Table 9.3.4 Index of real active human capital by gender and by rural urban (1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100	100.00	100.00	100	100
1986	107.73	110.63	104.23	107.36	108.09
1987	116.01	121.91	108.88	112.88	119.03
1988	116.56	125.14	106.20	112.19	120.79
1989	117.03	128.42	103.28	113.60	120.34
1990	134.45	151.07	114.39	131.85	136.96
1991	146.74	167.22	122.00	142.46	150.86
1992	156.60	181.30	126.77	151.32	161.69
1993	155.46	183.37	121.76	153.52	157.34
1994	141.61	168.92	108.63	138.83	144.30
1995	134.38	162.27	100.68	132.20	136.47
1996	139.37	170.70	101.53	137.25	141.40
1997	155.24	193.92	108.52	155.14	155.33
1998	180.06	224.88	125.93	183.17	177.06
1999	209.91	264.90	143.49	218.56	201.55
2000	249.88	316.70	169.18	277.63	223.10

2001	275.44	348.57	187.11	320.51	231.95
2002	317.21	400.64	216.44	393.79	243.31
2003	363.18	458.14	248.49	480.23	250.23
2004	409.26	514.72	281.89	578.44	246.01
2005	456.74	574.89	314.04	682.12	239.26
2006	520.68	654.79	358.71	811.15	240.39
2007	564.32	710.55	387.72	907.26	233.41
2008	598.80	755.81	409.18	989.09	222.20

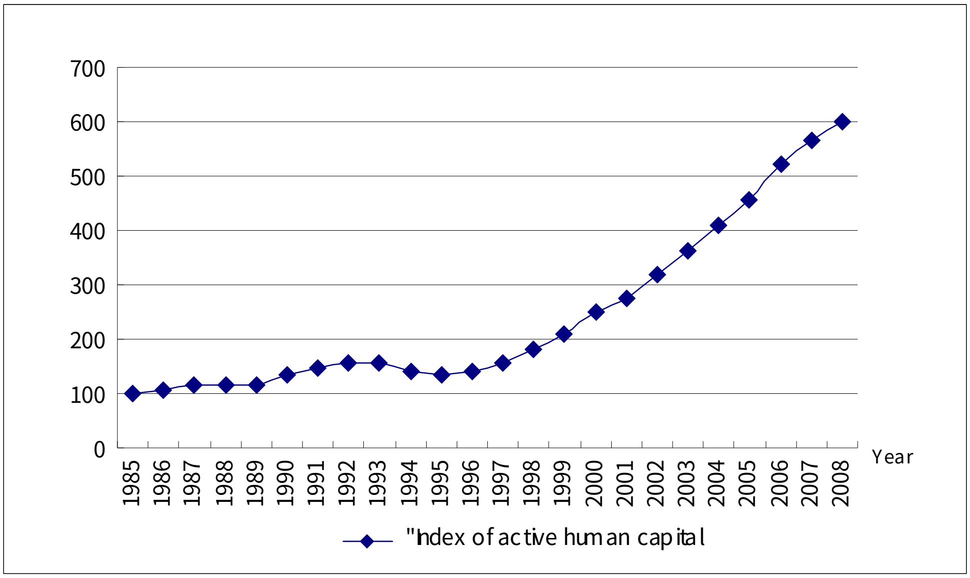


Figure 9.3.5 Index of real active human capital

9.3.2 Active human capital per capita

Similar to the analysis of per capita human capital above, we calculate the active human capital per capita. Table 9.3.5 shows that active human capital per capita in both real values and nominal values exhibits a rising trend.

Table 9.3.5 Nominal and real active human capital per capita, Nominal GDP per capita

Unit: Yuan

Year	Nominal active human capital per capita		Real active human capital per capita		Nominal GDP per capita	Ratio of human capital to GDP
	Five-education category	Six-education category	Five-education category	Six-education category		
1985	14728.05		14727.97		608	24.22
1986	16748.20		15727.31		684	24.49
1987	18961.11		16578.36		764	24.82
1988	21889.06		16193.13		905	24.19
1989	25265.33		15849.84		1007	25.09
1990	28975.17		17589.90		1099	26.37
1991	32679.90		18883.10		1204	27.14
1992	36994.07		20009.41		1384	26.73
1993	42179.08		19739.77		1600	26.36
1994	47206.85		17813.67		1920.6512	24.58
1995	52767.64		16647.10		2316.1976	22.78
1996	60053.86		17222.84		2946.1661	20.38
1997	68476.96		19086.31		3199.1917	21.40
1998	77563.13		21836.25		3541.0799	21.90
1999	87505.20		25204.01		3778.4689	23.16
2000	102170.93	102745.25	29494.98	29658.28	4129.3758	24.74
2001	115159.16	115935.28	31917.82	32131.29	4385.5888	26.26
2002	131232.75	132283.97	36377.85	36668.91	4768.0848	27.52
2003	149524.41	150854.33	41004.41	41369.10	5429.3974	27.54
2004	168526.34	170289.78	45216.50	45695.02	6566.1455	25.67
2005	187737.20	189713.33	49596.66	50125.87	7476.5293	25.11
2006	213412.19	216184.61	55772.90	56506.48	8757	24.37
2007	240469.25	244182.59	59677.79	60611.37	10346	23.24
2008	271897.47	276799.69	62485.74	63625.46	12110	22.45

Table 9.3.6 and Table 9.3.7 report the active human capital per capita classified by rural-urban and gender respectively. The active human capital

per capita was much smaller in rural area than in urban area. And the active human capital per capita was smaller for female than for male.

Table 9.3.6 Nominal and real active human capital per capita by urban-rural

Unit: Yuan

Year	Nominal active human capital per capita		Real active human capital per capita	
	Urban	Rural	Urban	Rural
1985	34482	9485	34482	9485
1986	37383	10918	34936	10300
1987	40675	12624	35068	11183
1988	45895	14586	32810	11138
1989	51881	16825	31379	10925
1990	58431	19455	34681	12066
1991	64640	22138	36297	13139
1992	71717	25234	37532	14075
1993	81361	28484	36960	13721
1994	90517	32001	33002	12481
1995	100811	35872	30912	11630
1996	115307	40655	32055	12016
1997	133575	45687	36123	13122
1998	152678	50956	41705	14798
1999	175234	56410	49247	16682
2000	210464	62134	59622	18357
2001	244372	67037	67213	18773
2002	283593	71293	78550	19787
2003	326948	74688	89753	20443
2004	374934	76270	101601	20015
2005	420339	76675	112555	19535
2006	483465	78257	127924	19663
2007	555373	80195	139688	18956
2008	638105	82352	148612	17908

Table 9.3.7 Nominal and real active human capital per capita by gender

Unit: Yuan

Year	Nominal active human capital per capita		Real active human capital per capita	
	Male	Female	Male	Female
1985	15408.47	13982.32	15408.13	13982.53
1986	17937.12	15435.28	16836.10	14502.88
1987	20733.71	16991.58	18107.61	14879.21
1988	24419.79	19060.36	18018.70	14152.63
1989	28697.81	21397.67	17958.23	13474.15
1990	33500.92	23823.25	20309.04	14494.54
1991	38374.79	26216.13	22143.77	15182.21
1992	44253.64	28807.84	23909.87	15611.07
1993	51386.61	31795.84	24031.20	14900.37
1994	58292.41	34772.44	21987.52	13131.96
1995	66105.81	37886.58	20854.43	11953.10
1996	76138.90	42032.66	21839.43	12050.56
1997	88144.93	46224.42	24570.42	12881.54
1998	100041.74	52274.24	28179.62	14699.84
1999	113830.65	57764.89	32801.77	16620.69
2000	133024.41	67058.31	38418.64	19339.45
2001	152144.38	74454.93	42174.19	20630.14
2002	175301.80	84017.03	48594.02	23289.40
2003	201940.34	94758.82	55378.81	25985.65
2004	229913.55	106079.98	61691.59	28457.16
2005	259519.77	116537.38	68579.60	30767.81
2006	294748.19	132745.73	77056.09	34664.93
2007	331901.34	149477.84	82410.21	37054.93
2008	375807.94	168312.61	86426.00	38620.50

Finally we calculate a set of total human capital indexes using 1985 as the base year and setting the value in 1985 at 100. Table 9.3.9 reports the results.

Table 9.3.8 Index of real active human capital per capita（1985=100）

Year	Total	Male	Female	Urban	Rural
1985	100.00	100.00	100.00	100.00	100.00
1986	106.79	109.27	103.72	101.32	108.59
1987	112.56	117.52	106.41	101.70	117.90
1988	109.95	116.94	101.22	95.15	117.43
1989	107.62	116.55	96.36	91.00	115.18
1990	119.43	131.81	103.66	100.58	127.21
1991	128.21	143.71	108.58	105.26	138.52
1992	135.86	155.18	111.65	108.85	148.39
1993	134.03	155.96	106.56	107.19	144.66
1994	120.95	142.70	93.92	95.71	131.59
1995	113.03	135.35	85.49	89.65	122.61
1996	116.94	141.74	86.18	92.96	126.68
1997	129.59	159.46	92.13	104.76	138.34
1998	148.26	182.89	105.13	120.95	156.01
1999	171.13	212.89	118.87	142.82	175.88
2000	200.27	249.34	138.31	172.91	193.54
2001	216.72	273.71	147.54	194.92	197.92
2002	247.00	315.38	166.56	227.80	208.61
2003	278.41	359.41	185.84	260.29	215.53
2004	307.01	400.38	203.52	294.65	211.02
2005	336.75	445.09	220.04	326.42	205.96
2006	378.69	500.10	247.92	370.99	207.31
2007	405.20	534.85	265.01	405.10	199.85
2008	424.27	560.91	276.21	430.98	188.80

Appendix A Population imputation

1. Data collection

1.1 Macro-data

When estimating population by age, gender and education in urban and rural areas, we use the following data sources:

Data	Sources	Notes
National, urban and rural "population aged 6 and over by age, gender and education attainment": 1982,1987, 1990,1995, 2000,2005	• 1982,*China Demographic Statistics Yearbook* 1988 edited by Department of Demographic Statistics of National Bureau of Statistics • 1987,*China 1987 1% Demographic Sampling* Survey edited by Department of Demographic Statistics of National Bureau of Statistics • 1990,*China 1990 Census* edited by Census Office of State Council, and Department of Demographic Statistics of National Bureau of Statistics • 1995,*China Demographic Statistics Yearbook.*1998 edited by Department of Demographic and Employment Statistics of National Bureau of Statistics • 2000,http://www.stats.gov.cn/tjsj/ndsj/renkoupucha/2000pucha/pucha.htm • 2005,http://www.stats.gov.cn/tjsj/ndsj/renkou/2005/renkou.htm	

National, urban and rural population aged 0-5 by age and sex: 1982,1987, 1990,1995, 2000,2005	• 1982,*China 1982 Census* edited by State Department Census Office, Department of Demographic Statistics of National Bureau of Statistics • 1987,*China Demographic Statistics Yearbook.1989* edited by Department of Demographic Statistics of National Bureau of Statistics • 1990,*China 1990 Census* edited by State Department Census Office, Department of Demographic Statistics of National Bureau of Statistics • 1995,*China Demographic Statistics Yearbook.1996* edited by Department of Demographic and Employment Statistics of National Bureau of Statistics • 2000,http://www.stats.gov.cn/tjsj/ndsj/renkoupucha /2000pucha /pucha.htm • 2005,http://www.stats.gov.cn/tjsj/ndsj/renkou/2005 /renkou.htm	We assume that those aged 05 receive no schooling
National, urban and rural population by age and sex: 1982-2007	• *China Demographic Statistics Yearbook.1988-1993* edited by Department of Demographic Statistics of National Bureau of Statistics • *China Demographic Statistics*	

	Yearbook.1994-1998,2006 edited by Department of Demographic and Employment Statistics of National Bureau of Statistics • *China Demographic Statistics Yearbook.1999-2005* edited by Department of Demographic and Social Science Statistics of National Bureau of Statistics • *China Demographic and Employment Statistics Yearbook 2007-2008* edited by Department of Demographic and Employment Statistics of National Bureau of Statistics	
Mortality rate by age and sex: 1986,1989-1990, 1994-2007	• *China Demographic Statistics Yearbook*：*1988-2007*	In the yearbooks of 1988 and 1989, the only mortality rate is of 1986. In the yearbooks of 1992 and 1993, the mortality rate is not separated by age and sex.
Enrollment by education level: 1980-2007	• *Educational Statistics yearbook of China.1987* edited by the Plan and Finance Bureau of National Educational Committee • *Educational Statistics yearbook of China.1989--1992* edited by the Plan and Development Department of National Educational Committee • *Educational Statistics yearbook of China*	*Educational Statistics Yearbook of China. 1980-1986,1988, 1992* are downloaded from http://www.pinggu.org/bbs/

	1993-1996 edited by the Plan and Development Department of National Educational Committee • *Educational Statistics yearbook of China 1997* edited by the Plan and Development Department of National Educational Ministry • *Educational Statistics yearbook of China.1998-2007* edited by the Development and Plan Department of National Educational Ministry	
National, urban and rural population and birth rate for each year	• *China Statistics Yearbook 2008.* http://www.stats.gov.cn/tjsj/ndsj/2008/indexch.htm • *Statistics Summary for 55 years in China.* China Statistics Press	
Students by age and grade of primary and junior school: 2003-2007	• *Educational Statistics yearbook of China.2003-2007* edited by the Development and Plan Department of National Educational Ministry	
Forecasted national population and forecast national birth population: 2008-2020 、 2008-2020 forecast national birth population	• *The Report on China's National Strategy on Population Development （I）* by China Population Press	
The ratio of urbanization: 2008-2020	• *The Report on China's National Strategy on Population Development （II）* by China Population Press	

1.2 Micro-data

(1) Urban Household Survey (UHS)

The Urban Household Survey aims to study the conditions and living standard of urban households. Using sampling techniques and daily accounting method, the survey collects data from non-agricultural households in different cities and counties. It records household information about income and consumption expenditure, demographic characteristics, work and employment, accommodation and other family related information. This is a continuous, large scale social-economic survey, which covers from 1986 to 1997. One hundred and three cities and 80 counties are included in the survey.

(2) China Health and Nutrition Survey (CHNS)

The China Health and Nutrition Survey, implemented by national and local governments, was designed to examine the effects of the health, nutrition, and family planning policies and programs and to see how the social and economic transformation of Chinese society is affecting the health and nutritional status of its population. The survey was conducted by an international team of researchers in nutrition, public health, economics, sociology, Chinese studies, and demography. It is funded by National Institutes of Health (NIH). The CHNS is coordinated by Barry Popkin of the Carolina Population Center at the University of North Carolina. The CHNS is a collaborative project of the National Institute of Nutrition and Food Safety (INFS), the Chinese Center for Disease Control and Prevention (CCDC), and the University of North Carolina at Chapel Hill (UNC-CH). Dr. Fengying Zhai, Associate Director of the INFS, is the director of the Chinese group. Nine provinces were covered in the survey: Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, Shandong. Four counties were selected in each province. In addition, the provincial capital and a lower income city were selected when feasible. The surveyed years include 1988, 1991, 1993, 1997, 2000, 2004 and 2006. CHNS 1989 included 3,795 households. And 3,616 households, 3,441 households, 3,875 households, and 4,403 households participated in CHNS 1991, CHNS 1993, CHNS 1997 and CHNS 2000, respectively.

(3) Chinese Household Income Project (CHIP)

China's Income Distribution Project (1988-92), funded by Ford Foundation, was conducted by Institute of Economic Studies, Chinese Academy of Social Science in collaboration with some foreign scholars such as Keith Griffin, Carl Riskin and John Knight. China's income survey consists of two parts: urban and rural. The urban sample includes 9,009 households and the rural one includes 10,258 households. Items surveyed include basic information of both the sample households and their members, focusing on income and wage, sources of income and household expenditure. For the rural households, information of their assets and debts, sale and consumption of their products, and purchase of production means were also collected. The 1995 survey records information on urban and rural household income and expenditure of that year. Because of the change in the economic structure in China, the questionnaire was redesigned to reflect this change. Provinces covered by the survey involve 28 provinces for the rural survey, excluding Xinjiang and Tibet and 10 provinces (Beijing, Shanxi, Liaoning, Jiangsu, Anhui, Henan, Hubei, Guangdong, Yunan and Gansu) for the urban residents. The years surveyed include 1988, 1995 and 2002.

2. Data processing

2.1 Basic population data

2.1.1 Census data

Due to direct registration and computer aggregation, the Census data do not take into account the left-out population.[42] The total populations from the 1982, 1990 and 2000 census data published at that time are slightly different from the population released in *China Statistics Yearbook 2008*. Thus, some adjustments need to be made to the population data by age, sex and educational attainment. The adjustment is described by the following method. Tthe adjusted urban population by age, sex and educational attainment equals the urban population by age, sex and educational attainment from the census data times the ratio of total urban population released in *China Statistics Yearbook 2008* to the total urban population in the census data. A similar equation is applied to the rural population.

2.1.2 1%-Sample data

We adjust the sample data to match the total rural and urban data. Urban population by age, sex and educational attainment is divided by urban sampling ratio, which is the ratio of urban sample population to urban total population released in *China Statistics Yearbook 2008*. The same method is applied to the rural data.

[42] See Zhang, Weimin and Hongyan Cui(2003),“The estimation accuracy of China Census 2000”,*Population Research*, Vol.27, No.4 (July), pp.25-35.

2.2 New enrollment

2.2.1 Educational category in China

There are six education levels in China: no schooling, primary school, junior middle school (including regular junior middle school and vocational junior middle school), senior middle school (including regular senior middle school, regular specialized middle school and vocational high school), college, and university and above. “College” and “university and above” were combined as “college and above” before 1990.

2.2.2 National enrollment data

The new enrollments by gender of primary school from 1985 to 1990 are not available, so it is assumed that the share of females in the new enrollments equals that in Grade 1. From 1980 to 1983, we have no information about the share of females in the new enrollments, so we use female share in new enrollment of the closest year. From 1980 to 2003, we only have new enrollment of college and university and the total females in college and university. To separate females in college and university, we assume that the proportion of female is the same as in college and university.

2.2.3 New enrollment data of urban and rural

The new enrollments by gender in urban and rural areas in each educational level are not available. We assume that the proportions of female in urban and rural equal the corresponding proportion at the national level. The new enrollments of specialized middle school are not separated by urban and rural. So we assume that the ratio of urban to rural new enrollments in specialized middle school is the same as that of regular senior middle school. From 2003 to 2007, the new enrollments of vocational high school are also not separated by urban and rural and the processing method is the same as above.

3. Imputation method

We use the perpetual inventory method to impute the population data.

3.1 Perpetual inventory method

The perpetual inventory formula is:

$$L(y,e,a,s) = L(y-1,e,a,s)\cdot(1-\delta(y,a,s)) + IF(y,e,a,s) - OF(y,e,a,s) + EX(e,a,s)$$

where $L(y,e,a,s)$ is the population at year *y* with education level *e*, age *a* and sex *s*. $\delta(y,a,s)$ is the mortality rate. $IF(y,e,a,s)$ is the inflow of population of age *a*, sex *s* and education level *e* in year *y*. $OF(y,e,a,s)$ represents the outflow of population of age *a* and sex *s* and education level *e* in year *y*. $EX(e,a,s)$ is a residual term.

$$IF(y,e,a,s) = \lambda(y,e,a,s)\cdot ERS(y,e,s)$$

$$OF(y,e,a,s) = \lambda(y,e+1,a,s)\cdot ERS(y,e+1,s)$$

ERS is the new enrollment of different education levels, λ is the age distribution of new enrollment of different education levels and

$$\sum_a \lambda(y,e,a,s) = 1$$

3.2 Estimate the age distribution λ

3.2.1 Estimate the age distribution λ: using micro-data

The micro-data we use include CHNS (China Health and Nutrition Survey: 1989, 1991, 1993, 1997, 2000) and CHIP (Chinese Household

Income Project: 1995). CHNS includes not only the age, gender of the individuals but also the grade if the individuals are in school. CHIP only records the education level without grade. For this reason, we consider CHNS firstly when we estimate the age distribution of new enrollment.

3.2.1.1 Using CHNS data

(1) The age distribution of the students at Grade 1 in primary school

Select the students at Grade 1 in primary school from the CHNS sample, and classify them according to age. The last two rows in Table A.1 show that the students at Grade 1 in primary school are mainly 5-10 years old, with the share over 95%. For simplicity and also for consistency with the age limits of other education levels, students aged less than 5 and over 10 are dropped from the sample. The age distribution is calculated for the students at Grade 1 in primary school aged 5-10 (Table A.2).

(2) The age distribution of students at Grade 1 in junior middle school

The number of students at Grade 1 in junior middle school can be obtained by the same fashion, as shown in Table A.3. These students are mainly aged from 11-16, with the share over 95% except for 1993. In 1993, the number of students at Grade 1 in junior middle school is as large as 47, which is rare under the education framework of China, so they are dropped (Table A.4).

(3) The age distribution of students at Grade 1 in senior middle school, college and university.

The number of the students at Grade 1 in senior middle school, college and university in CHNS sample is too small to estimate the age distributions. The number of students at Grade 1 in senior middle school is shown in Table A.5, and there are only 81 students at Grade 1 in college and university from 1989 to 2000 in CHNS sample.

3.2.1.2 Using CHIP95 data

Select the students in senior middle school (including professional schools), college and above (Table A.6). CHIP95 only records the education level, thus we do not know which grade the student is in. To estimate the age distribution for Grade 1, we assume the age distributions of students at each grade are the same as their Grade 1. Take the male students in senior middle school for example, as shown in Table A.7.

We also assume that the numbers of students at Grade 1, Grade 2 and Grade 3 are x, y, and z, respectively. We have

$a \cdot x = 26$

$b \cdot x + a \cdot y = 72$

$c \cdot x + b \cdot y + a \cdot z = 147$

$d \cdot x + c \cdot y + b \cdot z = 203$

$e \cdot x + d \cdot y + c \cdot z = 175$

$f \cdot x + e \cdot y + d \cdot z = 61$

$f \cdot y + e \cdot z = 60$

$f \cdot z = 28$

$a + b + c + d + e + f = 1$

Solve these equations for the age distribution ($a,b,c,d,e,f,$). Similarly, we can derive the age distributions of female students at Grade 1 in senior middle school, male students at Grade 1 in college and university, and female students at Grade 1 in college and university. We present some results in Table A.8 and Table A.9.

3.2.2 Estimate the age distribution λ: using macro-data

We use the data in *China Educational Statistical Yearbook: 2003-2007* to estimate the age distribution of new enrollments.

We have the data of new enrollment of primary school by age and the data of new enrollment of junior middle school by age and grade from 2003 to 2007.

For primary school, we assume that males and females have the same age distribution.

For junior middle school, we assume that the age distribution of Grade 1 students is the same as that of new enrollments. Then we assume that males and females have the same age distribution

For senior middle school, we assume that students in Grade 3 in junior middle school have the same age distribution as those of new entrants to senior middle school in the same year. Then we assume that males and females have the same age distribution. For example, in 2004 the age distribution of new entrants to senior middle school is the same as that of Grade 3 students in junior middle school (TableA.10).

For university, we assume that the age distribution of new entrants to university is the same as that of Grade 1 students in senior middle school three years ago. For example, in 2007, the age distribution of new entrants to university is the same as that of Grade 1 students of senior middle school in 2004. See Table A.11.

Using the method above, we can get the age distribution of enrollment of each educational level (Table A.12). Here males and females have the same age distribution.

3.3 Method of imputing population data: 1985-2005

When adopting the perpetual inventory method to estimate the urban and rural population, we ignore migrants between urban and rural China. To take these migrants into account, we make the following adjustments. For example, from 1982 to 1990, we get the estimated 1990 population data by gender, education and age using the perpetual inventory method. The actual

1990 population by gender, education and age subtracted the estimated 1990 population by gender, education and age gives the net migrants between urban and rural China in these eight years. We assume that the number of immigrants in each year is the same, and then we add the average difference to the estimated population data.

3.4 Method of imputing population data: 2006-2020

With the population by age, gender and education level of 2005 as the benchmark, we use the perpetual inventory method to obtain preliminary estimates, and then adjust the sum of population estimated to match data released in *China Statistics Yearbook 2008*, and then forecast population from 2008 to 2020.

The method of adjustment is the following. We use the total population reported in *China Statistics Yearbook 2008*, which is deducted by the sum of the estimated population and we retrieve the difference. Then we add the difference back to the estimated population data according to the 2005 structure of the population by age, gender and education level.

When it comes to estimating the enrollment data, we assume that the enrollment rate of the population of a certain sex, age and education level from 2008 to 2020 equals that of the 2005 population. For example, the rate of male population of 15 years old of junior middle school in 2004 divided by male entrants of 16 years old of senior middle school in 2005 is defined as the enrollment rate. Thus we get the enrollment rate by age, gender and education level. When we calculate the number of population in college and university of rural areas, we assume that the change of each year equals that from 2004 to 2005.

4. Some specific problems

4.1 National, rural and urban population at age zero: 1985-2007

4.1.1 National population at age zero

The total populations at the year end and the birth rates for each year are obtained from Table 3-1 ‘Population and Its Composition’ and Table 3-2 ‘Birth Rate, Death Rate and Natural Growth Rate of Population’ in *China Statistic Yearbook 2008*. We assume that the population at the beginning of a given year equals that at the end of the previous year. Thus, the average of the populations at the end of the given year and the previous year is the average population of the given year. The product of the average population and the corresponding birth rate gives the new-born population. Multiplying the new-born population and the survival rate of those aged zero at the corresponding year gives the population at age zero at the end of the year.

(Definition[43]: birth rate, also called gross birth rate, refers to the ratio of the new-born population in a given region during a given period, usually one year, and the average population of the same period. The birth rate here is yearly birth rate, which is calculated from the following equation: Birth rate = (new-born population/average population)* 1000‰, where new-born population is the number of the new-born babies who are alive when they are detached from the mothers no matter how long they have been in their mother’s body. Average population is the average of the populations at the beginning and at the end of the year, or the population at the middle of the year.)

[43] From *China Statistics Yearbook 2008*.

4.1.2 Rural and urban population at age zero

The data used include total national population for each year from 1983 to 2007, birth rate for each year from 1983 to 2007, national, rural and urban population by age and gender from the population sampling surveys for 1987 and each year from 1989 to 2007.

The share of urban population at age zero in the national population at age zero can be calculated from these sampling data, and this share is assumed to be the true share. In other words, multiplying it with the national population at age zero produces the urban population at age zero. Further, the gender ratio from the sampling data is also assumed to be true, thus we can divide the urban population at age zero into the two genders. Similar steps are used for the rural population at age zero.

Since there is no population sampling data for 1983-1986 and 1988, we assume the numbers of those aged 1, 3, 4, 5, 6 equals the new-born population for 1988, 1986, 1985, 1984 and 1983 respectively with the sampling weights adjusted. Migration between urban and rural regions is neglected here.

4.2 The application of forecasted population data: 2008-2020

4.2.1 National population and birth population

The following assumptions are made when forecasting the national population:[44]

(1) From 2004 the non-agricultural population's PTFR is1.18 and agricultural population's PTFR is 1.88.

---

[44]See Jiang Zhenghua(2007),The Report on China's National Strategy on Population Development（I）,China Population Press, pp.1001-1128

(2) Only single-child couples can give birth to a second child, and the second child's PTFR（2）=0.95. Assume that single-and non-single child marry randomly, the third child's PTFR follows the original plan.

(3) It is assumed that people transfer from agricultural population to non-agricultural population during 2000 to 2005. At the end of 2000, the ratio of the non-agricultural population to the total population is 24.7%, and it reaches 55.0% at the end of 2050.

See Table A.13.

4.2.2 The rate of urbanization

It is assumed that the rate of urbanization increases by 1% per year from 2007 to 2020. The rate of urbanization is the ratio of urban population to the total population. See Table A.14.

4.3 Urban and rural population aged zero from 2008 to 2020

We have data of forecasted national birth population from 2008-2020, but we need to separate it by urban and rural. We assume that the ratio of urban birth population to rural birth population from 2008-2020 is equal to the ratio of 2007. We also assume that the ratio of the number of the male new-born to the number of the female new-born is equal to that of 2007. Then we convert the birth population to the population aged zero by using the death rate of those aged zero which also equals that of 2007.

4.4 The death rate of those aged 65 and over

4.4.1 The death rate of those aged 65 and over: 1985-2007

When imputing the population by age, gender and education level with perpetual inventory method, the number of those aged 65 and over should be multiplied by (1-death rate). The death rate is calculated in the following way. With the population and the death rate, both by age and gender, from the population sampling data for each year, the number of deaths of those aged 65 and over for each year can be calculated, and dividing it by the corresponding total population gives the death rate of those aged 65 and over. Since there is no population sampling data for 1983-1986 and 1988, the death rate of the closest year is used.

4.4.2 The death rate of those aged 65 and over: 2008-2020

The death rate of those aged 65 and over from 2008 to 2020 equals that of 2007.

4.5 Application of the age distributions of every education level for each year

The age distributions are obtained from the macro- and micro-level data, and the enrollment numbers for each year are used with adjustments. They change over time, but do not vary between urban and rural regions.

4.6 STATA programming

The imputation process is realized by a STATA program, which includes adjustments of negative numbers.

Tables and figures of appendix A

Table A.1 Number of students at Grade 1 in primary school in CHNS sample

Age	1989	1989	1991	1991	1993	1993	1997	1997	2000	2000
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
4	1									
5	7	5	13	8	3	3	11	6	5	3
6	48	39	32	30	14	13	31	37	12	9
7	67	64	41	40	21	9	50	47	22	12
8	47	23	24	12	5	4	23	7	6	3
9	6	4	10	6	3	2	3	1		4
10	3	2	2	3	2	3	1	1		1
11							1		2	
12	1	1	2	1	1					
13	1						1			
14	1		1			1		1		1
15				1						
16							1			
25							1			
Total	182	138	125	101	49	35	123	100	47	33
Of which： Those aged 5-10	178	137	122	99	48	34	119	99	45	32
The share of those aged 5-10	0.978	0.993	0.976	0.98	0.98	0.971	0.967	0.99	0.957	0.97

Table A.2 Age distribution of students at Grade 1 in primary school in CHNS sample

Age	1989	1989	1991	1991	1993	1993	1997	1997	2000	2000
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
5	0.0393	0.0365	0.1066	0.0808	0.0625	0.0882	0.0924	0.0606	0.1111	0.0938
6	0.2697	0.2847	0.2623	0.3030	0.2917	0.3824	0.2605	0.3737	0.2667	0.2813
7	0.3764	0.4672	0.3361	0.4040	0.4375	0.2647	0.4202	0.4747	0.4889	0.3750
8	0.2640	0.1679	0.1967	0.1212	0.1042	0.1176	0.1933	0.0707	0.1333	0.0938
9	0.0337	0.0292	0.0820	0.0606	0.0625	0.0588	0.0252	0.0101	0.0000	0.1250
10	0.0169	0.0146	0.0164	0.0303	0.0417	0.0882	0.0084	0.0101	0.0000	0.0313
Total	1	1	1	1	1	1	1	1	1	1

Table A.3 Number of students at Grade 1 in junior middle school in CHNS sample

Age	1989 Male	1989 Female	1991 Male	1991 Female	1993 Male	1993 Female	1997 Male	1997 Female	2000 Male	2000 Female
6					1					
7					8	7				
8					4	12				
9	1				9	6				
10					2		1		2	
11	5	1	5	8	7	8	6	11	16	10
12	16	21	24	23	28	31	26	19	51	38
13	36	32	22	30	34	30	41	43	56	40
14	35	21	22	28	25	22	20	19	23	12
15	18	8	16	11	11	6	7	4	3	3
16	8	4	10	1	1	1	1	2	1	1
17	1		4		1	3	1		1	
18				1		1		1		
19		1								1
21				1						
22							1			
35	1									
36		1								
38				1						
45	1					1				
63								1		
Total	122	89	103	104	131	128	104	100	153	105
Of which：Those aged 11-16	118	87	99	101	106	98	101	98	150	104
The share of those aged 11-16	0.97	0.98	0.96	0.97	0.81	0.77	0.97	0.98	0.98	0.99

Table A.4 Age distribution of students at Grade 1 in junior middle school in CHNS sample

Age	1989 Male	1989 Female	1991 Male	1991 Female	1993 Male	1993 Female	1997 Male	1997 Female	2000 Male	2000 Female
11	0.0424	0.0115	0.0505	0.0792	0.0660	0.0816	0.0594	0.1122	0.1067	0.0962
12	0.1356	0.2414	0.2424	0.2277	0.2642	0.3163	0.2574	0.1939	0.3400	0.3654
13	0.3051	0.3678	0.2222	0.2970	0.3208	0.3061	0.4059	0.4388	0.3733	0.3846

14	0.2966	0.2414	0.2222	0.2772	0.2358	0.2245	0.1980	0.1939	0.1533	0.1154
15	0.1525	0.0920	0.1616	0.1089	0.1038	0.0612	0.0693	0.0408	0.0200	0.0288
16	0.0678	0.0460	0.1010	0.0099	0.0094	0.0102	0.0099	0.0204	0.0067	0.0096
Total	1	1	1	1	1	1	1	1	1	1

Table A.5 Number of students at Grade 1 in senior middle school in CHNS sample, with professional school included

Age	1989	1989	1991	1991	1993	1993	1997	1997	2000	2000
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
11					1	1				
12						2				
13			1		1					
14	1	2	2		1		1	5	1	4
15	6	8	9	6	10	11	13	13	7	9
16	10	5	9	7	6	10	19	14	16	20
17	5	5	5	5	6	10	4	10	15	9
18	1	1	1		4	1	1	3	3	5
19	1	1	2			2	1	2		3
20									1	1
21			1							
28								1		
Total	24	22	30	18	29	37	39	48	43	51

Table A.6 Number of Students in senior middle school and above in CHIP95 sample

Age	Senior middle school (including professional schools)	Senior middle school (including professional schools)	College and higher	College and higher
	Male	Female	Male	Female
1	1			
2		1		
3		1		
4	1			
5				1
6	2	1	1	1
7			2	3

Age	Senior middle school (including professional schools)	Senior middle school (including professional schools)	College and higher	College and higher
	Male	Female	Male	Female
8		3	5	3
9	1	1	1	
10	6	2	1	1
11	2	3		1
12	5	4	4	
13	14	16		3
14	26	23	1	1
15	72	78	1	4
16	147	176	2	4
17	203	162	6	10
18	175	164	17	20
19	61	86	26	22
20	60	45	34	26
21	28	23	21	19
22	13	11	16	9
23	6	3	11	4
24	2	2	3	5
25		2	5	
26				1
27			1	
28	1			
31		1		
38		1		
40		1		
88		1		
Total	826	811	158	138
Of which：	age 14-21		age 17-24	
Number of students	772	757	134	115
share	0.9346	0.9334	0.8481	0.8333

Table A.7 The assumption that the age distributions of students at each grade are the same as their Grade 1

Age	Grade 1	Grade 2	Grade 3
14	a		
15	b	a	
16	c	b	a
17	d	c	b
18	e	d	c
19	f	e	d
20		f	e
21			f

Table A.8 Age distribution of male students at Grade 1 in senior middle school

Age	Share
15	0.273
16	0.351
17	0.158
18	0.144
19	0.085

Table A.9 Age distributions for Grade 1 in college and university

Age	Male	Female
17	0.044	0.044
18	0.423	0.423
19	0.438	0.438
20	0.082	0.082
21	0.013	0.013

TableA.10 Age distribution of new entrants of senior middle school of 2004

Age	Grade three students in junior middle school	Proportion
11 and below	21	0.000001
12	2185	0.000098
13	79869	0.003586
14	1279586	0.057452

Age	Grade three students in junior middle school	Proportion
15	8893796	0.399322
16	9785227	0.439346
17	1899324	0.085278
18	293469	0.013176
19 and above	38789	0.001742
Total	22272266	1.000000

Table A.11 Age distribution of new entrants of university of 2007

Age	Proportion
14 and below	0.000001
15	0.000098
16	0.003586
17	0.057452
18	0.399322
19	0.439346
20	0.085278
21	0.013176
22 and above	0.001742
Total	1.000000

Table A.12 Age distribution of enrollment of each educational level of 2007

Age	Illiterate to primary school	Primary school to junior middle school	Junior middle school to senior middle school	Senior middle school to college	Senior middle school to university
	Proportion	Proportion	Proportion	Proportion	Proportion
5	0.029				
6	0.624				
7	0.325				
8	0.018				
9	0.003				
10	0.001	0.001			
11		0.041			
12		0.445			

13		0.415	0.002		
14		0.079	0.006		
15		0.016	0.447		
16		0.003	0.440	0.004	0.004
17		0.001	0.087	0.058	0.058
18			0.015	0.399	0.399
19			0.003	0.439	0.439
20				0.085	0.085
21				0.013	0.013
22				0.002	0.002
Sum	1	1	1	1	1

Table A.13 Forecast national population and birth population, in millions

Year	National population	New-born population
2008	1,328.70	16.71
2009	1,336.00	17.08
2010	1,343.50	17.49
2011	1,351.40	17.89
2012	1,359.30	18.17
2013	1,367.30	18.28
2014	1,375.10	18.23
2015	1,382.50	18.02
2016	1,389.50	17.69
2017	1,396.00	17.29
2018	1,401.90	16.86
2019	1,407.20	16.41
2020	1,411.90	15.97

Table A.14 Rate of urbanization from 2008-2020

Year	Rate of urbanization
2008	0.4594
2009	0.4694
2010	0.4794
2011	0.4894

Year	Rate of urbanization
2012	0.4994
2013	0.5094
2014	0.5194
2015	0.5294
2016	0.5394
2017	0.5494
2018	0.5594
2019	0.5694
2020	0.5794

Appendix B Mincer parameters

Main Equation:

$$\ln(inc) = \alpha + \beta \cdot e + \gamma \cdot exp + \delta \cdot exp^2 + u$$

where *inc* is income; *e* is years of schooling; *exp* is years of work experience; α, β, γ, δ are corresponding parameters; u is an error term.

1. Samples and Methods

1.1 Surveys

(1) The annual Urban Household Survey (UHS);

(2) Chinese Health and Nutrition Survey (CHNS).

1.2 Components of Income

(1) Regular and non-regular income;

(2) Other cash income from work;

(3) Estimated market value of received items;

(4) Various subsidies;

(5) Individual's share of household income according to working-hour share.

1.3 Work experience

exp = age–e– 6.

1.4 Selection of sample

(1) 16-60 years old for males, and 16-55 years old for females;

(2) Must have information on income and educational attainment;

(3) Students, retirees, people who are unemployed but looking for a job, the disabled, people who are waiting to enter school and housekeepers are excluded.

1.5 Imputation method

(1) To make all parameters comparable, we first use UHS to obtain all urban parameters and CHNS to obtain urban/rural ratios of parameters. Then we derive rural parameter estimates as rural parameters = urban parameters/ ratio.

For example, from UHS1989, we can get α^u89(UHS); from CHNS1989, we can get α^u89(CHNS) and α^r89(CHNS); then, the ratio for intercept(CHNS) = α^u89(CHNS)/α^r89(CHNS); finally, we estimate 1989 parameter for rural group, α^r89 = α^u89(UHS) /ratio(CHNS). We get β^r89, γ^r89, δ^r89 in a similar manner. (Note that α^r89 indicates the α parameter of year 1989 for rural population.)

(2) For urban parameters, we use UHS to get urban parameters for 1986-1997, but we actually need parameters for 1985-2007. To impute parameters for 1985 and 1998-2007, we estimate a time trend model of the parameters using 1986-1997 and then impute parameter estimates for other years.

(3) We are only able to obtain urban/rural parameter ratios for 1989, 1991, 1993, 1997, and 2000, which are then used to fit a time trend model for each parameter. We impute the ratios for the rest of the years based on the fitted time trend.

1.6 Parameter α

$$\ln(y) = \alpha_0 + \alpha_1 \cdot e + \alpha_2 \cdot \exp + \alpha_3 \cdot \exp^2$$

$\hat{y} = \alpha \times e^{\hat{\ln y}}$, where α is an adjustment factor. We estimate it as follows:

(1) Obtain $\hat{\ln y}$ from the regression of $\ln(y_i)$ on all right-hand-side variables.

(2) Obtain $\hat{m}_i = e^{\hat{\ln y}}$

(3) Regress y_i on $\hat{m}_i$ without the intercept: $\hat{y} = \alpha \times \hat{m}_i$ and keep α.

(4) For given values e= c1, exp = c2, exp^2 = c3, obtain $\widehat{\ln y}$.

(5) $\hat{y} = \alpha \times e^{\widehat{\ln y}}$

For the years we do not have urban data, we use the estimated α from the most recent year.

For rural sample, we use the estimated α obtained from urban data in the same year.

1.7 Forecast beyond 2008

While there is evidence suggesting these parameters follow a time trend up to recent years, it is hard to determine if the trend will continue beyond 2008. Therefore, we assume the fitted urban/rural parameter ratios and imputed parameter values for the period 2008 to 2020 to be constant and equal to the values of their counterparts in 2007.

2. Data

We use two well-known household surveys in China. The first one is the annual Urban Household Survey (UHS) conducted by the National Statistical Bureau of China from 1986 to 1997. It records household information about income and consumption expenditure, demographic characteristics, work and employment, accommodation and other family related matters. UHS covers 103 cities and 80 counties. We use UHS to estimate the Mincer equation for each year and fit a linear or exponential time trend model. We then use the fitted time trend model to impute parameters of the Mincer equation for the urban population for the period 1985 through 2020.

The second one is the China Health and Nutrition Survey (CHNS), which covers nine provinces-Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, Shandong. Four counties are sampled in each province. In addition, the provincial capital and a lower income city are selected when feasible. CHNS was conducted in1988, 1991, 1993, 1997, 2000, 2004 and 2006. Numbers of households participated in the first five waves are 3,795, 3,616, 3,441, 3,875, and 4,403 respectively. Due to changes in the questionnaire, we do not use 2004 and 2006. CHNS covers both the urban and rural population. We estimate separate Mincer equations for the rural and urban population. We then calculate the urban-to-rural ratio for all parameters. Further, we use the ratio to fit a time trend, which is used to impute the ratio over the period 1985 to 2020. We use imputed ratios and the imputed parameters from UHS to derive the parameters for the rural earnings models over the period 1985 to 2020.

The CHIP (Chinese Household Income Project) data include the urban sample is 9,009 households and the rural one is 10,258. Items surveyed include basic information of both the sample households and their members, focusing on income and wage, sources of income and household expenditure. For the rural households, information of their assets and debts, sale and consumption of their products, and purchase of production means were also collected. Provinces covered by the survey involve 28 provinces for the rural survey, excluding Xinjiang and Tibet and 10 provinces (Beijing, Shanxi, Liaoning, Jiangsu, Anhui, Henan, Hubei, Guangdong, Yunan and Gansu) for the urban residents. The years surveyed include 1988, 1995 and 2002.There are two reasons that we don’t use this data set. From one aspect, this data set only covers three years of 1988, 1995 and 2002, which are 7-year apart from each other; in addition, the survey questions and the people who are surveyed changed over the three sample years. These might make the results difficult to compare. As a result, we finally choose UHS and CHNS to estimate the final parameters for 1985-2020.

The distribution of the two data sets across years is shown in Table B.1.

3. Key variables

3.1 CHNS

3.1.1 Income variables

Income includes wage, subsidies and agricultural income.

3.1.1.1 Wage

Wage includes wage payments by piece and by hour.

Variable definition：

(1) **1989**

wage = c5 * c3 * 52 or wage = c6 * c7 * 52

c3: average work days per week

c5: daily wage

c6: wage by piece

c7: average number of pieces completed per week

(2) **1991-2006**

wage = c3 * c8

c3: months worked last year

c8: average monthly wage

3.1.1.2 Subsidies and other kinds of income

Subsidies include food subsidies, one-child subsidy, health subsidy, bathing and haircutting subsidy, books and newspaper subsidy, etc. Other kinds of income include bonuses, gifts, coupons, and in-kind income.

Variable definition：

totalsub = (I9 + I10 + I11 + I12 + I13 + I14) * 12 + I19 + I21

I9: monthly food subsidy

I10: monthly one-child subsidy

I11: monthly health subsidy

I12: monthly bath/haircut subsidy

I13: monthly book/newspaper subsidy

I14: monthly other subsidies

I19: total salary bonuses in 12 months

I21: value of gifts or coupons in 12 months (only for 1989)

3.1.1.3 Agricultural income

Agricultural income includes incomes from five sources: gardening, farming, livestock raising, fishing, and small handicraft and commercial household businesses. These incomes come from either collective or household businesses or both.

(1) **Gardening**

Household

gardhhdinc = (D5_91 - D7_91)+ D6_91 * 12

D5: sale of home-plot produce

D6: saving from consuming home-plot produce

D7: money spent on home garden last year

(2) **Farming**

Household

farmhhdinc = E15 + E17 + E19 - E13

E13: expenditure on growing crops in 12 months

E15: government price per unit for crops in last year

E17: amount received if kept-farm-crop sold in 12 months

E19: amount received if given-farm-crop sold in 12 months

Collective

farmcltinc = E7 + E9

E7: amount from collective farm work in 12 months

E9: value of durable goods

(3) Livestock Raising

Household

livestockhhdinc = F17 + F19 + F21 + F15- F14

F14: amount spent on animal operation in 12 months

F15: amount saved using homegrown feed in 12 months

F17: amount received from sale of animal products

F19: value if kept animal products sold

F21: value if animal products given away sold

Collective

livestockcltinc = F7 + F9;

F7: amount received for animal work in collective

F9: market value of animals received, if sold

(4) **Fishing**

Household

fishhhdinc = G11 + G13 + G15 - G16

G11: revenue from fish sales (In 1989 and 1991, G11 is measured by month. In other years, it is measured by year)

G13: amount earned if household fish sold

G15: amount earned if gift fish sold

G16: operating expenses of fish business

Collective

fishcltinc = G7 + G9

G7: amount received from collective fishing

G9: amount received if fish from collective sold

(5) Small handicraft and commercial household business

Household

commercialinc = 12 * (H3 - H4);

H3: average monthly revenue, home business

H4: average monthly expense, home business

(In1989, H3/H4 are measured by week. In other years, they are measured by month)

3.1.2 Imputing individual share of household income

Agricultural income includes incomes from five sources: gardening, farming, livestock raising, fishing, and small handicraft and commercial household businesses. These incomes come from either collective or household businesses or both.

We assume each individual's contribution to the household income is proportional to his or her share of time allocated to five activities: gardening, farming, raising livestock, fishing and small handicraft and commercial household business. First, we add up all working hours of all family members in each of these activities. Second, we calculate the working hour share of each member in the family's total hours. Third, we multiply the household income by the share to approximate individual income. Finally, we add up individual income from the four categories for each family member.

3.1.3 Years of schooling

Level	e
None	0
Completed primary school	6
Junior middle school degree	9
Senior middle school degree	12
Middle technical, professional , or vocational degree	11
3- or 4- year college degree	16
Master's degree or above	18

3.1.4 Selection of sample (Also see Section 1.4)

(1) Males of 16 to 60 years of age and females of 16 to 55 years of age；

(2) Exclude individuals who fail to provide information on wage and educational attainment, those who are self-employed or business owners；

(3) Incomes from secondary work are not included.

3.2. UHS

3.2.1 Definition of income (see questionnaire)

(1) **1986-1987**

Monthly wage: u010--u080

Yearly income=monthly wage*12

Hourly wage=yearly income/(52*5*8)

(2) **1988-1991**

Regular wages: v0012-v7012

Other income from work unit: v0019-v7019

Income of employees of individual enterprise: v0022-v7022

Yearly income = normal wage + other income from work unit + income of employees of individual enterprise

Hourly wage=yearly income / (52*5*8)

(3) **1992**

Regular wages: vp113-vp813

Other income from work unit: vp120-vp820

Income of employees of individual enterprise: vp122-vp822

Yearly income = normal wage + other income from work unit + income of employees of individual enterprise

Hourly wage=yearly income / (52*5*8)

(4) **1993-1997**

Wages: x13/x50/x87/ x124/ x161/ x198/ x235/ x272

Operating profit: x22/x59/x96/ x133/ x170/ x207/ x244/ x281

Yearly income = wages+ operating profit

3.2.2 Years of schooling

(1)**1986-1991**

LEVEL	e
College	16
Professional school	11

LEVEL	e
Senior middle school	12
Junior middle school	9
Primary school	6
Others	0

(2)**1992-1997**

LEVEL	e
College	16
Community college	15
Professional school	11
Senior middle school	12
Junior middle school	9
Primary school	6
Others	0

3.2.3 Selection of sample

(1) Include male individuals of 16 to 60 years old and female individuals from 16 to 55 years old；

(2) Discard individuals whose value of regular wage is missing, individuals who failed to report education information；

(3) Discard individuals who are self-employed, the short term contract workers, retired, job seekers, disabled, homemakers, students in school, workers waiting for job assignment, students waiting to enter a higher school, etc.

4. Imputing parameters

4.1. Imputation method of urban parameters

4.1.1 Parameter estimates based on UHS 1986 to 1997

We use the UHS data to estimate the earnings equation by gender and year. Table B.2 contains means and standard deviations of each variable. The estimates are reported in Table B.3.

4.1.2 General idea about imputation

We use the parameter estimates over the period 1988-1997 to fit a time trend model, and then get the fitted values of each parameter by gender for the years 1985-2007. These fitted values are the final urban imputed parameters.

4.1.3 Specifications

We treat α , β , γ , δ separately and use the parameters of each group as the dependent variable and use time (i.e., year) as the independent variable.

For α and β , we use the linear time trend model. We rely on R^2 and AIC values and SIC values in choosing among alternative regression models. The regression equation is: Y= a0 + a1 * time + u.

For γ and δ, we use the exponential time trend model. We rely on R^2 and AIC values and SIC values in choosing among alternative regression models. The regression equation is: ln(Y)= a0 + a1 * time + u.

For α and β , we assume that they increase or decrease at a constant rate each year. Taking the α_male as an example, we assume that the intercept increases at the growth rate of a1 per year.

For γ and δ, we assume that they increase or decrease at a constant rate in percentage terms per year. Taking γ_male as an example, we assume that the coefficient of exp increases a1*100% per year.

Some other treatments

(1) As the coefficient of $\exp^2$ is negative, we use its absolute value as dependent variable and use the negative of the fitted value as its imputed value.

(2) From Figures B.1-8, we can see that the estimates for 1986 and 1987 deviate substantially from the time trend. We exclude them when fitting time trend models.

Figures B.9-16 show the parameter estimates of each group and the sample regression lines of the time trend models. The fitted values of the time trend models are the values of our imputed parameters for the period 1985 to 2007.

Assuming that the imputed parameters remain constant after 2007, we obtain the imputed parameters as shown in Table B.4.

4.2 Imputation method of ratio parameters

We use CHNS data to get the urban and rural estimates of the earnings equation and then obtain the urban-to-rural ratios of parameter estimates. Table B.5 contains means and standard deviations of each variable.The specific urban and rural estimates and the corresponding ratios are showed in Table B.6.

We treat $\alpha, \beta, \gamma, \delta$ separately and use the parameters of each group as the dependent variable and time as the independent variable. We fit an exponential model for each of them. The regression model is: ln(Y)= a0 + a1 * time + u.

We assume that the urban-to-rural ratios for $\alpha, \beta, \gamma, \delta$ increase or decrease at a constant rate in percentage terms per year. Taking the ratio of α _male as an example, we assume that the ratio increases by a1*100% per year.

Figures B.17-24 show the sample regressions lines of the exponential trend models. The fitted values are the imputed ratios for the period 1985 to 2007.

We assume the ratios remain constant for the period 2008 to 2020 and equal to the values of their counterparts in 2007. Table B.7 shows the imputed ratios for the period 1985 to 2020.

4.3 Imputed parameters for the rural population

Rural parameters = urban parameters/ratio, Table B.8 shows the imputed values of the rural parameters.

4.4 α_value

Table B.9 shows α_value for each year.

Tables and figures of appendix B

Table B.1 Data availability across years

Year	CHNS	UHS
1985		
1986		U
1987		U
1988		U
1989	U/R	U
1990		U
1991	U/R	U
1992		U
1993	U/R	U
1994		U
1995		U
1996		U
1997	U/R	U
1998		
1999		
2000	U/R	
2001		
2002		
2003		
2004	U/R	
2005		
2006	U/R	
2007		

Note: CHNS: China Health and Nutrition Survey

UHS: Urban Household Survey

Table B.2 Summary statistics: UHS Samples

year	variables	male		female	
		mean	s.d.	mean	s.d.
1986	inc.	1297.96	483.99	1024.33	408.31
	e	9.90	2.71	9.32	2.44
	exp	20.93	9.74	17.50	7.48
	exp2	532.75	451.62	361.96	278.57
1987	inc.	1371.29	554.52	1095.88	2.60
	e	10.11	2.75	9.44	8.05
	exp	21.99	10.17	18.08	304.86
	exp2	586.97	476.19	391.73	499.15
1988	inc.	1305.24	572.86	1084.10	485.04
	e	10.81	2.92	9.99	2.72
	exp	20.46	10.79	17.78	9.27
	exp2	534.94	462.39	401.93	339.21
1989	inc.	1271.55	588.98	1061.46	508.92
	e	10.96	2.95	10.15	2.67
	exp	20.68	10.85	18.15	9.25
	exp2	545.26	463.82	414.79	340.43
1990	inc.	1391.31	616.28	1168.13	537.63
	e	11.12	2.91	10.33	2.68
	exp	21.08	10.73	18.35	9.20
	exp2	559.29	465.08	421.40	339.07
1991	inc.	1459.93	642.87	1243.88	560.47
	e	11.28	2.93	10.54	2.63
	exp	20.57	10.44	18.09	8.92
	exp2	532.10	450.88	406.64	329.27
1992	inc.	1665.07	847.26	1408.29	684.67
	e	11.43	2.75	10.75	2.53
	exp	20.89	10.47	18.47	8.91
	exp2	545.81	454.58	420.52	331.40
1993	inc.	1723.47	1101.08	1457.79	886.08
	e	11.41	2.70	10.79	2.52
	exp	21.19	10.47	18.83	8.94
	exp2	558.60	455.37	434.34	332.45
1994	inc.	1936.37	1298.04	1600.68	1079.34
	e	11.54	2.75	10.96	2.46
	exp	21.01	10.42	18.66	8.95
	exp2	549.83	453.84	428.30	335.27
1995	inc.	2028.32	1278.67	1697.88	1095.80
	e	11.62	2.71	11.00	2.47
	exp	21.27	10.17	18.92	8.81
	exp2	555.58	442.11	435.46	330.75
1996	inc.	2049.76	1434.03	1718.10	1273.71
	e	11.65	2.68	11.11	2.40
	exp	21.60	10.22	19.26	8.86
	exp2	571.04	446.94	449.47	334.93

1997	inc.	2307.20	1692.37	1912.28	1488.65
	e	11.67	2.67	11.14	2.40
	exp	21.80	10.05	19.47	8.90
	exp2	576.19	439.15	458.28	338.97

Table B.3 Estimates of the earnings equation: UHS Samples

year	male				female			
	α	β	γ	δ	α	β	γ	δ
1986	6.23576	0.01733	0.04990	-0.00068	5.93734	0.04191	0.04009	-0.00052
1987	6.30749	0.01972	0.04401	-0.00057	6.21450	0.03498	0.02692	-0.00035
1988	5.82832	0.03011	0.07377	-0.00114	5.45430	0.05372	0.08222	-0.00149
1989	5.77330	0.03439	0.07000	-0.00104	5.48916	0.05408	0.07291	-0.00126
1990	5.90239	0.03487	0.06492	-0.00094	5.59197	0.05612	0.06922	-0.00118
1991	6.04919	0.03434	0.05797	-0.00083	5.73593	0.05424	0.06254	-0.00104
1992	6.11499	0.04256	0.05333	-0.00074	5.71777	0.06484	0.06199	-0.00104
1993	6.04489	0.04847	0.05139	-0.00069	5.67653	0.07269	0.05478	-0.00085
1994	5.96259	0.06311	0.04913	-0.00062	5.47777	0.09354	0.05503	-0.00085
1995	6.08869	0.06006	0.04471	-0.00053	5.61289	0.08757	0.05414	-0.00082
1996	5.94992	0.06845	0.04642	-0.00055	5.62366	0.09123	0.04320	-0.00054
1997	6.01672	0.07218	0.04450	-0.00052	5.51068	0.10781	0.04197	-0.00051

Table B.4 Imputed earnings equation parameters for the urban population, 1985 to 2020

year	male				female			
	α	β	γ	δ	α	β	γ	δ
1985	5.81248	0.01089	0.08555	-0.00147	5.55553	0.02677	0.09859	-0.00209
1986	5.83390	0.01595	0.08061	-0.00134	5.56000	0.03301	0.09198	-0.00187
1987	5.85532	0.02101	0.07595	-0.00122	5.56447	0.03926	0.08581	-0.00167
1988	5.87673	0.02608	0.07156	-0.00111	5.56894	0.04550	0.08006	-0.00150
1989	5.89815	0.03114	0.06742	-0.00102	5.57342	0.05174	0.07469	-0.00134
1990	5.91956	0.03620	0.06353	-0.00093	5.57789	0.05798	0.06968	-0.00120
1991	5.94098	0.04126	0.05986	-0.00084	5.58236	0.06422	0.06501	-0.00107
1992	5.96239	0.04632	0.05640	-0.00077	5.58683	0.07046	0.06065	-0.00096
1993	5.98381	0.05138	0.05314	-0.00070	5.59130	0.07670	0.05658	-0.00086
1994	6.00522	0.05645	0.05007	-0.00064	5.59577	0.08295	0.05279	-0.00077
1995	6.02664	0.06151	0.04717	-0.00058	5.60024	0.08919	0.04925	-0.00069

year	male				female			
	α	β	γ	δ	α	β	γ	δ
1996	6.04805	0.06657	0.04445	-0.00053	5.60472	0.09543	0.04595	-0.00062
1997	6.06947	0.07163	0.04188	-0.00048	5.60919	0.10167	0.04287	-0.00055
1998	6.09088	0.07669	0.03946	-0.00044	5.61366	0.10791	0.03999	-0.00049
1999	6.11230	0.08176	0.03718	-0.00040	5.61813	0.11415	0.03731	-0.00044
2000	6.13372	0.08682	0.03503	-0.00037	5.62260	0.12040	0.03481	-0.00040
2001	6.15513	0.09188	0.03300	-0.00033	5.62707	0.12664	0.03248	-0.00035
2002	6.17655	0.09694	0.03110	-0.00030	5.63155	0.13288	0.03030	-0.00032
2003	6.19796	0.10200	0.02930	-0.00028	5.63602	0.13912	0.02827	-0.00028
2004	6.21938	0.10707	0.02761	-0.00025	5.64049	0.14536	0.02637	-0.00025
2005	6.24079	0.11213	0.02601	-0.00023	5.64496	0.15160	0.02460	-0.00023
2006	6.26221	0.11719	0.02451	-0.00021	5.64943	0.15785	0.02295	-0.00020
2007	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018
2008	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018
2009	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018
2010	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018
2011	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018
2012	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018
2013	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018
2014	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018
2015	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018
2016	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018
2017	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018
2018	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018
2019	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018
2020	6.28362	0.12225	0.02309	-0.00019	5.65390	0.16409	0.02141	-0.00018

Table B.5 Summary statistics: CHNS samples

year	variables	urban				rural			
		male		female		male		female	
		mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
1989	inc.	1408.10	3241.52	1189.11	2372.01	1348.32	3851.84	901.35	1362.31
	e	9.49	3.59	9.20	3.44	8.05	3.17	7.42	3.36
	exp	17.39	11.23	14.58	10.00	16.34	11.01	14.07	9.64
	exp2	428.29	476.81	312.50	368.49	387.96	440.00	290.84	340.20

1991	inc.	1153.55	808.71	967.68	783.45	900.19	1175.17	744.35	833.47
	e	8.87	4.36	8.16	4.49	7.63	3.59	6.27	4.05
	exp	19.21	11.29	16.99	10.06	18.66	11.44	16.82	10.09
	exp2	496.32	497.28	389.87	385.10	479.12	487.08	384.78	380.04
1993	inc.	2078.45	14505.79	1217.92	1427.18	1582.89	8583.10	959.17	2029.63
	e	10.08	2.72	9.92	2.52	8.99	2.37	8.73	2.25
	exp	19.03	10.29	16.27	8.91	17.96	10.80	15.53	9.33
	exp2	467.69	446.90	344.01	326.41	439.13	448.84	328.27	334.82
1997	inc.	1893.67	1697.23	1424.90	1119.92	1603.38	2395.21	1603.38	2395.21
	e	10.14	3.23	9.89	3.11	8.75	2.68	8.75	2.68
	exp	20.45	10.78	17.91	9.83	19.69	11.10	19.69	11.10
	exp2	534.09	465.68	417.36	384.70	510.94	481.11	510.94	481.11
2000	inc.	2222.72	3049.41	1754.13	2286.47	1782.89	2451.73	1412.02	2112.49
	e	10.67	3.16	10.48	3.07	8.96	2.51	8.43	2.60
	exp	21.70	10.86	19.16	9.80	20.77	11.60	18.71	10.06
	exp2	588.50	477.26	463.01	376.98	565.89	515.33	451.12	400.88

Table B.6 Estimates of the earnings equation: CHNS samples

urban

year	**male**				**female**			
	α	β	γ	δ	α	β	γ	δ
1989	5.35231	0.05317	0.08802	-0.00164	5.23546	0.04431	0.10510	-0.00221
1991	5.38600	0.06477	0.08016	-0.00164	5.28786	0.05821	0.09337	-0.00217
1993	5.55869	0.03794	0.09307	-0.00178	5.03143	0.09546	0.09077	-0.00215
1997	5.69877	0.07534	0.07415	-0.00150	5.37693	0.07968	0.08416	-0.00182
2000	5.60947	0.09419	0.05005	-0.00073	5.52488	0.10861	0.04354	-0.00086

rural

year	**male**				**female**			
	α	β	γ	δ	α	β	γ	δ
1989	5.50869	0.04460	0.06652	-0.00122	5.40414	0.02650	0.08193	-0.00177
1991	4.50197	0.09802	0.08308	-0.00143	4.71452	0.05462	0.11713	-0.00242
1993	4.55075	0.06913	0.12595	-0.00258	4.72135	0.06616	0.09862	-0.00190
1997	4.86154	0.11040	0.08449	-0.00159	5.21502	0.09536	0.05349	-0.00104
2000	5.36047	0.10431	0.06387	-0.00128	5.65727	0.09195	0.02870	-0.00047

ratio								
year	male				female			
	α	β	γ	δ	α	β	γ	δ
1989	0.97161	1.19215	1.32321	1.34426	0.96879	1.67208	1.28280	1.24859
1991	1.19636	0.66078	0.96485	1.14685	1.12161	1.06573	0.79715	0.89669
1993	1.22149	0.54882	0.73894	0.68992	1.06568	1.44287	0.92040	1.13158
1997	1.17222	0.68243	0.87762	0.94340	1.03105	0.83557	1.57338	1.75000
2000	1.04645	0.90298	0.78362	0.56709	0.97660	1.18119	1.51707	1.82049

Table B.7 Fitted ratios of urban-to-rural parameter estimates, CHNS samples

year	male				female			
	α	β	γ	δ	α	β	γ	δ
1985	1.09803	0.83932	1.26307	1.58516	1.06655	1.62640	0.80399	0.80879
1986	1.10016	0.83102	1.21894	1.48731	1.06256	1.57306	0.83867	0.85417
1987	1.10229	0.82281	1.17635	1.39550	1.05859	1.52147	0.87484	0.90209
1988	1.10443	0.81468	1.13525	1.30936	1.05463	1.47157	0.91257	0.95270
1989	1.10658	0.80663	1.09559	1.22853	1.05069	1.42330	0.95193	1.00615
1990	1.10873	0.79866	1.05731	1.15270	1.04676	1.37662	0.99299	1.06260
1991	1.11088	0.79077	1.02037	1.08154	1.04284	1.33147	1.03582	1.12221
1992	1.11304	0.78296	0.98472	1.01478	1.03894	1.28781	1.08050	1.18517
1993	1.11520	0.77522	0.95032	0.95214	1.03506	1.24557	1.12710	1.25167
1994	1.11736	0.76756	0.91711	0.89336	1.03119	1.20472	1.17572	1.32189
1995	1.11953	0.75997	0.88507	0.83822	1.02733	1.16521	1.22643	1.39605
1996	1.12171	0.75246	0.85415	0.78647	1.02349	1.12699	1.27933	1.47437
1997	1.12389	0.74503	0.82431	0.73793	1.01966	1.09003	1.33451	1.55709
1998	1.12607	0.73767	0.79551	0.69238	1.01585	1.05428	1.39207	1.64445
1999	1.12825	0.73038	0.76771	0.64964	1.01205	1.01970	1.45211	1.73671
2000	1.13044	0.72316	0.74089	0.60953	1.00827	0.98626	1.51474	1.83415
2001	1.13264	0.71601	0.71501	0.57191	1.00450	0.95391	1.58008	1.93705
2002	1.13484	0.70894	0.69003	0.53661	1.00074	0.92263	1.64823	2.04572
2003	1.13704	0.70193	0.66592	0.50348	0.99700	0.89237	1.71932	2.16050
2004	1.13925	0.69500	0.64265	0.47240	0.99327	0.86310	1.79348	2.28171
2005	1.14146	0.68813	0.62020	0.44324	0.98956	0.83480	1.87084	2.40972

2006	1.14368	0.68133	0.59853	0.41588	0.98586	0.80742	1.95153	2.54492
2007	1.14590	0.67460	0.57762	0.39021	0.98217	0.78094	2.03570	2.68769
2008	1.14590	0.67460	0.57762	0.39021	0.98217	0.78094	2.03570	2.68769
2009	1.14590	0.67460	0.57762	0.39021	0.98217	0.78094	2.03570	2.68769
2010	1.14590	0.67460	0.57762	0.39021	0.98217	0.78094	2.03570	2.68769
2011	1.14590	0.67460	0.57762	0.39021	0.98217	0.78094	2.03570	2.68769
2012	1.14590	0.67460	0.57762	0.39021	0.98217	0.78094	2.03570	2.68769
2013	1.14590	0.67460	0.57762	0.39021	0.98217	0.78094	2.03570	2.68769
2014	1.14590	0.67460	0.57762	0.39021	0.98217	0.78094	2.03570	2.68769
2015	1.14590	0.67460	0.57762	0.39021	0.98217	0.78094	2.03570	2.68769
2016	1.14590	0.67460	0.57762	0.39021	0.98217	0.78094	2.03570	2.68769
2017	1.14590	0.67460	0.57762	0.39021	0.98217	0.78094	2.03570	2.68769
2018	1.14590	0.67460	0.57762	0.39021	0.98217	0.78094	2.03570	2.68769
2019	1.14590	0.67460	0.57762	0.39021	0.98217	0.78094	2.03570	2.68769
2020	1.14590	0.67460	0.57762	0.39021	0.98217	0.78094	2.03570	2.68769

Table B.8 Imputed earnings equation parameters for the rural population, 1985 to 2020

year	male				female			
	α	β	γ	δ	α	β	γ	δ
1985	5.29358	0.01297	0.06773	-0.00093	5.20888	0.01646	0.12262	-0.00258
1986	5.30279	0.01919	0.06613	-0.00090	5.23264	0.02099	0.10967	-0.00219
1987	5.31194	0.02554	0.06456	-0.00088	5.25651	0.02580	0.09809	-0.00186
1988	5.32103	0.03201	0.06303	-0.00085	5.28047	0.03092	0.08773	-0.00157
1989	5.33007	0.03860	0.06154	-0.00083	5.30455	0.03635	0.07846	-0.00133
1990	5.33906	0.04532	0.06008	-0.00080	5.32873	0.04212	0.07017	-0.00113
1991	5.34799	0.05218	0.05866	-0.00078	5.35302	0.04823	0.06276	-0.00096
1992	5.35687	0.05916	0.05727	-0.00076	5.37741	0.05472	0.05613	-0.00081
1993	5.36569	0.06628	0.05591	-0.00074	5.40191	0.06158	0.05020	-0.00069
1994	5.37446	0.07354	0.05459	-0.00071	5.42653	0.06885	0.04490	-0.00058
1995	5.38317	0.08094	0.05330	-0.00069	5.45125	0.07654	0.04016	-0.00049
1996	5.39183	0.08847	0.05204	-0.00067	5.47607	0.08468	0.03592	-0.00042
1997	5.40043	0.09615	0.05080	-0.00066	5.50101	0.09327	0.03212	-0.00035

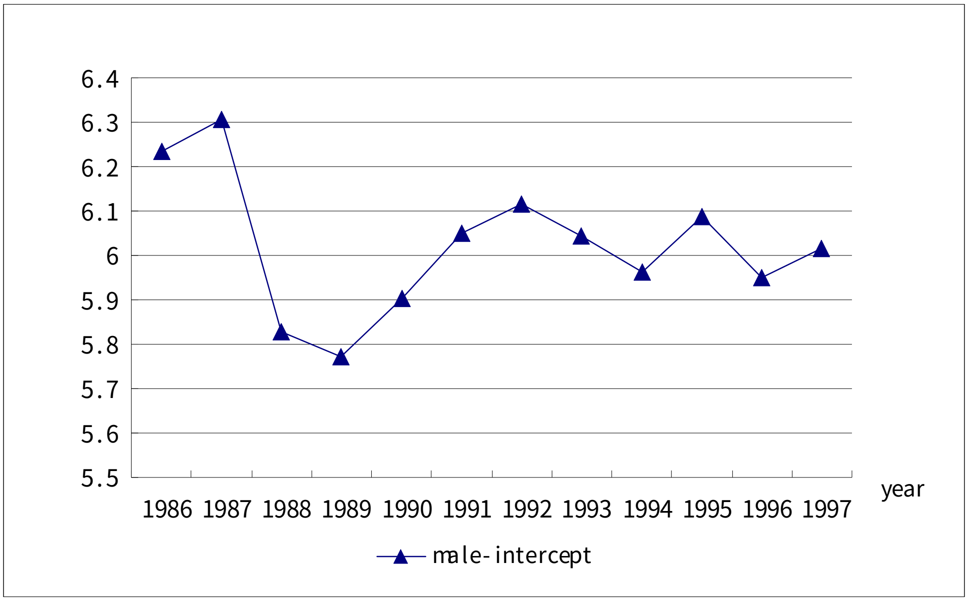
year	male				female			
	α	β	γ	δ	α	β	γ	δ
1998	5.40899	0.10397	0.04960	-0.00064	5.52606	0.10236	0.02873	-0.00030
1999	5.41748	0.11194	0.04843	-0.00062	5.55122	0.11195	0.02569	-0.00025
2000	5.42593	0.12005	0.04728	-0.00060	5.57649	0.12207	0.02298	-0.00022
2001	5.43432	0.12832	0.04616	-0.00058	5.60187	0.13276	0.02055	-0.00018
2002	5.44266	0.13674	0.04507	-0.00057	5.62736	0.14402	0.01838	-0.00015
2003	5.45095	0.14532	0.04400	-0.00055	5.65297	0.15590	0.01644	-0.00013
2004	5.45918	0.15405	0.04296	-0.00054	5.67869	0.16842	0.01470	-0.00011
2005	5.46736	0.16295	0.04194	-0.00052	5.70452	0.18161	0.01315	-0.00009
2006	5.47549	0.17200	0.04095	-0.00051	5.73047	0.19549	0.01176	-0.00008
2007	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007
2008	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007
2009	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007
2010	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007
2011	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007
2012	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007
2013	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007
2014	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007
2015	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007
2016	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007
2017	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007
2018	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007
2019	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007
2020	5.48357	0.18122	0.03998	-0.00049	5.75653	0.21012	0.01052	-0.00007

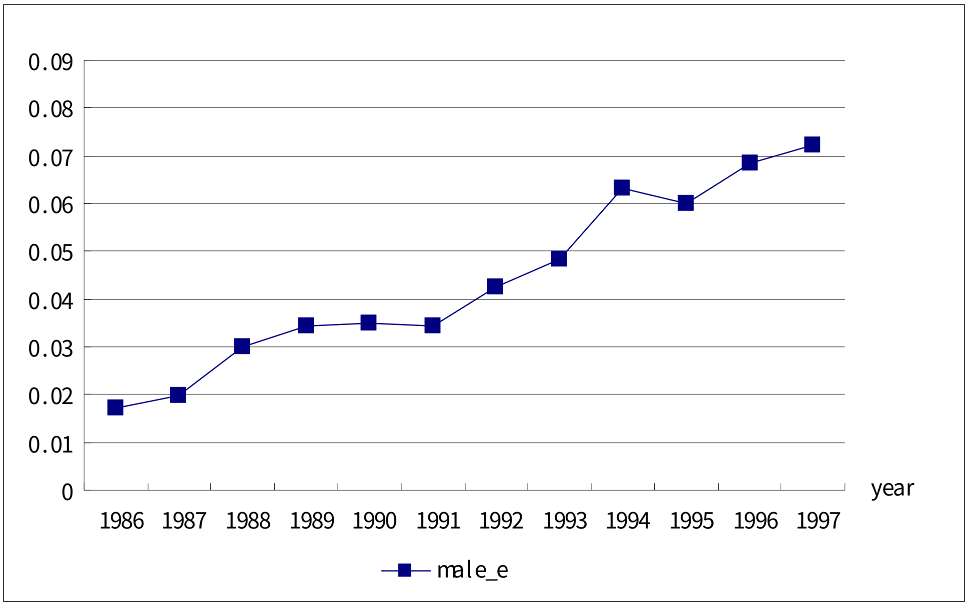
Table B.9 α values

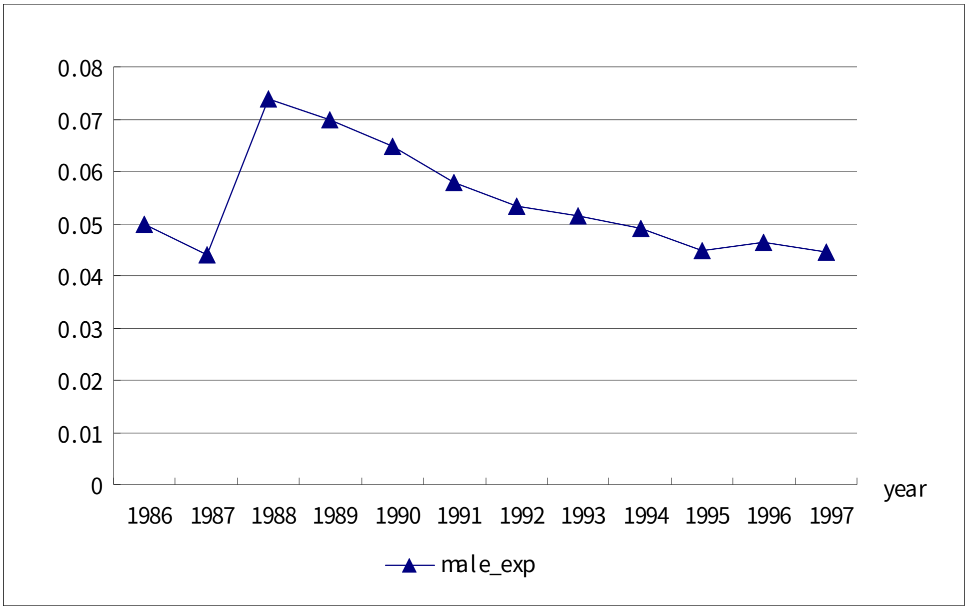
α_value	male	female
1985	1.05637	1.07552
1986	1.05637	1.07552
1987	1.06643	1.09893
1988	1.06640	1.08521

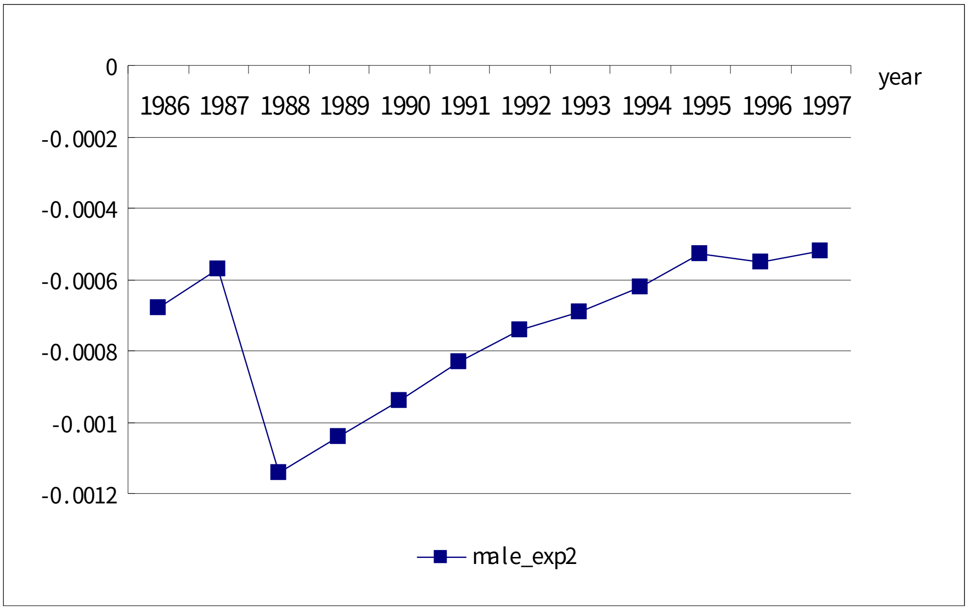
1989	1.06135	1.08638
1990	1.05763	1.07798
1991	1.06023	1.07839
1992	1.07039	1.09548
1993	1.11611	1.13272
1994	1.14799	1.17606
1995	1.13978	1.16159
1996	1.15789	1.19970
1997	1.18900	1.23888
1998	1.18900	1.23888
1999	1.18900	1.23888
2000	1.18900	1.23888
2001	1.18900	1.23888
2002	1.18900	1.23888
2003	1.18900	1.23888
2004	1.18900	1.23888
2005	1.18900	1.23888
2006	1.18900	1.23888
2007	1.18900	1.23888
2008	1.18900	1.23888
2009	1.18900	1.23888
2010	1.18900	1.23888
2011	1.18900	1.23888
2012	1.18900	1.23888
2013	1.18900	1.23888
2014	1.18900	1.23888
2015	1.18900	1.23888
2016	1.18900	1.23888
2017	1.18900	1.23888
2018	1.18900	1.23888
2019	1.18900	1.23888
2020	1.18900	1.23888

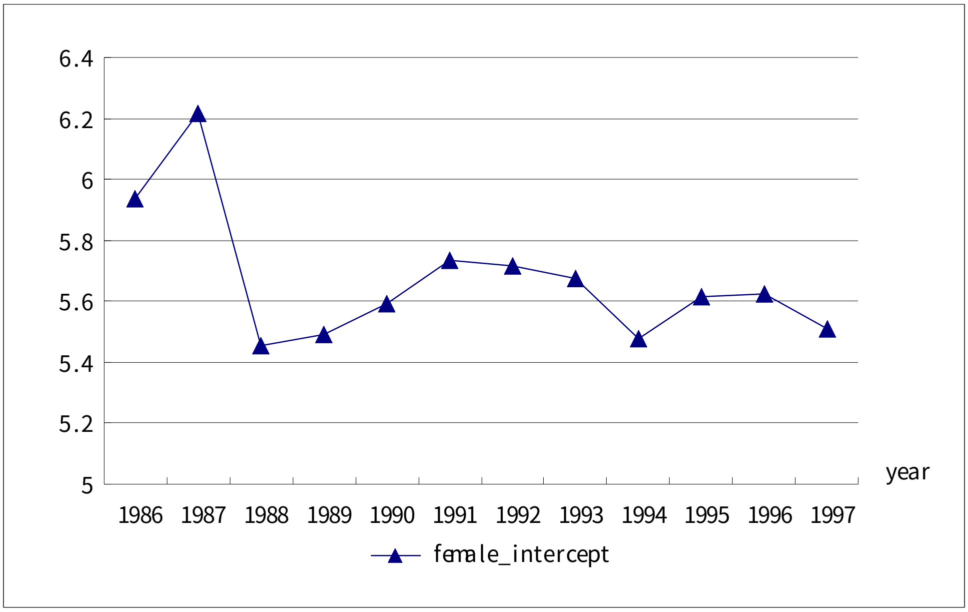
Figures B.1~8 Plotting parameter estimates against time: urban sample

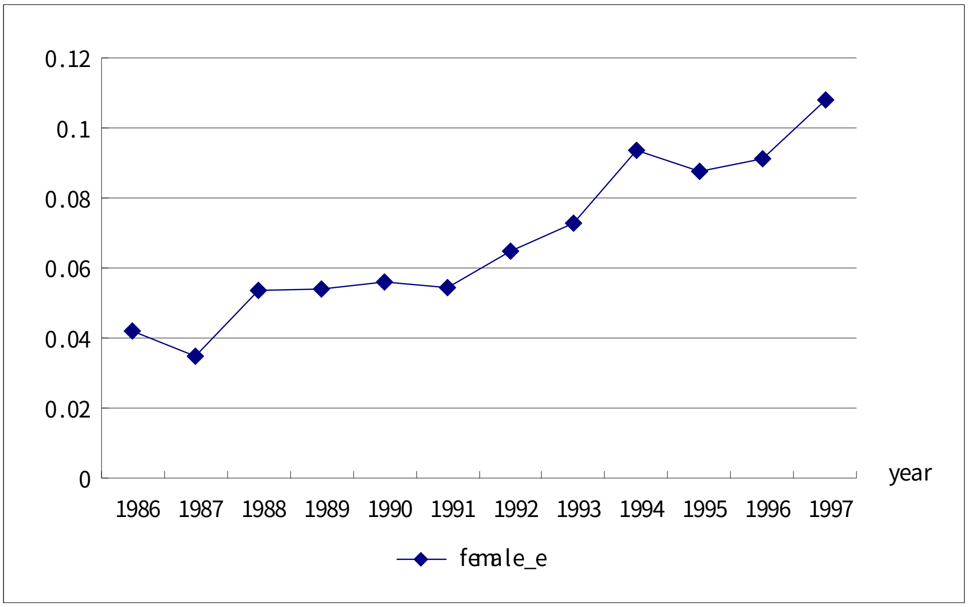


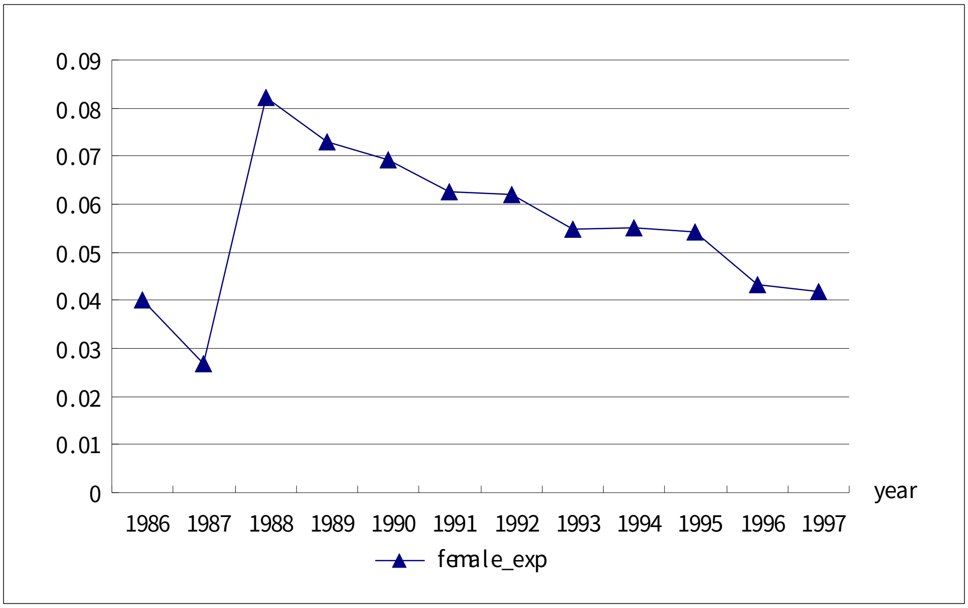



0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997
year
male_exp

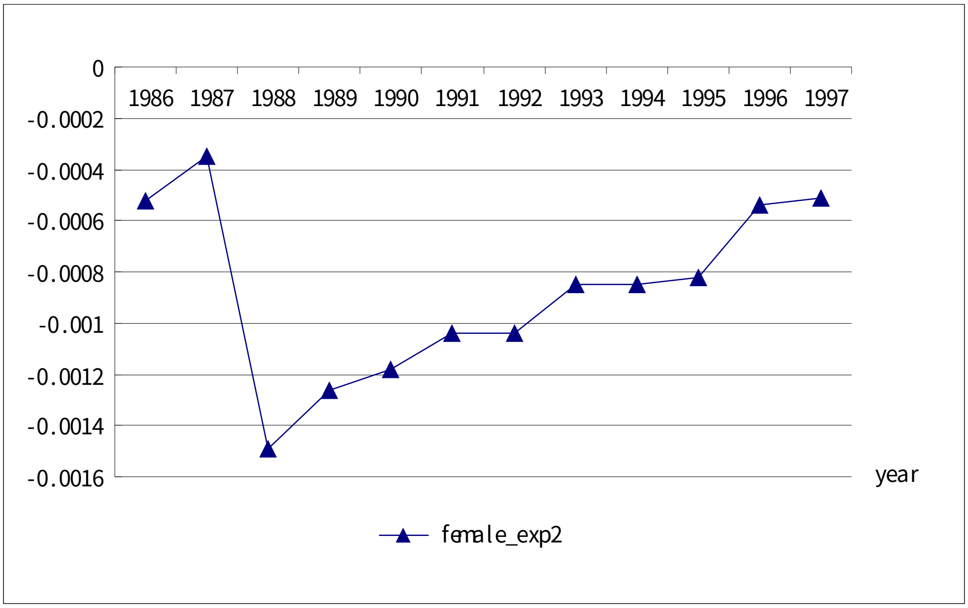

0
-0.0002
-0.0004
-0.0006
-0.0008
-0.001
-0.0012
1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997
year
male_exp2


6.4
6.2
6
5.8
5.6
5.4
5.2
5
year
1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997
female_intercept


0.12
0.1
0.08
0.06
0.04
0.02
0
year
1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997
female_e

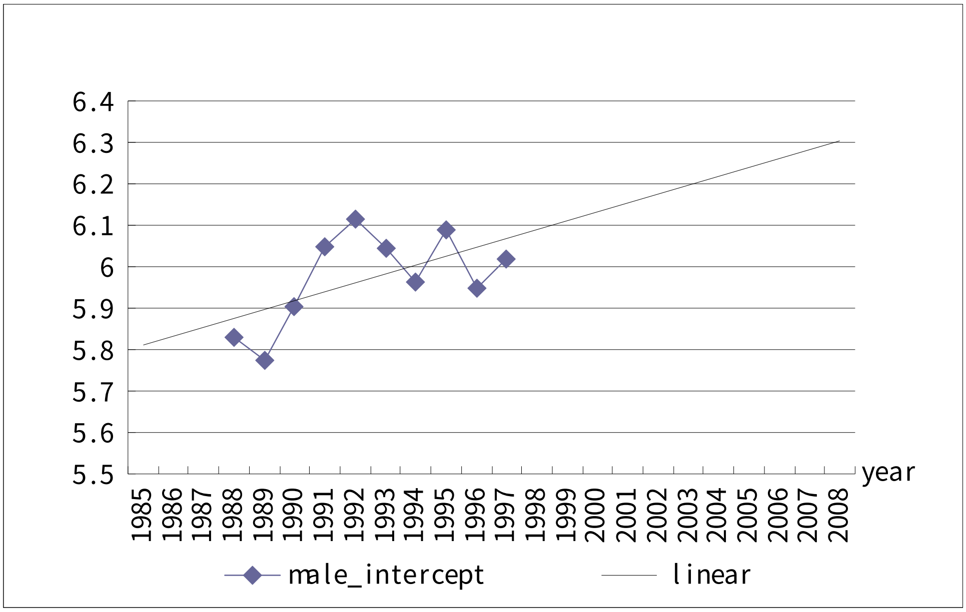


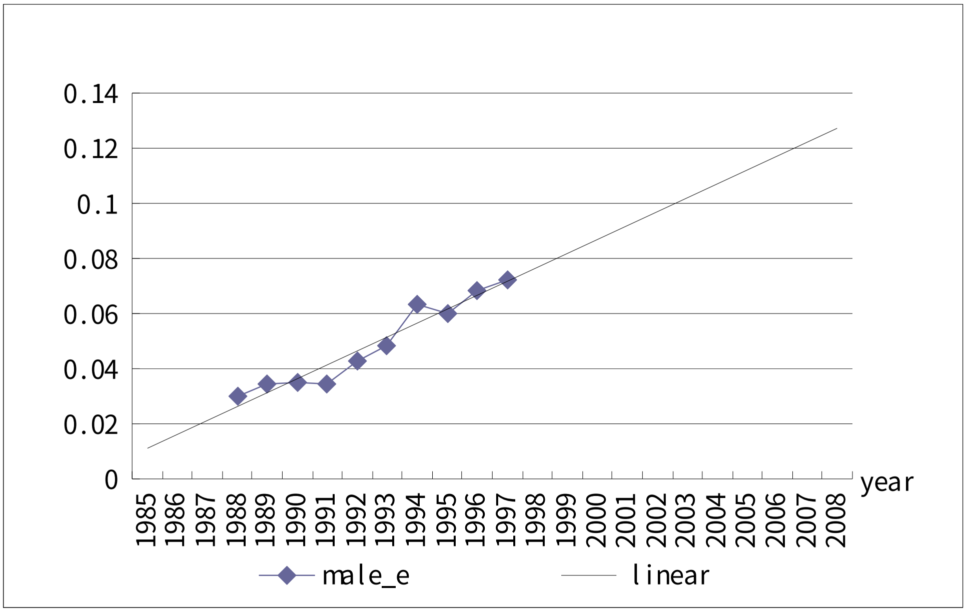
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997
year
female_exp

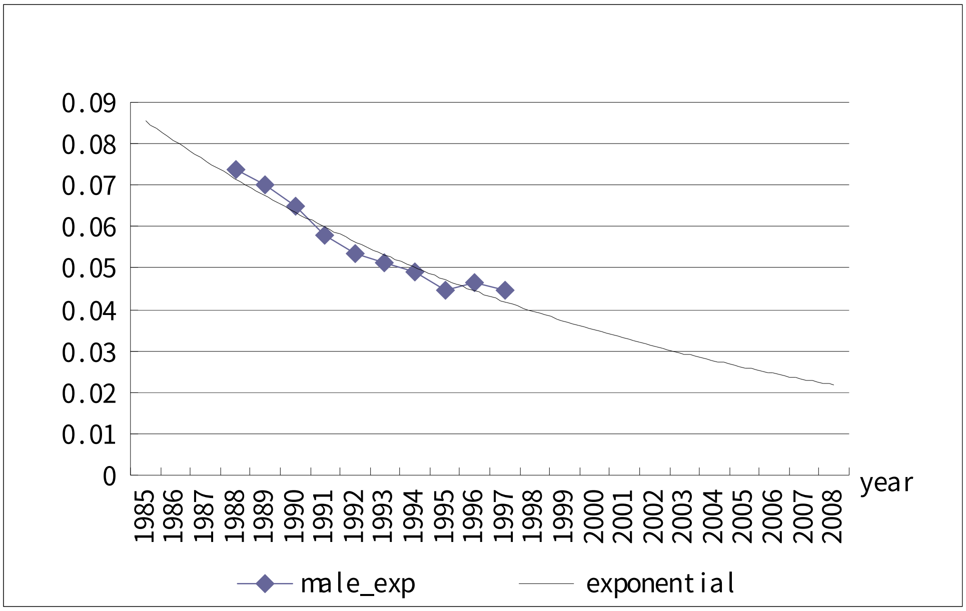


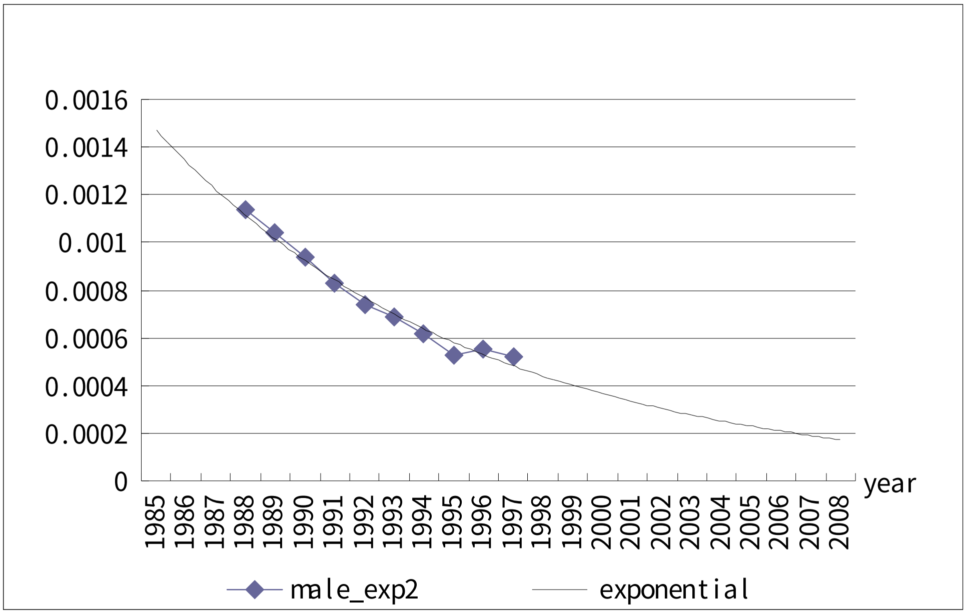
0
-0.0002
-0.0004
-0.0006
-0.0008
-0.001
-0.0012
-0.0014
-0.0016
1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997
year
female_exp2

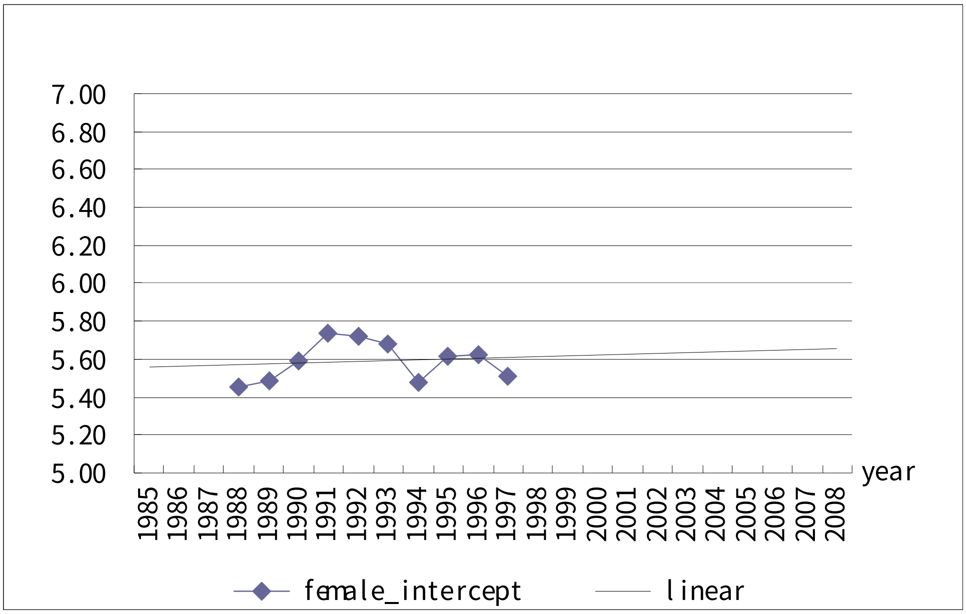
Figures B.9~16 Sample regression lines of parameter estimates, urban sample

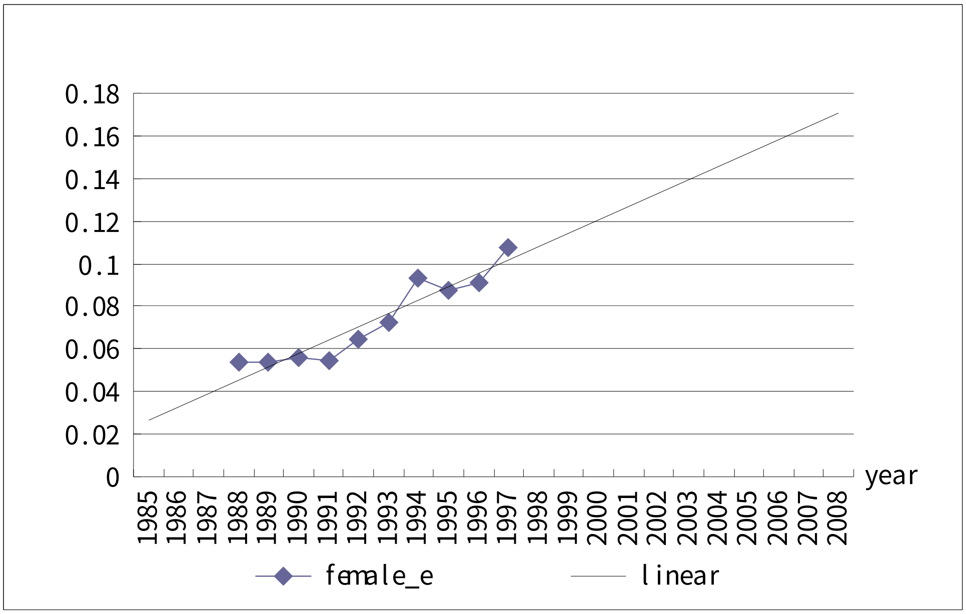


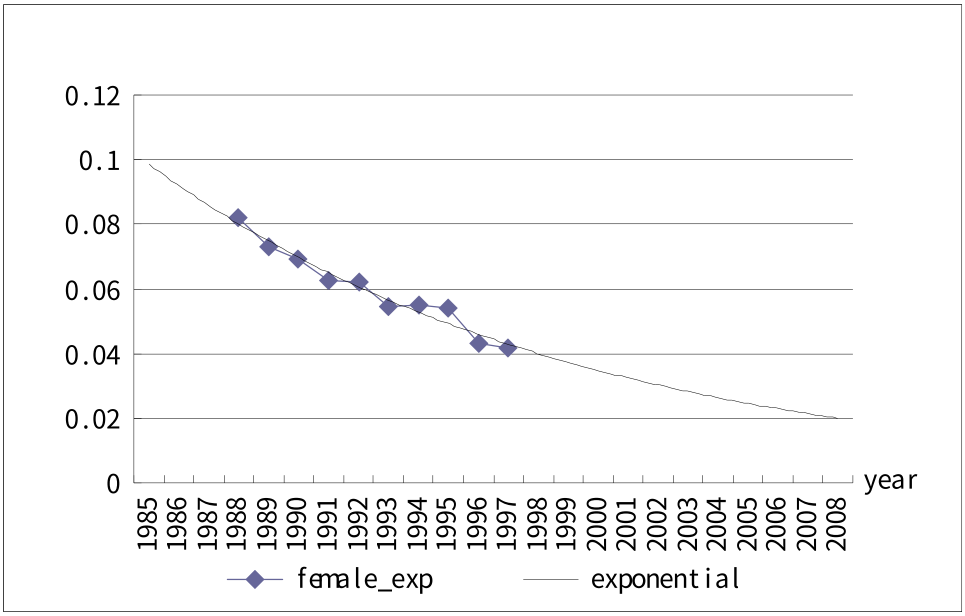


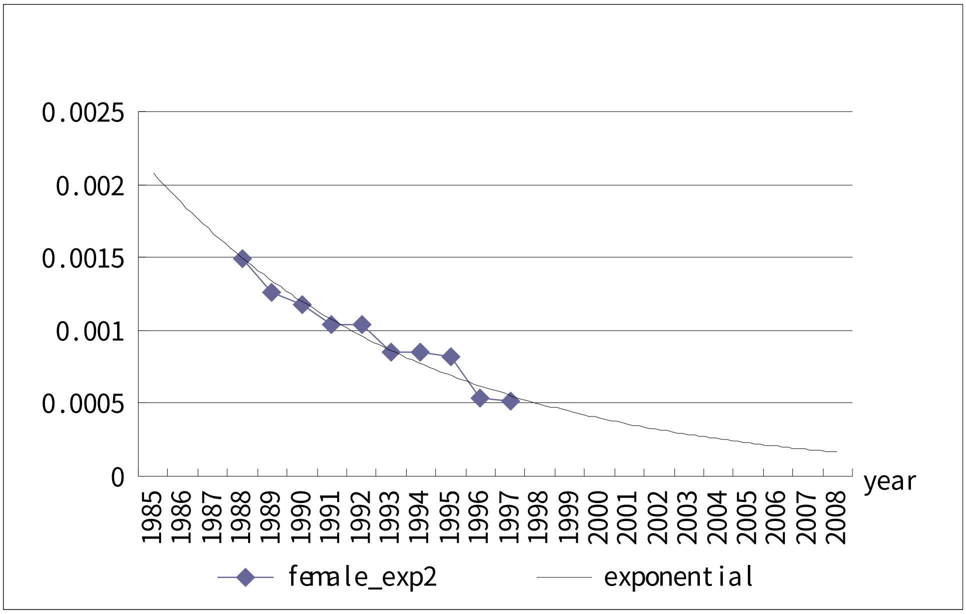

0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
year
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
male_exp
exponential


0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
year
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
male_exp2
exponential

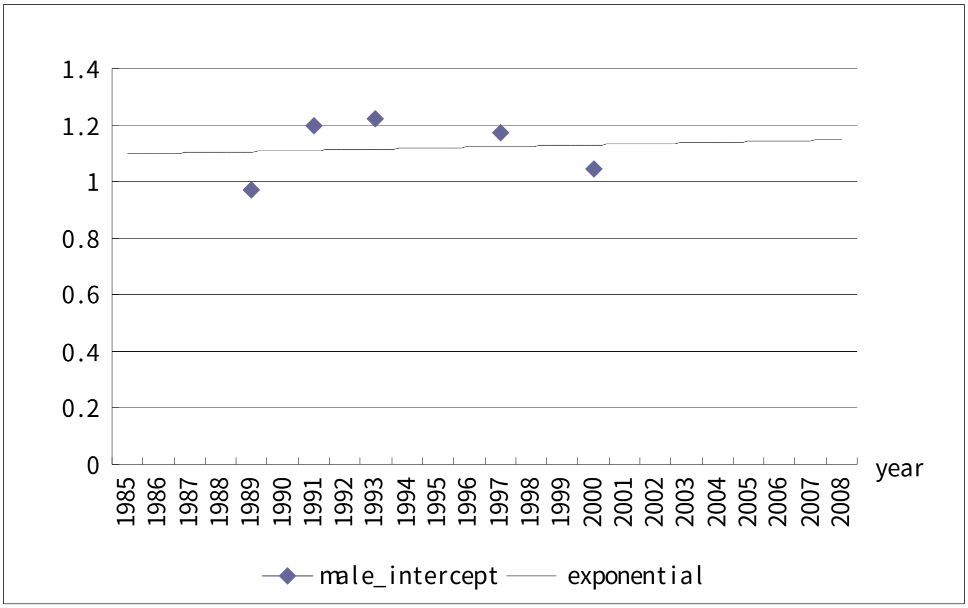

7.00
6.80
6.60
6.40
6.20
6.00
5.80
5.60
5.40
5.20
5.00
year
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
female_intercept
linear

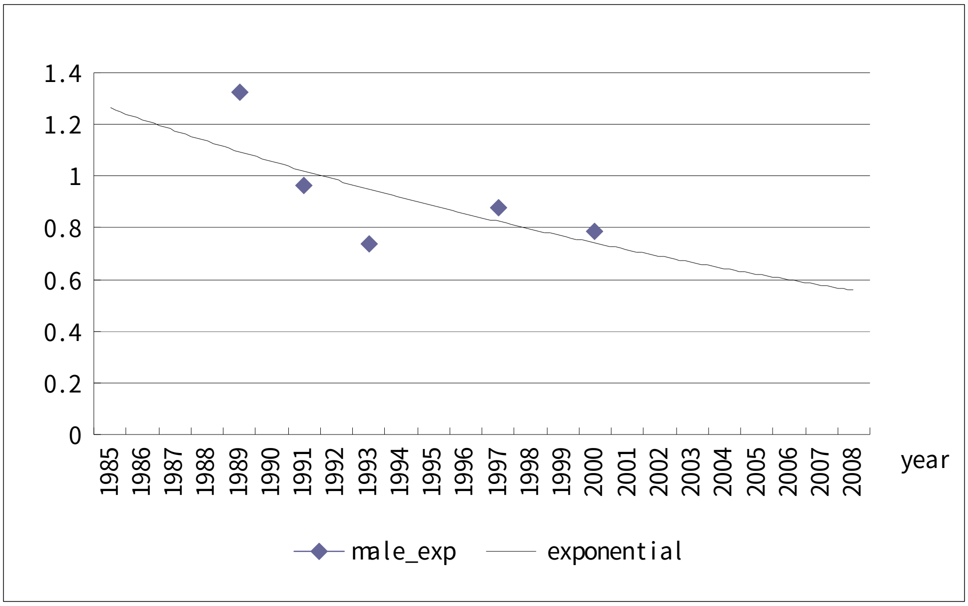

0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
year
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
female_e
linear

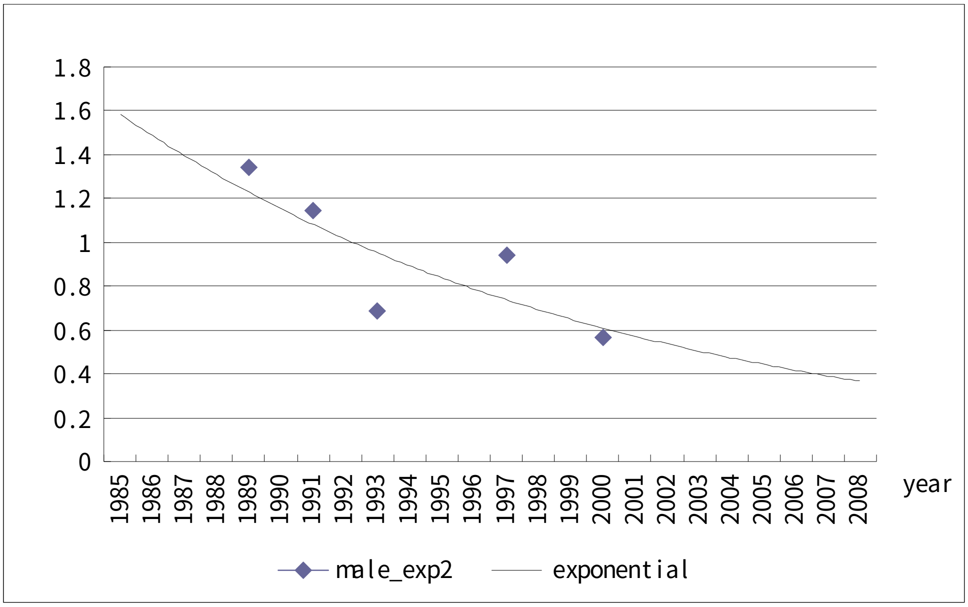

0.12
0.1
0.08
0.06
0.04
0.02
0
year
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
female_exp
exponential

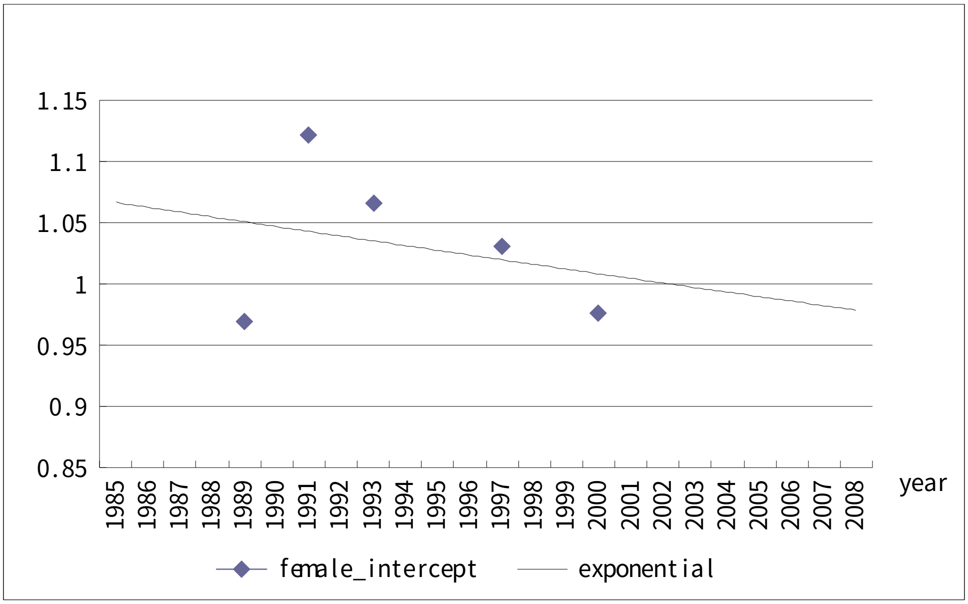

0.0025
0.002
0.0015
0.001
0.0005
0
year
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
female_exp2
exponential

Figures B.17~24: Sample regression lines of urban/rural ratio: CHNS samples

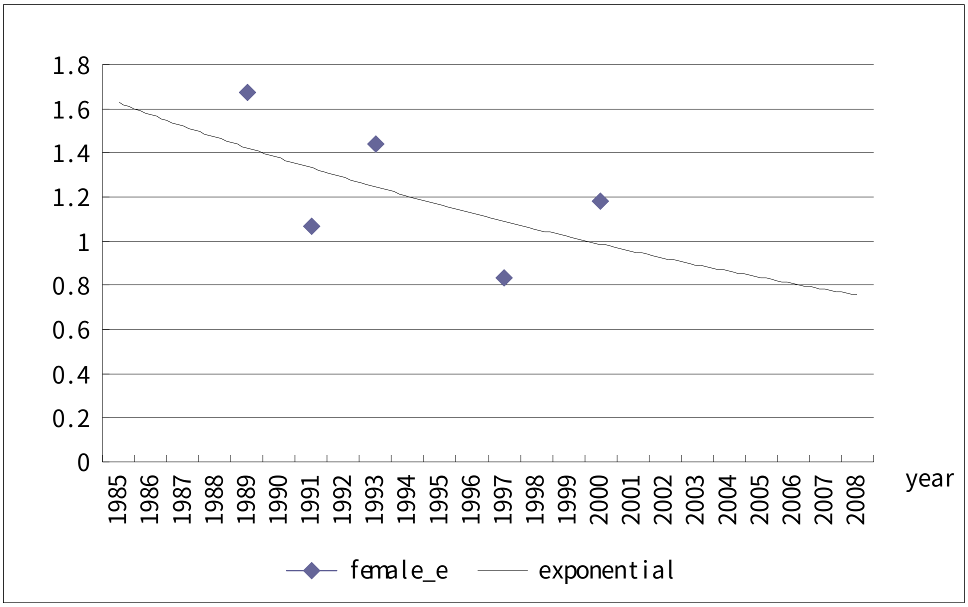



1.4
1.2
1
0.8
0.6
0.4
0.2
0
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
year
male_exp
exponential

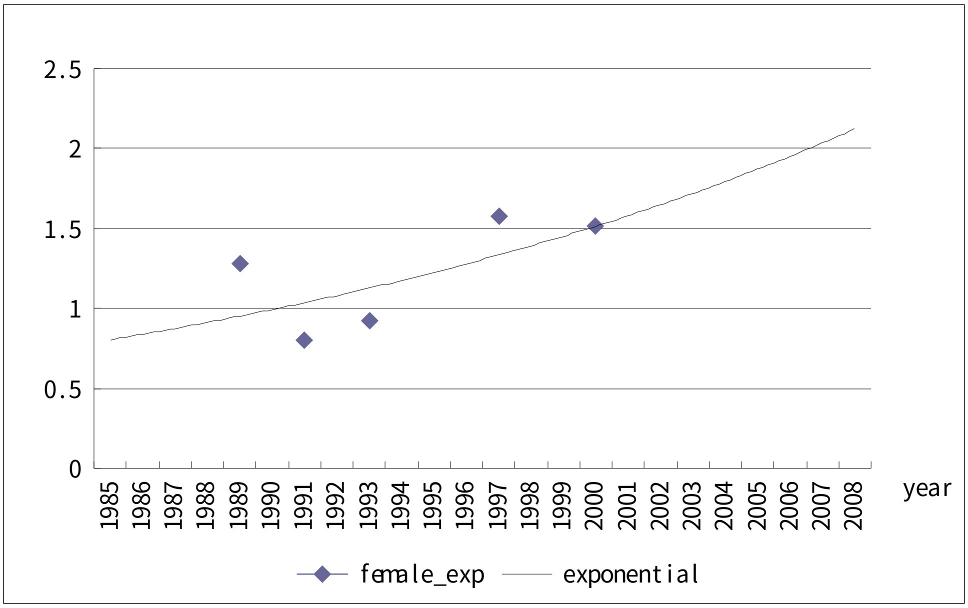

1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
year
male_exp2
exponential

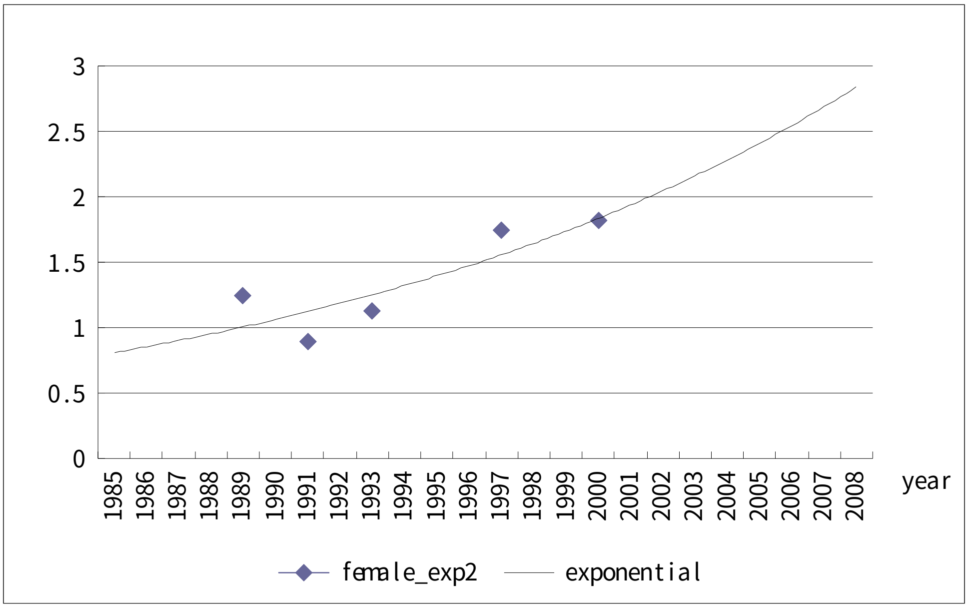


1.15
1.1
1.05
1
0.95
0.9
0.85
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
year
female_intercept
exponential



1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
year
female_e
exponential


2.5
2
1.5
1
0.5
0
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
year
female_exp
exponential


3
2.5
2
1.5
1
0.5
0
1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
year
female_exp2
exponential

Appendix C Human capital stock calculation

This section summarizes the basic methods and procedures of measuring China's human capital stock from 1985 to 2020 based on the J-F approach. In particular, it explicitly explains the necessary data estimation of the J-F approach based on China's data. We use the following notations:

y = 1980, 1981, 1982, … , 2020, calendar year

s = 1,2, sex, male or female

a = 0, 1, …. 60, age

e: education level, which is described below.

For years 1985-2020 it is classified into five categories: no schooling (ns), primary school (pri), junior middle school (jm), senior middle school (sm), and college (col). For years 2000-2020 it is classified into six categories: no schooling (ns), primary school (pri), junior middle school (jm), senior middle school (sm), college (col) and university (uni).

Variables used in measuring the human capital stock:

whrs(y,s,a,e): annual market hours worked per person employed, in year y, with sex s, age a , and education level e

empr(y,s,a,e): employment rate, in year y, with sex s, age a , and education level e

mhrs(y,s,a,e): market labor time per capita, in year y, with sex s, age a , and education level e

com(y,s,a,e): hourly compensation, net of taxes on labor income

yinc(y,s,a,e): annual income of the group employed in year y, with sex s, age a , and education level e

ymi(y,s,a,e): annual market income per capita, net of tax on labor compensation, in year y, with sex s, age a , and education level e

employed(y,s,a,e): the population employed in year y, with sex s, age a , and education level e

pop(y,s,a,e): the population in year y, with sex s, age a , and education level e

newEnroll(y,s,a,e): the population enrolled in education level e, in year y, with sex s, age a

pop_inschool(y,s,a,e-n): the number of the group in school in year y, with sex s, age a, education level e, in grade n+1.

senr(y,s,a,e+1,e-n): the possibility of the group enrolled in the next education level e+1 in school in year y, with sex s, age a , education level e, and grade n+1.

mi(y,s,a,e): the lifetime income of the group not in school in year y, with sex s, age a , and education level e.

R = (1+real growth rate of income)/(1+discount rate)

pop_inschool(y,s,a,e): the number of the group in school in year y, with sex s, age a , and education level e.

pop_nischool(y,s,a,e): the number of the group not in school in year y, with sex s, age a , and education level e.

Le(y)：total population with education level e in year y.

Ls(y)：total population with sex s.

Mi(s): the lifetime income for both sexes (nominal income).

v_e：the shares of current value lifetime income for population with education level e.

$\bar{v}_e$：the average shares of the current value lifetime income for population with education level e.

$\bar{v}_s$：the average shares of the current value lifetime income for population with sex s.

ΔlnK：the growth rate of aggregate human capital stock

Poplog(y,s): the logarithmic growth rate of the population for both sexes in year y.

Mitg (y): cumulated the growth rate of aggregate human capital stock

MiQ(y): the quantity total lifetime income of the country in year y according to the base year.

1. Age categories for calculating lifetime income in the J-F approach

no school or work	**0-5**
school only	6-16
work and school	16- a
work only	a -59
retirement	male：60+；female：55+

(1) When calculating the lifetime income using the J-F approach, the retirement age is 60 for male and 55 for female. The legal retirement age is set by the second meeting of the fifth NPC Standing Committee on May 24, 1978. Detailed regulations are described in “The Temporary Method of Settling the Old, Weak, Ill, and Disabled Cadre by the State Council” and “The Temporary Method of the Retired Workers by the State Council” (1978, No.104). In general, the legal retirement age is 60 for male, 50 for female workers and 55 for female cadres. However, for workers who work in high temperature, high elevation, highly exhausting conditions, and harmful conditions, the legal retirement age is 55 for male and 45 for female. For people who become disabled due to illness and other reasons, the legal retirement age is 50 for male and 45 for female.

(2) The *a* in the table is the upper bound of “work and school”, and the lower bound of “work only”. This age is regulated according to the calculation of the lower bound of people in school in each year. The method of calculating the people in school is discussed in section 3.2.

2. Estimation of annual market income ymi(y,s,a,e)

2.1 Estimation of annual income of the employed

2.1.1 Estimation of annual income of the employed using Mincer equation.

Using CHIP (Chinese Household Income Project), CHNS (China Health and Nutrition Survey), and UHS (Urban Household Survey), we regress the logarithm of yearly income *ln yinc* on years of schooling *s*, work experience *exp* and the square of work experience *exp*^{2} by OLS.

$$\ln \text{yinc} = \alpha + \beta e + \gamma \exp + \delta \exp^2 + \text{u}$$

We use the fitted value of *ln yinc* from the equation above to obtain $\text{m}_\text{i} = e^{\ln \text{yinc}}$. Then we use the yearly income observed in the survey data as the dependent variable, regress it on the independent variable m_i by OLS (without the intercept), we obtain the parameter α [45]. Finally we calculate yearly income of the employed as yinc=$\alpha \times e^{\ln \text{yinc}}$.

Note: The yearly income estimated by Mincer equation is the real yearly income (1985 as based year).

2.1.2 The years of schooling and working experience in the Mincer equation

(1) Years of schooling:

	No schooling	Primary school	Junior middle school	Senior middle school	College	University
1985-1999	0	6	9	12	15	
2000-2007	0	6	9	12	15	16

[45] Jeffrey M. Wooldridge (2005), Introductory Econometrics: A Modern Approach, 3rd edition.

(2) Work experience:

For people younger than16, working experience is 0: *exp*=0;

For people older than16, if s<10, working experience: *exp*=age -6;

For people older than16, if s≥10, working experience: exp=age-schooling-6.

2.2 The estimation of annual market income

When estimate the yearly income of the employed using the Mincer equation, we obtain $\mathrm{yinc}_{y,s,a,e} = \mathrm{whrs}_{y,s,a,e} \times \mathrm{com}_{y,s,a,e}$.

According to

$\mathrm{mhrs}_{y,s,a,e} = \mathrm{whrs}_{y,s,a,e} \times \mathrm{empr}_{y,s,a,e}$, $\mathrm{ymi}_{y,s,a,e} = \mathrm{whrs}_{y,s,a,e} \times \mathrm{empr}_{y,s,a,e} \times \mathrm{com}_{y,s,a,e}$,

we can translate the formula in the J-F approach to:

$$\mathrm{ymi}_{y,s,a,e} = \mathrm{yinc}_{y,s,a,e} \times \mathrm{empr}_{y,s,a,e}.$$

2.2.1 Calculation of employment rate empr(y,s,a,e)

To calculate employment rate empr(y,s,a,e) by age, sex and education level for people older than 16, we use the average of the employment rates of 1995 and 2000. The people employed and the total population in 1995 only include the education level of college and above, so we assume that the employment rate is the same for people at this education level.

The formula to calculate the employment rate is:

$$\mathrm{empr}(y,s,a,e)=[\mathrm{employed}(y,s,a,e)]/\mathrm{pop}(y,s,a,e)$$

The data sources of employment rate are listed in the table below:

Data	**Sources**
The employed by age, sex, and education level in 1995	"China Population Statistical Yearbook 2000"
Population by age, sex, and education level in 1995	"China Population Statistical Yearbook 1999"
The employed by age, sex, and education level in 2000	"China Population Census 2000"
Population by age, sex, and education level in 2000	"China Population Census 2000"

Note: The 1% sample population in 1995 is converted into the whole population by the actual sampling percentage of 1.04%.

The employed in "China Population Census 2000" of each province, autonomous region and municipality directly under the central government is converted into the whole population employed by the actual sampling percentage of 10%.

3. Calculation of enrollment rate

Enrollment rate is the probability that a group with education level *e* is enrolled in a higher education level *e*+1.

3.1 Calculation of enrollment by sex, age and education level

According to the age distribution of enrollment number for a certain education level and sex, the formula for the enrollment number of each year by sex, age and education level is:

NewEnroll (y,s,a,e) = NewEnroll (y,s,e)*[NewEnroll(y,s,a,e)/NewEnroll(y,s,e)]

Note: [NewEnroll (y,s,a,e)/ NewEnroll (y,s,e)] refers to the age distribution of enrollment number for each education level and sex, which is consistent with the age distribution when estimating the population using the perpetual inventory method.

There is no college or university in rural area, so the enrollment number of college and university in rural areas is assumed to be 0.

3.2 In-school population of each education level and each grade

The in-school population of age *a*, sex *s*, education level *e*, grade *n*+1 in year *y* is the enrollment population of age a-n, sex s , education level e in year y-n:

pop_inschool(y,s,a,e-n)= NewEnroll (y-n, s, a-n, e)

3.3 Enrollment rate of each education level and each grade

The probability of advancing to the next higher education level is estimated as the average ratio of the sum of all students of any age in a year who are initially enrolled to the sum of all students of any age initially enrolled in the next higher education level *X* years later. "*X*" depends upon the number of years it takes to complete an education level.

3.3.1 Enrollment rate from no schooling to primary school

The formula from no schooling to primary school is:

senr(y,s,a,pri-ns) = Newenroll(y+1,s,a+1,pri)/pop(y,s,a,ns)

The upper bound of people out of school in year y and enroll into primary school in year y+1 is determined by the upper bound of age distribution for enrollment of primary school in year y+1. For example, the age distribution for enrollment of primary school in year y+1 is from 6 to 12, the upper bound of people no schooling in year y and enrolled into primary school in year y+1 is 11. The upper bound of people out of school in 2007 and enroll into primary school in 2008 is the same for 2006.

3.3.2 Enrollment rate from primary school to junior middle school

The steps of calculating this enrollment rate by sex and age in year y are:

(1) The enrollment rate of the first grade of primary school in year y by age and sex is the average enrollment rate that the group in this grade can enroll in the first grade of junior middle school six years later, and the formula is:

senr(y,s,a,jm-pri) = newEnroll (y+6, s, jm)/ newEnroll (y, s, pri)

(2) The population of the second grade of primary school in year y by age and sex is the enrollment population of primary school in year y-1 by age and sex. The probability of the group in this grade can enroll in junior middle school 5 years later is the average enrollment rate that the group in this grade can enroll in the first grade of junior middle school five years later, and the formula is:

senr(y,s,a,jm-pri-1) = newEnroll (y+5, s, jm)/ newEnroll (y-1, s, pri)

(3) The population of the third grade of primary school in year y by age and sex is the enrollment population of primary school in year y-2 by age and sex. The probability of the group in this grade can enroll in junior middle school 4 years later is the average enrollment rate that the group in this grade can enroll in the first grade of junior middle school four years later, and the formula is:

senr(y,s,a,jm-pri-2) = newEnroll (y+4, s, jm)/ newEnroll (y-2, s, pri)

(4) Similarly, we can calculate the probability of the group of each grade in primary school that enroll in junior middle school in year y.

3.3.3 Enrollment rate from junior middle school to senior middle school

The steps of calculating this enrollment rate by sex and age in year *y* are:

(1) The enrollment rate of the first grade of junior middle school in year y by age is the average enrollment rate that the group in this grade can enroll in the first grade of senior middle school three years later, and the formula is:

senr(y,s,a,sm-jm) = newEnroll (y+3, s, sm)/ newEnroll (y, s, jm)

(2) The population of the second grade of junior middle school in year y by age and sex is the enrollment population of junior school in year y-1 by age and sex. The probability of the group in this grade can enroll in senior middle school two years later is the average enrollment rate that the group in this grade can enroll in the first grade of senior middle school two years later, and the formula is:

senr(y,s,a,sm-jm-1) = newEnroll (y+2, s, sm)/ newEnroll (y-1, s, jm)

(3) Similarly, we can calculate the probability of the group of each grade in junior middle school that enroll in senior middle school in year y.

3.3.4 Enrollment rate from senior middle school to college or university

The steps of calculating the enrollment rate from senior middle school to college by sex and age in year *y* are:

(1) The enrollment rate of the first grade of senior middle school in year *y* by age is the average enrollment rate that the group in this grade can enroll in the first grade of college three years later, and the formula is:

senr(y,s,a,col-sm) =newEnroll (y+3, s, col)/ newEnroll (y, s, sm)

(2) The population of the second grade of senior middle school in year y by age and sex is the enrollment population of senior school in year y-1 by age and sex. The probability of the group in this grade can enroll in college two years later is the average enrollment rate that individuals in this grade can enroll in the first grade of college two years later, and the formula is:

senr(y,s,a,col-sm-1) = newEnroll (y+2, s,col)/ newEnroll (y-1, s, sm)

(3) Similarly, we can calculate the probability of the group of each grade in senior middle school that can enroll in college in year *y*.

The steps of calculating the enrollment rate from senior middle school to university by sex and age in year *y* are:

(1) The enrollment rate of the first grade of senior middle school in year y by age is the average enrollment rate that the group in this grade can enroll in the first grade of university three years later, and the formula is:

senr(y,s,a,col-uni) =newEnroll (y+3, s, uni)/ newEnroll (y, s, sm)

(2) The population of the second grade of senior middle school in year y by age and sex is the enrollment population of senior school in year y-1 by age and sex. The probability of the group in this grade can enroll in university two years later is the average enrollment rate that the group in this grade can enroll in the first grade of university two years later, and the formula is:

senr(y,s,a, uni -sm-1) = newEnroll (y+2, s,uni)/ newEnroll (y-1, s, sm)

(3)Similarly, we can calculate the probability of the group of each grade in senior middle school that can enroll in university in year *y*.

Note:

1) By using different years' enrollment population in the calculation of enrollment rate, an adjustment has already been made for survival rate. Therefore, the survival rate is not included in the formula. We also assume that no one drops out, skips a grade, repeats, or stays out for a year or more within a certain education category.
2) After 2002, fix the enrollment rates from the last available year.

4. Lifetime income calculation for in-school population

The number of years discounted until they realize the higher level of lifetime income depends on the number of years it takes to complete the starting grade level and the current grade of enrollment within the starting grade level.

4.1 Lifetime income of population in primary school by age and sex

(1) If the individual in the first grade of primary school can advance to the next higher education level, he could get lifetime income equal to someone who is currently six years older and whose educational attainment is junior middle school, and discount 6 years before he realizes junior middle school: senr(y,s,a,jm-pri)*mi(y,s,a+6,jm)*R^6.

(2) If the individual in the second grade of primary school can advance to the next higher education level, senr(y,s,a,jm-pri-1)*mi(y,s,a+5,jm)*R5 is calculated by similar way.

(3) Similarly, we can calculate the lifetime income of the group in each grade of primary school.

4.2 Lifetime income of the group in junior middle school and above by age and sex

Take junior middle school as an example,

(1) If the individual in the first grade of junior middle school can advance to the next higher education level, he could get lifetime income equal to someone who is currently three years older and whose educational attainment is senior middle school, and discount 3 years before he realizes senior middle school: senr(y,s,a,sm-jm)*mi(y,s,a+3,sm)*R^3

(2) If the individual in the second grade of junior middle school can advance to the next higher education level, senr(y,s,a,sm-jm-1)*mi(y,s,a+2,sm)*R^2 is calculated by similar way.

(3) Similarly, we can calculate the lifetime income of the group in each grade of junior middle school.

For the years that do not separate university from college (there are five categories for education level, and the last level is college and above), to get the lifetime income of the group in the first grade of senior middle school, we should use the equation senr(y,s,a,col-sm)*mi(y,s,a+3,col)*R^3, senr(y,s,a,col-sm-1)*mi(y,s,a+2,col)*R^2 for grade 2 students, and so on.

For the years that separate university from college (there are six categories for education level, and the last level is university and above), we should use the equation:

senr(y,s,a,col-sm)*mi(y,s,a+3,col)*R3+senr(y,s,a,uni-sm)*mi(y,s,a+3,uni)*R3, as fora senior middle school students, they can go to college or university after their graduation. Calculate senr(y,s,a,col-sm-1)*mi(y,s,a+2,col)*R2+senr(y,s,a,uni-sm-1)*mi(y,s,a+2,uni)*R2 for grade 2 students, and so on. Similarly, we can calculate the lifetime income of the group in each grade of senior middle school.

Note: By using the average ratio of the sum of all students of any age in a year who are initially enrolled to the sum of all students of any age initially enrolled in the next higher education level 'X' years later, an adjustment has already been made for survival. Accordingly there is no survival rate in the formula.

5. Out-of-school population's lifetime income

5.1 Calculation of out-of-school population

In-school population of age a, sex s, education level e in year y, pop_inschool(y,s,a,e), is the sum of population of each grade:

$$pop\_inschool(y,s,a,e) = \sum_{n=0}^{y(e)} pop\_inschool(y,s,a,e-n)$$

y(e) is the number of years to achieve education level e. The formula for calculating out-of-school population of age a, sex s, education level e in year y is:

pop_nischool(y,s,a,e) = pop(y, s, a,e) - pop_inschool(y,s,a,e)

Note: Following adjustment is necessary for negative values in out-of-school population

(1) Reset negative out-of-school population for certain gender, age, education level to 0. The negative out-of-school population mainly appears in primary school for students aging 5-10.

(2) Add the negative out-of-school population for certain gender, age, education level to the in-school population by grades. The weights to add the negative number are the proportion of certain grade of the total population in school with this gender, age, education level.

5.2 Out-of-school category's lifetime income

The out-of-school population is the population that works only, we can use the fourth and fifth stages of J-F approach to calculate the lifetime income for this category. When age < 60, the formula of lifetime income is:

mi(y,s,a,e) = ymi(y,s,a,e) + sr(y+1,s)*mi((y,s,a+1,e)*R

When age > 60, lifetime income is zero, i.e. ymi = 0.

6. Growth rate of real wage and discount rate

6.1 Growth rate of real wage

We use the average labor productivity growth rate to be the real wage growth rate of urban and rural areas. Moreover, we use the labor productivity of the primary sector as the rural labor productivity, and the labor productivity of the secondary and tertiary sectors as the urban labor productivity. The values are 6% for urban area and 4.11% for rural area.

6.2 Discount rate

We use average real interest rate of long-term government bonds, which is 3.14% over our sample period.

7. Tax rate and non-market income

(1) We use Mincer equation to estimate the employed population's annual income. For incomes reported in CHIP, CHNS and UHS, it is not clear whether it is the after-tax income; therefore we do not deduct tax when estimating the average market annual income.

(2) Non-market lifetime income is not included in the calculation; the final human capital stock is derived from market income only.

8. Calculation of Divisia index

8.1 Using educational level information

The steps of calculating the Divisia index using educational level information are as follows:

(1) Using Tornqvist aggregation, the growth rate of aggregate human capital stock is calculated as a weighted sum of the growth rates of the

number of individuals across different educational level categories of population:

$$\Delta \ln K^{edu} = \sum_e \bar{v}_e \Delta \ln L_e$$

where ΔlnK denotes the growth rate of aggregate human capital stock, L_e denotes the number of individuals with educational level e. Δ denotes a first difference, or change between two consecutive years,

$$\Delta \ln L_e = \ln L_e(y) - \ln L_e(y-1)$$

where *y* denotes the year.

Weights are given by current dollar lifetime income share for each educational level of the population in the aggregate current dollar lifetime income：

$$\bar{v}_e = \frac{1}{2}[v_e(y) + v_e(y-1)],\ v_e = \frac{Mi_e}{\sum_e Mi_e}$$

where Mi_e is the total current dollar market lifetime income of individuals with educational level e.

(2) We use year 2001 as the base year

(3) Add up (cumulate) the growth rate of aggregate human capital stock to obtain the cumulated growth rates Mitg(y) for year *y*,

$$Mitg(y) = \sum_{1986}^{y} \Delta \ln K$$

That is,

Mitg(1986) = ΔlnK(1986)

Mitg(1987) = Mitg(1986) + ΔlnK(1987)

……

Mitg(2007) = Mitg(2006) + ΔlnK(2007)

(4) Take the exponential of all of the added up (cumulated) growth rates Mitg(y) for year *y*,

$$Mitg\exp(y) = \exp[Mitg(y)]$$

(5) Then normalize these results, so that the Mi, Mi(Q), in year *y*,

$$MiQ(y) = \frac{Mitg\exp(y) \cdot Mi(b)}{Mitg\exp(b)}$$

Where Mi(b) is the total current dollar lifetime market income in the base year. After normalization, in the base year the quantity of human capital MiQ is equal to current dollar human capital Mi.

8.2 Quantity index using gender information

For indexes based on gender information, the number of weighted growth rates is *s* sub-aggregate components (male, female). Similarly, the growth rate of aggregate human capital stock is calculated as a weighted sum of the growth rates of the number of individuals across different gender of the population

$$\Delta \ln K^{gender} = \sum_{s} \bar{v}_s \Delta \ln L_s$$

When computing the total growth rates of the human capital stock, we continue the step (2) to (5) as in 8.1, and obtain the index.

9. Human capital stock in China: 1985-2020

When calculate the human capital, the income estimated by Mincer equation is the real yearly income (based year is 1985), and then we use CPI to inflate and obtain the nominal yearly income.

Tables C.1~8 give the real human capital in China in 1985-2020. We also create a new human capital series starting from 2000, as the reported education categories separate college and university or above. After 2007, we use the population forecast and all other values as of 2007 to forecast the human capital in China.

Tables and figures of appendix C

Table C.1 Urban real total human capital 1985-2020, in trillions

year	real urban total human capital	male	female
1985	10.95	7.12	3.84
1986	11.84	7.67	4.17
1987	12.94	8.29	4.65
1988	13.84	8.98	4.86
1989	14.66	9.48	5.19
1990	15.61	10.12	5.50
1991	16.80	10.99	5.81
1992	18.01	11.71	6.30
1993	19.80	12.83	6.97
1994	21.69	13.88	7.81
1995	22.93	14.62	8.31
1996	26.88	17.06	9.81
1997	31.67	20.04	11.62
1998	35.31	22.36	12.95
1999	40.15	25.15	15.00
2000	44.51	27.71	16.80
2001	48.41	30.11	18.31
2002	53.07	32.79	20.27
2003	58.37	35.79	22.58
2004	62.17	38.40	23.76
2005	66.93	41.57	25.36
2006	72.36	44.55	27.81
2007	78.50	48.43	30.07
2008	79.45	49.08	30.37
2009	80.89	50.00	30.89
2010	82.20	50.78	31.42
2011	83.98	51.90	32.08
2012	85.74	52.97	32.77
2013	87.56	54.09	33.47
2014	89.37	55.19	34.18
2015	91.07	56.23	34.84
2016	92.57	57.16	35.41
2017	94.04	58.09	35.95
2018	95.52	59.02	36.49
2019	96.91	59.89	37.02
2020	98.19	60.69	37.49

Note: The results are for five education categories.

Table C.2 Urban real total human capital 2000-2020, in trillions

year	real urban total human capital	male	female
2000	45.81	28.39	17.42
2001	49.88	30.87	19.01
2002	54.81	33.69	21.12
2003	60.45	36.85	23.60
2004	64.46	39.59	24.88
2005	69.58	42.95	26.63
2006	75.46	46.16	29.31
2007	82.08	50.29	31.79
2008	83.08	50.97	32.10
2009	84.60	51.94	32.66
2010	86.01	52.76	33.24
2011	87.91	53.95	33.96
2012	89.80	55.09	34.71
2013	91.75	56.28	35.47
2014	93.68	57.44	36.24
2015	95.50	58.53	36.97
2016	97.10	59.52	37.58
2017	98.66	60.50	38.16
2018	100.24	61.48	38.75
2019	101.73	62.40	39.33
2020	103.09	63.25	39.84

Note: The results are for six education categories.

Table C.3 Rural real total human capital 1985-2020, in trillions

year	real rural total human capital	male	female
1985	16.03	8.73	7.29
1986	16.19	9.01	7.18
1987	16.44	9.23	7.21
1988	16.76	9.66	7.11
1989	17.02	9.95	7.07
1990	17.41	10.40	7.01
1991	17.84	10.95	6.89
1992	18.46	11.45	7.01
1993	19.68	12.42	7.26

1994	21.04	13.29	7.76
1995	21.68	13.83	7.85
1996	22.88	14.65	8.23
1997	24.35	15.60	8.75
1998	25.17	16.24	8.93
1999	26.31	17.00	9.31
2000	27.69	17.93	9.76
2001	28.63	18.43	10.21
2002	29.56	18.84	10.72
2003	30.83	19.43	11.40
2004	32.42	20.17	12.25
2005	34.85	21.37	13.48
2006	37.10	22.19	14.91
2007	40.25	23.58	16.67
2008	39.41	23.11	16.30
2009	38.49	22.59	15.90
2010	37.58	22.07	15.51
2011	36.78	21.61	15.17
2012	35.94	21.14	14.80
2013	35.16	20.71	14.45
2014	34.42	20.30	14.12
2015	33.71	19.91	13.80
2016	33.03	19.54	13.49
2017	32.35	19.18	13.17
2018	31.71	18.84	12.87
2019	31.09	18.51	12.59
2020	30.36	18.10	12.26

Note: The results are for five education categories.

Table C.4 Rural real total human capital 2000-2020, in trillions

year	real rural total human capital	male	female
2000	27.69	17.93	9.76
2001	28.64	18.43	10.21
2002	29.57	18.84	10.72
2003	30.85	19.44	11.41
2004	32.44	20.19	12.25
2005	34.88	21.38	13.49
2006	37.14	22.21	14.93

year	real rural total human capital	male	female
2007	40.30	23.61	16.69
2008	39.46	23.14	16.33
2009	38.56	22.62	15.93
2010	37.65	22.10	15.55
2011	36.85	21.65	15.21
2012	36.01	21.18	14.84
2013	35.24	20.75	14.49
2014	34.51	20.34	14.16
2015	33.80	19.95	13.84
2016	33.12	19.58	13.53
2017	32.45	19.23	13.22
2018	31.81	18.89	12.92
2019	31.19	18.55	12.64
2020	30.46	18.15	12.31

Note: The results are for six education categories.

Table C.5 Urban real average human capital, 1985-2020

Unit: Yuan

year	real urban average human capital	male	female
1985	47,874	58,718	35,653
1986	49,445	60,867	36,750
1987	51,671	63,392	38,847
1988	53,269	65,544	39,569
1989	54,687	66,565	41,241
1990	56,851	69,018	42,924
1991	59,528	73,340	43,905
1992	62,253	76,554	46,209
1993	66,830	82,689	49,387
1994	71,541	87,563	53,989
1995	73,996	91,024	55,665
1996	81,441	99,423	61,962
1997	90,412	109,776	69,320
1998	95,361	115,128	73,550
1999	102,885	122,988	80,753
2000	108,553	128,636	86,319

2001	113,484	134,902	89,989
2002	119,520	142,030	95,132
2003	126,543	149,527	101,754
2004	131,048	156,205	103,983
2005	137,882	165,300	108,406
2006	146,019	173,136	116,727
2007	154,803	183,536	123,629
2008	153,427	181,627	122,649
2009	152,987	180,708	122,552
2010	152,552	179,586	122,701
2011	152,905	179,612	123,259
2012	153,122	179,443	123,775
2013	153,620	179,662	124,463
2014	153,963	179,799	124,968
2015	154,009	179,980	124,921
2016	153,864	179,932	124,700
2017	153,423	179,713	124,091
2018	153,654	179,831	124,374
2019	154,169	179,605	125,434
2020	154,089	178,859	125,872

Note: The results are for five education categories.

Table C.6 Urban real average human capital, 2000-2020

Unit: Yuan

year	real urban average human capital	male	female
2000	111,730	131,804	89,506
2001	116,929	138,316	93,468
2002	123,440	145,896	99,110
2003	131,055	153,976	106,333
2004	135,891	161,012	108,864
2005	143,343	170,799	113,828
2006	152,289	179,385	123,022
2007	161,855	190,589	130,681
2008	160,422	188,616	129,650
2009	160,014	187,722	129,595
2010	159,607	186,592	129,812
2011	160,060	186,711	130,477

year	real urban average human capital	male	female
2012	160,364	186,609	131,100
2013	160,960	186,912	131,904
2014	161,391	187,123	132,512
2015	161,500	187,368	132,527
2016	161,387	187,355	132,337
2017	160,963	187,165	131,731
2018	161,249	187,333	132,074
2019	161,830	187,136	133,244
2020	161,779	186,391	133,743

Note: The results are for six education categories.

Table C.7 Rural real average human capital, 1985-2020

Unit: Yuan

year	Real rural average human capital	male	female
1985	21,856	22,781	20,843
1986	22,018	23,411	20,490
1987	22,269	23,891	20,489
1988	22,517	24,726	20,079
1989	22,655	25,186	19,850
1990	22,921	26,027	19,475
1991	23,409	27,315	19,077
1992	24,160	28,501	19,346
1993	25,728	30,873	20,020
1994	27,499	33,028	21,370
1995	28,340	34,453	21,590
1996	30,256	36,887	22,924
1997	32,607	39,668	24,755
1998	34,199	41,799	25,705
1999	36,332	44,350	27,320
2000	38,896	47,442	29,228
2001	41,135	49,997	31,163
2002	43,461	52,399	33,438
2003	46,493	55,511	36,416
2004	50,040	59,077	39,968
2005	55,208	64,353	45,059

2006	59,796	67,846	50,821
2007	66,164	73,340	58,117
2008	66,125	73,086	58,257
2009	65,942	72,674	58,272
2010	65,829	72,348	58,349
2011	65,885	72,185	58,599
2012	65,770	71,919	58,611
2013	65,891	71,965	58,779
2014	65,958	72,042	58,816
2015	65,951	72,252	58,579
2016	66,083	72,592	58,485
2017	66,033	72,699	58,254
2018	66,513	73,133	58,729
2019	67,170	73,361	59,756
2020	67,255	72,656	60,603

Note: The results are for five education categories.

Table C.8 Rural real average human capital, 2000-2020

Unit: Yuan

year	Real rural average human capital	male	female
2000	38,904	47,452	29,232
2001	41,145	50,010	31,169
2002	43,474	52,417	33,446
2003	46,512	55,533	36,429
2004	50,067	59,109	39,989
2005	55,248	64,398	45,094
2006	59,854	67,906	50,877
2007	66,248	73,421	58,205
2008	66,220	73,175	58,358
2009	66,047	72,772	58,385
2010	65,945	72,455	58,475
2011	66,011	72,301	58,738
2012	65,907	72,043	58,763
2013	66,039	72,098	58,945
2014	66,118	72,185	58,995

year	Real rural average human capital	male	female
2015	66,121	72,404	58,770
2016	66,265	72,754	58,689
2017	66,226	72,871	58,471
2018	66,718	73,316	58,960
2019	67,388	73,554	60,005
2020	67,486	72,857	60,870

Note: The results are for six education categories.

Table C.9 Deflators used to adjust human capital

Year	CPI（1985=100）		Deflator for fixed capital formation (1952=1) (Zhang 2004)	Deflators of fixed assets (2000=100) (Holz 2006)
	Urban	Rural		
1985	100.00	100.00	1.28	34.6
1986	107.00	106.10	1.362	36.82
1987	116.39	112.70	1.434	38.75
1988	140.46	132.40	1.628	43.99
1989	163.34	157.90	1.766	47.73
1990	165.42	165.10	1.863	50.35
1991	173.85	168.90	2.021	55.13
1992	188.82	176.80	2.284	63.56
1993	219.23	201.00	2.856	80.47
1994	274.07	248.00	3.152	88.84
1995	320.12	291.40	3.34	94.08
1996	348.29	314.40	3.474	97.84
1997	359.09	322.30	3.533	99.51
1998	356.93	319.10	3.526	99.31
1999	352.31	314.30	3.512	98.91
2000	355.14	314.00	3.5506	100
2001	357.60	316.50	3.564802	100.4
2002	354.02	315.20	3.571932	100.6
2003	357.23	320.20	3.650515	102.81
2004	369.00	335.60	3.854943	
2005	374.89	343.00	3.916622	
2006	380.48	348.10	3.975372	
2007	397.62	366.90	4.130411	

Appendix D Calculation and selection of growth rate and discount rate

According to the income-based approach, human capital is computed from the discounted lifetime income.[46] In order to evaluate the lifetime income of a country, we need to estimate the lifetime income and adjust it by the survival rate. The future income of an individual with known gender and educational level is based on the average income of the group with the identical personal characteristics as this particular individual, and we must take into account the annual growth rate of real income.[47] We then convert the future income into current value according to the discount rate. Since we build the human capital indices for urban and rural areas separately, we use different growth rates and discount rates for urban and rural areas.

1. Growth Rates

1.1 Growth rate of real income

The growth rates of real annual income are reported in the series of the *China Statistical Yearbook* published by National Bureau of Statistics of China. For urban areas, the average wage index divided by 100 is the growth rate of real wage. The wage only includes labor wage, which is defined as the average labor wage adjusted by inflation rate. 'Labor' refers to 'those who work in or get paid from the state-owned, urban collective,

---

[46] Jorgenson, Dale W. and Barbara M. Fraumeni (1992b), "The Output of the Education Sector," in Z. Griliches, T. Breshnahan, M. Manser, and E. Berndt (eds.), The Output of the Service Sector, Chicago, NBER, 1992, pp. 303-341

[47] Jorgenson, D. W. and K - Y. Yun (1990). "Tax Reform and U.S. Economic Growth", *Journal of Political Economy*98: pp.S151-193.

joint venture, joint-stock, foreign and Hong Kong, Macao and Taiwan invested in other units and its subsidiary bodies.' The average wage index 'reflects the relative change of real wage, indicating the degree that the level of real wage increases or decreases.[48] The calculation of average growth rate of real wage is given in Table D.1. Table D.1 shows the average growth rate is 7.09% over the period of 1978 – 2007; the trend of past thirty years is reported in Figure D.1.

For rural areas, we adopt, in general, the net income to evaluate the income status of farmers. According to the *China Statistical Yearbook*, 'net income' refers to 'the summed income from all sources deducted from the corresponding expenses'. The calculation formula is 'net income = total income – tax and fees – household operation expenses – depreciation of fixed assets used in productive activities – gifts to relatives.' The average net income of farmers is 'the level of net income with regards to the population, indicating the mean income of a region or a resident in a rural household.[49] After taking out the inflation effect, we find that the growth rate of net per cap income in rural areas is 6.34% from 1978 - 2007.

The above calculations, urban or rural, have obvious shortcomings: for urban areas, the wage is one of all possible sources of income, this method therefore is not comprehensive; for rural areas, the net income per cap includes all the family members in the household, thus it is not an accurate measure of the growth rate of productivity.

1.2 Growth rate of labor productivity

Harrod-Neutral model assumes the production function：

$$Y=F(K, A(t)\cdot L(t))$$

$$A(t)=A_0e(\theta t)$$

[48] All definitions here come from National Statistical Yearbook.

[49] National Bureau of Statistics of China, China Statistical Yearbook 2008, Website: http://www.stats.gov.cn/tjsj/ndsj/2008/indexch.htm.

$$L(t)=L_0e(nt)$$

Where A(t) is the measure of technological progress, A>0 and dA/dt>0. θ is the natural growth rate and n is the population growth rate. At the steady state, the growth rate of labor productivity (Y/L) and of real wage (w) equal to θ . Thus, Harrod-Neutral model provides the theoretical support the statement that we can use the growth rate of labor productivity to predict the future income.[50]

The real GDP is calculated as follows:

Real GDP = 1978 Nominal GDP * Real GDP Index (base = 1978)

Thus, the growth rate of labor productivity is calculated as follows:

Labor productivity = (1978 Nominal GDP * Real GDP Index)/ Employment Growth rate of labor productivity for year *t* = ln (Labor productivity for year *t*) - ln (Labor productivity for year *t*-1)

According to the above method, the growth rate of labor productivity is 7.09% (Table D.1).

In order to calculate the rural and urban growth rate of labor productivity, we use primary industry for rural areas and secondary and tertiary industries for urban areas.

Labor productivity of agriculture is calculated as follows:

Labor productivity of Agriculture = Real GDP of Agriculture/Employment of Agriculture

Real GDP is calculated in the same way. The rural and urban growth rate of labor productivity is 4.11% and 6.00% respectively.

Some research uses the growth rate of GDP per capita as the urban growth rate of labor productivity,[51] which is far greater than our estimation.

---

[50] http://homepage.newschool.edu/het/essays/growth/neoclass/solowtech.htm

[51] Xu Xunchuan (2008), "The analysis of labor productivity's impact on employment." *Contemporary Finance & Economics* 10: pp.17-22

Since they use population instead of employment, their method is less accurate.

Following the above calculation, we draw the trend graph to show the change of the growth rate of labor productivity, the growth rate of real wage, and the rural and urban growth rate of labor productivity (Figure D.1 and D.2). As shown in Figure D.1, although the mean values of the growth rate of labor productivity and real wage are close, the growth rate of real wage varies dramatically. This fact indicates the statistical data is not stable across time. In Figure D.2, we notice that the rural growth rate is constantly lower than the urban growth rate. One possible reason is that service and industry have grown faster than agriculture during the past thirty years.

In conclusion, we choose 4.11% and 6.00% to estimate the lifetime income. After thirty years of economic transition, China's average growth rate is close to steady-state. In future research, we will apply time-varying growth rate to reflect the transformation of the economic structure.

1.3 International Comparison

According to the Bureau of Labor Statistics in United States, the labor productivity estimates are 1.5% (U.S. 1979-2007), 2.0% (Japan), and 4.3% (North Korea). OECD use GDP per hour worked to measure labor productivity: 1.62% for U.S. from 1979 to 2007, 2.61% for Japan, and 5.29% for South Korea (Data for 1978 and 1979 are missing). The difference is due to the disparity of the length of working hours in each country. In addition, the labor productivity of Taiwan increased significantly: 7.38% during the period of 1953 – 1961, 9.15% during the period of 1962 – 1971, and 3.84% during the period of 1972 -1981.[52] The United States Bureau of Labor Statistics also published labor productivity in the

[52] Zhang Yushan(1987), "The comparison of labor productivity of Tiwan and South Korea." *Asia-pacific Economic Review* 6

non-agriculture sector: 1.4%-1.5% from 1979-1995 and 2.5% from 1995-2008.[53]

2. Discount Rate

Discount rate reflects the time value of currency and is computed from the long-term rates of return. We use the average rate of return of long-term government bond as our discount rate. We choose the 10-year government bond (1996-1997) and use its average interest rate. After taking out average inflation, the discount rate reported in Table D.3 is 3.14%. This is lower than the U.S. discount rate of 4.58%.[54]

Tables and figures of appendix D

Table D.1 Growth Rate in China, 1978-2007

Year	Nominal GDP (100 million)	Real GDP Indices (1978 =100)	Real GDP (100 million)	Employed Person (10 thousand)	Labor Productivity (Yuan Per Person)	National Labor Productivity	Average Real Wage Growth Rate
1978	3645.22	100.00	3645.22	40152	907.85		
1979	4062.58	107.60	3922.25	41024	956.09	0.0518	0.0670
1980	4545.62	116.01	4228.75	42361	998.26	0.0432	0.0610
1981	4891.56	122.09	4450.47	43725	1017.83	0.0194	-0.0110
1982	5323.35	133.15	4853.54	45295	1071.54	0.0514	0.0150
1983	5962.65	147.60	5380.29	46436	1158.65	0.0782	0.0140
1984	7208.05	170.00	6196.81	48197	1285.72	0.1041	0.1470
1985	9016.04	192.89	7031.28	49873	1409.84	0.0922	0.0530
1986	10275.18	209.95	7653.29	51282	1492.39	0.0569	0.0830
1987	12058.62	234.27	8539.80	52783	1617.91	0.0808	0.0100
1988	15042.82	260.70	9503.13	54334	1749.02	0.0779	-0.0080

[53] http://data.bls.gov/PDQ/servlet/SurveyOutputServlet and http://www.bls.gov/fls/#tables

[54] Jorgenson, D. W. and K – Y. Yun (1990). “Tax Reform and U.S. Economic Growth”, *Journal of Political Economy*, 98: S151-193.

Year	Nominal GDP (100 million)	Real GDP Indices (1978 =100)	Real GDP (100 million)	Employed Person (10 thousand)	Labor Productivity (Yuan Per Person)	National Labor Productivity	Average Real Wage Growth Rate
1989	16992.32	271.29	9889.27	55329	1787.36	0.0217	-0.0480
1990	18667.82	281.71	10268.92	64749	1585.96	-0.1195	0.0920
1991	21781.50	307.57	11211.50	65491	1711.91	0.0764	0.0400
1992	26923.48	351.37	12808.09	66152	1936.16	0.1231	0.0670
1993	35333.92	400.43	14596.65	66808	2184.87	0.1208	0.0710
1994	48197.86	452.81	16506.00	67455	2446.96	0.1133	0.0770
1995	60793.73	502.28	18309.27	68065	2689.97	0.0947	0.0380
1996	71176.59	552.55	20141.76	68950	2921.21	0.0825	0.0380
1997	78973.03	603.92	22014.35	69820	3153.01	0.0764	0.0110
1998	84402.28	651.23	23738.81	70637	3360.68	0.0638	0.0720
1999	89677.05	700.85	25547.66	71394	3578.40	0.0628	0.1310
2000	99214.55	759.95	27701.66	72085	3842.92	0.0713	0.1140
2001	109655.17	823.02	30000.98	73025	4108.32	0.0668	0.1520
2002	120332.69	897.77	32725.69	73740	4437.98	0.0772	0.1550
2003	135822.76	987.78	36006.57	74432	4837.51	0.0862	0.1200
2004	159878.34	1087.39	39637.85	75200	5270.99	0.0858	0.1050
2005	183217.40	1200.84	43773.17	75825	5772.92	0.0910	0.1280
2006	211923.50	1340.70	48871.43	76400	6396.78	0.1026	0.1271
2007	249529.90	1500.70	54703.78	76990	7105.31	0.1050	0.1360

Data Source：

1. Total employed person and average real wage growth rate of 1978-1990: 55 year's data of New China, Department of Comprehensive Statistics of National Bureau of Statistics of China, Beijing, China Statistics Press, 2005, P118-P119.
2. Other data: National Bureau of Statistics of China, China Statistical Yearbook 2008, Table 2-1, 2-2, 4-3, 4-23.

Website: http://www.stats.gov.cn/tjsj/ndsj/2008/indexch.htm.

Note:

1. Indices of Gross Domestic Product (1978=100)：Real GDP index is the multiple of nominal GDP based on base GDP, which is calculated based on constant price. Here the base year indicates 1978.

2. Employed Persons refers to persons aged 16 and over who are engaged in gainful employment and thus receive remuneration payment or earn business income.
3. Average real wage growth rate equals to indices of average real wage growth rate (preceding year=100) divided by 100. Average real wage of staff and workers refers to the average wage of staff and workers after removing the effects of the price changes. Average real wage indices of staff and workers refers to the change of real wage, which reflects the relative increasing or decreasing level of real wage of staff and workers. Here wage only indicates wage of staff and workers; staff and workers refer to persons working in, and receive payment from units of state ownership, collective ownership, joint ownership, share holding ownership, foreign ownership, and ownership by entrepreneurs from Hong Kong, Macao, and Taiwan, and other types of ownership and their affiliated units.
4. Real GDP=Nominal GDP of 1978 * Indices of GDP(1978=100)
5. Labor Productivity Growth Rate= Ln (Labor Productivity of year *t*) - Ln (Labor Productivity of year *t*-1).

Table D.2 Growth rate of labor productivity of urban and rural sector

Year	Labor Productivity Growth Rate in Rural Sector				Labor Productivity Growth Rate in Urban Sector			
	Real GDP of Primary Industry (100 million)	Total Employed Persons of Primary Industry (10 thousand)	Labor Producti-vity of Primary Industry (Yuan Per person)	Labor Productivity Growth Rate of Primary Industry	Real GDP of Secondary and Tertiary Industry (100 Million)	Total Employed Persons of Secondary and Tertiary Industry (10 Thousand)	Labor Productivity of Secondary and Tertiary Industry (Yuan Per Person)	Labor Productivity Growth Rate of Secondary and Tertiary Industry
1978	1027.53	28318	362.86		2617.68	11835	2211.81	
1979	1090.21	28634	380.74	0.0481	2829.36	12391	2283.40	0.0319
1980	1074.39	29122	368.93	-0.0315	3141.99	13239	2373.29	0.0386
1981	1149.41	29777	386.01	0.0453	3285.95	13948	2355.86	-0.0074
1982	1281.93	30859	415.42	0.0734	3550.37	14436	2459.38	0.0430
1983	1388.66	31151	445.78	0.0706	3978.19	15285	2602.68	0.0566
1984	1567.53	30868	507.82	0.1303	4624.06	17329	2668.39	0.0249
1985	1596.43	31130	512.83	0.0098	5475.72	18743	2921.47	0.0906
1986	1649.41	31254	527.74	0.0287	6072.21	20027	3032.01	0.0371
1987	1727.00	31663	545.43	0.0330	6918.75	21121	3275.77	0.0773
1988	1770.94	32249	549.15	0.0068	7888.05	22085	3571.68	0.0865
1989	1825.40	33225	549.41	0.0005	8231.92	22105	3724.01	0.0418
1990	1959.16	38914	503.46	-0.0873	8467.07	25835	3277.37	-0.1278
1991	2006.18	39098	513.12	0.0190	9482.73	26393	3592.90	0.0919
1992	2100.49	38699	542.78	0.0562	11189.03	27453	4075.70	0.1261
1993	2199.24	37680	583.66	0.0726	13114.80	29128	4502.47	0.0996
1994	2287.22	36628	624.45	0.0675	15207.21	30827	4933.08	0.0913
1995	2401.60	35530	675.94	0.0792	17122.74	32535	5262.87	0.0647
1996	2524.11	34820	724.90	0.0699	19053.79	34130	5582.71	0.0590
1997	2612.44	34840	749.84	0.0338	21064.22	34979	6021.96	0.0757
1998	2703.85	35177	768.64	0.0248	22906.61	35460	6459.84	0.0702
1999	2779.56	35768	777.11	0.0110	24853.24	35626	6976.15	0.0769
2000	2846.27	36043	789.69	0.0161	27220.98	36042	7552.57	0.0794

2001	2925.97	36513	801.35	0.0147	29670.32	36512	8126.18	0.0732
2002	3010.82	36870	816.61	0.0189	32643.08	36870	8853.56	0.0857
2003	3086.09	36546	844.44	0.0335	36457.69	37886	9623.00	0.0833
2004	3280.52	35269	930.14	0.0967	40391.58	39931	10115.34	0.0499
2005	3452.11	33970	1016.22	0.0885	44969.25	41855	10744.06	0.0603
2006	3624.72	32561	1113.21	0.0912	50683.62	43839	11561.31	0.0733
2007	3758.72	31444	1195.37	0.0712	57342.36	45546	12589.99	0.0852

Data Source:

1. The data come from National Bureau of Statistics of China, China Statistical Yearbook 2008, Table 2-1、2-2、4-3. Website：http://www.stats.gov.cn/tjsj/ndsj/2008/indexch.htm.

Note:

1. Because of data accessibility and statistical accuracy, we use labor productivity of primary industry to measure labor productivity of rural sector, and use labor productivity of secondary and tertiary industry to measure labor productivity of urban sector, although there exist some primary industry in urban sector, secondary and tertiary industry in rural sector.Primary industry refers to agriculture, forestry, animal husbandry and fishery and services in support of these industries. Secondary industry refers to mining and quarrying, manufacturing, production and supply of electricity, water and gas, and construction. Tertiary industry refers to all other economic activities not included in the primary or secondary industries.
2. Indices of Gross Domestic Product (1978=100) :Real GDP index is the multiple of nominal GDP based on base GDP, which is calculated based on constant price. Here, the base year indicates 1978. Real GDP=Nominal GDP of 1978 * Indices of GDP (1978=100)
3. Labor Productivity Growth Rate= Ln (Labor Productivity of year *t*) - Ln (Labor Productivity of year *t*-1).
4. In some years, the sums of employed person in three industries in table 2 are more than total employed person in table 1; in some other years, it is the opposite. The reason might be round off.
5. The article calculates the real GDP in the form of multiplication of real GDP indices and base GDP. The Statistical Bureau publishes the national and industrial real GDP indices (base year=1978) in the yearbook. It is possible that the summation of three industries' real GDP is unequal to the national real GDP due to the inconsistent GDP growth in different industries.

Table D.3 Discount rate

Year	Ten-year Bond Rate（%）	Average Ten-year Bond Rate (%)	Inflation Rate (%)	Discount Rate (%)
1996	11.83	11.83	8.31	3.52
1997	9.78	9.78	2.79	6.99
1998	5.50	5.50	-0.79	6.29
1999	3.33	3.33	-1.41	4.74
2000	2.87	2.87	0.42	2.45
2001	2.95	3.00	0.69	2.31
	3.05			
2002	2.54	2.54	-0.80	3.34
2003	3.02	3.02	1.20	1.82
2005	4.44	4.44	1.80	2.64
2006	2.80	2.86	1.51	1.35
	2.92			
2007	3.40	3.90	4.80	-0.90
	4.40			
Average Discount Rate：				**3.14**

Data Source:

1. Individual-oriented ten-year treasury bond: China Financial Association, China Financial Yearbook 1997-2008, China Financial Yearbook Editorial, table 1.4.2
   China Securities Regulatory Commission:
   http://www.csrc.gov.cn/n575458/n4239016/n4239073/n9321343/n9321457/9334474.html (data of 1999)
   http://www.csrc.gov.cn/n575458/n4239016/n4239073/n8913123/n8913221/9332062.html (data of 2000)
   http://www.csrc.gov.cn/n575458/n4239016/n4239073/n8876669/n8876824/8881333.html (data of 2001)
2. Consumer Price Index:
   National Bureau of Statistics of China (NBS),China Statistical Yearbook 2008,table 8-2.
   Website:http://www.stats.gov.cn/tjsj/ndsj/2008/indexch.htm;
   Department of Comprehensive Statistics of NBS,"55-year Data Collection Since the Establishment of New China" Beijing,China Statistics Press,2005,page84 to page85.

Note:

1. Inflation rate = (year *t* price level – year *t*-1 price level)/year *t*-1price level.
   The price level here is the CPI based on 1978.
2. Discount rate=Individual-oriented ten-year treasury bond rate - inflation rate rate.

3. In 2001, the government issued ten-year account treasury bond targeted at all sorts of investors :

   ten-year treasury bond: 2.95%   twelve-year treasury bond: 3.05%

4. In 2006, the government issued ten-year treasury bond targeted at all banks/exchange: (bonds can be purchased by individuals).

   three-year treasury bond: 2.80%   sixteen-year treasury bond：2.92%

5. In 2007, the government issued ten-year treasury bond targeted at all banks/exchange: (bonds can be purchased by individuals).

   three-year treasury bond: 3.40%   ten-year treasury bond：4.40%

Figures of appendix D

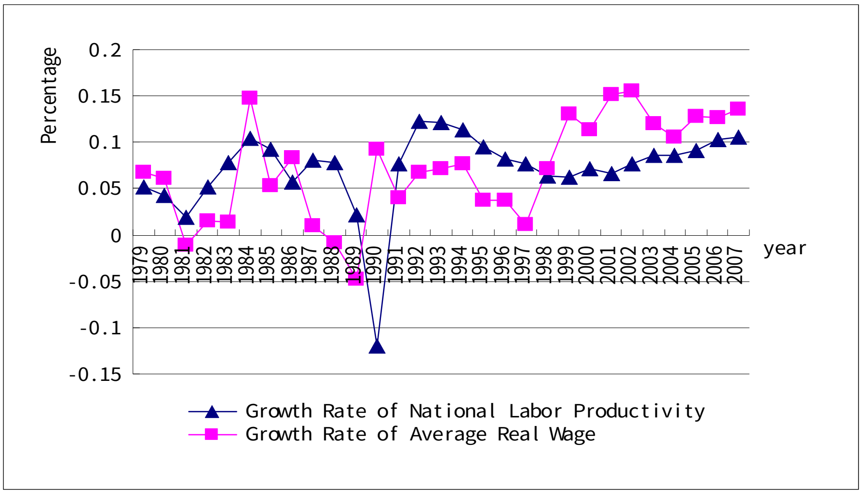


Figure D.1 Growth rate of national labor productivity and average real wage

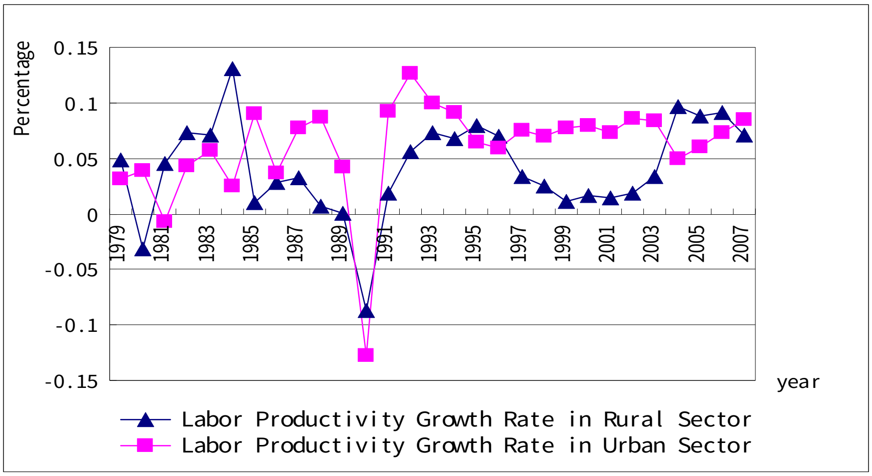


Figure D.2 Growth rate of labor productivity in urban and rural sectors

Appendix for provincial human capital calculation

See the Chinese version report.