China Human Capital Report Series

Human Capital In China

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China Center for Human Capital and Labor Market Research

Central University of Finance and Economics

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Human Capital in China

Principal Investigator

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A Brief Introduction to

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 at the CUFE. 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 at the Harvard University.

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

Faculty members and research fellows of the CHLR all hold U.S. Ph.D. degrees in economics and some 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. Since 2008, the CHLR has admitted 46 Master's students, 6 doctoral students, and 1 post-doctoral fellow.

The Center is first and foremost an international research institution. We have a team of international scholars and train graduate students to international standards. We also adopt international management practices in the Center's daily operation. Faculty performance is evaluated using standards similar to those commonly adopted by research universities in the United States.

China's Human Capital Project and Its Social Impact

The research project, "China's Human Capital: Measurement and Index Construction," is conducted by the China Center for Human Capital and Labor Research Center (henceforth the Center) and funded by the National Natural Science Foundation of China and the Central University of Finance and Economics. The project aims to establish China's first scientific and systematic human capital index, quantitatively describe China's human capital distribution, trend and dynamics. It constructs important measurements for further evaluating human capital and its contribution to economic development, and provides policy-makers with important data. The measurement has become a part of the international human capital index system, and joined the effort of eventually incorporating human capital into the national income and product accounting.

The project is led by the Director of the Center, Prof. Haizheng Li. The research team includes Prof. Barbara Fraumeni (a la Jorgenson-Fraumeni method of human capital calculation), other full-time and special-term professors, graduate students, and administrative staff at the Center. Since the inaugural issue of China Human Capital Report in 2009, the project has generated great social impact, and drawn attention of academia and government both at home and abroad.

- Part of the project report is a chapter in *The Changing Wealth of Nations* by the World Bank (2010. Washington, DC: World Bank).
- An English version academic paper of the project report is a National Bureau of Economic Research (NBER) working paper (http://papers.nber.org/papers/w15500).
- A Chinese version academic paper of the project report was published in the top journal in economics, *Economic Research* (2010, vol. 8), in China.
- The sub-report on Beijing from the project has been included in 2010 *Beijing Human Capital Blue Book* published by the Beijing Municipal Department of Organization, Human Capital Research Center.
- In August 2010, Prof. Haizheng Li was invited to speak on China's human capital measurement in the plenary session of the 31st meeting of the

International Association for Research in Income and Wealth (http://www.IARIW.org).

- On November 16, 2010, Prof. Haizheng Li was invited by the Lisbon Council to speak in the "High-level Working Group on Skills and Human Capital" in Brussels. The speech is titled "Measuring Human Capital in China."
- The Center is invited to join the European Union "Lifelong Learning" research project. The project has eight research teams from different countries/regions.
- OECD Director of Statistics Directorate Mr. Paul Schreyer has officially made the recommendation to China National Bureau of Statistics minister Mr. Jiantang Ma that Prof. Haizheng Li and the Center's research team should participate in the OECD human capital consortium as China's officially designated representative.
- State Councilor Yandong Liu praised the Center's achievement when she visited CUFE in Oct. 2009. She concluded "China is in a transition from a country with huge population to a country with strong human capital, therefore it is very important to conduct research in China's human capital."
- China Ministry of Education requested Center's 2009 research report. Meanwhile, the special adviser to the Ministry of Organization has also submitted the part of the human capital report for the Second National Meeting on Talents as supplementary materials.
- The Office of Planning of the "Twelfth Five-Year Plan" in the Ministry of Education has invited the Center's research team to conduct a special project on the contribution of education investment on economic growth.
- The Director of the Center, Prof. Haizheng Li, was invited by the Beijing Municipal Government, Department of Organization to preside over the "Beijing High Skill Talent Development Summit – Global City, Global Talent." The Center is also invited to be one of the co-organizers of the summit.
- Prof. Haizheng Li was invited to speak on the "Ford Class Experts Forum" organized by the Renmin University of China. The title of the speech is "China's human capital investment: current status and its contribution." Later on August 29, 2010, the *Jie-Fang Daily* newspaper published the speech.

Acknowledgement

We thank all the participants in a series of international symposiums on human capital hosted in CHLR since 2009 for their valuable suggestions. We are grateful for the comments and suggestions from scholars at other international and domestic conferences, as well as from anonymous referees.

We are especially grateful to Nobel Laureate Prof. Kenneth J. Arrow, and the founder of the income-based method for measuring human capital, Prof. Dale W. Jorgenson at the Harvard University, for their support to this project.

This research project and its related conferences have benefited tremendously from the supports of the administration at the Central University of Finance and Economics (CUFE). President Guangqian Wang and other university leaders 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 offices to ensure the success of the project and the conferences.

Many offices in the CUFE, such as the President's Office, Office of Research, Human Resources Office, Finance/Accounting Office, International Cooperation Office and Assets Management Office provided various administrative supports that facilitated this research. 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, offered strong support to the project. Last but not least, we greatly appreciate the help for our conferences from two Chinese academic journals – *Economic Research Journal* and *Labor Economics and Labor Relations*.

What's New in the 2011 Report

This report updates the 2010 Report in the following aspects:

- Revised the methodology for estimating national and provincial level Mincer model parameters for urban and rural areas by combining survey data and provincial statistical data. This new approach allows us to overcome the data shortage problem at the provincial level and makes it possible to estimate Mincer model and calculate human capital for all provinces.
- Added more survey data into our estimation of Mincer models (including CHIP 07 and CHNS 04, 06, 09)
- Calculated human capital for seven new provinces: Shanghai, Anhui, Shandong, Henan, Hubei, Hunan and Guizhou.
- Updated and extended previous human capital estimates at the national level and for five provinces, Beijing, Liaoning, Jiangsu, Guangdong and Gansu, by using revised methods and additional data sets, so that all provincial estimates are comparable.
- Added interprovincial comparison of human capital estimates.

Briefing Notes:

Abbreviations:

- Provinces:

GD=Guangdong	JS=Jiangsu	SD=Shandong
HeN=Henan	HB=Hubei	HuN=Hunan
AH=Anhui	SH=Shanghai	LN=Liaoning
BJ=Beijing	GZ=Guizhou	GS=Gansu

- HC: Human capital
- LFHC: Labor force human capital

Definitions and Clarifications:

- Total human capital: 16-55 for female; 16-60 for men
- Labor force human capital:

  Non-retired population aged 16 and over, not full-time students
- Growth rates:

  Use real values, calculated by the difference of logarithm
- Average growth rate: take arithmetic average of growth rates for different years
- Ratio of HC to GDP: use their current values
- Ratio of GDP to LFHC: use their current values

Contents

Executive Summary

Although the importance of human capital in economic growth and innovation is clearly recognized by academics and policy makers, constructing an accurate measure of human capital is still a difficult research agenda. It mainly is for the following three reasons: First, required data are hard to obtain; second, the characteristics of human capital make it quite hard to evaluate; and finally, the collecting, sorting and processing of the data is very time-consuming and challenging.

Considering the features of Chinese data, we adopted the widely used Jorgenson-Fraumeni lifetime income approach (hereafter referred to as the J-F approach) to calculate the stock of Chinese human capital. According to the human capital theories, we also modified the J-F approach to combine micro data with the macro data. This significantly improves the feasibility and rationality of applying the J-F approach to China. In this way, we constructed systematical measurement of Chinese human capital, and build various human capital indexes.

In this report we calculated and updated the national human capital stocks of China from 1985 to 2009. Total and per capita human capital are calculated for the same period by gender and for urban and rural areas. In addition, human capital stocks are estimated for 12 provinces: Beijing, Liaoning, Shanghai, Jiangsu, Anhui, Shandong, Henan, Hubei, Hunan, Guangdong, Guizhou and Gansu.

The main findings are summarized below (real values are calculated in 1985's currency and growth rates are calculated based on real values).

1. China's human capital reached 598.4 trillion Yuan in 2009. Urban and rural human capital was 428.7 and 169.7 trillion Yuan, respectively, accounting for 72% and 28% of the total human capital.
2. China's human capital increased at an average annual rate of 7.20%

during 1985-2009. This growth accelerated after 1995, with a growth rate of 2.26% for 1985-1994 and 10.16% for 1995-2009.

3. Per capita human capital reached 541.5 thousand Yuan in 2009. Urban and rural per capita human capital was 820.8 and 291.1 thousand Yuan, respectively. Male (Female) per capita human capital was 658.3 (410.3) thousand Yuan.
4. Per capital human capital almost quintuplicated during 1985-2009. Total human capital grew at a higher rate than per capita human capital before 1995 (2.26% and 1.10% average annual rate, respectively), but the two grew at more comparable rates after 1995 (10.16% and 9.91%, respectively); while population grew at an average annual rate of 1.38% before 1995 and 0.72% after 1995. Thus, the result suggests larger effects of education improvement and other factors besides population on human capital growth after 1995.
5. During 1985-2009, rural human capital grew at an average annual rate of 4.20%, but urban human capital grew at 9.66%. Growth rates in both urban and rural area accelerated since 1995 (13.19% and 6.01%, respectively for 1995-2009). Urban human capital exceeded rural human capital starting in 1996, and the gap is ever increasing.
6. Rural per capita human capital grew at an average annual rate of 5.16% during 1985-2009, while it was 6.18% in urban for the same period. Before 1995, the rural human capital per capita grew slightly faster than the urban area (0.70% and 0.65%, respectively). After that, however, the urban human capital per capita grew much faster than the rural area (9.51% and 7.83%, respectively). Clearly, the urban-rural gap in human capital rises quickly.
7. At the national level, the ratio between human capital and physical capital decreased rapidly before 1995 and then began to climb slowly, indicating a relatively higher growth rate of human capital relative to

physical capital in later years.

8. During 1985-2009, the ratio of labor force human capital (LFHC) including students to total human capital increased, indicating aging of population, in part due to the one child policy. However, the ratio of LFHC excluding students to total human capital decreased in the urban area but increased in the rural area. This phenomenon is likely caused by the rapidly growing share of students in the urban population due to expansion of education.
9. At the national level, the ratio of GDP to human capital shows an upward trend, suggesting increasing efficiency of human capital.
10. Human capital at the provincial level generally shows a similar trend to national human capital. However, since provinces differ in their population, education structure and the degree of market mechanism, their dynamics in human capital also show some differences.
11. Among the 12 provinces estimated, the top three provinces ranked by human capital stock in 2009 are Guangdong, Jiangsu and Shandong; and by human capita per capital are Shanghai, Jiangsu, and Beijing.
12. China has a large total human capital stock, but small per capita human capital, compared to developed countries. Therefore, there is still a long way to go before China will become a leading country in human capital, in spite of its large population.

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. An Organization for Economic Co-operation and Development (OECD) publication defines human capital as "The knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being" (OECD, 2001, page 18). Human capital has been called probably "the most important and most original development in the economics of education" in the second part of the 20th century (Coleman, 1990, page 304). In most countries, human capital accounts for more than 60% of the nation's wealth (World Bank, 1997).[1]

It is generally believed that human capital is an essential source of economic growth and innovation, and an important factor for sustainable development and reducing poverty and inequality (see, for example, Stroombergen et al., 2002, and Keeley, 2007). Detailed analyses of human capital accounts for Canada, New Zealand, Norway, Sweden, and the United States unanimously show that human capital is a key source of economic growth.[2] The Stiglitz Commission report noted the importance of human capital as a "beyond Gross Domestic Product" measure of economic and social progress.[3]

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[1] These World Bank wealth estimates include natural resources, physical capital and intangible capital, which is primarily human capital.

[2] 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).

[3] See Stiglitzet. al. (2009).

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, 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 1985 the largest population masses were concentrated in the “no schooling” and “primary school” categories (Figure 4.2.5). By 2009 the largest

population mass was concentrated in the "junior middle" school category (Figure 4.2.7). Developing comprehensive measures of human capital in China provides the necessary early work for constructing China's human capital account and 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 Jorgenson-Fraumeni (J-F) national human capital accounts. The U.S. Bureau of Economic Analysis has recently supported research on human capital (Abraham 2010 and Christian 2010). Statistics Canada (Gu and Wong 2008), the Australian Bureau of Statistics (Wei 2008), and Statistics Norway (Greaker and Liu 2008) have established similar research programs on the measurement of human capital using agency researchers. 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 joinedan OECD consortium to develop human capital accounts. A researcher from Statistics Norway, Gang Liu, has been at the OECD since October 2009 to coordinate this effort.[4] The work of this consortium will facilitate cross-country comparisons.

Another approach to estimating the impact of human capital has been undertaken by the Lisbon Council which is located in Brussels. The Lisbon Council European Human Capital Index has been constructed for the 13

[4] J-F human capital accounts have been constructed for several other countries independent of the consortium efforts. These countries include Argentina (Coremberg, 2010), New Zealand (Le, Gibson, and Oxley, 2005), and Sweden (Ahlroth and Bjorkland, 1997). O'Mahony and Stevens (2004) applied J-F methodology to evaluate government provided education in the United Kingdom.

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 and emerging 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 J-F method and its application and modifications for China. Chapter 4 states China's population and education dynamics. The estimated national results of human capital are reported in Chapter 5, Chapter 6 shows the cross-province comparison results, followed by the disaggregated human capital results for Beijing, Liaoning, Shanghai, Jiangsu, Anhui, Shandong, Henan, Hubei, Hunan, Guangdong, Guizhou 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 also often 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 method in The Lisbon Council's approach (2006);

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

(5) 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.[5] 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 the previous section 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.

When estimating lifetime income to calculate human capital, an important issue is that income (or implicit income) can be generated from both market and nonmarket 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

[5] 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 in China. But the income approach is the most commonly 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 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.

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.[6]

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

[6] Among the most recent human capital estimates, i.e., Mira and Liu (2010), Gu and Ambrose (2008), Greaker and Liu (2008) and Christian (2010), 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.

formal education costs include all types of expenditure, 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 J-F human capital estimate is substantially larger than Kendrick's.[7] 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 example, we may need to get

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

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.[8] 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.[9] As it has cost components

[8] 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.

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

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.[10]

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 as 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：

$$\ln\left(\frac{H}{L}\right)=\sum_{e}\sum_{a} w_{e,a}\,\ln\left(r_{e,a}\right) \qquad (1)$$

$$w_{e,a}=\frac{e^{\sum_{s}\left(b_s e+g_s Exp+d_s Exp^2\right)j_{s,a}}L_{e,a}}{\sum_{e}\sum_{a} e^{\sum_{s}\left(b_s e+g_s Exp+d_s Exp^2\right)j_{s,a}}L_{e,a}} \qquad (2)$$

where e and a denote years of formal schooling and age, respectively.

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

$r_{e,a} = L_{e,a} / L$ is the proportion of working age individuals of age a with e years of schooling. $w_{e,a}$ 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 $j_{e,a}$ 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.[11]

[11] 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 more 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 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 J-F Method and its application for China

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.[12] When it's applied to China, we made some modifications and assumptions about the method and parameters used accordingly.

3.1 Estimate lifetime income by backward recursion

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

$$mi_{y,s,a,e} = 0 \qquad (3)$$

where the subscripts y, s, a, and e denote respectively year, sex, age and

[12] 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.

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):

$$mi_{y,s,a,e} = ymi_{y,s,a,e} + sr_{y+1,s,a+1} \times mi_{y,s,a+1,e} \times \frac{1+G}{1+R} \qquad (4)$$

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):

$$mi_{y,s,a,e} = ymi_{y,s,a,e} + \left[senr_{y+1,s,a+1,e+1} \times sr_{y+1,s,a+1} \times mi_{y,s,a+1,e+1} + (1 - senr_{y+1,s,a+1,e+1}) \times sr_{y+1,s,a+1} \times mi_{y,s,a+1,e}\right] \times \frac{1+G}{1+R} \qquad (5)$$

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):

$$mi_{y,s,a,e} = \left[senr_{y+1,s,a+1,e+1} \times sr_{y+1,s,a+1} \times mi_{y,s,a+1,e+1} + (1 - senr_{y+1,s,a+1,e+1}) \times sr_{y+1,s,a+1} \times mi_{y,s,a+1,e}\right] \times \frac{1+G}{1+R} \qquad (6)$$

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

$$mi_{y,s,a,e} = sr_{y+1,s,a+1} \times mi_{y,s,a+1,e} \times \frac{1+G}{1+R} \qquad (7)$$

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:

$$MI(y) = \sum_{s} \sum_{a} \sum_{e} mi_{y,s,a,e} L_{y,s,a,e} \qquad (8)$$

Similar equations can be applied to estimate lifetime nonmarket labor

income[13], which can be added to lifetime market labor income to obtain total lifetime labor income:

$$LIFE(y) = \sum_{s}\sum_{a}\sum_{e}(mi_{y,s,a,e} + nmi_{y,s,a,e}) \cdot L_{y,s,a,e} \qquad (9)$$

3.2 Estimate current income using Mincer models

One important component of the income approach is the estimation of future potential earnings for all individuals in the population. With the J-F income-based approach, we first need data or estimates of individual's annual market labor income per capita. 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 2009.

The data used for estimating the parameters of the earnings equation come from three 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. The second data set we use is the China Health and Nutrition Survey (CHNS) for the years of 1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009. The third data set we use is the China Household Income Project (CHIP) for the years of 1988, 1995, 2002, 2007. The CHIP and CHNS cover both urban and rural population, while UHS only covers urban population.

[13] Nonmarket activities include household production, e.g., cooking, cleaning, and childrearing and other nonmarket activities such as education and health-related activities. In our calculation we exclude the nonmarket lifetime income because it is difficult to quantify.

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 old 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. Chinese Appendix B.3.1 provides a complete description of the income and education definition and sampling standards. Chinese Appendix Table B.1.1 lists the entire statistic descriptions.

CHIP is China Household Income Project survey, which reports income, consumption, job, production and other related information of urban and rural population. Chinese Appendix B.3.2 provides a complete description of the income and education definition and sampling standards. Chinese Appendix Table B.1.2 includes the entire statistic descriptions.

CHNS is an international project that aims to learn more about China transitional economy and society's impact on social economy, population and health behaviors in urban and rural areas. Chinese Appendix B.3.3 provides a complete description of the income and education definition and sampling standards. Chinese Appendix Table B.1.3 lists the entire statistic descriptions.

With these three data sets, we estimate the parameters of the Mincer

equation for each gender of the urban and rural population by year. If we have more than one data set for any year, we weighted the estimates by sampling size to get the parameter estimates for that year. Finally, we 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 and rural population for the period 1985 through 2009.

3.2.1 Estimate current income using Mincer models at the national level

We first estimate the basic Mincer equation:

$$\ln(inc) = a + b \cdot e + g \cdot Exp + d \cdot Exp^2 + u \qquad (10)$$

where ln*inc* is the logarithm of earnings, e is years of schooling, Exp 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 (10) has been 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 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.[14]

We use UHS, CHIP and CHNS to estimate parameters of the basic

[14] 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).

Mincer equation, and get the fitted values for the intercept, return to education, and experience related terms. More details about this parameter estimation are in the Chinese Appendix B Table B.1.4 and Table B.1.5. The constant term, which measures the base wage for the no-school, no-experience population, clearly reveals a male advantage. Chinese Appendix B Figure B.1.1 shows an evident gap between urban and rural population during 1985-2009, intercepts for urban are higher than rural ones, urban male has higher intercept than female, while the opposite is true for rural population. Returns to schooling are positive and in general increasing over the sample years. When the Soviet-type wage grid was replaced by market wages (Fleisher, Sabirianova, Wang 2005), 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. Figure 3.2.1-Figure 3.2.4 shows the measurement method and trend of the return to education for male and female in rural and urban areas. 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 but fluctuates for females. For most recent years the male profile doesn't curve downward as much as that of female, and the male profile is much higher than the female profile, indicating uniformly higher return to experience for male than for female, *ceteris paribus*.

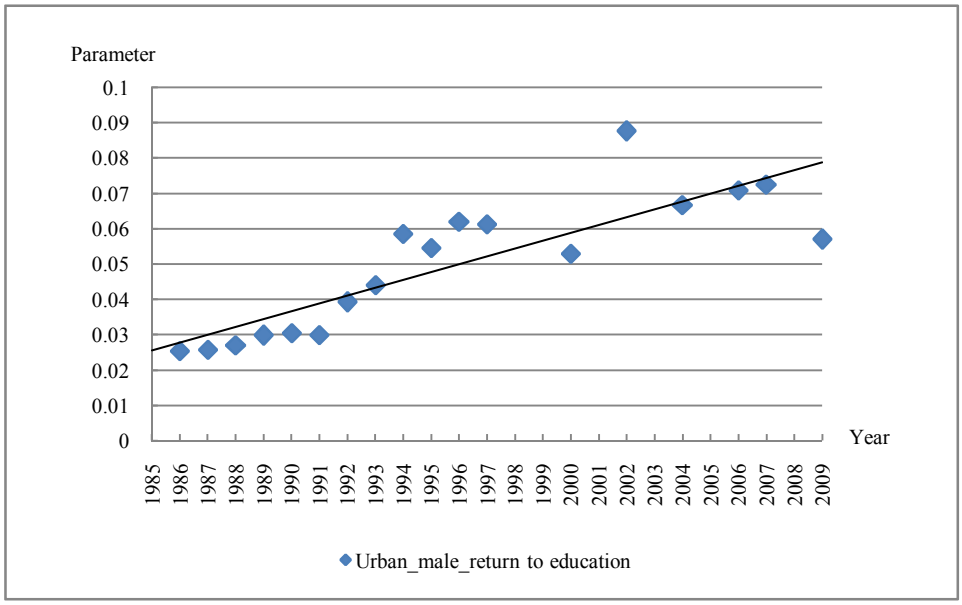


Figure 3.2.1 Return to Education for Urban Male

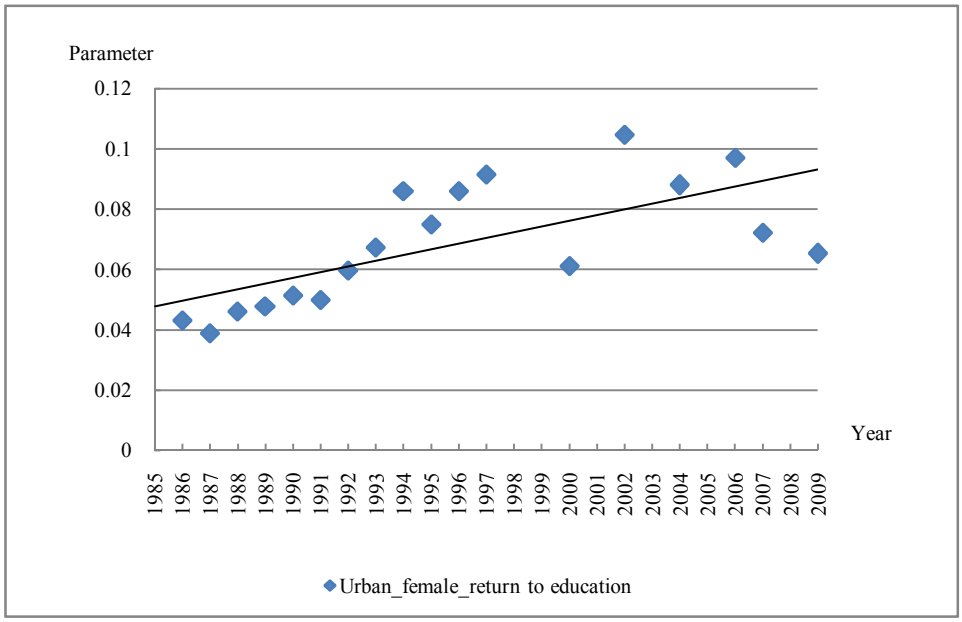


Figure 3.2.2 Return to Education for Urban Female

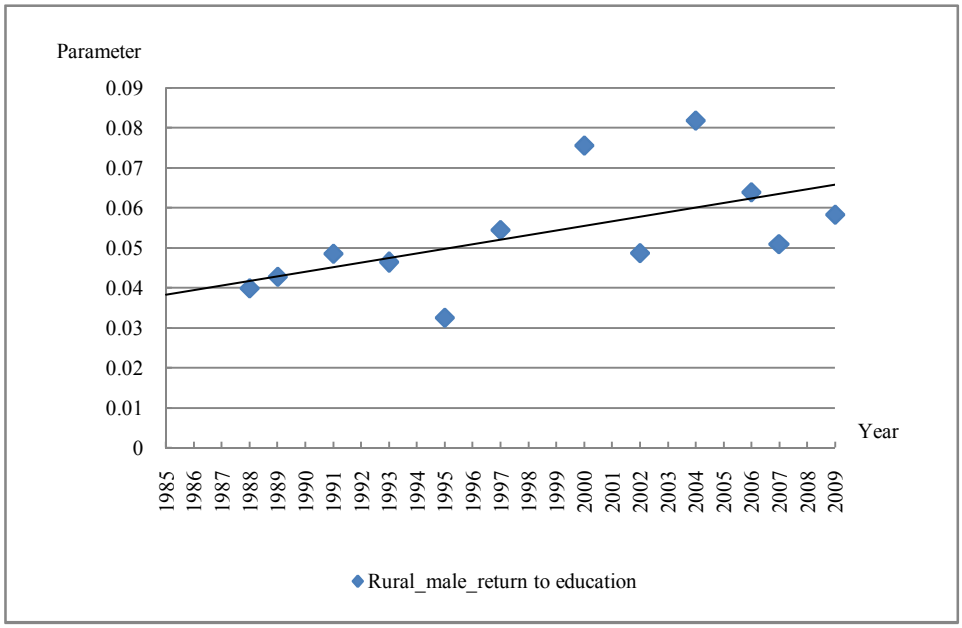


Figure 3.2.3 Return to Education for Rural Male

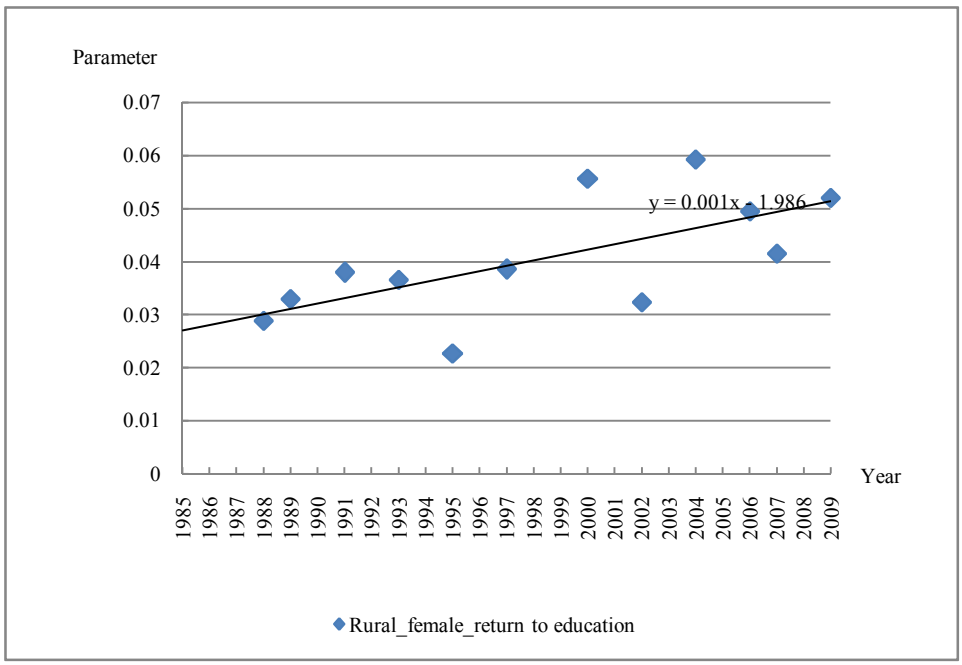


Figure 3.2.4 Return to Education for Rural Female

3.2.2 Estimate current income using Mincer models at the provincial level

As for the provincial level parameter estimation, on the base of Mincer equation, we implement macro data for adjustment. We estimate the following Mincer equation:

$$\ln(inc) = b_0 + b_1 \cdot \ln(Avwage) + b_2 \cdot Sch + b_3 \cdot Sch \cdot \text{A}vgdp + b_4 \cdot Sch \cdot Ratio + b_5 \cdot Exp + b_6 \cdot Exp^2 + m \quad (11)$$

where ln*inc* is the logarithm of earnings, *Sch* is years of schooling, *Exp* and Exp^2 are, respectively, years of work experience and experience squared, and *u* is a random error. *Avwage* represents the average employee nominal salary for the rural and urban population accordingly. It could reflect income gap between different provinces to some extent. *Avgdp* stands for nominal GDP per capita. *Ratio* means the primary industry employment ratio of the total working population. The parameters of *SchAvgdp* and *SchRatio* could reflect the job market situation of the educated population. We add *Avwage* into the intercept term, add *Avgdp* and *Sch* as an interaction term, add the first industry employment ratio of the total working population and *Sch* as an interaction term into the equation. Adding these additional variables into the conventional Mincer equation not only makes full use of the existing data and helps solve the missing data problem in parameter estimations, it also makes the estimation results more realistic.

In the model, $b_0 + b_1 \cdot \ln(Avwage)$ is the logarithm of the base wage for the no-school, no-experience population. $b_2 + b_3 \cdot Avgdp + b_4 \cdot Ratio$ represents return to education, b_5 and b_6 measure the return to experience. For Shanghai, it only has urban parameter estimates. Moreover, we assume male has different return to experience for urban and rural areas, but shares the same parameter for *Exp* and Exp^2 across all provinces, this is the same case for female.

Like national Mincer parameter estimation, provincial data used for estimation also comes from UHS, CHIP and CHNS. We use ordinary least squares to estimate equation (11). When all three data sets are available for a sample year, we drop CHNS and use UHS and CHIP estimates because of the relatively low quality of CHNS income measures, then they are weighted by respective sample size for larger sample size will make estimates closer to the real value. We adopt the same sampling standards as in the national estimation. We use the fitted trend lines to generate imputed values of the parameters for each gender by year over the period 1985 to 2009. Graphs show that when we plot each of the parameter estimates against time, they are generally trended. We adopt the linear trend model to get the fitted values for parameter, that is $Y = a_0 + a_1 \times time + m$. Under the assumption that the effect of *Avwage*, *Sch*, *Exp*, Exp^2 on income growth grows at a fixed rate, we use the linear trend fitting method for all the parameters.

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.[15] 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.

[15] 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.

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 and discount these incomes back to the present. We use the following method to estimate the real income growth rates for urban and rural areas respectively.[16]

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

$$Y = (AL)^a K^b \qquad (12)$$

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.[17] 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 real wage.

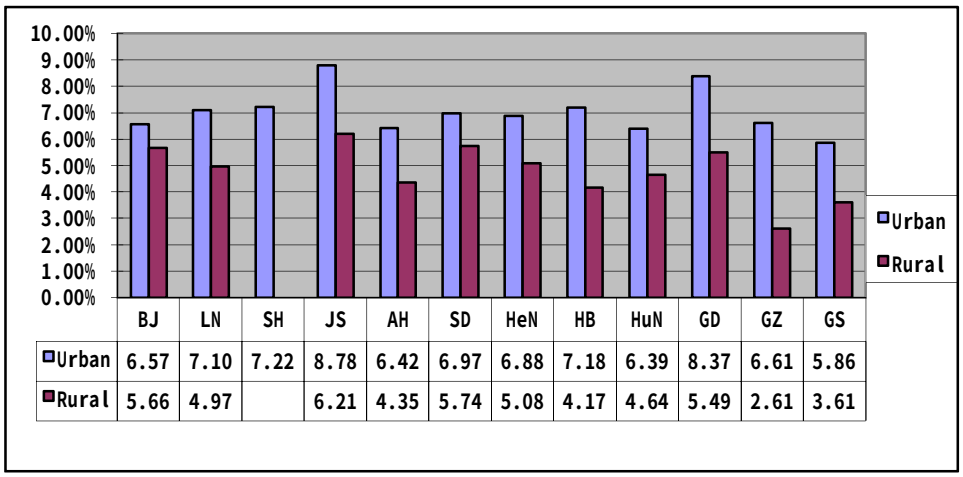
The labor productivity for the rural sector is calculated using real GDP of the primary industry divided by the number of workers in that industry; and for the urban sector we use real GDP of the secondary and tertiary industries divided by the number of workers in these industries. The result shows that, for the 30-year period 1978-2009, labor productivity grew on average 4.33% and 6.14% per annum in the rural and urban sectors, respectively. Those

[16] In China, there are also growth rates of real annual income in urban areas reported in the series of the *China Statistical Yearbook*, but this income only includes labor wage for those who work in or get paid from the state-owned, urban collective, joint venture, joint-stock, foreign and Hong Kong, Macao and Taiwan invested companies and their subsidiaries. This cannot reflect the overall income level in China, because Chinese enterprises have other ownership forms.

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

growth rates will be used in the J-F calculation.[18]

We use the same method to calculate the provincial income growth rates for Beijing, Liaoning, Shanghai, Jiangsu, Anhui, Shandong, Henan, Hubei, Hunan, Guangdong, Guizhou, and Gansu, their growth rates for urban and rural areas are shown in Figure 3.3.1. We assume that provincial labor productivity (real income) grows at a fixed annual rate.



	BJ	LN	SH	JS	AH	SD	HeN	HB	HuN	GD	GZ	GS
Urban	6.57	7.10	7.22	8.78	6.42	6.97	6.88	7.18	6.39	8.37	6.61	5.86
Rural	5.66	4.97		6.21	4.35	5.74	5.08	4.17	4.64	5.49	2.61	3.61

Figure 3.3.1 Provincial Income Growth Rate

3.3.2 The discount rate

The discount rate that is used to value future incomes into present terms should reflect the rate of return one expects from investments over a long time horizon. We adopt the discount rate of 4.58% which is also used by Jorgenson and Fraumeni (1992a). 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

[18] 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.

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%[19]; the average benchmark lending rate over 5 years in China from 1996 to 2009, 5.51%;[20] and the social discount rate based on the method from the World Bank, 8.14%.[21]

3.3.3 The deflators

In order to convert nominal human capital into real human capital, we use price deflators. For national human capital, we use the CPI for urban and rural, deflator for fixed capital formation in Zhang, Wu and Zhang (2004) and deflators of fixed assets in Holz (2006), But for provincial estimates, we use two 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 .

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

Besides annual population data by age, sex, and educational attainment, the J-F method requires additional information on the lifetime income,

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[19] The details could be found in the *China Human Capital Index Analysis Report* 2009 Version. However, although the ideal discount rate should include 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 and found that the difference of the results are minor.

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

[21] We calculated the average growth rate of individual consumption 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 economic growth in China, both from the 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.

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.

Following J-F as previously described, 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 previous 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 where we break down college and above into college (less than 4 years) and university (at least 4 years) 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 estimation college and above is the highest education level. For the

six categories of schooling estimation college or university and above are the highest education levels. We do not allow for the possibility that one can go to college and then to university.

Because data is not available for some age groups and some education levels, additional imputations and assumptions are needed. Imputations of data sets for certain age groups 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. We 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, no grades are skipped, 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 on 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, continuing 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 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 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 the student 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 China population and education dynamics

4.1 Population imputation

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 1987, 1995, and 2005 from the 1% Population Sampling Survey and for the years 1982, 1990, 2000 from the Population Census. The data sets also contain disaggregated numbers for urban and rural populations categorized by age and gender.

For all other years, based on the existing years' population data, we combine birth rate, mortality rate by age and sex, and enrollment at different levels of education to impute yearly population by age, sex and educational attainment for urban and rural areas. 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 statistical 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:

$$L(y,e,a,s) = L(y-1,e,a,s)\cdot(1-d(y,a,s)) + IF(y,e,a,s) - OF(y,e,a,s) + EX(e,a,s) \quad (13)$$

$L(y,e,a,s)$ is the population in year y at education level e, with age a and sex s. $d(y,a,s)$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 who 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.[22] Moreover,

$$IF(y,e,a,s) = l(y,e,a,s) \cdot ERS(y,e,s) \tag{14}$$

$$OF(y,e,a,s) = l(y,e+1,a,s) \cdot ERS(y,e+1,s) \tag{15}$$

$$\sum_{a} l(y,e,a,s) = 1 \tag{16}$$

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 CHNS (China Health and Nutrition Survey, 1989, 1991, 1993, 1997, 2000) and CHIP (Chinese Household Income Project, 1995), macroeconomic data sets (China Education Statistical Yearbook, 2003-2007). Details can be found in Appendix A.

4.2 Trend of population and education distribution

Here we present several features of China's population growth, based on the population by educational attainment, 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 2009. The urban population increased by 412 million, while the rural population decreased by 92.8 million (Figure 4.2.1).

[22] For example, the discrepancy can be caused by migration, but we do not have the data.

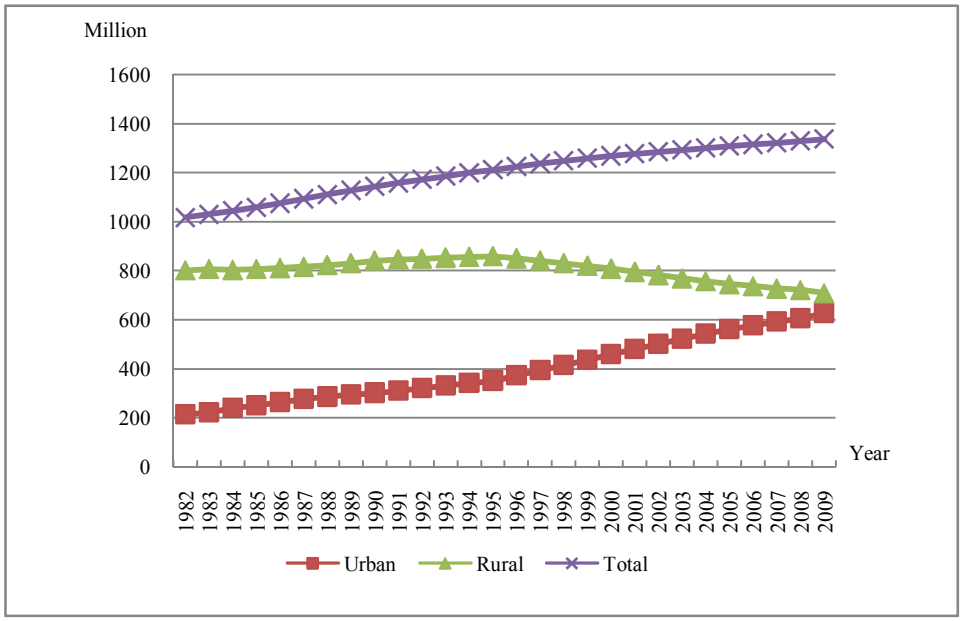

Figure 4.2.1 Population in China

Figure 4.2.2-4.2.4 shows the trend of national, urban and rural population classified by education attainment. The illiterate population was cut in half from 402 million in 1982 to 201 million in 2000, but was relatively stable from 2000 to 2009. The number of primary school graduates increased from 359 million in 1982 to the peak of 466 million in 1997, then declined gradually to 382 million in 2009. This decline is expected as more primary school graduates continue to receive higher education instead of terminating formal education. This is also shown in the rapid growth of junior middle school graduates.

Junior middle school students experienced the largest growth among all education levels: the number of junior middle school graduates increased from 181 million in 1982 to 489 million in 2008. This might be related to the implementation of 9-Year Compulsory Schooling Law since 1994 (9-year

schooling amounts to completing junior middle school). However, growth slowed down after 2001. Senior middle school and college and over, both started from very low numbers, have grown significantly. Senior middle school graduates increased from 68 million in 1982 to 169 million in 2008, while college and above increased from only 6 million in 1982 to 91 million in 2009. For the senior middle school and college and above level, the growth in rural areas is much slower than that in the urban areas.

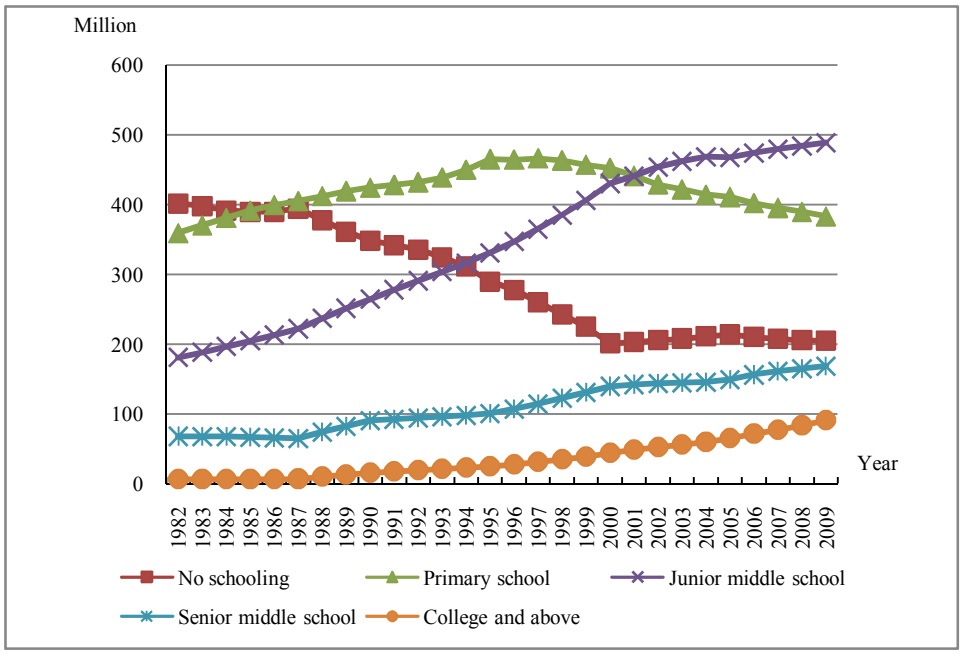

Figure 4.2.2 Population by Education Attainment in China

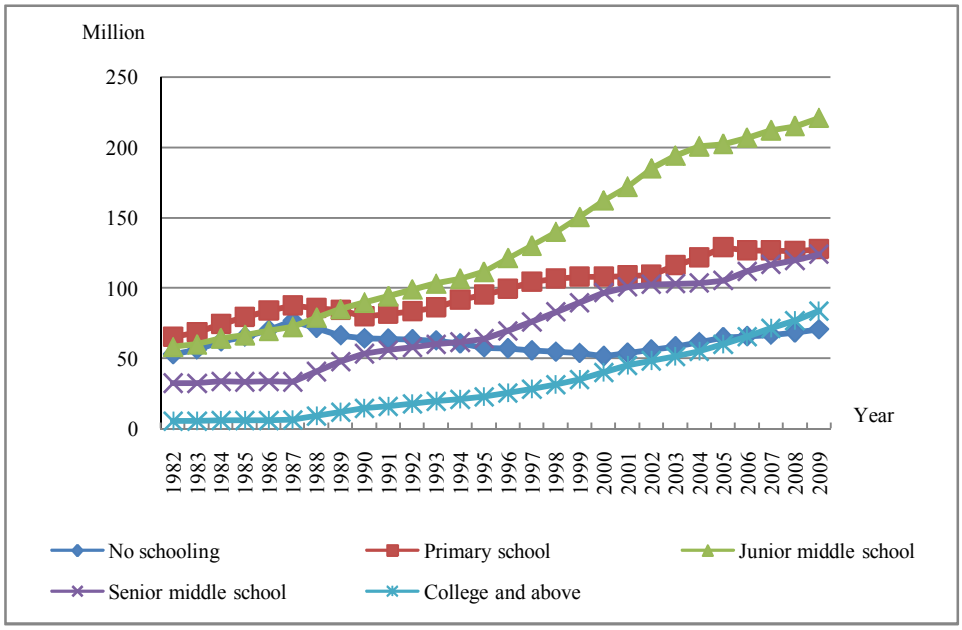

Figure4.2.3 Urban Population by Educational Attainment

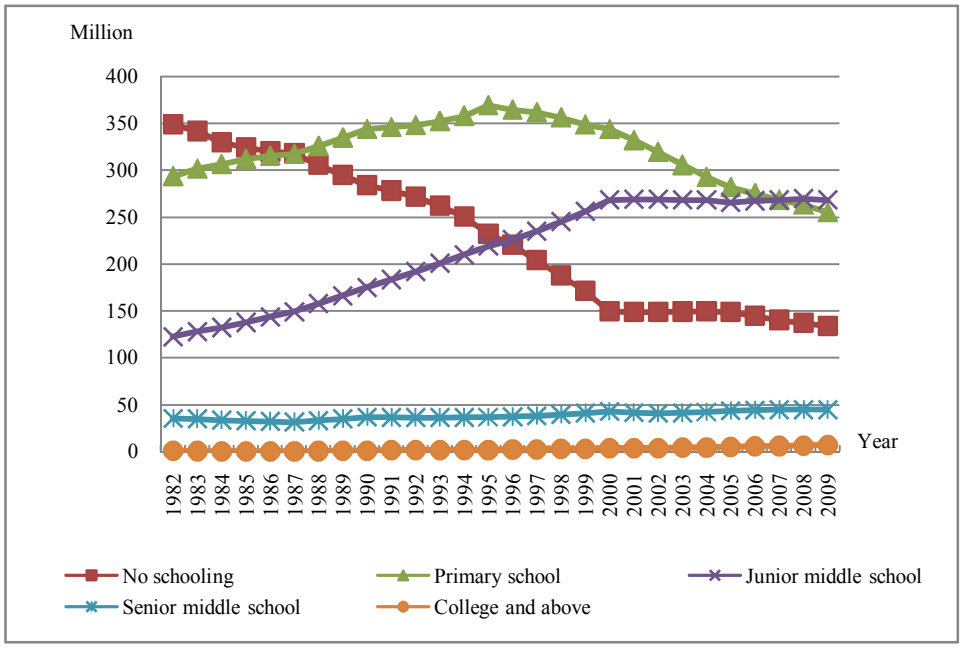

Figure4.2.4 Rural Population by Educational Attainment

We next take a closer look at the changes in the distribution of education attainment in the population at different time points. Figures 4.2.5 to 4.2.7 show the rightward shift of the educational attainment distribution in the population. In 1985, among the five education levels, the illiterates and primary educated dominated the distribution. The 1995 distribution is dominated by people with primary and junior middle education, i.e. the distribution remains heavily skewed to the right. By 2009, junior middle has become the dominant education level. The distribution is still skewed to the right, but it is much less so than in 1985. 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 gap 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 1985.

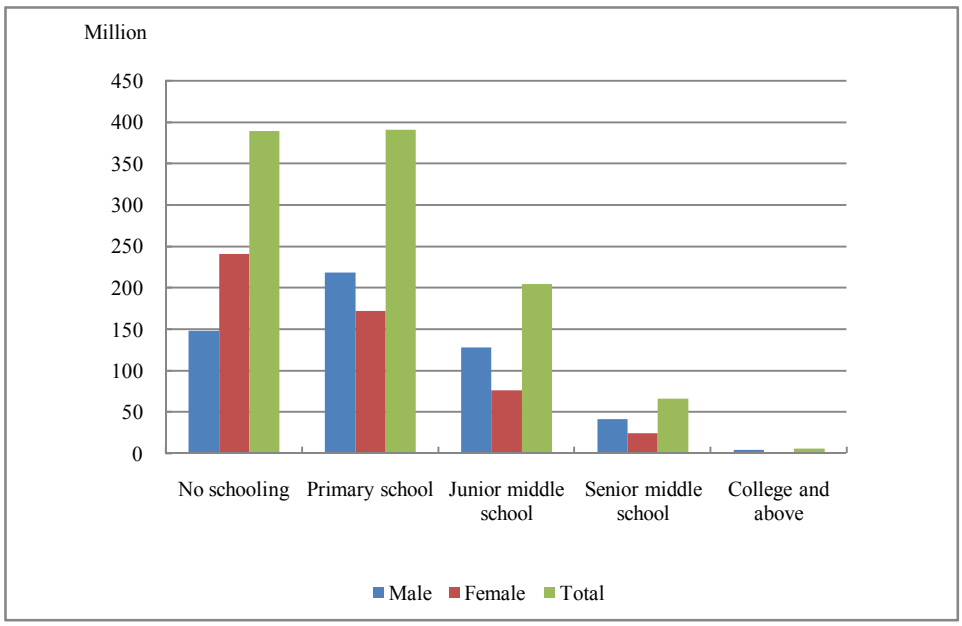

Figure 4.2.5 Population of Different Educational Levels by Gender, 1985

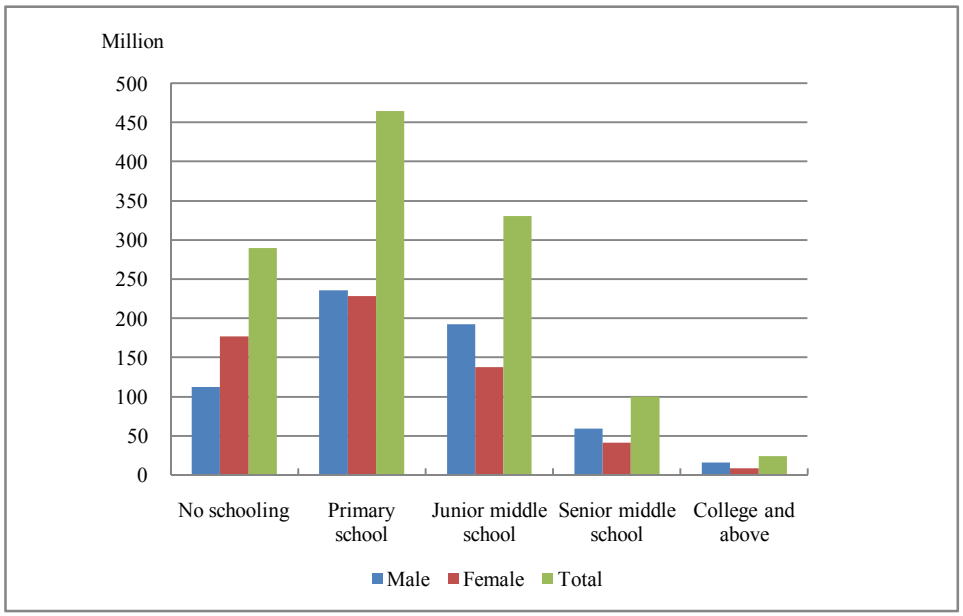

Figure 4.2.6 Population of Different Educational Levels by Gender, 1995

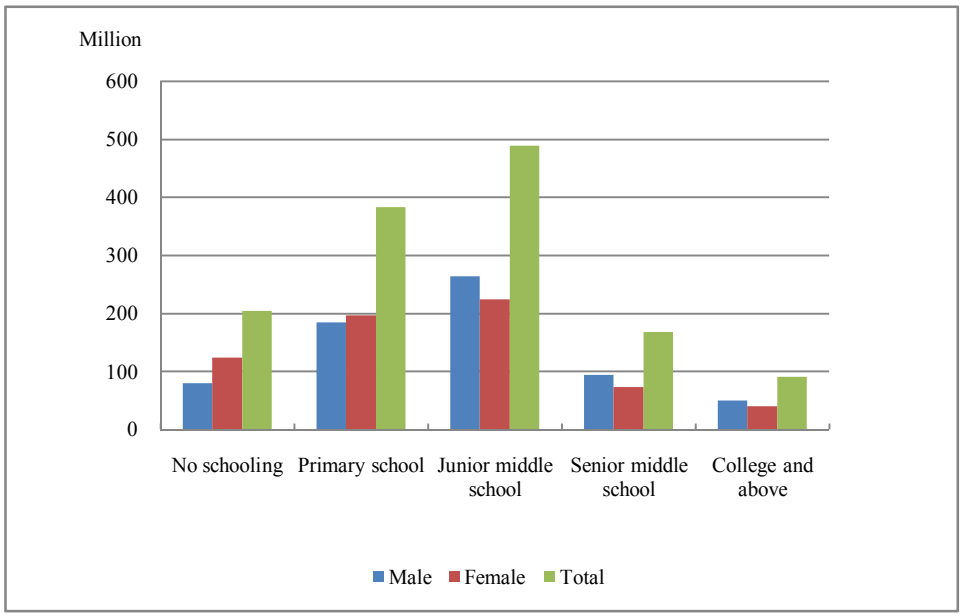

Figure 4.2.7 Population of different educational levels by gender, 2009

Figures 4.2.8 to 4.2.11 disaggregate the data into rural and urban subsamples. Not surprisingly, most of the illiterate population resided in the rural area. However, the rural illiterate population fell from 324 million in 1985 to 134 million in 2009. Although the urban illiterate population changed slightly in absolute terms, its share in the urban population fell from 26.06% in 1985 to 11.27% in 2009. 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 increased from 66 million to 221 million, while the rural junior middle school population roughly doubled, from 140 million to 268 million. The comparison is more startling in the highest two education levels. The urban senior middle school population increased from 33 million to 124 million, while the rural senior middle school population only increased from 32 million to 44 million. The urban college and over population increased from 5 million to 83 million, while in rural areas, it grew from 0.63 million to 7.26 million.

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 left, the improvement has certainly been more rapid and significant 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).[23]

[23] To take the migrants into account, we make the following adjustments in the population imputation part: under the assumption that the number of immigrants in each year is the same, we retrieve the average difference between imputed population data and the census data back to the estimated population data according to the structure of the population by age, gender and education level.

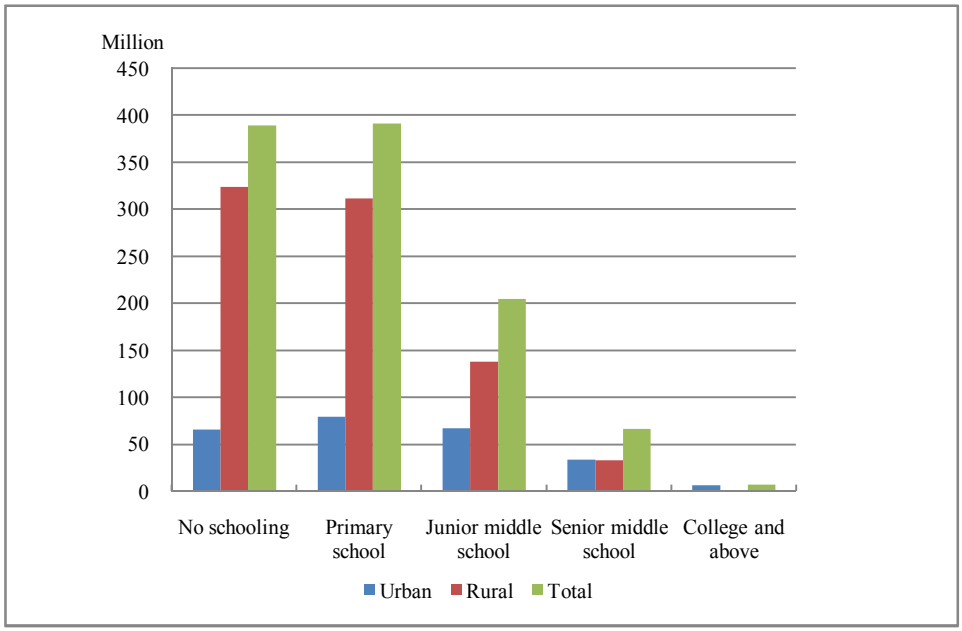

Figure 4.2.8 Population of Different Educational Levels by Urban and Rural, 1985

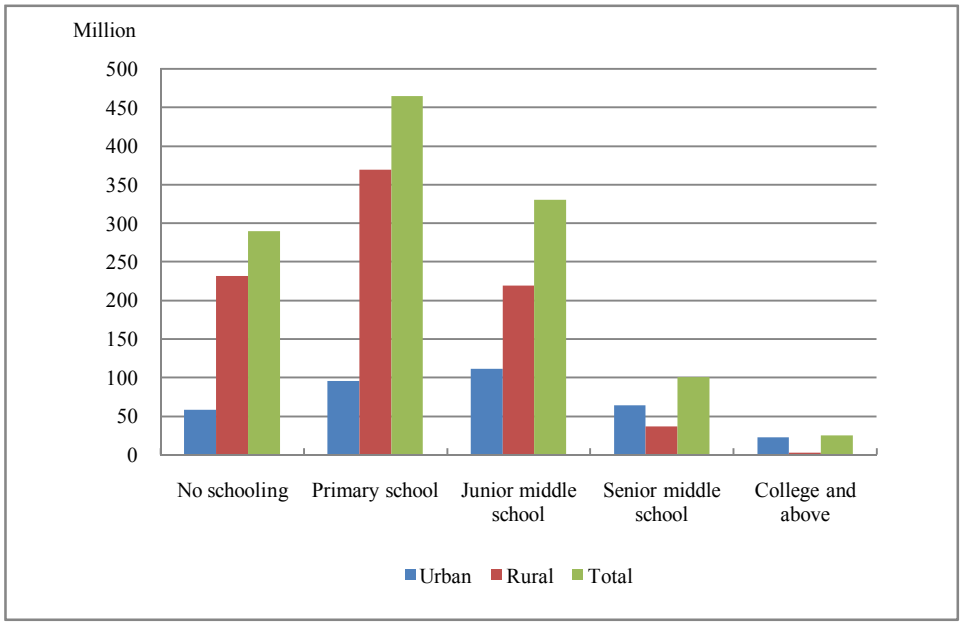

Figure 4.2.9 Population of Different Educational Levels by Urban and Rural, 1995

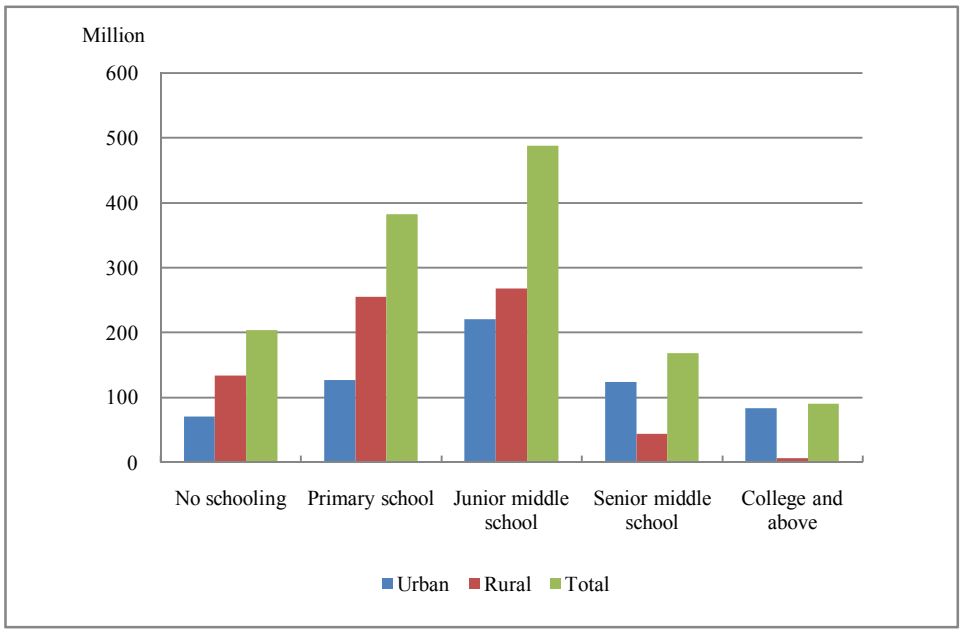

Figure 4.2.10 Population of Different Educational Levels by Urban and Rural, 2009

Chapter 5 National human capital[24]

5.1 Human capital, GDP, and physical capital

Based on the Mincer income parameter estimates and population imputation data, with 4.58% as the discount rate, we calculated human capital at the national level for 1985-2009, the results are reported in Table 5.1.1. 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, college and above was further divided into two categories: three-year college, and four-year university and above.[25]With this more detailed information on educational attainment, we create a separate human capital series starting from 2000. Columns 1 and 2 contain the national human capital measured in nominal terms by 5-6 education categories, and columns 3 and 4 present the national human capital measured in real terms (in 1985 Yuan) accordingly. National human capital becomes larger with six education categories. This is because the lifetime income of four-year university and above graduates is higher than the lifetime income of three-year college graduates. In this table, the real values are calculated using the CPI as a deflator.[26]

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[24] The national and provincial human capital estimates are developed mainly based on Jorgenson-Fraumeni methodology as previously described in the previous chapter.

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

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

Table 5.1.1 National Nominal and Real Human Capital, Nominal GDP

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	26033		26033		904	28.80
1986	29581		27783		1027	28.79
1987	33704		29508		1205	27.97
1988	38556		28415		1504	25.64
1989	43852		27371		1700	25.79
1990	50234		30397		1872	26.84
1991	56761		33177		2183	26.01
1992	64160		35227		2694	23.82
1993	73110		34964		3526	20.73
1994	82870		31905		4811	17.23
1995	93300		30629		5981	15.60
1996	107900		32613		7014	15.38
1997	125310		36757		7806	16.05
1998	144760		42689		8302	17.44
1999	167490		49961		8848	18.93
2000	193460	193820	57353	57416	9800	19.74
2001	218140	218740	64064	64183	10807	20.19
2002	247890	248770	73170	73390	11910	20.81
2003	281580	282750	81980	82280	13517	20.83
2004	318320	319740	89100	89460	15959	19.95
2005	364600	367560	100060	100830	18581	19.62
2006	402790	404930	108920	109450	21752	18.52
2007	458840	461600	118290	118950	26776	17.14
2008	525050	528950	127730	128610	31623	16.60
2009	598400	602990	146460	147530	34346	17.42

Note: The ratio of human capital to GDP is based on the current values for that year.

Figure 5.1.1 graphs national real and nominal human capital reported in Table 5.1.1. As is seen from the figure, human capital in both nominal and real terms rises steadily and nominal human capital grows faster than real human capital.

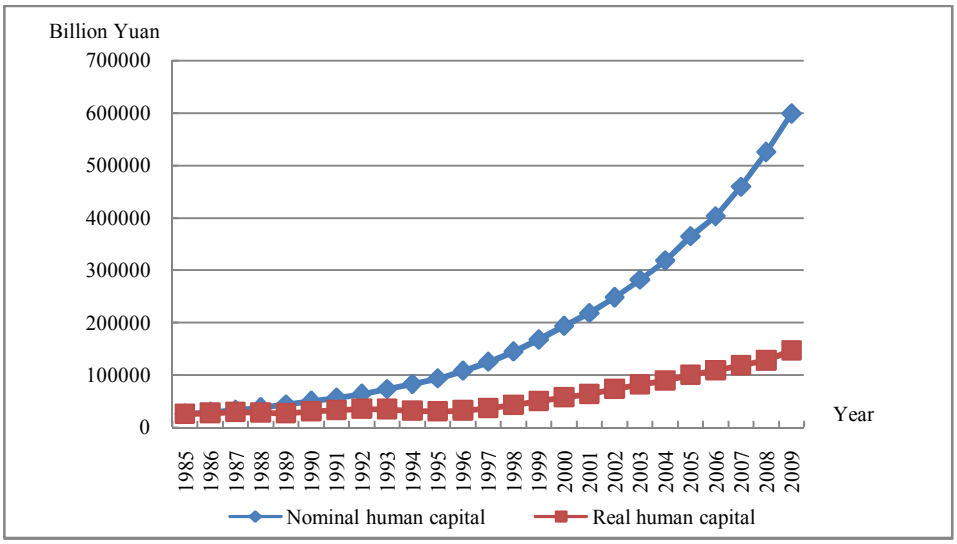


Figure 5.1.1 National Nominal and Real Human Capital

In order to get a sense of the magnitude of the estimated national human capital, we also report the ratio of human capital to GDP in Table 5.1.1.[27] Similar to physical capital, human capital stock plays an important role in GDP growth, so the ratio could also reflect human capital's influence on sustainable growth of GDP. As is seen from Figure 5.1.2 below, national nominal human capital is substantially higher than nominal GDP. The ratio of human capital to GDP drops over time from 29 in 1985 to 17 in 2009. Jorgenson and Fraumeni's (1992a) 1947 to 1986 estimates of the ratio of market human capital to GDP in the U.S. are between 18 and 22.The average annual growth for human capital in China from 1985 through 2009 is 7.20%

[27] We use nominal values for calculating ratios throughout in order to prevent influences caused by using different deflators.

per year, considerably lower than economic growth.[28] Over the same period, the Chinese economy grew at an annual rate of 8.33%.[29] This helps explain the declining ratio of human capital to GDP. There are three stages in this series: Downwards from 1985 through 1995, upwards from 1995 through 2003, and finally downward from 2003 through 2009. The period 1995 through 2009 overall is a period of rapid real human capital growth compared to earlier periods; however, this growth did slow down between 2003 and 2009. The downward trend in the most recent period is partly due to the confluence of continuing rapid economic growth with slower population growth. The decreasing ratio of human capital to GDP may also indicate possible constraints on China's future GDP growth.

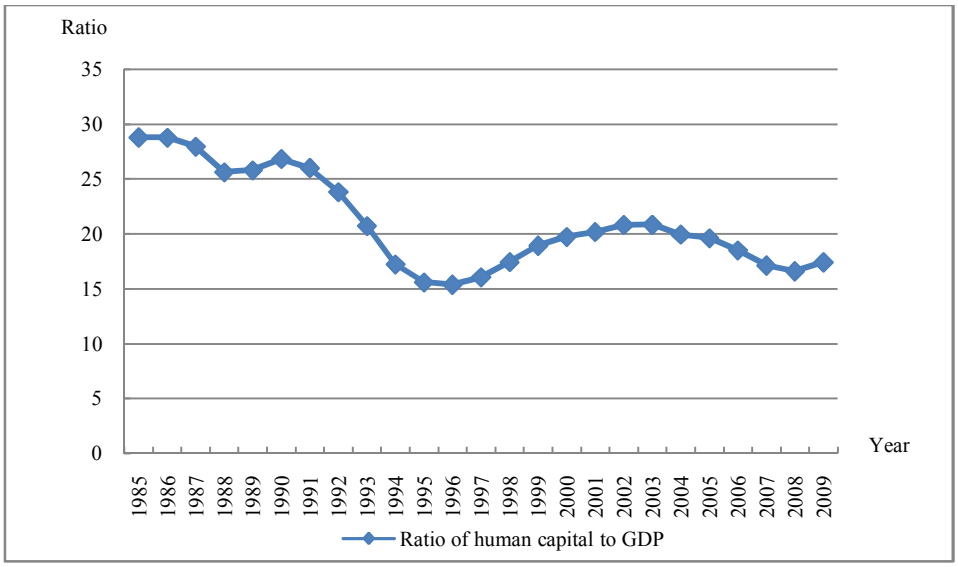


Figure 5.1.2 National Ratio of Human Capital to GDP

We also compare our human capital estimates with the estimated

[28] 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.

[29] The data come from "China Statistical Yearbook 2009", Table 2-1, 2-5.

physical capital in China. There are a few estimates of China's physical capital. Table 5.1.2 reports physical capital estimated by Zhang, Wu and Zhang (2004). [30]Table 5.1.3 reports physical capital estimates (fixed assets only) in Holz (2006). In both tables, we use deflators in Zhang, Wu and Zhang (2004) and Holz (2006) to calculate real capital.

Table 5.1.2 Human Capital and Physical Capital (Zhang et. al. 2004), 1985-2000

Year	Human capital	Physical capital	Ratio of human capital to physical capital
	Trillions of 1985 Yuan		
1985	26.03	1.42	18.33
1986	27.81	1.57	17.71
1987	30.08	1.76	17.09
1988	30.32	1.95	15.55
1989	31.78	2.08	15.28
1990	34.51	2.2	15.68
1991	35.95	2.37	15.17
1992	35.96	2.61	13.78
1993	32.77	2.94	11.14
1994	33.65	3.34	10.08
1995	35.76	3.8	9.41
1996	39.75	4.29	9.27
1997	45.40	4.79	9.48
1998	52.55	5.36	9.80
1999	61.05	5.92	10.31
2000	69.75	6.54	10.66

Note: We converted the real physical capital series from 1952 based to 1985 based (see Table C.9).

[30] These estimates were published in Economic Research, a leading academic journal in China.

Table 5.1.3 Human Capital and Mid-year Real Original Value of Fixed Assets of Holz (2006), 1985-2003

Year	Human capital	Mid-year real original value of fixed assets	Ratio of human capital to fixed assets
	Trillions of 1985 Yuan		
1985	26.03	1.73	15.05
1986	27.81	1.95	14.26
1987	30.10	2.18	13.81
1988	30.33	2.43	12.48
1989	31.78	2.7	11.77
1990	34.52	2.97	11.62
1991	35.62	3.26	10.93
1992	34.93	3.58	9.76
1993	31.43	3.94	7.98
1994	32.28	4.32	7.47
1995	34.31	4.75	7.22
1996	38.16	5.24	7.28
1997	43.58	5.78	7.54
1998	50.43	6.35	7.94
1999	58.58	6.94	8.44
2000	66.94	7.56	8.85
2001	75.17	8.19	9.18
2002	85.25	8.87	9.61
2003	94.76	9.66	9.81

Note: We converted real fixed assets series from 2000 based to 1985 based. See the deflators of fixed assets (2000=100) in Table C.9.

As can be seen in Figure 5.1.3 and Figure 5.1.4, in both cases human capital is much higher than physical capital. More specifically, human capital is about 7 to 18 times the amount of physical capital. This is not surprising,

given that in most countries intangible capital, which is predominantly human capital, accounts for over 60% of national wealth.[31] On the other hand, the ratio of human capital to physical capital is declining almost continuously, based on both estimates of physical capital. It is unclear whether such a trend indicates that the Chinese government has overly weighted towards physical capital investment relative to human capital investment.[32]

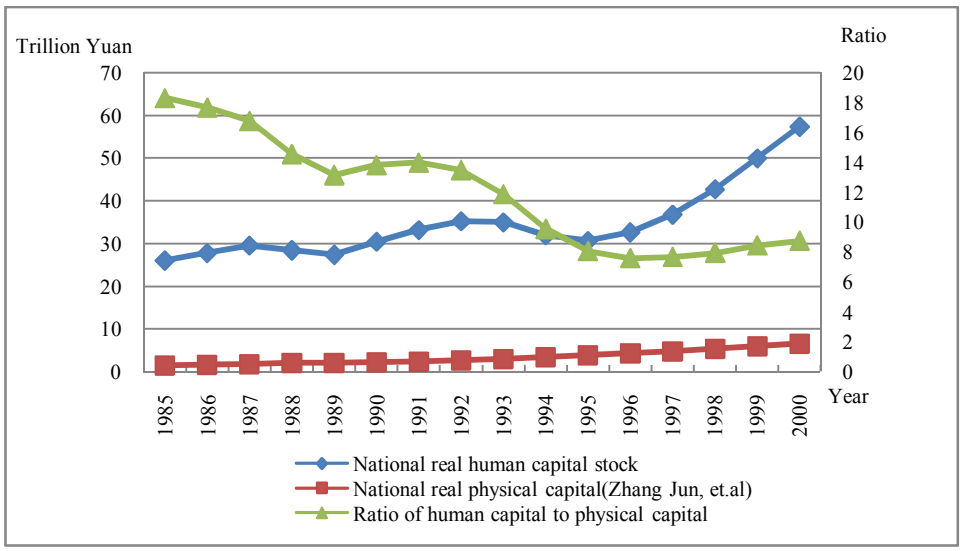


Figure 5.1.3 Human Capital and Physical Capital (Zhang et. al. 2004), 1985-2000

[31] World Bank (1997). The World Bank wealth estimates include physical capital, natural resources, and other forms of intangible capital besides human capital.

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

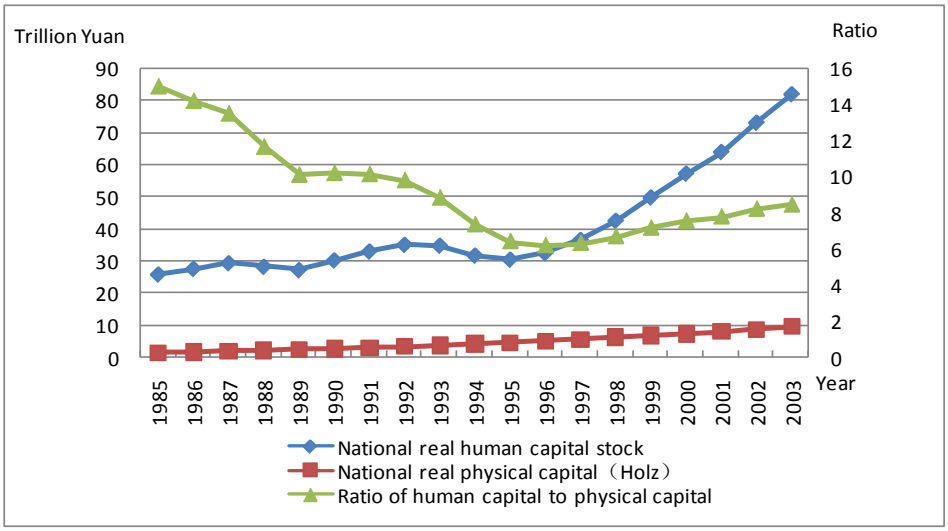


Figure 5.1.4 Human Capital and Physical Capital (Holz), 1985-2003

5.2 Trends in human capital

In order to discuss the trend of 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.

Table 5.2.1 shows real human capital for the country as a whole, by gender, and by urban or rural areas. From 1985 to 2009, the human capital increased from 26.03 trillion to 146.44 trillion Yuan, an increase of nearly five-fold. Moreover, based on Fleisher, Li and Zhao (2010), the Chinese economy exhibits a structural change after 1994. Such a change is also reflected in the trend of human capital growth. Specifically, the growth of human capital accelerated after 1994. The average annual growth for 1985-1994 is 2.26%, and for 1995-2009 is 10.16%.

Male real human capital is higher than female real human capital. Male real human capital increased from 15.76 trillion to 93.96 trillion Yuan; female real human capital increased from 10.27 trillion to 52.50 trillion Yuan. Male real human capital increased by about five-fold over this period while female real human capital increased by about four-fold.

Both urban and rural real human capital increased from 1985 to 2009. Rural real human capital increased from 15.89 trillion to 43.54 trillion Yuan; urban real human capital grew from 10.14 trillion to 102.90 trillion Yuan. The corresponding annual growth rates are 4.2% and 9.66% for rural and urban areas, respectively. From 1985 through 1996, urban real human capital is smaller than rural real human capital, but by 2009 it is more than twice as large. The urban-rural gap increased from 0.25 trillion in 1997 to over 59 trillion in 2009, growing at an annual rate of 45.58%. The gap is getting bigger from 1997 to 2009 as urban real human capital growth is much faster than rural real human capital growth, with an average annual growth rate of 7.25% for rural and 14.49% for urban.

Table 5.2.1 National Real Human Capital by Gender and Urban-Rural[33]

Billions of 1985 Yuan

Year	National	Male	Female	Urban	Rural
1985	26033	15762	10271	10140	15893
1986	27783	16895	10888	11051	16732
1987	29508	18010	11498	11905	17603
1988	28415	17448	10967	11517	16898
1989	27371	16862	10509	11447	15924
1990	30397	18816	11581	13228	17169
1991	33177	20561	12616	14463	18714

[33] Some discrepancy may exist when summing up male and female, urban and rural to get the national amount. This is mainly caused by rounding errors.

Year	National	Male	Female	Urban	Rural
1992	35227	21852	13375	15377	19850
1993	34964	21787	13177	15423	19541
1994	31905	19965	11940	14227	17678
1995	30629	19128	11501	13965	16664
1996	32613	20410	12203	15648	16965
1997	36757	23110	13647	18506	18251
1998	42689	26990	15699	22447	20242
1999	49961	31680	18281	27368	22593
2000	57353	36470	20883	32430	24923
2001	64064	40740	23324	37330	26734
2002	73170	46580	26590	44230	28940
2003	81980	52260	29720	51300	30680
2004	89100	56780	32320	57350	31750
2005	100060	63350	36710	66550	33510
2006	108920	69840	39080	72440	36480
2007	118290	75860	42430	80210	38080
2008	127730	81840	45890	88340	39390
2009	146460	93960	52500	102920	43540

Figure 5.2.1 shows that real human capital stock by five education categories keeps growing, and it grew even faster during 1996-2009. One reason male real human capital is higher than female real human capital is the earlier retirement age for women (age 55 vs. age 60 for men based on China Labor Law). Accordingly, men have a longer time to generate income in the market. Another reason is higher educational attainment for men. Moreover, the male-female income gap has been on expanding. The results based on six education categories show similar trends.

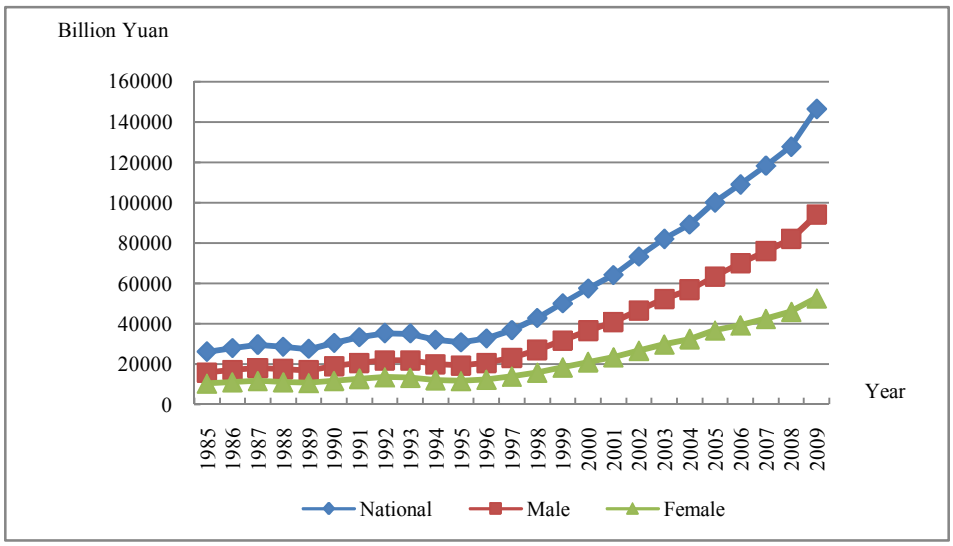


Figure 5.2.1 National Real Human Capital by Gender

Figure 5.2.2 shows real human capital for urban and rural China separately. As previously noted, before 1998, the amount of real human capital in both areas was very close. In fact, rural real human capital was even larger than that in the urban area until 1997. Since 1996, however, the real human capital in the urban area has been rising much more rapidly, while the real human capital in the rural area grew quite slowly, which results in a larger urban-rural gap.

There are several reasons for such a trend. First, in the early years, the rural population was significantly larger than the urban population, 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 222 million. By 2009, however, the population in rural China reduced to 583 million, much closer to the urban population of 522 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. Another reason is the education gap between the urban and rural population. Urban areas usually have a larger proportion of educated population than rural areas.

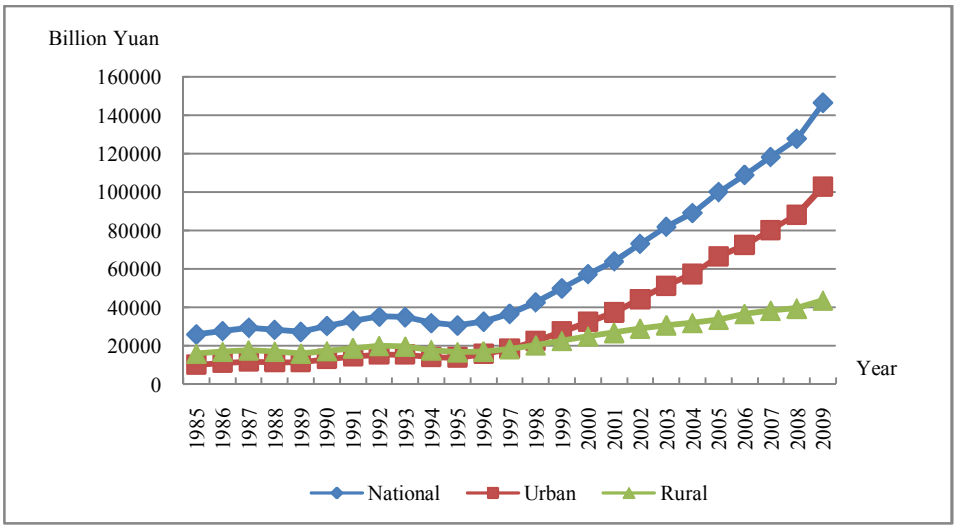


Figure 5.2.2 National Real Human Capital by Urban-Rural

Figures 5.2.3 and 5.2.4 show the trends of male and female real human capital in urban and rural areas. Male and female real human capital estimates in the urban area exhibit similar trends, but the gender gap seems to be widening. The gender-based real human capital estimates for the rural population paint a somewhat different picture. In the later part of the period, the growth of male real human capital seems to have slowed down while that of females seems to have sped up; 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.

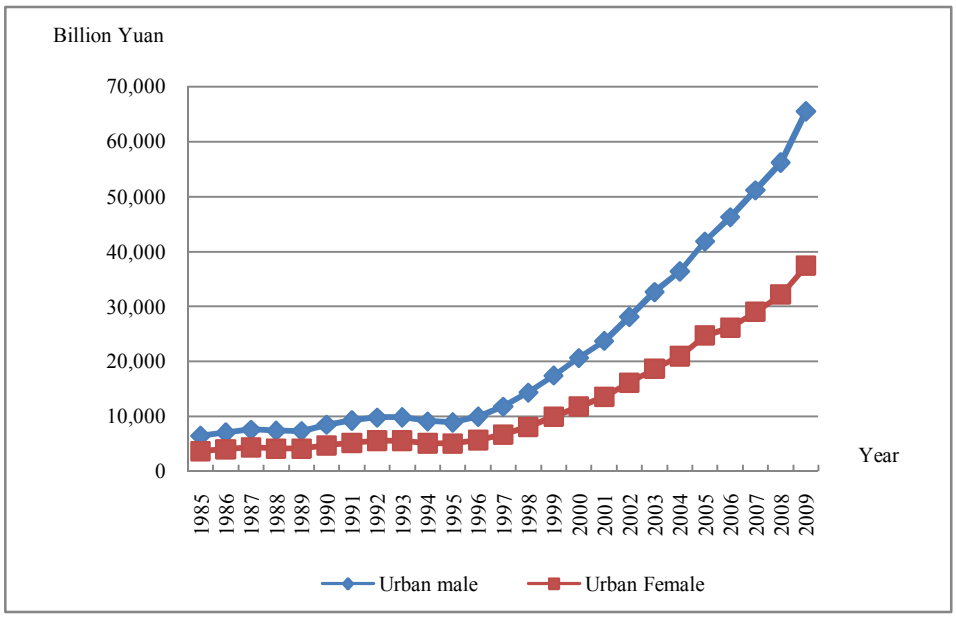


Figure 5.2.3 National Urban Real Human Capital by Gender

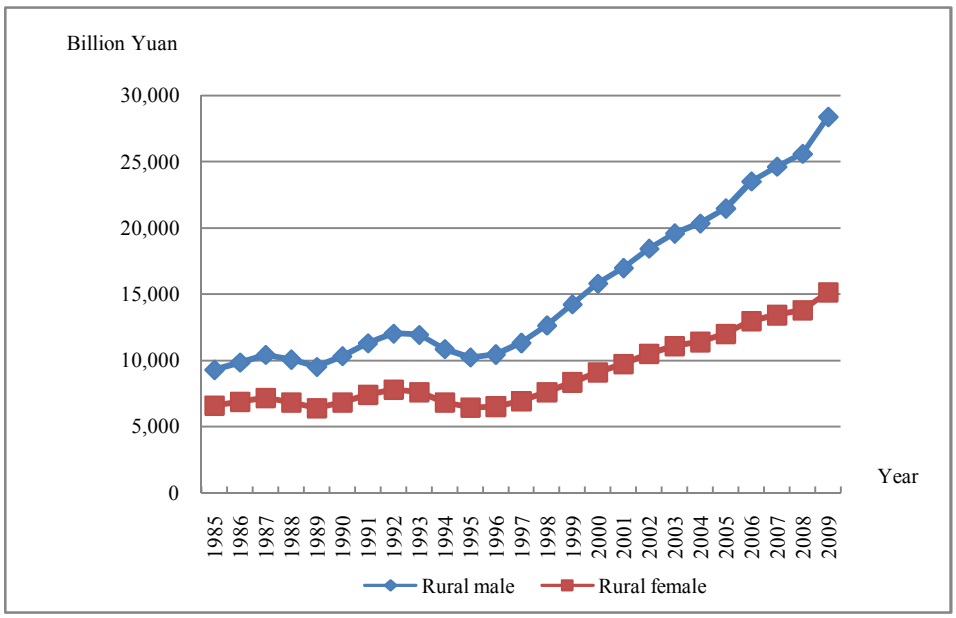


Figure 5.2.4 National Rural Real Human Capital by Gender

Finally we calculate real human capital indices setting 1985 equal to 100. The results for each group are reported in Table 5.2.2.

Table 5.2.2 National Real Human Capital Index (1985=100)

Year	National	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	106.72	107.19	106.01	108.98	105.28
1987	113.35	114.26	111.95	117.41	110.76
1988	109.15	110.70	106.78	113.58	106.32
1989	105.14	106.98	102.32	112.89	100.20
1990	116.76	119.38	112.75	130.45	108.03
1991	127.44	130.45	122.83	142.63	117.75
1992	135.32	138.64	130.22	151.65	124.90
1993	134.31	138.22	128.29	152.10	122.95
1994	122.56	126.67	116.25	140.31	111.23
1995	117.65	121.36	111.98	137.72	104.85
1996	125.28	129.49	118.81	154.32	106.75
1997	141.19	146.62	132.87	182.50	114.84
1998	163.98	171.23	152.85	221.37	127.36
1999	191.91	200.99	177.99	269.90	142.16
2000	220.31	231.38	203.32	319.82	156.82
2001	246.09	258.47	227.09	368.15	168.21
2002	281.07	295.52	258.88	436.19	182.09
2003	314.91	331.56	289.36	505.92	193.04
2004	342.26	360.23	314.67	565.58	199.77
2005	384.36	401.92	357.41	656.31	210.85
2006	418.39	443.09	380.49	714.40	229.54
2007	454.38	481.28	413.10	791.03	239.60
2008	490.65	519.22	446.79	871.20	247.84
2009	562.59	596.12	511.15	1014.99	273.96

Figure 5.2.5 shows the index of national human capital. Before 1997 the index grows quite steadily; it accelerates after that year. Figures 5.2.6 and 5.2.7 show the indices by gender and for urban and rural areas, respectively. A comparison of these three figures demonstrates that the growth in the urban index is the main catalyst for the acceleration of the national index beginning in 1997 as the urban index reaches a maximum value of about 1000 in 2009 compared to a maximum value of less than 600 for any of the other indices.

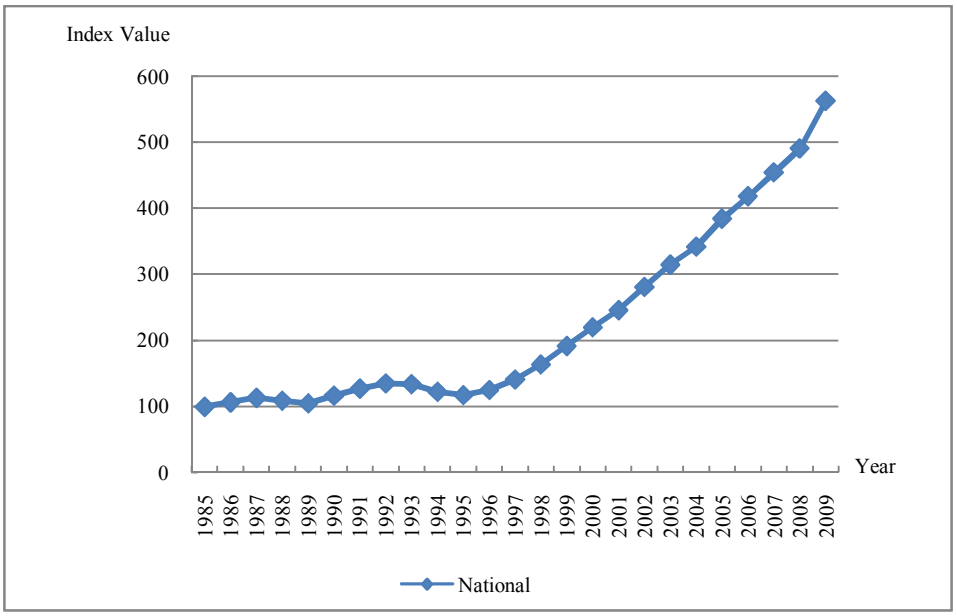


Figure 5.2.5 National Real Human Capital Index

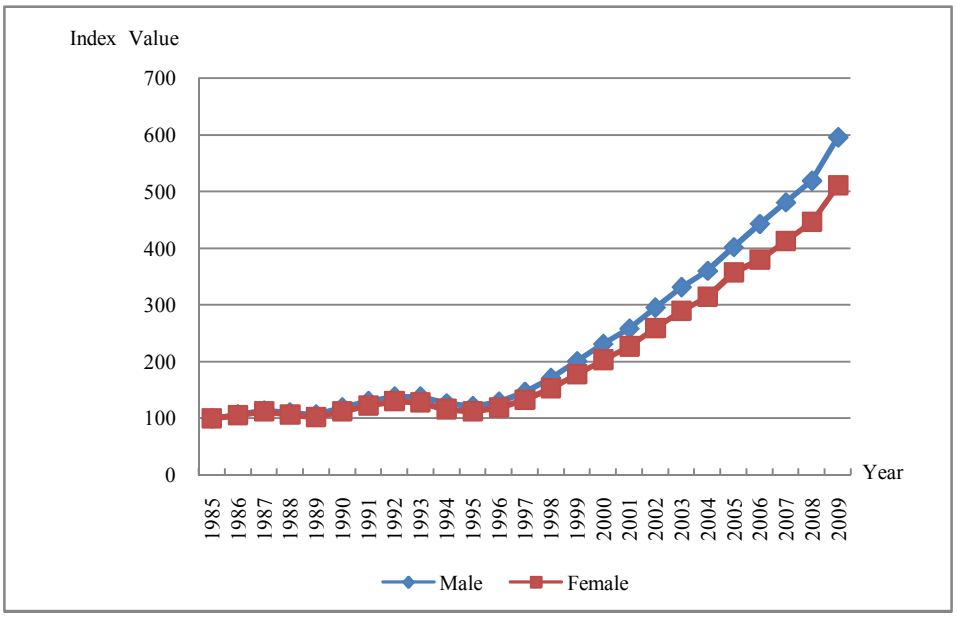


Figure 5.2.6 National Real Human Capital Index by Gender

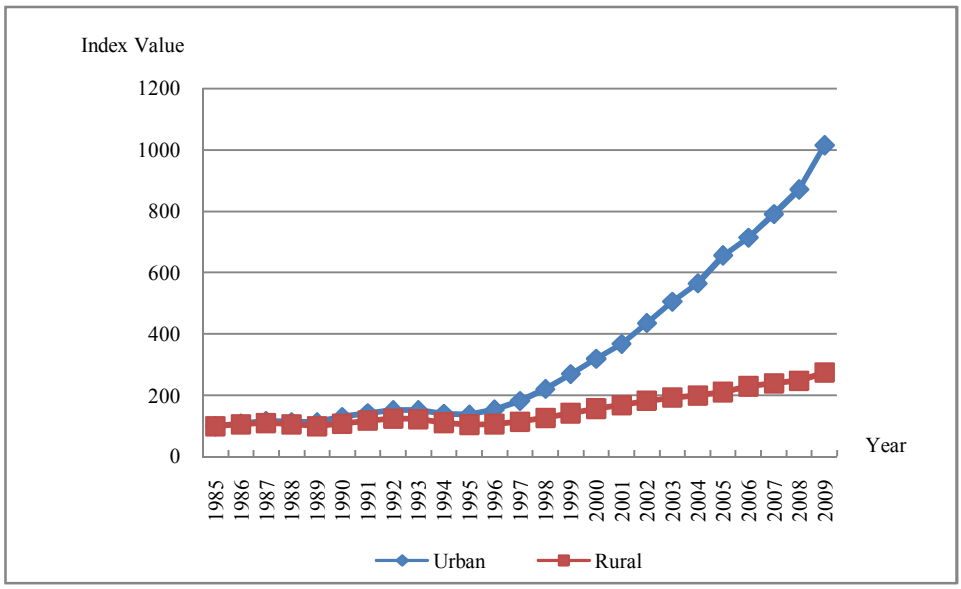


Figure 5.2.7 National Real Human Capital Index by Urban-Rural

5.3 Per capita human capital

An increase in real human capital can be caused by a number of factors, such as population growth, demographic changes (e.g., the size of retirement group), urban-rural 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, and higher rates of return to on-the-job training. In order to get further information on the dynamics of human capital in China, we calculate per capita real human capital, i.e., the ratio of real human capital to non-retired population (Table 5.3.1).

Based on the 5-education category, the per capita real human capital was 27,119 Yuan in 1985, 28,579 Yuan in 1995, and 132,433 Yuan in 2009. From 1985 to 2009, per capita real human capital increased by around 4 times. Per capita real human capital growth accelerated from 1996. The average annual growth rate was 0.96% from 1985 to 1996, and 11.4% from 1997 to 2009.

The growth rate in the later period is eleven times higher than that in the earlier period. These growth rates are very high. These high growth rates are probably a result of the dramatic economic growth since 1978, rapid expansion of education, transition toward market-oriented system (so that human capital can realize much higher values), and urban-rural migration. Male per capita real human capital is higher than female per capital real human capital; however both male and female per capita real human capital exhibit an evident rising trend. Urban per capita real human capital remains higher and grows faster than that for rural.

Table 5.3.1 National Per Capita Real Human Capital by Gender and Urban-Rural

Thousands of 1985 Yuan

Year	National	Male	Female	Urban	Rural
1985	27.12	31.29	22.52	44.66	21.68
1986	28.56	33.05	23.58	46.50	22.76
1987	29.95	34.76	24.60	47.92	23.86
1988	28.36	33.03	23.14	44.70	22.71
1989	26.93	31.37	21.95	43.05	21.21
1990	29.46	34.40	23.89	48.58	22.61
1991	31.84	37.34	25.69	51.70	24.56
1992	33.51	39.32	26.99	53.64	26.00
1993	33.03	39.00	26.36	52.57	25.55
1994	29.95	35.59	23.67	47.35	23.10
1995	28.58	34.00	22.59	45.50	21.78
1996	30.13	35.95	23.71	47.85	22.45
1997	33.57	40.18	26.26	53.27	24.46
1998	38.69	46.44	30.06	61.10	27.52
1999	44.97	53.96	34.90	70.65	31.24
2000	51.30	61.61	39.70	79.69	35.03
2001	57.28	68.96	44.21	88.20	38.45
2002	65.40	79.07	50.20	100.43	42.62

Year	National	Male	Female	Urban	Rural
2003	73.24	88.77	56.01	112.16	46.34
2004	79.79	96.92	60.88	122.01	49.12
2005	90.09	108.75	69.50	138.44	53.19
2006	98.06	119.79	74.06	147.63	58.88
2007	106.70	130.28	80.63	159.93	62.74
2008	115.34	140.43	87.47	172.46	66.26
2009	132.43	161.32	100.32	197.04	74.71

Figure 5.3.1 shows the trend of per capita real human capital by gender at the national level. Per capita real human capital shows a similar trend for males and females. Per capita real human capital for male and female both exhibit an accelerated growth after 1996. Specifically, the average annual growth rate during 1985-1996 was 1.26% for males and 0.47% for females; the average annual growth rate during 1997-2009 was 11.55% for males and 11.09% for females. As a result, the male-female gap has been widening.

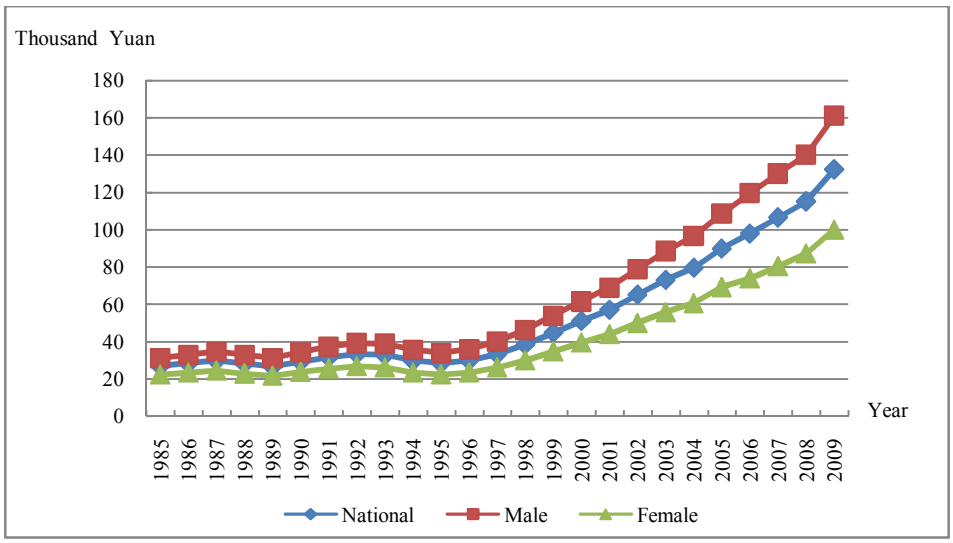


Figure 5.3.1 National Per Capita Real Human Capital by Gender

Figure 5.3.2 shows trends in per capita real human capital in urban and rural areas. There is a similar trend for males and females (see Figure 5.3.3

and 5.3.4). During the period of 1985-2009, per capita real human capital for urban and rural both exhibit an accelerated growth after 1996. Based on 5-education category, in 1985, per capita real human capital was 44,663 Yuan in the urban area and 21,684 Yuan in the rural area; the corresponding numbers become 197,043 Yuan and 74,713 Yuan, respectively, in 2009. The absolute size of the urban-rural gap has been on the rise. The annual growth rate was 6.18% for the urban area (0.63% during 1985-1996 and 10.89% during 1997-2009), and 5.15% for the rural area (0.31% during 1985-1996 and 9.25% during 1997-2009). Therefore, the urban-rural gap kept widening over the 1985-2009 period. 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.

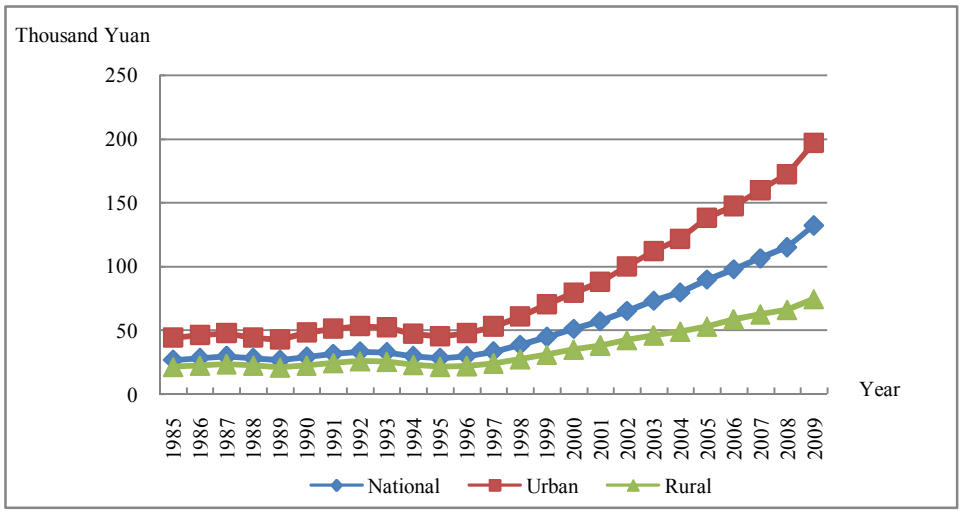


Figure 5.3.2 National Per Capita Real Human Capital by Urban-Rural

Figures 5.3.3 and 5.3.4 show the gender differences for urban and rural areas, respectively. The patterns are similar to that of national human capital.

In particular, per capita real human capital for males and females show similar trends in the urban area, but per capita real human capital grew faster for males than for females in the rural area in recent years.

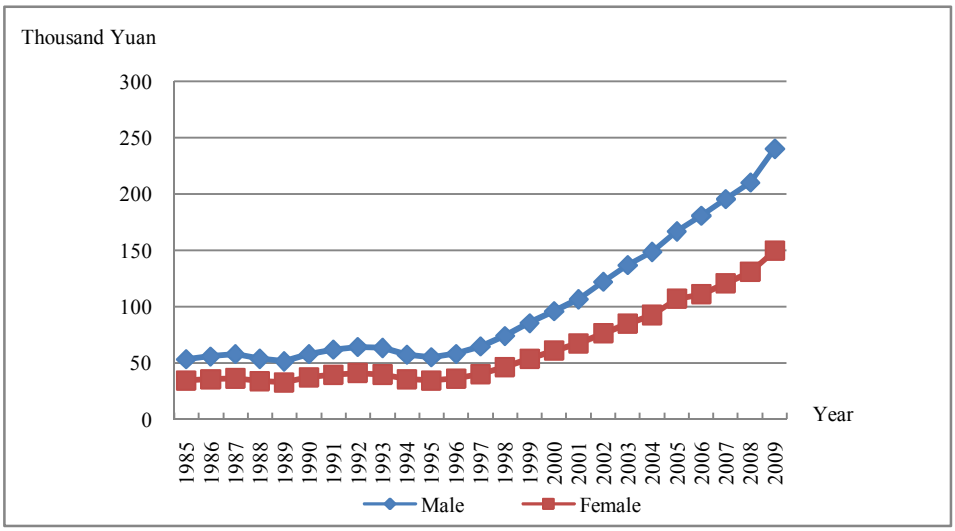


Figure 5.3.3 National Urban Per Capita Real Human Capital

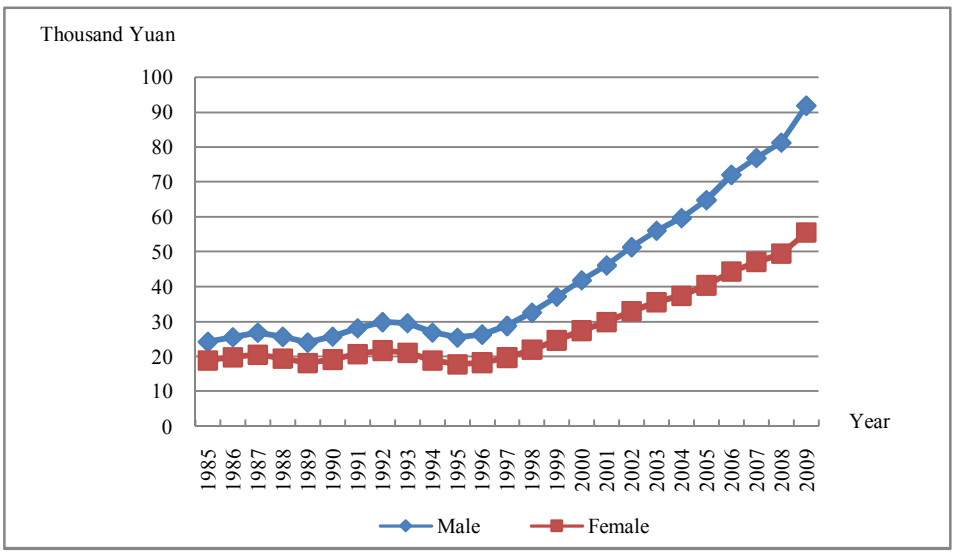


Figure 5.3.4 National Rural Per Capita Real Human Capital

We also construct per capita real human capital indices setting 1985 equal to 100 (Table 5.3.2).

Table 5.3.2 National Per Capita Real Human Capital Index (1985=100)

Year	National	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	105.30	105.65	104.70	104.12	104.98
1987	110.45	111.11	109.20	107.28	110.02
1988	104.57	105.58	102.73	100.09	104.71
1989	99.30	100.27	97.44	96.39	97.81
1990	108.65	109.95	106.07	108.77	104.27
1991	117.40	119.35	114.05	115.75	113.26
1992	123.56	125.68	119.83	120.09	119.89
1993	121.78	124.65	117.04	117.70	117.82
1994	110.44	113.75	105.10	106.02	106.53
1995	105.38	108.67	100.30	101.87	100.45
1996	111.12	114.91	105.26	107.13	103.51
1997	123.78	128.43	116.60	119.28	112.78
1998	142.66	148.45	133.45	136.81	126.91
1999	165.82	172.47	154.94	158.19	144.05
2000	189.16	196.92	176.28	178.43	161.55
2001	211.22	220.41	196.30	197.47	177.31
2002	241.15	252.73	222.87	224.87	196.56
2003	270.06	283.74	248.68	251.11	213.68
2004	294.20	309.80	270.29	273.17	226.50
2005	332.21	347.60	308.58	309.96	245.28
2006	361.60	382.88	328.82	330.54	271.54
2007	393.46	416.41	358.01	358.09	289.33
2008	425.32	448.88	388.38	386.14	305.56
2009	488.34	515.62	445.43	441.18	344.55

Figure 5.3.5-5.3.7 show trends of various per capita real human capital indices. As is seen from the graph below, per capita real human capital was essentially stable before 1996, but significant growth occurred after 1996. The patterns of the per capita real human capital indices by gender and by location are similar to that of national per capita real human capital index.

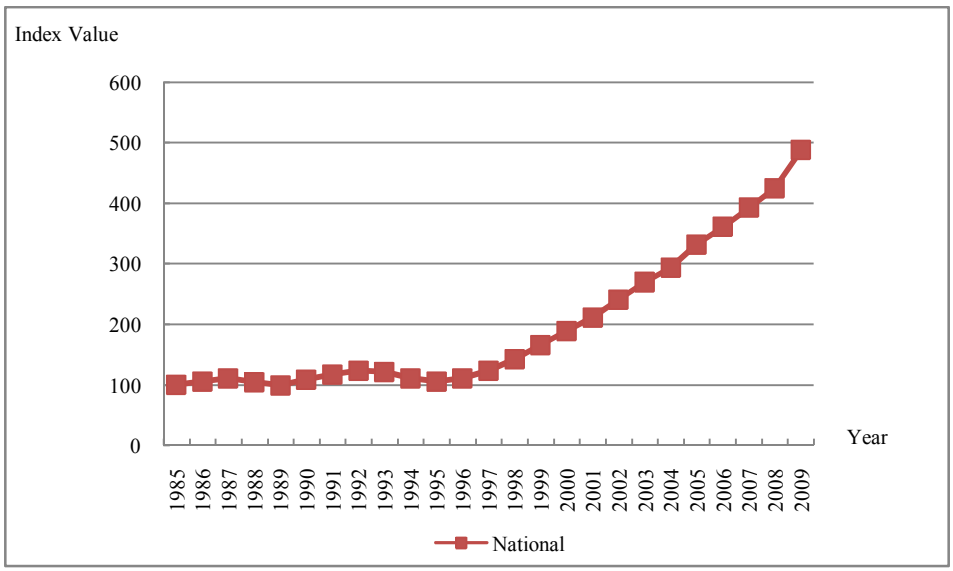


Figure 5.3.5 National Per Capita Real Human Capital Index

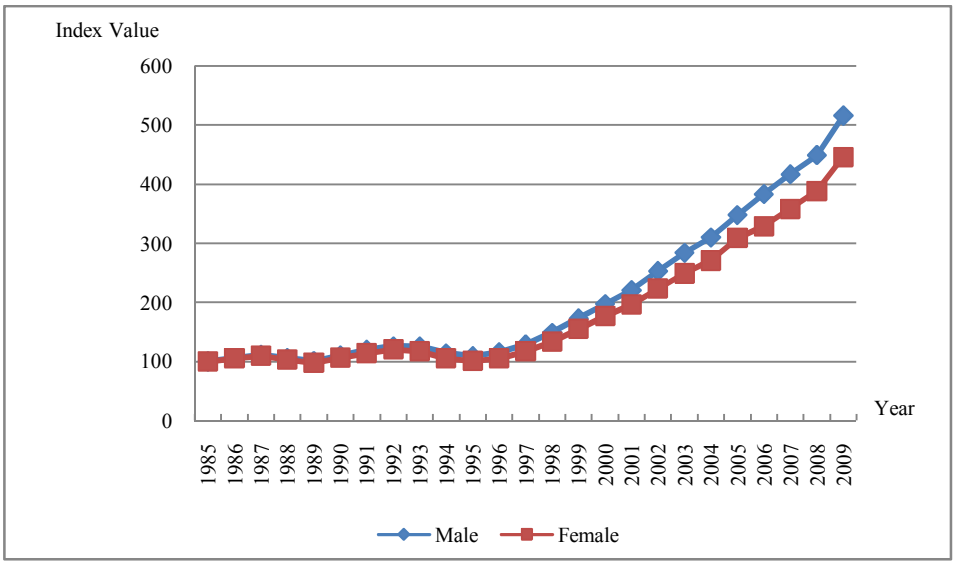


Figure 5.3.6 National Per Capita Real Human Capital Index by Gender

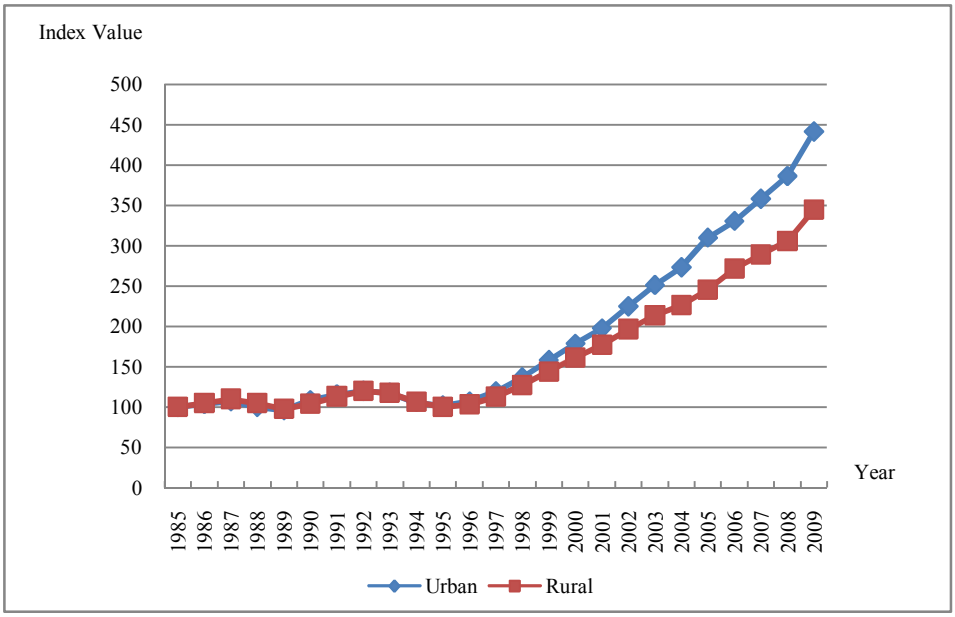


Figure 5.3.7 National Per Capita Real Human Capital Index by Urban-Rural

5.4 Labor force human capital

5.4.1 National labor force human capital

Labor force human capital represents the human capital of the population that is over 15 years old, non-retired and out-of-school. Labor force human capital is estimated in the same way as national human capital. The national labor force human capital is reported in Table 5.4.1. The real values in this table are calculated by deflating the nominal values with the CPI.

Table 5.4.1 National Nominal and Real Labor Force Human Capital and Nominal GDP

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of labor force human capital to GDP
	By five education category	By six education category	By five education category	By six education category		
1985	12727		12727		904	14.08
1986	14645		13757		1027	14.25
1987	16902		14811		1205	14.03
1988	19768		14580		1504	13.15
1989	22993		14354		1700	13.52
1990	26420		15987		1872	14.11
1991	30163		17640		2183	13.82
1992	34128		18767		2694	12.67
1993	38555		18480		3526	10.93
1994	42800		16526		4811	8.90
1995	47693		15703		5981	7.97
1996	54602		16568		7014	7.78
1997	63300		18646		7806	8.11
1998	73920		21892		8302	8.90
1999	85180		25522		8848	9.63
2000	99120	97400	29501	29011	9800	10.11
2001	110360	108820	32558	32108	10807	10.21
2002	123140	121830	36527	36153	11910	10.34
2003	138130	137290	40445	40193	13517	10.22
2004	151430	151330	42607	42564	15959	9.49
2005	168410	168360	46477	46437	18581	9.06
2006	191700	191700	52108	52091	21752	8.81
2007	215860	215870	55960	55941	26776	8.06
2008	241830	241920	59166	59163	31623	7.65
2009	274310	274420	67508	67499	34346	7.99

Note: The ratio of labor force human capital to GDP is based on the current values for that year.

The trends in national nominal and real labor force human capital are presented in Figure 5.4.1. Similar to the trend of national human capital, from 1985 to 2009, national labor force human capital both in nominal and real terms have kept on increasing.

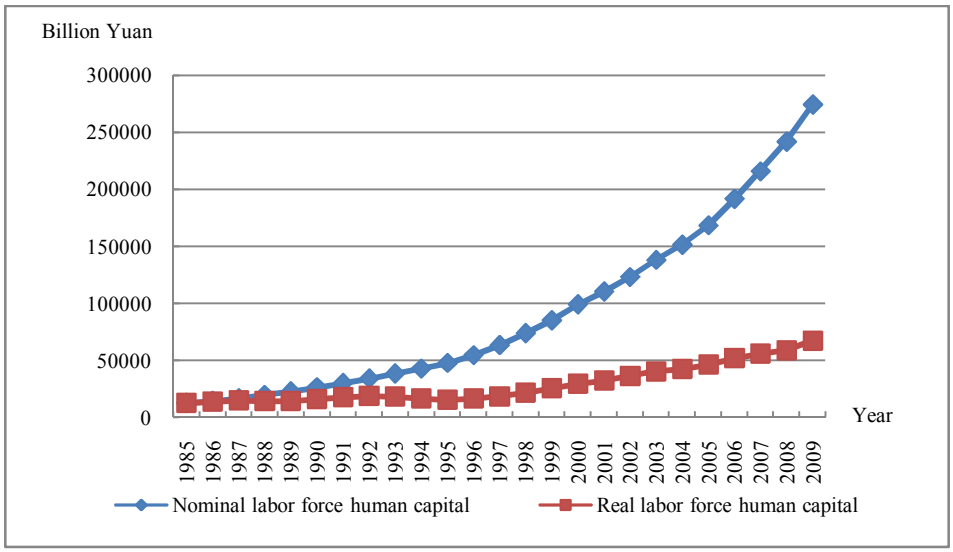


Figure 5.4.1 National Nominal and Real Labor Force Human Capital

We also calculate the ratio of labor force human capital to GDP for China. The results are reported in the last column of Table 5.4.1. As before, the ratio could reflect human capital's influence on sustainable growth of GDP, and may also reflect changes in human capital productivity and efficiency. Figure 5.4.2 shows the trend for the ratio. The pattern of the ratio for national labor force human capital is almost the same as that for national human capital. The level of nominal labor force human capital is much higher than that of nominal GDP. The ratio remains between 8 and 14 and generally shows a decreasing trend. It indicates that although national human capital stock level still remains much higher than physical capital, the efficiency of human capital has improving, however, the decreasing trend may also indicate possible constraints on the future GDP growth in China.

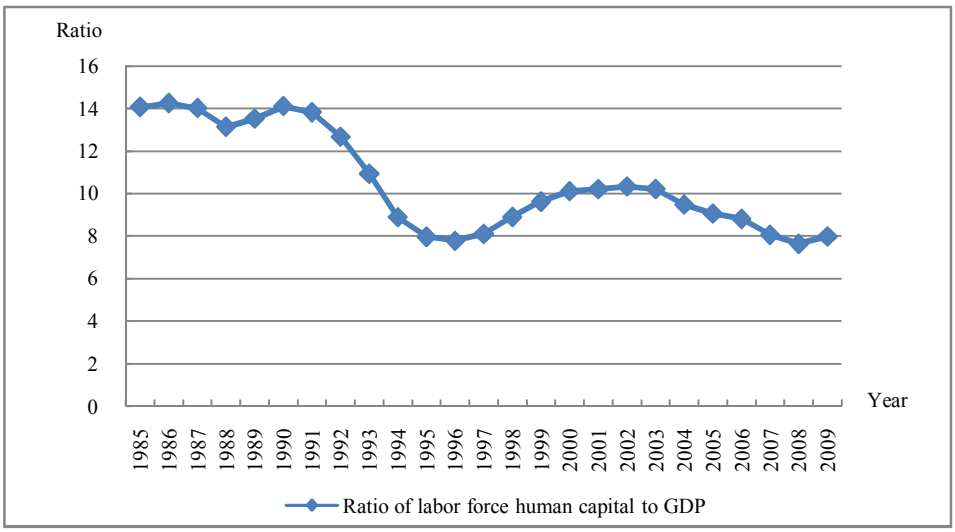


Figure 5.4.2 National Ratio of Labor Force Human Capital toGDP

Labor force human capital by gender is reported in Table 5.4.2. Both male and female real labor force human capital exhibit an increasing trend. Male real labor force human capital is larger than that of female throughout the whole period.

Table 5.4.2 National Nominal and Real Labor Force Human Capital by Gender[34]

Year	Nominal labor force human capital (Billions of Yuan)			Real labor force human capital (Billions of 1985 Yuan)		
	National	Male	Female	National	Male	Female
1985	12727	7776	4951	12727	7776	4951
1986	14645	8962	5683	13757	8417	5340
1987	16902	10370	6532	14811	9082	5729
1988	19768	12207	7561	14580	8994	5586
1989	22993	14280	8713	14354	8910	5444

[34] Some discrepancy may exist when summing up male and female, urban and rural to get the national amount. This is mainly caused by rounding errors.

1990	26420	16508	9912	15987	9989	5998
1991	30163	18849	11314	17640	11019	6621
1992	34128	21345	12783	18767	11727	7040
1993	38555	24180	14375	18480	11579	6901
1994	42800	26890	15910	16526	10371	6155
1995	47693	29970	17723	15703	9860	5843
1996	54602	34570	20032	16568	10480	6088
1997	63300	40360	22940	18646	11878	6768
1998	73920	47470	26450	21892	14050	7842
1999	85180	55030	30150	25522	16477	9045
2000	99120	64470	34650	29501	19176	10325
2001	110360	71710	38650	32558	21144	11414
2002	123140	80000	43140	36527	23720	12807
2003	138130	89750	48380	40445	26270	14175
2004	151430	98450	52980	42607	27690	14917
2005	168410	109500	58910	46477	30210	16267
2006	191700	125470	66230	52108	34100	18008
2007	215860	141680	74180	55960	36720	19240
2008	241830	159050	82780	59166	38910	20256
2009	274310	181070	93240	67508	44560	22948

Figure 5.4.3 shows that both male and female real labor force human capital exhibit a rising trend from 1985 to 2009. Before 1997, male and female real labor force human capital grew quite slowly. Both increased significantly from 1997.The gender gap was fairly stable before 1997, but increased afterwards.

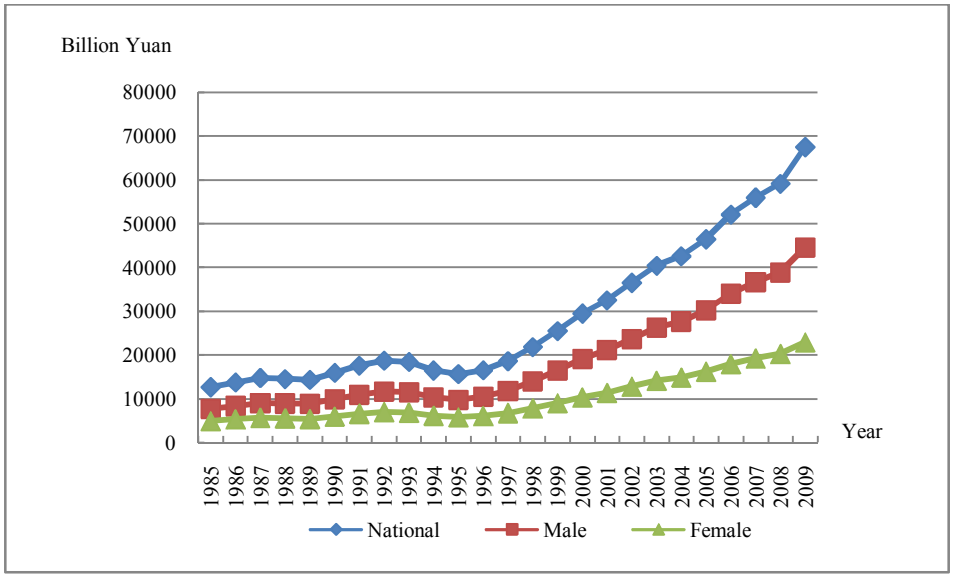


Figure 5.4.3 National Real Labor Force Human Capital by Gender

Table5.4.3 shows the nominal and real labor force human capital for urban and rural respectively. The pattern of national real labor force human capital is almost the same as that of the national real human capital. Urban real labor force human capital surpassed its rural counterpart for the first time in 1999. The urban-rural gap has increased from less than 1 trillion Yuan in 1999 to 16.25 trillion Yuan in 2009.

Table 5.4.3 National Nominal and Real Labor Force Human Capital by Urban-Rural

Year	Nominal labor force human capital (Billions of Yuan)			Real labor force human capital (Billions of 1985 Yuan)		
	National	Urban	Rural	National	Urban	Rural
1985	12727	4805	7922	12727	4805	7922
1986	14645	5678	8967	13757	5306	8451
1987	16902	6658	10244	14811	5719	9092
1988	19768	8018	11750	14580	5706	8874
1989	22993	9581	13412	14354	5863	8491

1990	26420	11110	15310	15987	6711	9276
1991	30163	12857	17306	17640	7389	10251
1992	34128	14756	19372	18767	7809	10958
1993	38555	16901	21654	18480	7706	10774
1994	42800	18953	23847	16526	6913	9613
1995	47693	21343	26350	15703	6662	9041
1996	54602	25562	29040	16568	7334	9234
1997	63300	31080	32220	18646	8650	9996
1998	73920	38080	35840	21892	10662	11230
1999	85180	45860	39320	25522	13013	12509
2000	99120	55680	43440	29501	15670	13831
2001	110360	63400	46960	32558	17721	14837
2002	123140	72470	50670	36527	20456	16071
2003	138130	82960	55170	40445	23216	17229
2004	151430	92520	58910	42607	25060	17547
2005	168410	105190	63220	46477	28044	18433
2006	191700	120010	71690	52108	31520	20588
2007	215860	135180	80680	55960	33980	21980
2008	241830	151840	89990	59166	36140	23026
2009	274310	174460	99850	67508	41880	25628

Figure 5.4.4 shows real labor force human capital for urban and rural respectively. The pattern of national labor force human capital is almost the same as that of national real human capital. The urban labor force human capital surpassed the rural one in 1999 and has grown much faster ever since.

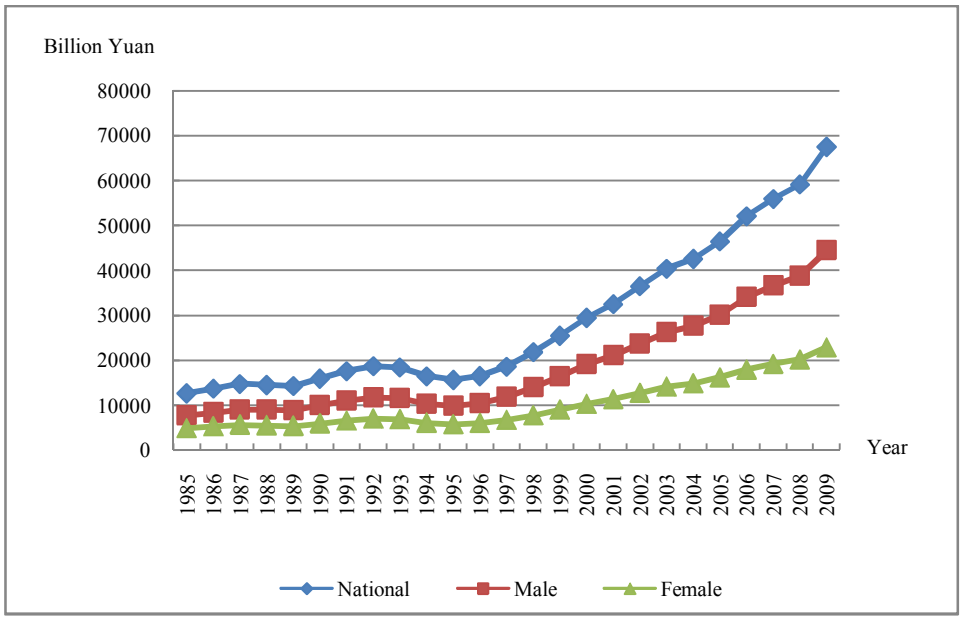


Figure 5.4.4 National Real Labor Force Human Capital by Urban-Rural

Similarly, we construct a set of real labor force human capital indices with their corresponding values in 1985 set to 100. Table 5.4.4 shows various human capital indices.

Table 5.4.4 National Real Labor Force Human Capital Index
（1985=100）

Year	National	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	108.09	108.24	107.86	110.43	106.68
1987	116.37	116.80	115.71	119.02	114.77
1988	114.56	115.66	112.83	118.75	112.02
1989	112.78	114.58	109.96	122.02	107.18
1990	125.61	128.46	121.15	139.67	117.09
1991	138.60	141.71	133.73	153.78	129.40

1992	147.46	150.81	142.19	162.52	138.32
1993	145.20	148.91	139.39	160.37	136.00
1994	129.85	133.37	124.32	143.87	121.35
1995	123.38	126.80	118.02	138.65	114.13
1996	130.18	134.77	122.97	152.63	116.56
1997	146.51	152.75	136.70	180.02	126.18
1998	172.01	180.68	158.39	221.89	141.76
1999	200.53	211.90	182.69	270.82	157.90
2000	231.80	246.60	208.54	326.12	174.59
2001	255.82	271.91	230.54	368.80	187.29
2002	287.00	305.04	258.68	425.72	202.87
2003	317.79	337.83	286.31	483.16	217.48
2004	334.78	356.10	301.29	521.54	221.50
2005	365.18	388.50	328.56	583.64	232.68
2006	409.43	438.53	363.72	655.98	259.88
2007	439.70	472.22	388.61	707.18	277.46
2008	464.89	500.39	409.13	752.13	290.66
2009	530.43	573.05	463.50	871.59	323.50

Figure 5.4.5 shows the index of national real labor force human capital. It follows the same trend of national real human capital. Growth in real labor force human capital has accelerated since 1997.

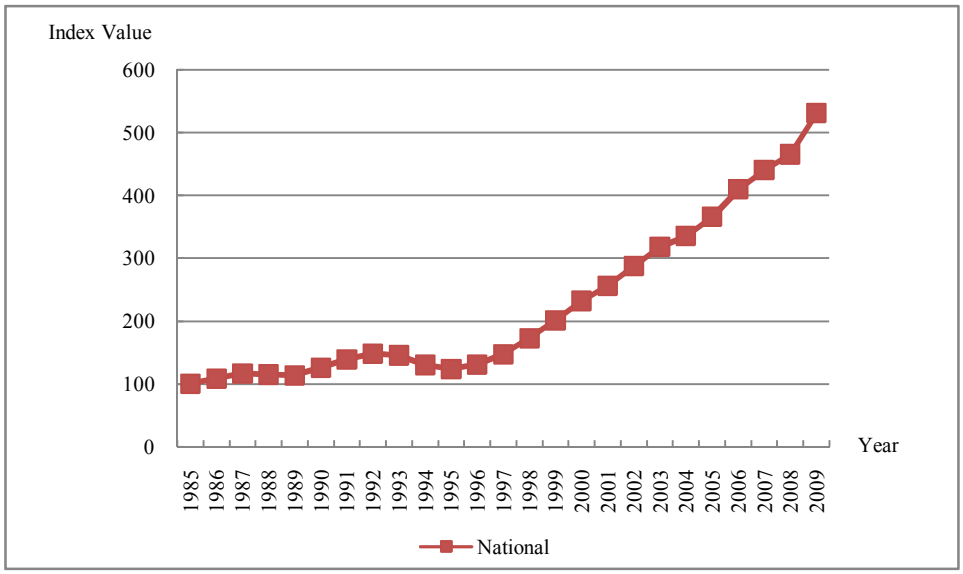


Figure 5.4.5 National Real Labor Force Human Capital Index

Figure 5.4.6 shows the national ratio of labor force human capital to total human capital by five education categories. The ratios reflect age structures as human capital for the young and often highly-educated population will be higher than that for the older and less-educated population. As is seen from the graph, before 1993, the ratio grew steadily, but it dropped dramatically after that. The decreasing trend may indicate that the proportion of young generation in total population is getting smaller, and the aging population phenomenon is becoming clear. Moreover, it may indicate constraints on the productivity efficiency improvement in future China.

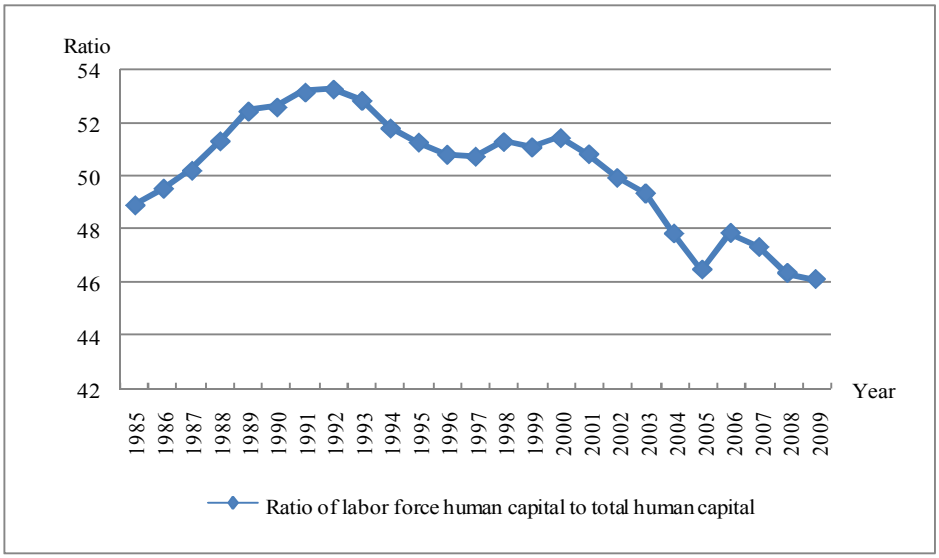


Figure 5.4.6 National Ratio of Labor Force Human Capital to Total Human Capital

5.4.2 Average labor force human capital

Similar to the analysis of per capita human capital above, we calculate the real average labor force human capital. Here the average labor force human capital means national labor force human capital divided by the number of the population that are over 15 years old, non-retired and out of school. Table 5.4.5 shows that the average labor force human capital both in real and nominal terms have kept increasing.

Table 5.4.5 National Nominal and Real Average Labor Force Human Capital

Year	Nominal average labor force human capital (Thousands of Yuan)		Real average labor force human capital (Thousands of 1985 Yuan)	
	By Five education category	By Six education category	By Five education category	By Six education category
1985	22.30		22.30	
1986	25.06		23.54	
1987	28.17		24.69	

Year	Nominal average labor force human capital (Thousands of Yuan)		Real average labor force human capital (Thousands of 1985 Yuan)	
	By Five education category	By Six education category	By Five education category	By Six education category
1988	31.85		23.49	
1989	36.01		22.48	
1990	40.41		24.45	
1991	45.02		26.32	
1992	49.99		27.49	
1993	55.80		26.73	
1994	61.73		23.84	
1995	68.23		22.46	
1996	77.34		23.47	
1997	87.92		25.90	
1998	100.43		29.74	
1999	113.89		34.12	
2000	129.90	128.84	38.66	38.37
2001	143.70	142.81	42.40	42.14
2002	159.92	159.48	47.44	47.32
2003	178.46	178.31	52.24	52.18
2004	197.17	198.09	55.48	55.72
2005	219.58	220.93	60.60	60.94
2006	247.34	249.00	67.24	67.65
2007	277.84	279.96	72.02	72.56
2008	311.59	314.22	76.24	76.84
2009	353.54	356.39	87.00	87.68

Table 5.4.6 reports the real average labor force human capital by gender. Additionally, the table shows that the real average labor force human capital for female was smaller than that for male.

Table 5.4.6 National Nominal and Real Average Labor Force Human Capital by Gender

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	National	Male	Female	National	Male	Female
1985	22.30	25.85	18.35	22.30	25.85	18.35
1986	25.06	29.16	20.50	23.54	27.39	19.26
1987	28.17	32.96	22.90	24.69	28.87	20.08
1988	31.85	37.41	25.69	23.49	27.56	18.98
1989	36.01	42.26	28.99	22.48	26.37	18.11
1990	40.41	47.56	32.32	24.45	28.78	19.56
1991	45.02	53.25	35.79	26.32	31.13	20.95
1992	49.99	59.29	39.60	27.49	32.58	21.81
1993	55.80	66.61	43.81	26.73	31.90	21.03
1994	61.73	74.28	48.04	23.84	28.65	18.58
1995	68.23	82.34	52.90	22.46	27.09	17.44
1996	77.34	93.69	59.44	23.47	28.40	18.07
1997	87.92	107.06	66.88	25.90	31.51	19.73
1998	100.43	122.98	75.57	29.74	36.40	22.41
1999	113.89	139.67	85.17	34.12	41.82	25.55
2000	129.90	159.98	96.25	38.66	47.58	28.68
2001	143.70	177.50	106.18	42.40	52.34	31.36
2002	159.92	198.51	117.55	47.44	58.86	34.90
2003	178.46	222.15	130.76	52.24	65.02	38.31
2004	197.17	246.74	143.58	55.48	69.40	40.43
2005	219.58	275.13	159.65	60.60	75.90	44.08
2006	247.34	311.34	178.04	67.24	84.62	48.41
2007	277.84	349.83	199.41	72.02	90.67	51.72
2008	311.59	391.75	223.73	76.24	95.84	54.75
2009	353.54	444.89	252.68	87.00	109.48	62.19

Table 5.4.7 reports the real average labor force human capital by location. The real average labor force human capital was much smaller in rural area than in urban area.

Table 5.4.7 National Nominal and Real Average Labor Force Human Capital by Urban-Rural

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	National	Urban	Rural	National	Urban	Rural
1985	22.30	33.71	18.50	22.30	33.71	18.50
1986	25.06	37.71	20.67	23.54	35.24	19.48
1987	28.17	42.16	23.14	24.69	36.22	20.54
1988	31.85	47.84	25.96	23.49	34.05	19.60
1989	36.01	54.28	29.01	22.48	33.22	18.37
1990	40.41	61.43	32.38	24.45	37.11	19.62
1991	45.02	68.27	35.93	26.32	39.24	21.28
1992	49.99	75.84	39.75	27.49	40.14	22.49
1993	55.80	84.64	44.10	26.73	38.59	21.94
1994	61.73	93.59	48.57	23.84	34.13	19.58
1995	68.23	103.11	53.54	22.46	32.19	18.37
1996	77.34	116.96	59.51	23.47	33.56	18.92
1997	87.92	133.64	66.28	25.90	37.20	20.56
1998	100.43	152.54	73.79	29.74	42.71	23.12
1999	113.89	172.33	81.64	34.12	48.89	25.97
2000	129.90	195.75	90.70	38.66	55.10	28.89
2001	143.70	214.49	99.37	42.40	59.95	31.39
2002	159.92	237.32	108.95	47.44	67.00	34.56
2003	178.46	263.65	120.13	52.24	73.77	37.50
2004	197.17	289.35	131.48	55.48	78.38	39.17
2005	219.58	318.61	144.66	60.60	84.94	42.17
2006	247.34	354.24	164.56	67.24	93.05	47.26
2007	277.84	392.41	186.56	72.02	98.63	50.83
2008	311.59	436.53	210.54	76.24	103.91	53.86
2009	353.54	491.33	237.54	87.00	117.96	60.96

Finally we calculate a set of real average labor force human capital indices using 1985 as the base year and setting its values at 100. Table 5.4.8 reports the results.

Table 5.4.8 National Real Average Labor Force Human Capital Index (1985=100)

Year	National	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	105.54	105.95	104.98	104.55	105.31
1987	110.70	111.67	109.43	107.45	110.99
1988	105.34	106.62	103.43	101.01	105.96
1989	100.80	102.00	98.69	98.54	99.27
1990	109.64	111.32	106.57	110.10	106.03
1991	118.03	120.41	114.14	116.42	115.02
1992	123.25	126.01	118.85	119.08	121.53
1993	119.87	123.39	114.62	114.48	118.58
1994	106.89	110.82	101.27	101.26	105.82
1995	100.73	104.78	95.05	95.51	99.28
1996	105.23	109.86	98.45	99.58	102.27
1997	116.13	121.88	107.53	110.36	111.13
1998	133.35	140.80	122.10	126.73	124.98
1999	152.97	161.77	139.24	145.06	140.38
2000	173.36	184.07	156.29	163.46	156.12
2001	190.09	202.45	170.88	177.87	169.67
2002	212.72	227.68	190.16	198.79	186.78
2003	234.21	251.54	208.77	218.87	202.70
2004	248.77	268.46	220.29	232.54	211.69
2005	271.71	293.62	240.23	252.02	227.90
2006	301.48	327.32	263.80	276.05	255.42
2007	322.92	350.73	281.85	292.64	274.73
2008	341.83	370.73	298.33	308.27	291.13
2009	390.07	423.52	338.90	349.96	329.48

5.5 International comparison

Jorgenson-Fraumeni lifetime earnings approach has been adopted by many countries for human capital estimation, for example for Canada (Gu and Ambrose, 2008), New Zealand (Le, Gibson and Oxley, 2005), Norway (Greaker and Liu, 2008), Sweden (Alroth, 1997), and the United States of America (Jorgenson and Fraumeni, 1989, 1992a, 1992b and Christian, 2009). A summary of international comparison of human capital estimates is reported in Table 5.5.1. China's 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 human capital in China is around 15 times of that in Australia and about 144 times of that in New Zealand. In 2006, China's human capital is about 78 times of Norway's, and in 2007, China's human capital is 10.6 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.[35]

[35] More recent estimates include those for Argentina (Coremberg, 2010) and the United States (Abraham 2010 and Christian 2010).

Table 5.5.1 International Comparison of Human Capital Estimates

Currency unit: US Dollars

	Canada	Norway	New Zealand	U.S.A	Australia	China[36]		
	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 (Thousands)	54.85		32.32	about 70	35.56	6.57	11.74	13.06
National human capital (Trillions)	13.61	1.66	0.51	212	4.86	73.4	130.4	144.7
Ratio of human capital to GDP	11	8	6	>15	10	20.19	18.52	17.14

Note: The PPP exchange rates are from Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 7.0 (China version 1), Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, May 2011. The website link is http://pwt.econ.upenn.edu/php_site/pwt_index.php.

[36] We use the national nominal human capital in Table 5.1.1 to calculate the internationally comparable results for China.

Chapter 6 Cross-province comparison

In order to see the differences in human capital accumulation between provinces, in this chapter we compare nominal and real human capital, labor human capital, per capita real human capital, real average labor human capital, and the ratios of labor human capital to human capital and GDP to labor human capital across provinces.

6.1 Cross-province human capital comparison

Figure 6.1.1 shows the provincial comparison of nominal human capital. [37]Guangdong ranks the highest, followed by Jiangsu, and Gansu ranks the lowest. The notable features of the differences across provinces are: (1) Population plays a dominant role in influencing total human capital, despite other provincial differences in educational attainment, age structure, and income level. Provinces with large populations such as Jiangsu, Henan, Shandong, Guangdong, Hunan rank relatively higher. (2) The relative ranking of provinces basically remains the same, although the gap keeps enlarging. As is shown in the graph below, the human capital ranking in 2009 is quite similar to that in 1985 and 1995. This implies that it might be quite difficult for one province to surpass another province over time. In addition, the gap between provinces has gotten larger over time.

[37] We order provinces by the size of 2009 human capital indicators in all the cross-province comparison graphs below.

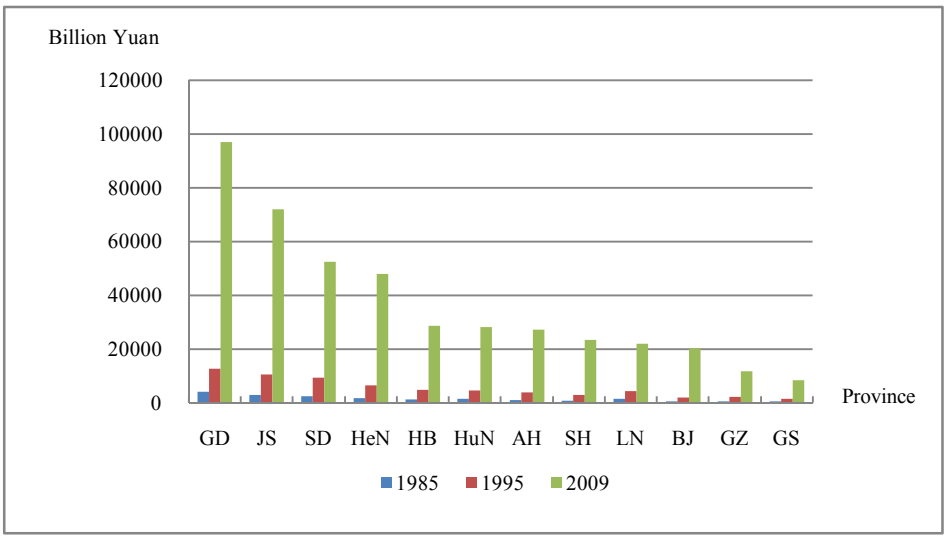


Figure 6.1.1 Provincial Nominal Human Capital

Figure 6.1.2 presents the provincial comparison of real human capital. Real human capital is created by deflating nominal human capital by a living cost index based on Brandt and Holz (2006).[38] We used their living cost index (based on Beijing 1990) and updated it across time using provincial CPI to construct a deflator that makes it comparable cross provinces and cross time. Accordingly, the real values of provincial human capital using the above deflator are comparable. The ranking of real human capital is similar to the nominal ranking: Guangdong has the highest real human capital, followed by Jiangsu, and Gansu has the lowest real human capital. Adjustment by a living cost index to some extent narrows the gap between developed and developing provinces. For example, Shanghai and Beijing's rankings clearly dropped compared to their nominal human capital rankings.

[38] Brandt, Loren, Holz, Carsten, 2006. Spatial price differences in China: estimates and implications. Economic Development and Cultural Change 55, 43–86.

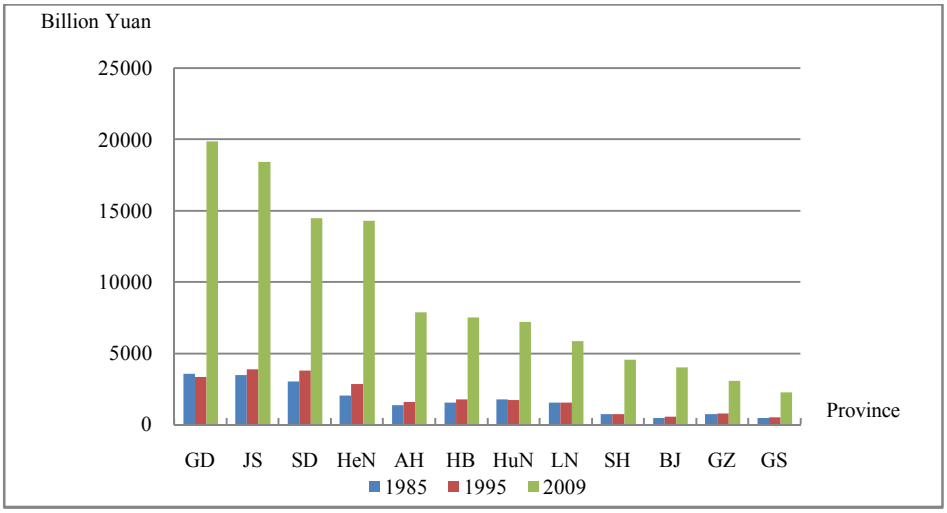


Figure 6.1.2 Provincial Real Human Capital

Figure 6.1.3 shows the provincial comparison of per capita real human capital. The provincial ranking of per capita real human capital is obviously different from that of provincial real human capital. Shanghai, Jiangsu, Beijing rank in the top three, Guizhou ranks last. We conclude that the rankings are closely related to the development stage of the provinces. Per capita real human capital is directly influenced by income level and income growth rate. The ranking results are also influenced by education level and population structure.

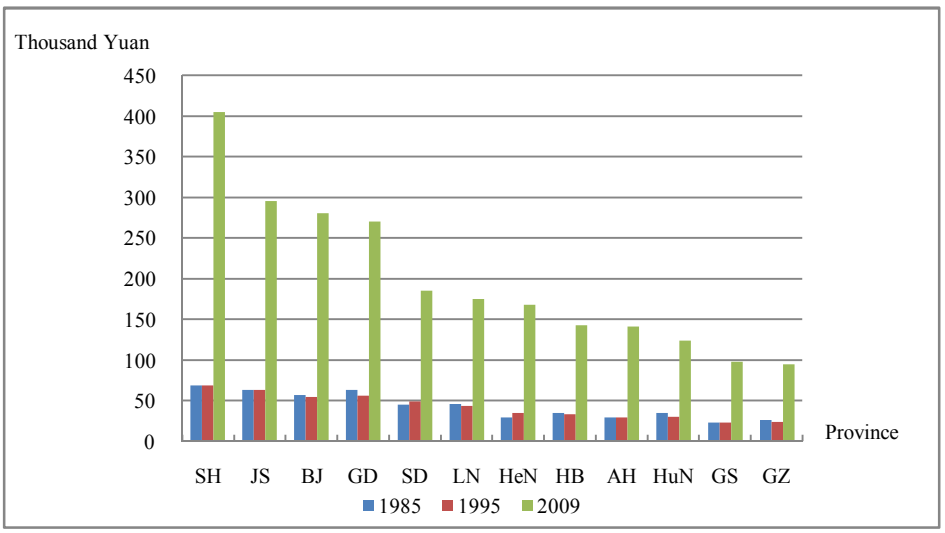


Figure 6.1.3 Provincial Real Per Capita Human Capital

6.2 Cross-province labor force human capital comparison

Figure 6.2.1 displays provincial real labor force human capital. Overall, Jiangsu has the highest real labor force human capital, with Shandong and Guangdong almost as high and Gansu the lowest. As the living cost index is negatively correlated with the stage of development, the gap between developed and developing provinces is narrowed to some extent. For example, Shanghai and Beijing's rankings dropped after the living cost adjustment. Also the real labor force human capital ranking could change because of different sizes of the provincial labor force population and the human capital population. This might explain why Shandong ranks higher than Guangdong in this category.

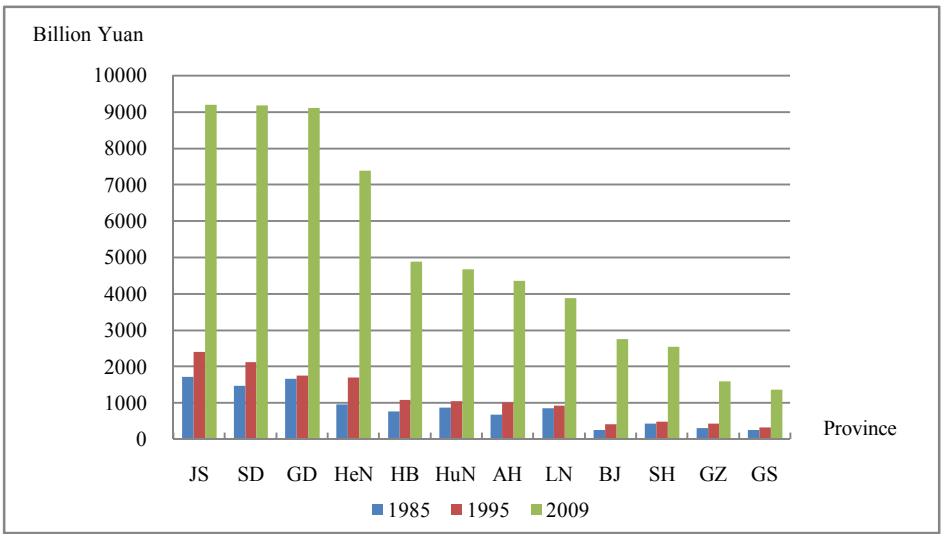


Figure 6.2.1 Provincial Real Labor Force Human Capital

Figure 6.2.2 shows the provincial comparison for real average labor force human capital. Average labor force human capital rankings are almost the same as those for real human capital per capita: Shanghai remains first, Beijing and Jiangsu follow, Guizhou stays in the last place. Composition of the population plays a dominant role in the magnitude of provincial real

average labor force human capital, both the absolute size of the labor force and its size relative to the human capital population are important factors.

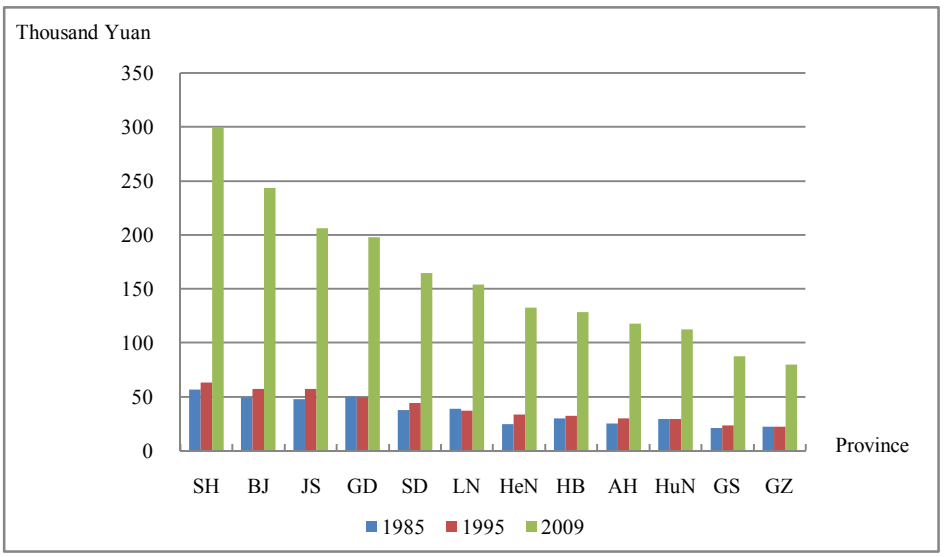


Figure 6.2.2 Provincial Real Average Labor Force Human Capital

6.3 Labor force human capital, human capital and GDP ratios

Figure 6.3.1 shows the ratios of labor force human capital to total human capital by province. The ratios reflect age structures as human capital for the young and often highly-educated population will be higher than that for the older and less-educated population. For provinces with low ratios and relatively small proportions of young individuals, the development of the area might rely to a greater extent on the inflows from other areas. As is seen from the graph, the ratio ranking in 2009 is quite different from the ranking in 1995. Beijing ranked the first in 1995, followed by Shanghai, and Guangdong ranks the last. In 2009 Beijing remained in the first place, Liaoning replaces Shanghai in second place, followed by Hubei, Hunan, Shandong and Guangdong. This ratio decreased for some relatively developed (such as

Beijing and Shanghai) and developing provinces (such as Henan and Guizhou) over time, while it rose for some middle income level provinces (such as Shandong and Hunan).

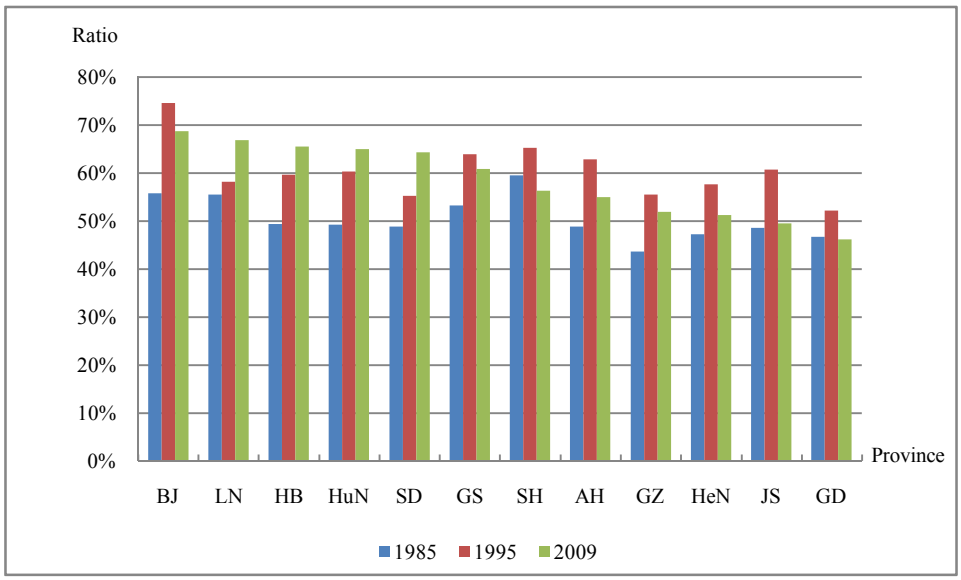


Figure 6.3.1 Provincial Nominal Ratio of Labor Force Human Capital to Total Human Capital

Figure 6.3.2 shows nominal ratios of provincial GDP to provincial labor force human capital. The provincial ratios dropped from 1995 to 2009, except for Jiangsu and Shandong. Overall, the ratios for developed provinces are relatively higher, with Shanghai ranked the highest and Guizhou the lowest. This indicates that developed provinces have higher human capital productivity.[3940]This result might be partly due to provinces with an advanced industry structure being able to more fully capitalize on the capabilities of

[39] This conclusion assumes that income can be used as a proxy for input.

[40] Human capital productivity with income as a proxy for input differs from labor productivity as human capital includes current income as well as expected future income, while labor productivity includes only current income.

their human capital. It may also reflect the efficiency of the local labor market.

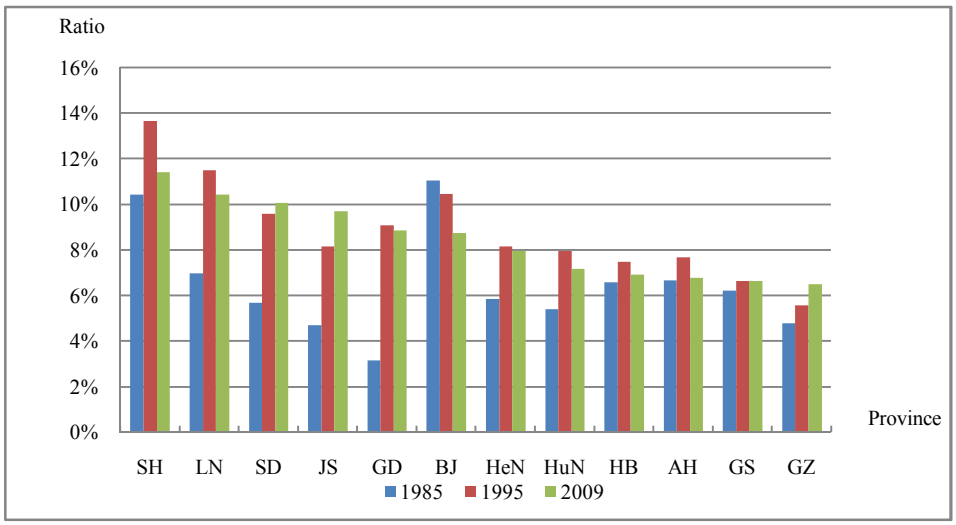


Figure 6.3.2 Provincial Nominal Ratio of GDP to Labor Force Human Capital

Chapter 7 Human capital for Beijing

1. Total human capital

Human capital stocks of Beijing are calculated using estimated income parameters and a 4.58% discount rate. The results are ported in TableBJ-1.1. Columns 1 and 2 contain the nominal human capital, and columns 3 and 4 contain the real human capital deflated by CPI (in 1985 Yuan).[41]

Table BJ-1.1 Nominal and Real Human Capital, Nominal GDP for Beijing

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	418		418		26	16.25
1986	487		456		28	17.09
1987	561		483		33	17.16
1988	677		485		41	16.50
1989	810		495		46	17.76
1990	973		564		50	19.42
1991	1110		575		60	18.53
1992	1274		600		71	17.96
1993	1472		583		89	16.62
1994	1701		540		115	14.86
1995	1938		524		151	12.85
1996	2304		558		179	12.88
1997	2749		632		208	13.23
1998	3288		739		238	13.83

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

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1999	3914		874		268	14.61
2000	4668	4923	1007	1062	316	14.76
2001	5435	5733	1138	1200	371	14.66
2002	6388	6751	1361	1439	432	14.80
2003	7545	7863	1605	1673	501	15.07
2004	8984	9410	1892	1982	603	14.89
2005	10377	10943	2153	2271	697	14.89
2006	12296	12801	2529	2632	812	15.15
2007	14445	15084	2901	3029	985	14.67
2008	17244	18061	3295	3451	1112	15.51
2009	20281	21297	3936	4133	1215	16.69

Note: The ratio of human capital to GDP is based on the current values for that year.

Figure BJ-1.1 graphs real and nominal human capital for Beijing reported in Table BJ-1.1. As is seen from the figure, both the nominal and real human capital rise steadily and nominal human capital grows faster than real human capital.

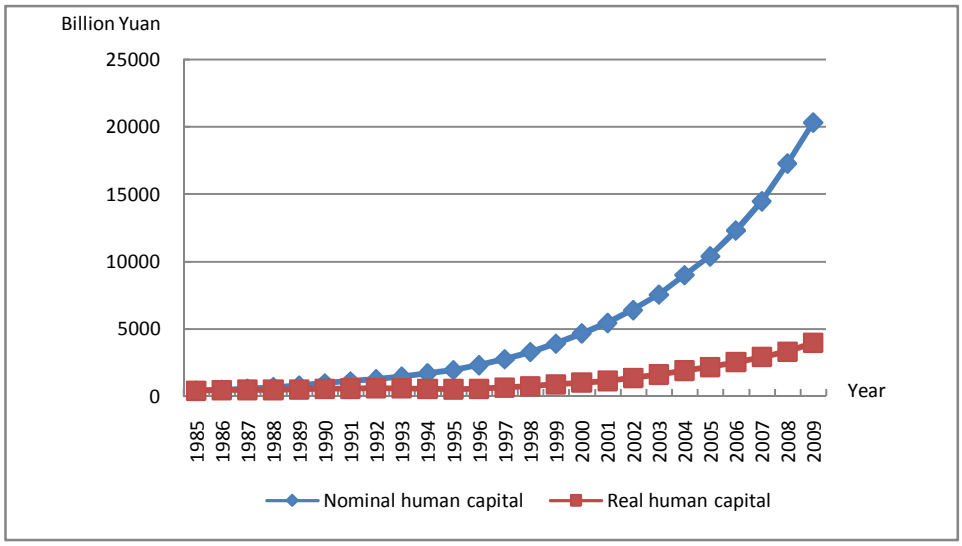


Figure BJ-1.1 Nominal and Real Human Capital for Beijing

In order to get a sense of the magnitude of the human capital in Beijing, we also present the ratio of nominal human capital to nominal GDP in Table BJ-1.1.[42]Similar to physical capital, human capital plays an important role in GDP growth, so the ratio could also reflect human capital's influence on sustainable growth of GDP. As is shown in Figure BJ-1.2, nominal human capital is substantially higher than nominal GDP for Beijing. There are three stages in this series: Upwards from 1985 through1990, downwards from 1990 through 1995, and finally upward from 2003 through 2009.

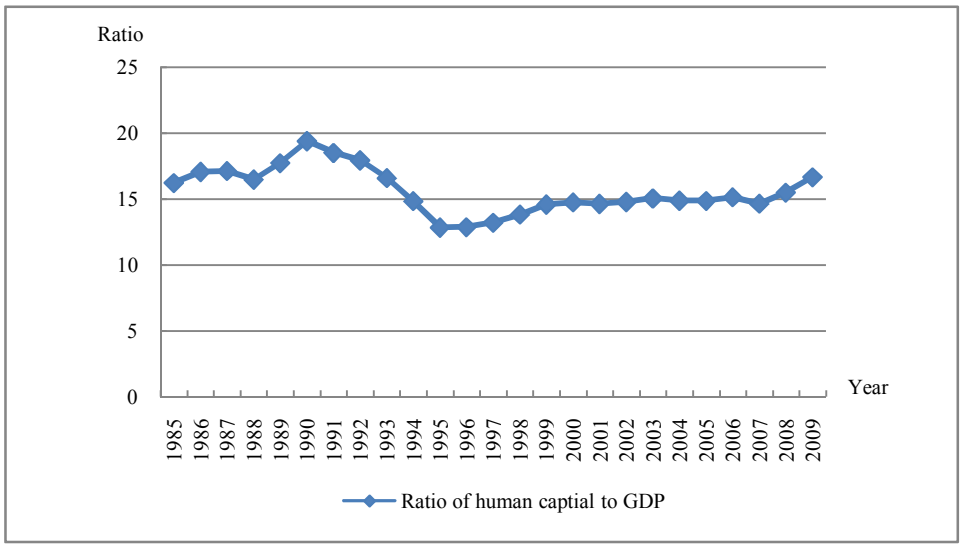


Figure BJ-1.2 Ratio of Human Capital to GDP for Beijing

In order to discuss the trend of human capital, we often need to adjust the nominal value into real value by using adjustment index. We calculate

[42] The reason for calculating the ratio at the nominal level is to avoid the differences between the real value of human capital and that of GDP caused by using different deflator indices.

the real values here using CPI. Table BJ-1.2 reports the human capital real values for Beijing by gender and urban-rural. The results based on five education categories show that the human capital for Beijing during 1985 to 2009 kept growing rapidly. More specifically, the human capital for Beijing increased from 0.42 trillion Yuan to 3.94 trillion Yuan (based on 1985), it had increased by 9 times, the annual growth rate of human capital over this period increased to 9.35%.[43]

From 1985 to 2009, male human capital in Beijing increased from 0.265 trillion Yuan to 2.538 trillion Yuan, the human capital for female in Beijing increased from 0.153 trillion Yuan to 1.398 trillion Yuan. During the same period, the annual growth rates of human capital were 9.42% and 9.22% for male and female respectively. The gender gap in the estimated human capital increased from 0.112 trillion Yuan in 1985 to 1.141 trillion Yuan in 2009. In 2009, the male human capital was about 1.8 times the amount of that for female in Beijing.

From 1985 to 2009, rural human capital for Beijing increased from 0.121 trillion Yuan to 0.264 trillion Yuan, urban human capital for Beijing increased from 0.297 trillion Yuan to 3.672 trillion Yuan. During the same period, the annual growth rates of human capital were 3.25% and 10.48% for rural and urban areas respectively. The urban-rural gap in the estimated

[43] 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.

human capital increased from 0.176 trillion Yuan in 1985 to 3.408 trillion Yuan in 2009. In 2009, the urban human capital was about 14 times the amount of that for rural in Beijing.

Table BJ-1.2 Real Human Capital by Gender and Urban-Rural for Beijing[44]

Billions of 1985 Yuan

Year	Total	Male	Female	Urban	Rural
1985	418	265	153	297	121
1986	456	289	166	329	127
1987	483	308	175	354	129
1988	485	308	176	361	124
1989	495	314	181	375	120
1990	564	356	207	435	129
1991	575	363	212	447	128
1992	600	378	222	471	129
1993	583	368	216	462	121
1994	540	340	200	432	107
1995	524	330	194	421	103
1996	558	353	205	457	101
1997	632	409	224	526	106
1998	739	477	261	624	115
1999	874	567	307	747	127
2000	1007	654	353	869	138
2001	1138	736	402	998	140
2002	1361	878	483	1212	150
2003	1605	1035	570	1447	158
2004	1892	1213	679	1724	168
2005	2153	1376	777	1976	177
2006	2529	1622	907	2336	193
2007	2901	1865	1036	2687	214
2008	3295	2122	1173	3066	229
2009	3936	2538	1398	3672	264

[44] Some discrepancy may exist when summing up male and female, or urban and rural to get the total amount. This is mainly caused by rounding errors.

Figure BJ-1.3 show that the human capital real values of male and female for Beijing exhibited a rising trend from 1985 to 2009. Before 1997, different human capital all grew quite slowly, starting from 1997, both the growth of human capital of male and female accelerated, the gender gap, which had been fairly stable, then appeared to be expanding.

The situation that the human capital of male is higher than that of female is consistent with that at the national level. One reason is that older retirement age for male, male has longer time to generate income from market, and thus end up with a higher lifetime income relative to female[45]. Also the income gap between male and female keeps expanding, which directly results in widening gap of the human capital between them.

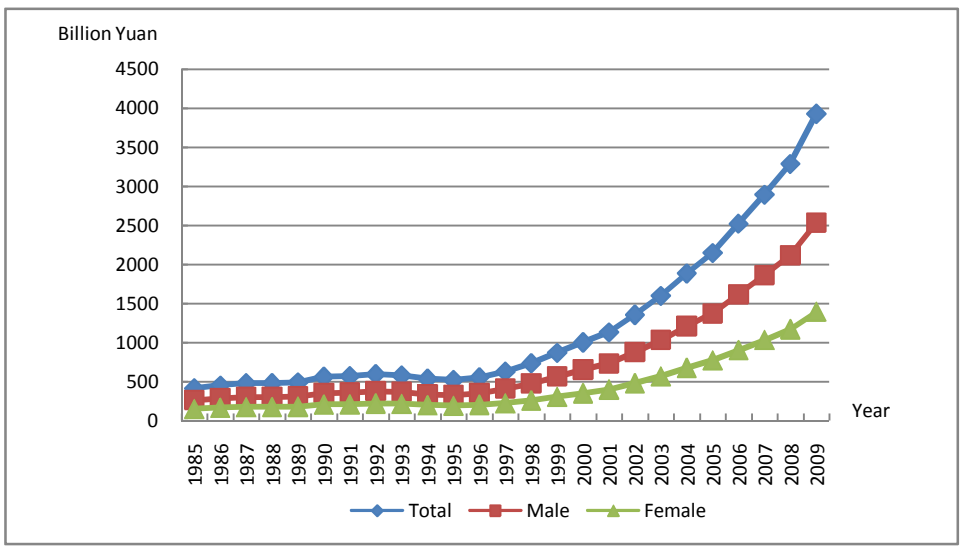


Figure BJ-1.3 Real Human Capital by Gender for Beijing

[45] To ensure the consistence of urban and rural, we define the retirement age of male and female in rural areas as 60 and 55.

Figure BJ-1.4 shows the human capital real values for urban and rural separately. The urban human capital remained larger than that for rural from 1985 to 2009. Before 1997, the urban human capital was about 3-4 times the amount of that for rural. Starting from 1997, however, the urban human capital was rising much more rapidly while rural human capital kept growing quite slowly, which resulted in an increasingly larger gap between rural and urban. Thus we could see that human capital changes almost simultaneously with urban human capital. Moreover, the gap showed a trend of further expansion as the human capital for urban increased much faster in later periods.

One reason that results in the gap between rural and urban is the rapid urbanization during the course of economic transition and a large scale migration of rural population to urban areas. Another one is the education gap between the rural and urban population.

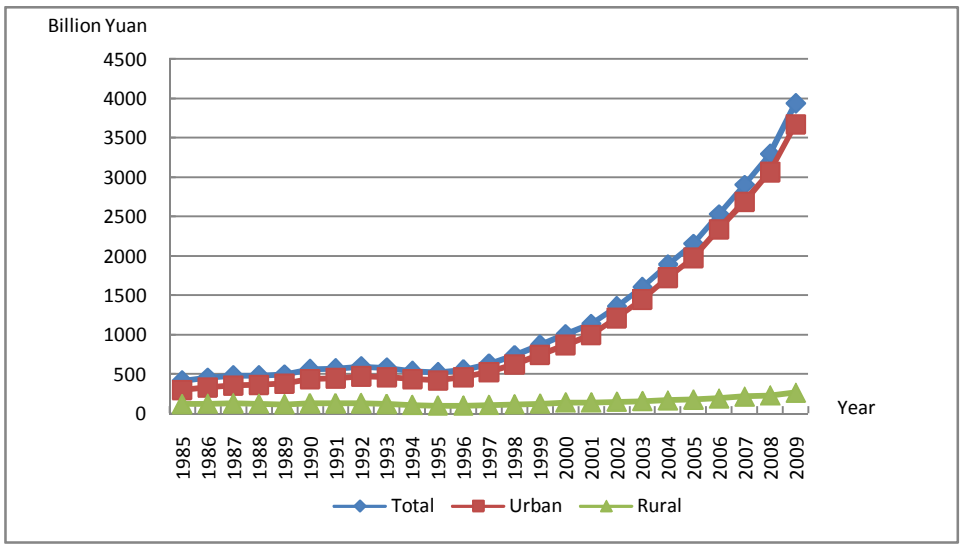


Figure BJ-1.4 Real Human Capital by Urban-Rural for Beijing

Human capital index could reflect the trend of human capital directly. Table BJ-1.3 reports a set of indices of real human capital classified by gender and urban and rural for Beijing from 1985 to 2009. We calculated them using 1985 as the base year and setting its value at 100.

Table BJ-1.3 Real Human Capital Index for Beijing (1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	109.13	109.27	108.88	110.95	104.65
1987	115.73	116.33	114.70	119.28	107.04
1988	116.05	116.40	115.45	121.51	102.65
1989	118.50	118.46	118.56	126.40	99.12
1990	135.01	134.60	135.71	146.66	106.41
1991	137.65	137.18	138.46	150.52	106.06
1992	143.74	142.76	145.44	158.74	106.93
1993	139.64	138.83	141.05	155.82	99.96
1994	129.20	128.23	130.87	145.73	88.64
1995	125.46	124.68	126.81	141.97	84.93
1996	133.67	133.36	134.20	154.11	83.50
1997	151.41	154.34	146.33	177.33	87.80
1998	176.89	180.31	170.97	210.21	95.14
1999	209.28	213.98	201.14	251.68	105.27
2000	241.16	247.13	230.81	293.00	113.97
2001	272.35	277.81	262.90	336.34	115.35
2002	325.96	331.67	316.07	408.38	123.73
2003	384.27	390.66	373.20	487.72	130.45
2004	453.02	457.94	444.48	580.87	139.31
2005	515.53	519.71	508.30	665.84	146.72
2006	605.39	612.40	593.23	787.12	159.48
2007	694.55	704.40	677.48	905.43	177.10
2008	788.89	801.16	767.64	1033.24	189.33
2009	942.34	958.56	914.24	1237.38	218.39

Figure BJ-1.5 shows the index of real human capital. It's obvious that the human capital has been rising much more rapidly since 1997.

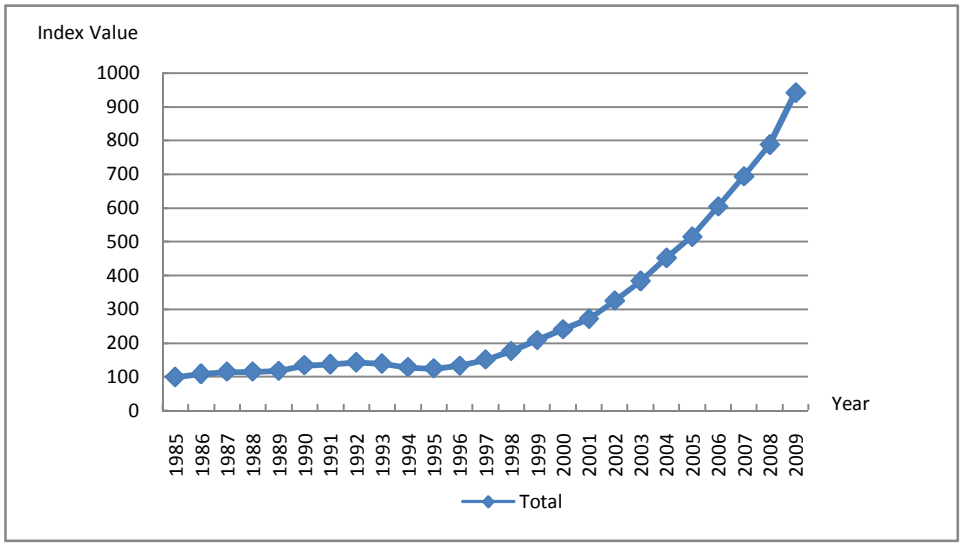


Figure BJ-1.5 Real Human Capital Index for Beijing

2. Per capita human capital

The increase in the human capital can be caused by population growth, demographic change (like retirement population scale), urbanization (like urban-rural migration), higher educational attainment, higher return to education, higher 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 human capital divided by non-retired population. Although the per capita human capital is influenced by the age distribution of the population, it could exclude the population factor

influence to a large extent, thus it could serve as a better indicator of the average human capital.

Table BJ-2.1 presents the trends of per capita human capital measured in nominal and real terms for Beijing by gender. Per capita human capital of male remained higher than that of female. Per capita human capital real values for male increased from 63,449 Yuan to 335,975 Yuan, increasing by around 5 times; per capita human capital real values for female increased from 43,640 Yuan to 210,316 Yuan, increasing by around 5 times as well. From1985 to 2009, the annual growth rate was 6.95% for male, and 6.55% for female.

Table BJ-2.1 Per Capita Nominal and Real Human Capital by Gender for Beijing

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	54.41	63.45	43.64	54.41	63.45	43.64
1986	61.42	71.97	48.95	57.51	67.39	45.83
1987	68.76	81.10	54.26	59.29	69.92	46.79
1988	77.62	92.21	60.82	55.59	66.03	43.56
1989	87.47	104.16	68.48	53.44	63.64	41.84
1990	99.26	118.46	77.63	57.54	68.67	45.00
1991	112.75	134.88	87.97	58.41	69.88	45.57
1992	128.99	154.39	100.79	60.80	72.78	47.51
1993	148.88	179.03	115.67	58.98	70.92	45.82
1994	171.57	206.65	133.19	54.41	65.54	42.24
1995	193.55	234.92	148.89	52.33	63.52	40.26
1996	222.97	270.65	171.09	54.02	65.57	41.45

1997	257.80	313.60	194.56	59.32	72.15	44.76
1998	299.62	363.12	227.08	67.32	81.59	51.02
1999	346.45	418.94	262.69	77.38	93.57	58.67
2000	401.43	482.62	305.96	86.63	104.15	66.02
2001	457.46	551.84	348.38	95.75	115.50	72.92
2002	525.59	636.45	399.18	112.02	135.65	85.08
2003	607.44	739.16	459.09	129.21	157.23	97.66
2004	709.00	862.79	537.88	149.32	181.71	113.28
2005	804.59	981.02	610.21	166.95	203.56	126.62
2006	933.71	1137.36	707.24	192.01	233.89	145.44
2007	1071.35	1303.70	811.00	215.15	261.82	162.87
2008	1240.62	1506.15	940.76	237.06	287.80	179.76
2009	1428.18	1731.17	1083.69	277.17	335.97	210.32

Figure BJ-2.1 shows that the per capita real human capital of male are higher than that of female for Beijing from 1985 to 2009. Before 1997, different human capital all grew quite slowly, starting from 1997, both the growth of human capital of male and female accelerated, the gender gap, which had been fairly stable, then appeared to be expanding.

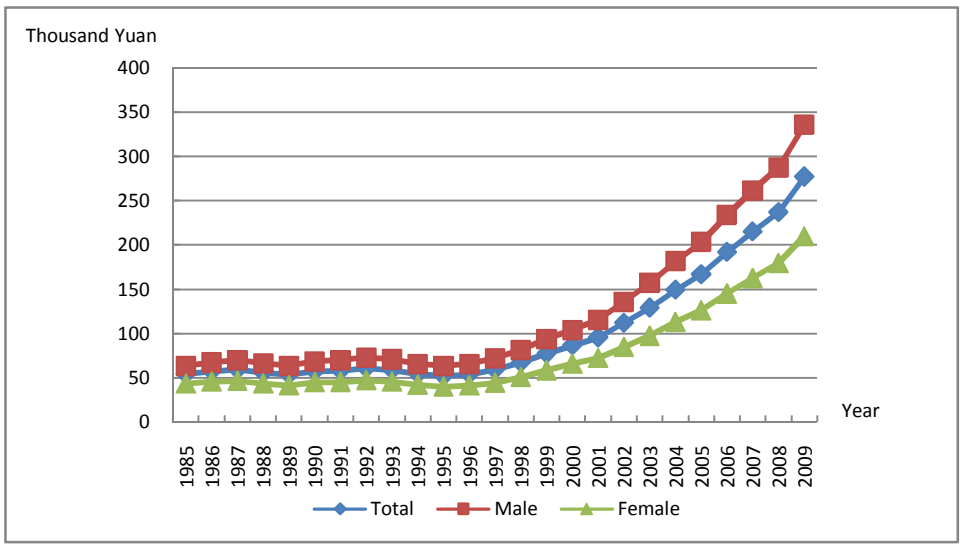


Figure BJ-2.1 Per Capita Real Human Capital by Gender for Beijing

Table BJ-2.2 reports the results of per capita human capital measured in nominal and real terms for Beijing classified by urban and rural separately. From 1985 to 2009, the per capita human capital in urban areas was significantly larger than that for rural. The per capita urban human capital increased from 55,285 to 303,798, the per capita rural human capital increased from 55,376 to 124,941. The per capita human capital in urban areas grew much faster than the one for rural.

Table BJ-2.2 Per Capita Nominal and Real Human Capital by Urban-Rural for Beijing

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	54.41	55.28	52.38	54.41	55.28	52.38
1986	61.42	62.77	58.18	57.51	58.77	54.47
1987	68.76	70.51	64.41	59.29	60.79	55.54
1988	77.62	79.76	72.03	55.59	57.11	51.58
1989	87.47	90.37	79.48	53.44	55.22	48.57
1990	99.26	103.56	87.02	57.54	60.04	50.44
1991	112.75	118.64	96.11	58.41	61.46	49.79
1992	128.99	137.27	105.73	60.80	64.71	49.84
1993	148.88	160.26	117.08	58.98	63.48	46.38
1994	171.57	186.75	129.20	54.41	59.23	40.98
1995	193.55	212.29	142.09	52.33	57.40	38.42
1996	222.97	246.05	156.51	54.02	59.61	37.92
1997	257.80	285.65	173.84	59.32	65.72	40.00
1998	299.62	333.41	193.39	67.32	74.91	43.45
1999	346.45	386.22	215.98	77.38	86.26	48.24

2000	401.43	448.18	242.11	86.63	96.71	52.25
2001	457.46	509.57	264.18	95.75	106.65	55.29
2002	525.59	583.73	290.91	112.02	124.42	62.01
2003	607.44	672.47	321.90	129.21	143.04	68.47
2004	709.00	781.51	363.73	149.32	164.59	76.60
2005	804.59	881.84	407.28	166.95	182.98	84.51
2006	933.71	1021.76	456.87	192.01	210.12	93.95
2007	1071.35	1173.13	512.99	215.15	235.60	103.02
2008	1240.62	1357.60	576.00	237.06	259.41	110.06
2009	1428.18	1565.38	643.78	277.17	303.80	124.94

Figure BJ-2.2 reflects the trend of per capita human capital measured in real terms and classified by urban and rural. As is shown in the graph, the size of the difference between urban and rural expanded rapidly after 1997, this is partly due to the long-tem stagnant status in the rural area before 2002. Based on five education categories, the ratio of urban to rural increased from 1.05 in 1985 to 2.43 in 2009, which indicates a rising size of urban-rural gap on per capita human capital. From 1985 to 2009, the annual growth rate was 7.10% for the urban area, and 3.62% for the rural area.

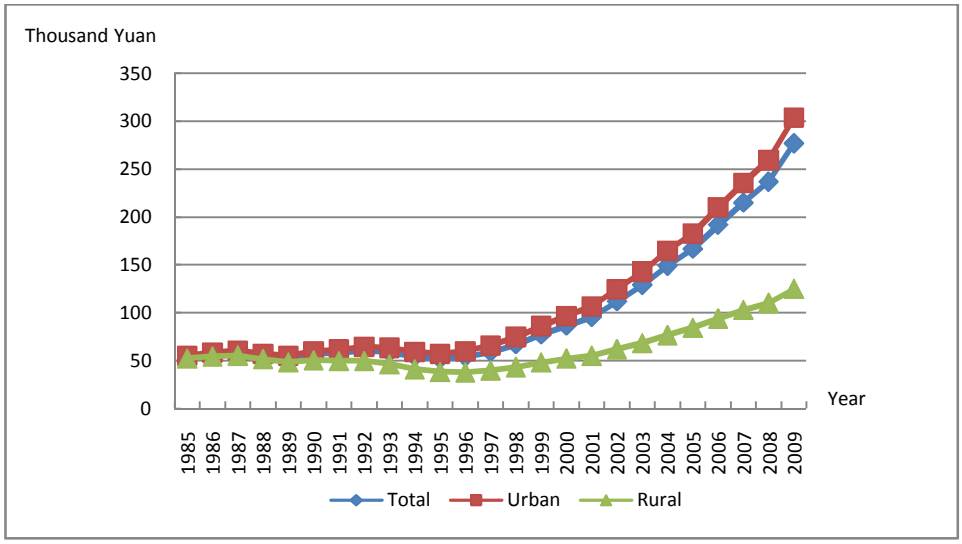


Figure BJ-2.2 Per Capita Real Human Capital by Urban-Rural for Beijing

Figure BJ-2.3 shows the per capita real human capital index for Beijing. It's obvious that the per capita human capital has been rising much more rapidly since 1997.

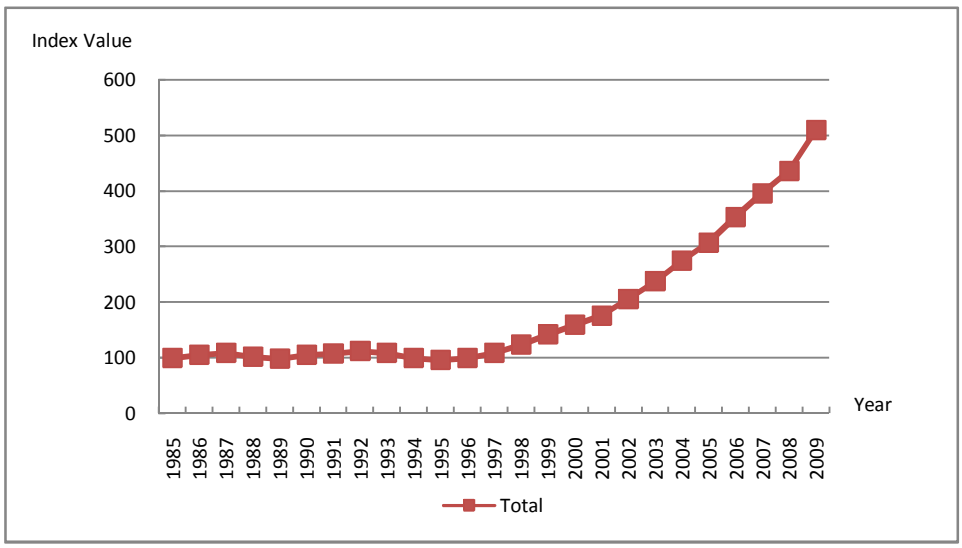


Figure BJ-2.3 Per Capita Real Human Capital Index for Beijing

3. Labor force human capital

3.1 Total labor force human capital

The labor force human capital represents the human capital of population that are over 15 years old, non-retired and out of school. The estimated approach of labor force 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 labor force human capital for Beijing is reported in Table BJ-3.1. The real values in this table are calculated by using CPI as the deflator with respect to nominal values. We also calculated the ratio of labor force human capital measured in nominal terms to nominal GDP. The results are reported in the last column of Table BJ-3.1.

Table BJ-3.1 Labor Force Human Capital and Nominal GDP for Beijing

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of labor force human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	198		198		26	7.71
1986	231		216		28	8.11
1987	272		234		33	8.32
1988	339		243		41	8.26
1989	420		256		46	9.20
1990	522		303		50	10.43

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of labor force human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1991	598		310		60	9.99
1992	681		321		71	9.61
1993	777		308		89	8.76
1994	874		277		115	7.63
1995	991		268		151	6.57
1996	1183		287		179	6.61
1997	1473		339		208	7.09
1998	1825		410		238	7.68
1999	2207		493		268	8.24
2000	2686	2589	580	559	316	8.49
2001	3066	2989	642	626	371	8.27
2002	3604	3559	768	758	432	8.35
2003	4273	4282	909	911	501	8.53
2004	4884	4979	1029	1049	603	8.09
2005	5683	5812	1179	1206	697	8.15
2006	6771	6941	1392	1427	812	8.34
2007	7976	8199	1602	1646	985	8.10
2008	9470	9759	1809	1865	1112	8.52
2009	11265	11650	2186	2261	1215	9.27

Note: The ratio of labor force human capital to GDP is based on the current values for that year.

The trends of labor force human capital in both real and nominal terms for Beijing are presented in Figure BJ-3.1. From 1985 to 2009, labor force human capital kept rising.

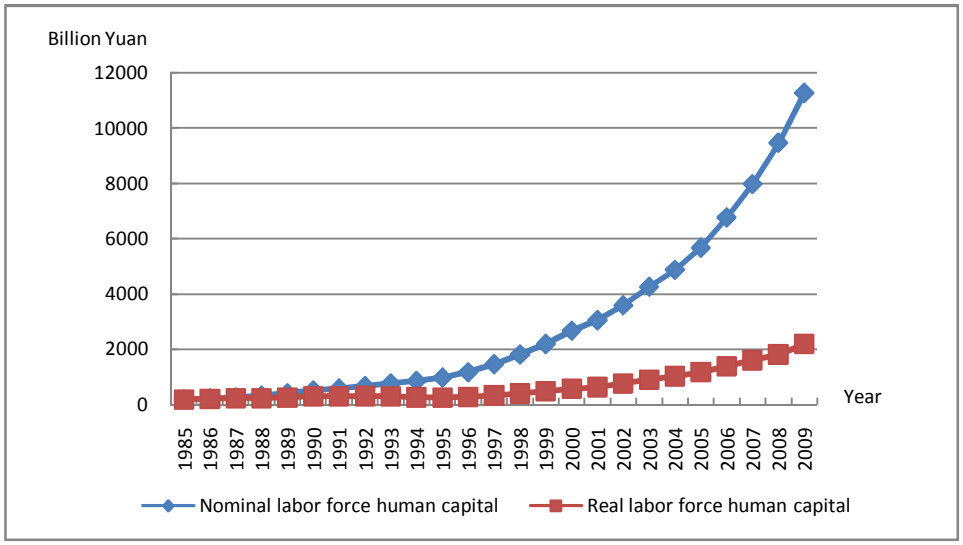


Figure BJ-3.1 Nominal and Real Labor Force Human Capital for Beijing

Similar to the analysis of human capital, in order to get a sense of the magnitude of the labor force human capital, we construct the ratio of labor force human capital measured in nominal terms to nominal GDP. It is shown in Figure BJ-3.2. The pattern of the ratio for labor force human capital is almost the same as that for human capital. The level of annual labor force human capital is much higher than that of GDP. There was an increase during 1985 to 1989, the ratio of labor force human capital to GDP in Beijing from 1990 to 1994 decreased at a considerable rate, the ratio increased slowly in small scale after 1994.

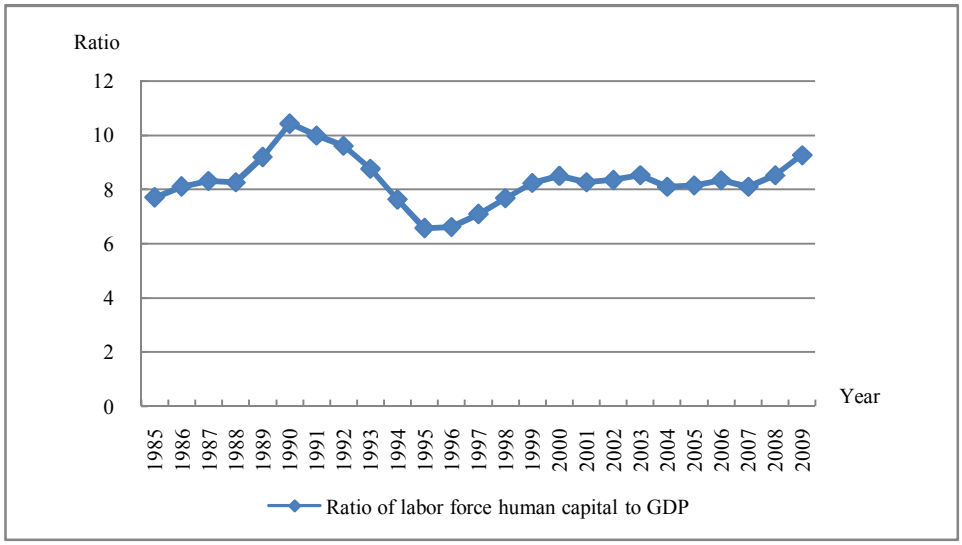


Figure BJ-3.2 Ratio of Labor Force Human Capital to GDP for Beijing

Table BJ-3.2 shows the labor force human capital real values for urban and rural separately. The pattern of the labor force human capital is almost the same as that for human capital. The urban human capital remained larger than that for rural from 1985 to 2009.

Table BJ-3.2 Nominal and Real Labor Force Human Capital by Urban-Rural for Beijing

Year	Nominal labor force human capital (Billions of Yuan)			Real labor force human capital (Billions of 1985 Yuan)		
	Total	**Urban**	**Rural**	**Total**	**Urban**	**Rural**
1985	198	147	51	198	147	51
1986	231	173	58	216	162	54
1987	272	206	66	234	178	57
1988	339	262	77	243	188	55
1989	420	330	89	256	202	54
1990	522	416	106	303	241	62

1991	598	477	121	310	247	63
1992	681	544	138	321	256	65
1993	777	620	157	308	246	62
1994	874	699	176	277	222	56
1995	991	791	200	268	214	54
1996	1183	956	227	287	232	55
1997	1473	1213	260	339	279	60
1998	1825	1524	301	410	342	68
1999	2207	1865	343	493	416	77
2000	2686	2299	387	580	496	84
2001	3066	2645	420	642	554	88
2002	3604	3143	461	768	670	98
2003	4273	3768	505	909	802	107
2004	4884	4344	540	1029	915	114
2005	5683	5103	580	1179	1059	120
2006	6771	6116	654	1392	1258	135
2007	7976	7230	746	1602	1452	150
2008	9470	8629	840	1809	1649	161
2009	11265	10294	971	2186	1998	188

Figure BJ-3.3 shows the labor force human capital real values for urban and rural separately. The pattern of the labor force human capital is almost the same as that for human capital. The rural labor force human capital grows quite slowly and much less than the one for urban, this has much to do with relatively few rural population and a correspondingly few labor force rural population in Beijing.

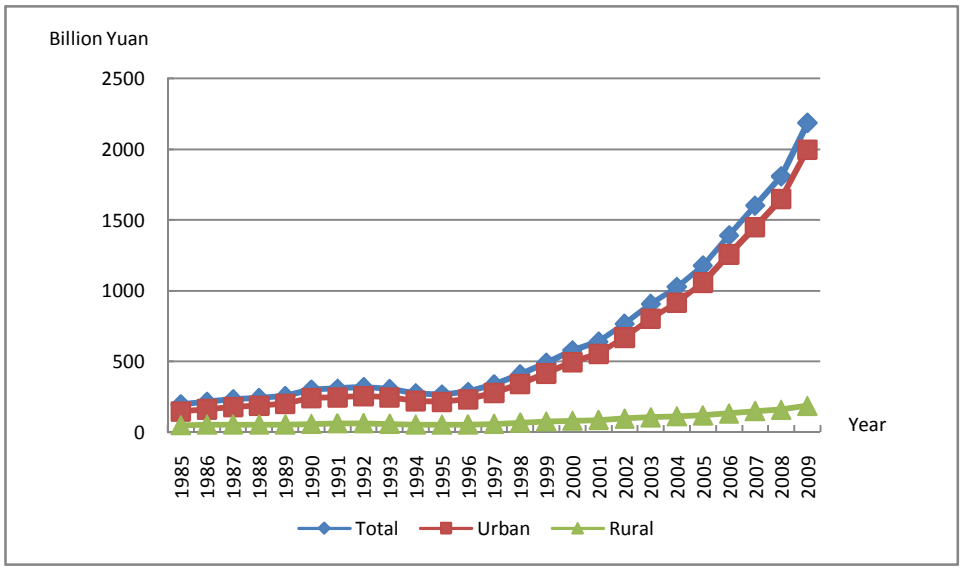


Figure BJ-3.3 Real Labor Force Human Capital by Urban-Rural for Beijing

3.2 Average labor force human capital

Similar to the analysis of per capita human capital above, we calculate the average labor force human capital. Here the average labor force human capital means labor force human capital divided by the number of the population that are over 15 years old, non-retired and out of school.

Table BJ-3.3 reports the real average labor force human capital classified by gender. And the average labor force human capital for female was smaller than that for male. More specifically, the number for male was about 1.8 times that for female in 2009.

Table BJ-3.3 Nominal and Real Average Labor Force Human Capital by Gender for Beijing

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	40.23	47.65	31.40	40.23	47.65	31.40
1986	45.09	53.88	34.70	42.22	50.45	32.49
1987	50.62	60.97	38.43	43.64	52.56	33.13
1988	57.59	69.68	43.71	41.24	49.90	31.30
1989	65.68	79.66	49.92	40.13	48.67	30.50
1990	75.31	91.66	57.06	43.66	53.14	33.08
1991	85.30	103.75	64.88	44.19	53.75	33.61
1992	96.42	117.25	73.58	45.45	55.27	34.68
1993	109.78	133.75	83.78	43.48	52.98	33.19
1994	124.00	151.24	94.90	39.33	47.97	30.10
1995	140.52	171.82	107.41	37.99	46.46	29.04
1996	161.74	198.23	122.75	39.19	48.03	29.74
1997	190.97	236.22	139.82	43.94	54.35	32.17
1998	222.61	275.80	161.70	50.02	61.97	36.33
1999	256.53	317.52	185.27	57.29	70.92	41.38
2000	299.97	371.16	214.61	64.73	80.09	46.31
2001	335.44	416.03	240.64	70.21	87.08	50.37
2002	382.66	475.70	275.49	81.56	101.39	58.72
2003	441.71	550.83	317.26	93.96	117.17	67.49
2004	500.34	625.33	359.72	105.38	131.70	75.76
2005	572.93	715.68	414.14	118.88	148.50	85.93
2006	661.98	828.74	474.34	136.13	170.43	97.55
2007	756.96	946.32	542.31	152.02	190.05	108.91
2008	865.65	1080.06	620.48	165.41	206.38	118.56
2009	998.40	1244.60	713.22	193.76	241.54	138.42

Table BJ-3.4 reports the real average labor force human capital classified by urban-rural separately. The average labor force human capital was much smaller in rural area than in urban area. The number for urban was about 1.9 times that for rural.

Table BJ-3.4 Nominal and Real Average Labor Force Human Capital by Urban-Rural for Beijing

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	40.23	40.65	39.09	40.23	40.65	39.09
1986	45.09	45.71	43.30	42.22	42.80	40.55
1987	50.62	51.52	47.98	43.64	44.42	41.37
1988	57.59	58.92	53.47	41.24	42.19	38.29
1989	65.68	67.60	59.43	40.13	41.30	36.31
1990	75.31	78.00	66.35	43.66	45.22	38.46
1991	85.30	88.90	73.61	44.19	46.06	38.13
1992	96.42	101.23	81.17	45.45	47.72	38.26
1993	109.78	116.17	90.14	43.48	46.02	35.70
1994	124.00	132.37	99.08	39.33	41.98	31.42
1995	140.52	151.54	109.18	37.99	40.97	29.52
1996	161.74	175.31	121.92	39.19	42.47	29.54
1997	190.97	208.34	137.52	43.94	47.93	31.64
1998	222.61	243.24	155.67	50.02	54.65	34.98
1999	256.53	280.60	174.91	57.29	62.67	39.07
2000	299.97	329.00	196.88	64.73	71.00	42.48
2001	335.44	367.02	217.63	70.21	76.82	45.55
2002	382.66	418.24	242.12	81.56	89.14	51.61
2003	441.71	482.39	271.00	93.96	102.61	57.65
2004	500.34	544.98	301.58	105.38	114.78	63.52
2005	572.93	622.17	337.62	118.88	129.10	70.05
2006	661.98	717.63	383.70	136.13	147.58	78.91
2007	756.96	821.04	431.02	152.02	164.89	86.56
2008	865.65	937.50	484.35	165.41	179.14	92.55
2009	998.40	1083.17	545.69	193.76	210.21	105.90

Chapter 8 Human capital for Liaoning

1. Total human capital

Human capital stocks of Liaoning are calculated using estimated income parameters and a 4.58% discount rate. The results are ported in Table LN-1.1. Column 1 and column 2 contain the nominal human capital; column 3 and column 4 contain the real human capital deflated by CPI (in 1985 Yuan).[46]

Table LN-1.1 Nominal and Real Human Capital, Nominal GDP for Liaoning

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	1343		1343		52	25.90
1986	1515		1426		61	25.03
1987	1708		1485		72	23.75
1988	1901		1398		88	21.58
1989	2116		1315		100	21.08
1990	2342		1405		106	22.03
1991	2603		1482		120	21.69
1992	2895		1555		147	19.65

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

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1993	3300		1546		201	16.41
1994	3716		1402		246	15.09
1995	4188		1360		279	14.99
1996	4742		1427		316	15.02
1997	5307		1545		358	14.81
1998	5911		1728		388	15.23
1999	6812		2011		417	16.33
2000	7847	7898	2310	2322	467	16.81
2001	8810	8898	2582	2603	503	17.50
2002	9680	9780	2861	2886	546	17.73
2003	10608	10720	3066	3095	600	17.67
2004	11919	12052	3309	3342	667	17.86
2005	13076	13232	3565	3604	805	16.25
2006	14944	15124	4018	4063	930	16.06
2007	16973	17207	4334	4390	1116	15.21
2008	19540	19848	4759	4831	1367	14.30
2009	21837	22234	5316	5408	1521	14.35

Note: The ratio of human capital to GDP is based on the current values for that year.

Figure LN-1.1 graphs real and nominal human capital for Liaoning reported in Table LN-1.1 As is seen from the figure, both the nominal and real human capital rise steadily and nominal human capital grows faster than real human capital.

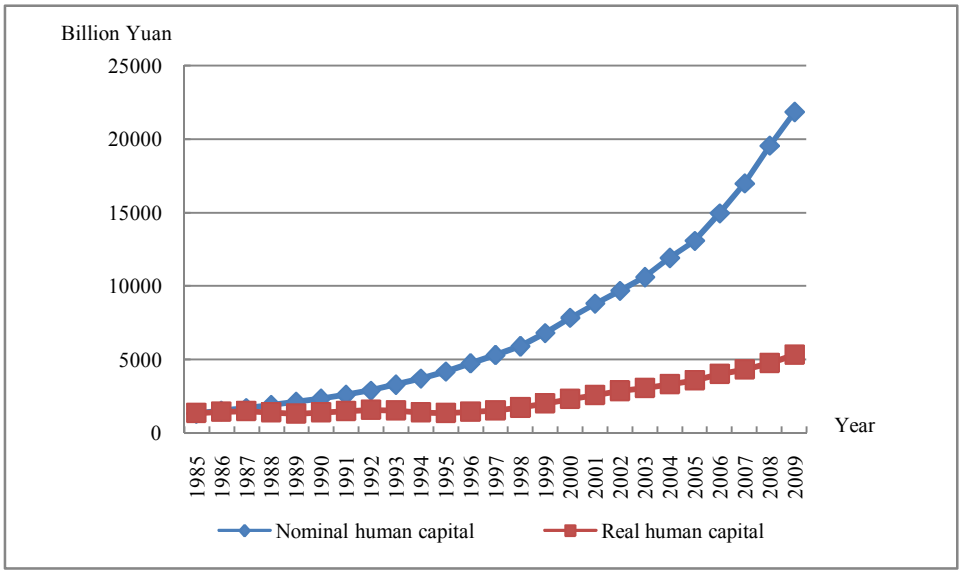


Figure LN-1.1 Nominal and Real Human Capital for Liaoning

In order to get a sense of the magnitude of the human capital in Beijing, we also present the ratio of nominal human capital to nominal GDP in Table LN-1.1.[47] Similar to physical capital, human capital plays an important role in GDP growth, so the ratio could also reflect human capital's influence on sustainable growth of GDP. As is shown in Figure LN-1.2, nominal human capital is substantially higher than nominal GDP for Liaoning. There are three stages in this series: Downwards from 1985 through1997, upwards from 1998 through 2004, and finally downward from 2005 through 2009.

[47] The reason for calculating the ratio at the nominal level is to avoid the differences between the real value of human capital and that of GDP caused by using different deflator indices.

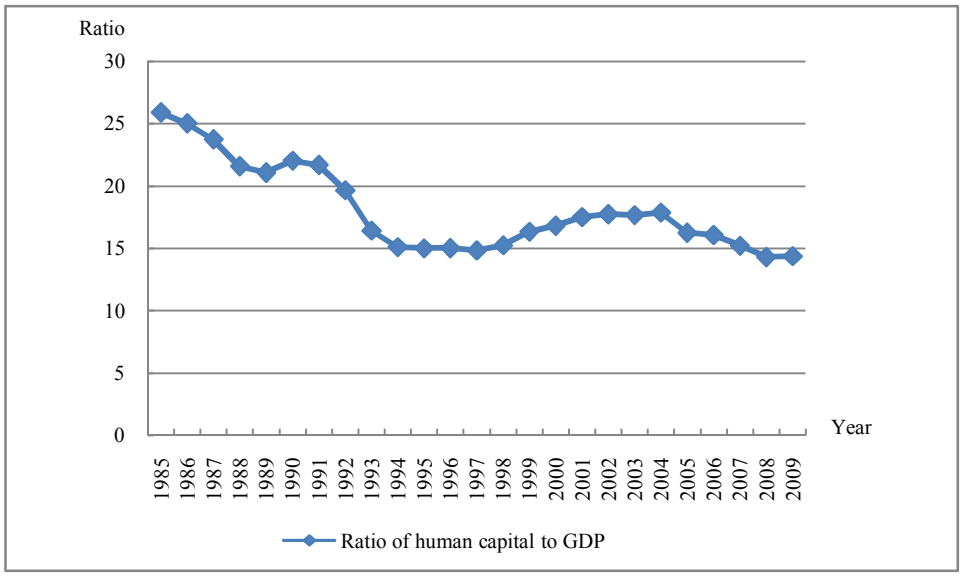


Figure LN-1.2 Ratio of Human Capital to GDP for Liaoning

In order to discuss the trend of human capital, we often need to adjust the nominal value into real value by using adjustment index. We calculated the real values here using CPI. Table LN-1.2 reports the human capital real values for Liaoning classified by gender and urban-rural. The results based on five education categories show that the human capital for Liaoning during 1985 to 2009 kept growing rapidly. More specifically, the human capital for Liaoning increased from 1.343 trillion Yuan to 5.316 trillion Yuan (calculated by 1985 comparable price), it had increased by 4 times, the annual growth rate of human capital over this period increased to 5.73%[48].

From 1985 to 2009, male human capital in Liaoning increased from 0.883 trillion Yuan to 3.364 trillion Yuan, the human capital for female in

[48] 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.

Liaoning increased from 0.460 trillion Yuan to 1.952 trillion Yuan. During the same period, the annual growth rates of human capital were 5.57% and 6.02 % for male and female respectively. The gender gap in the estimated human capital increased from 0.423 trillion Yuan in 1985 to 1.412 trillion Yuan in 2009. In 2009, the male human capital was about 1.72 times the amount of that for female in Liaoning.

From 1985 to 2009, rural human capital for Liaoning increased from 0.538 trillion Yuan to 0.964 trillion Yuan, the urban human capital in Liaoning increased from 0.805 trillion Yuan to 4.352 trillion Yuan. During the same period, the annual growth rates of human capital were 2.43% and 7.03 % for rural and urban areas respectively. The urban-rural gap in the estimated human capital increased from 0.267 trillion Yuan in 1985 to 3.388 trillion Yuan in 2009. In 2009, the urban human capital was about 4.51 times the amount of that for rural in Liaoning.

Table LN-1.2 Real Human Capital by Gender and Urban-Rural for Liaoning[49]

Billions of 1985 Yuan

Year	Total	Male	Female	Urban	Rural
1985	1343	883	460	805	538
1986	1426	932	494	872	555
1987	1485	969	516	916	569
1988	1398	903	495	872	526

[49] Some discrepancy may exist when summing up male and female, or urban and rural to get the total amount. This is mainly caused by rounding errors.

Year	Total	Male	Female	Urban	Rural
1989	1315	840	474	847	468
1990	1405	892	513	929	476
1991	1482	947	536	971	511
1992	1555	998	557	996	559
1993	1546	995	551	979	567
1994	1402	907	495	876	526
1995	1360	881	479	854	506
1996	1427	924	503	909	519
1997	1545	1005	540	989	556
1998	1728	1119	608	1117	611
1999	2011	1298	713	1334	677
2000	2310	1493	817	1564	746
2001	2582	1669	913	1798	784
2002	2861	1843	1017	2027	834
2003	3066	1982	1084	2230	836
2004	3309	2138	1171	2490	819
2005	3565	2294	1270	2753	812
2006	4018	2595	1423	3151	867
2007	4334	2787	1546	3474	860
2008	4759	3046	1713	3894	865
2009	5316	3364	1952	4352	964

Figure LN-1.3 show that the human capital real values of male and female for Liaoning exhibited a rising trend from 1985 to 2009. Before 1996, different human capital all grew quite slowly, starting from 1996, both the growth of human capital of male and female accelerated, the gender gap was fairly stable and appeared to be expanding.

The situation that the human capital of male is higher than that of female is consistent with that at the national level. One reason is that older retirement age for male, male has longer time to generate income from

market, and thus end up with a higher lifetime income relative to female.[50] Also the income gap between male and female keeps expanding, which directly results in widening gap of the human capital between them.

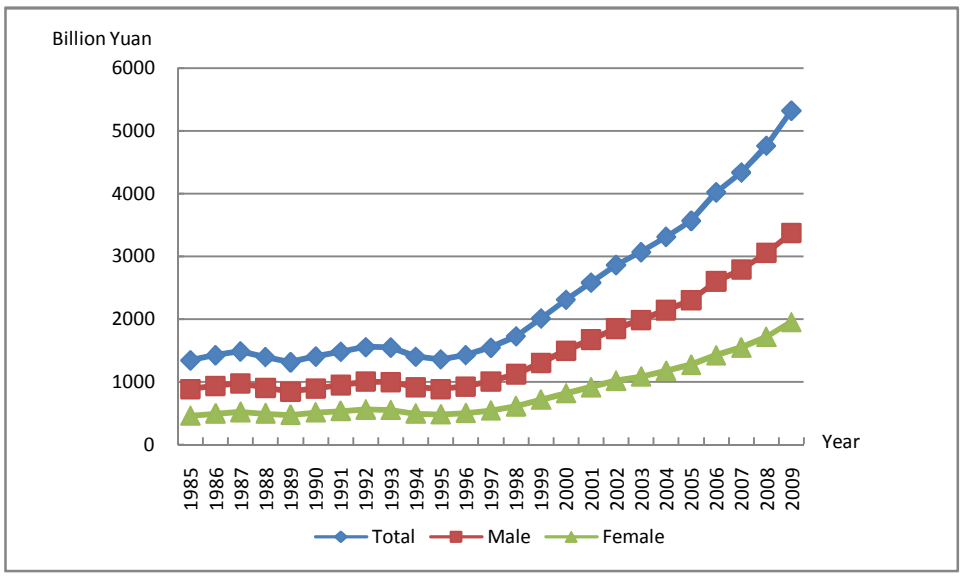


Figure LN-1.3 Real Human Capital by Gender for Liaoning

Figure LN-1.4 shows the human capital real values for urban and rural separately. The urban human capital remained larger than that for rural from 1985 to 2009. Before 1997, the urban human capital was about 2 times the amount of that for rural. Starting from 1997, however, the urban human capital was rising much more rapidly while rural human capital kept growing quite slowly, which resulted in an increasingly larger gap between rural and urban. Thus we could see that human capital changes almost

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

rural and urban. Thus we could see that human capital changes almost simultaneously with urban human capital. Moreover, the gap showed a trend of further expansion as the human capital for urban increased much faster in later periods.

One reason that results in the gap between rural and urban is the rapid urbanization during the course of economic transition and a large scale migration of rural population to urban areas. Another one is the education gap between the rural and urban population.

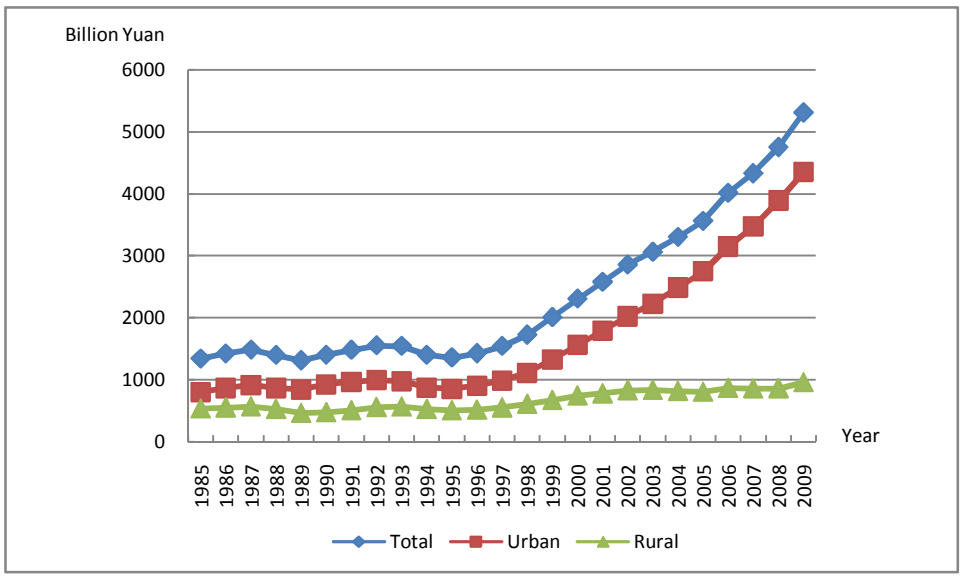


Figure LN-1.4 Real Human Capital by Urban-Rural for Liaoning

Human capital index could reflect the trend of human capital directly. Table LN-1.3 reports a set of indices of real human capital classified by gender and urban and rural for Liaoning from 1985 to 2009. We calculated them using 1985 as the base year and setting its value at 100.

Table LN-1.3 Real Human Capital Index for Liaoning (1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	106.17	105.55	107.39	108.25	103.07
1987	110.59	109.76	112.19	113.80	105.78
1988	104.11	102.33	107.52	108.32	97.81
1989	97.86	95.17	103.04	105.15	86.95
1990	104.58	101.04	111.41	115.35	88.46
1991	110.33	107.22	116.36	120.57	95.02
1992	115.76	113.06	120.99	123.73	103.83
1993	115.10	112.70	119.73	121.55	105.45
1994	104.39	102.79	107.50	108.79	97.81
1995	101.28	99.80	104.11	106.07	94.11
1996	106.25	104.66	109.32	112.83	96.39
1997	115.02	113.82	117.34	122.85	103.29
1998	128.63	126.79	132.13	138.72	113.53
1999	149.69	146.99	154.90	165.67	125.78
2000	171.94	169.10	177.41	194.24	138.57
2001	192.19	189.05	198.31	223.30	145.63
2002	212.96	208.78	220.99	251.74	154.93
2003	228.25	224.50	235.50	276.95	155.37
2004	246.34	242.15	254.38	309.24	152.19
2005	265.40	259.90	275.95	341.90	150.89
2006	299.17	293.97	309.19	391.33	161.23
2007	322.63	315.64	335.89	431.45	159.78
2008	354.30	345.07	372.06	483.61	160.76
2009	395.78	381.09	424.01	540.49	179.20

Figure LN-1.5 shows the index of real human capital. It's obvious that the human capital has been rising much more rapidly since 1996.

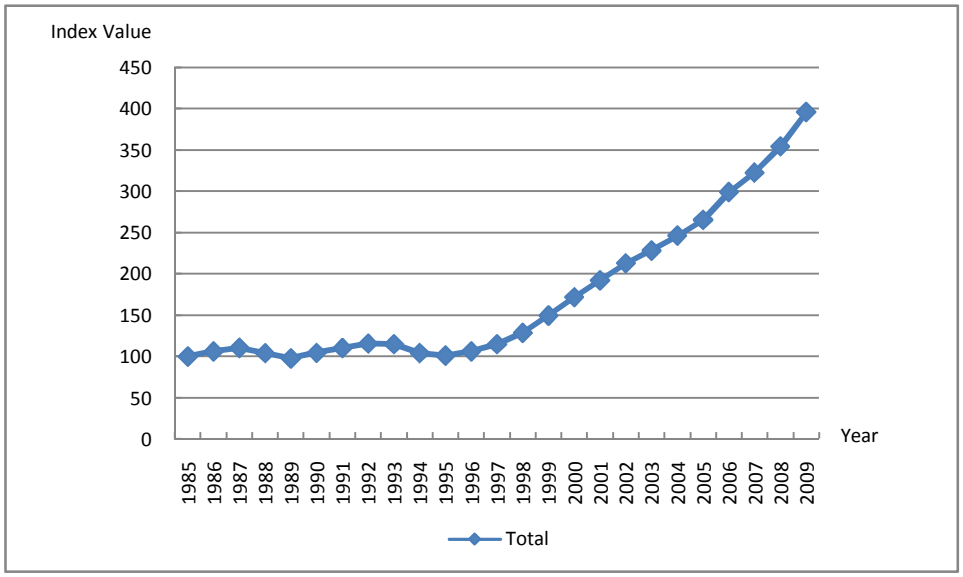


Figure LN-1.5 Total Human Capital Index for Liaoning

2. Per capita human capital

The increase in the human capital can be caused by population growth, demographic change (like retirement population scale), urbanization (like urban-rural migration), higher educational attainment, higher return to education, higher 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 human capital divided by non-retired population. Although the per capita human capital is influenced by the age distribution of the population, it could exclude the population factor influence to a large extent, thus it could serve as a better indicator of the average human capital.

Table LN-2.1 presents the trends of per capita human capital measured in nominal and real terms for Liaoning classified by gender. Per capita human capital of male remained higher than that of female. Per capita human capital real values for male increased from 48,144 Yuan to 195,536 Yuan, increasing by around 4 times; per capita human capital real values for female increased from 30,115 Yuan to 121,299 Yuan, increasing by around 4 times. From1985 to 2009, the annual growth rate was 5.84% for male, and 5.81% for female.

Table LN-2.1 Per Capita Nominal and Real Human Capital by Gender for Liaoning

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
1985	39.95	48.14	30.11	39.95	48.14	30.11
1986	44.79	54.40	33.59	42.16	51.20	31.64
1987	50.09	61.21	37.30	43.56	53.19	32.52
1988	55.35	68.30	41.11	40.71	50.16	30.30
1989	61.20	76.08	45.45	38.02	47.22	28.27
1990	67.58	84.78	49.93	40.54	50.83	29.98
1991	74.92	93.79	55.26	42.66	53.36	31.50
1992	83.13	103.87	61.20	44.65	55.73	32.93
1993	94.42	117.53	69.61	44.23	55.04	32.66
1994	105.93	131.88	77.81	39.97	49.74	29.39
1995	118.84	147.40	87.58	38.60	47.86	28.47
1996	134.09	166.32	98.91	40.36	50.03	29.78
1997	149.62	186.13	109.57	43.56	54.18	31.92
1998	166.38	206.07	122.87	48.63	60.25	35.88
1999	191.48	235.45	143.06	56.52	69.58	42.12
2000	218.90	268.52	163.81	64.43	79.12	48.09

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
2001	248.16	306.82	184.06	72.72	90.02	53.81
2002	275.62	341.90	204.22	81.45	101.15	60.19
2003	305.94	382.95	223.83	88.42	110.80	64.58
2004	347.97	436.57	254.08	96.60	121.30	70.41
2005	387.90	486.33	284.19	105.75	132.66	77.38
2006	437.62	548.80	319.69	117.65	147.70	85.82
2007	498.33	621.15	367.43	127.21	158.68	93.66
2008	576.37	714.16	429.26	140.37	174.13	104.38
2009	655.73	802.19	499.13	159.66	195.54	121.30

Figure LN-2.1 shows that the per capita real human capital of male are higher than that of female for Liaoning from 1985 to 2009. Before 1997, different human capital all grew quite slowly, starting from 1997, both the growth of human capital of male and female accelerated, the gender gap, which had been fairly stable, then appeared to be expanding.

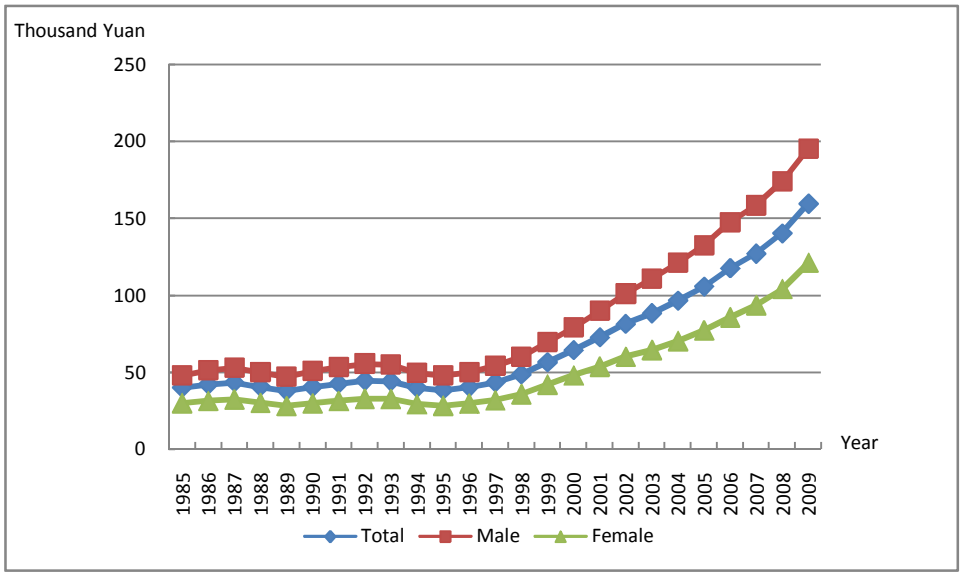


Figure LN-2.1 Per Capita Human Capital by Gender for Liaoning

Table LN-2.2 reports the results of per capita human capital measured

in nominal and real terms for Liaoning classified by urban and rural separately. From 1986 to 2009, the per capita human capital in urban areas was significantly larger than that for rural. The per capita human capital real values for urban increased from 52,397 Yuan to 193,042 Yuan, the per capita rural human capital increased from 29,469 Yuan to 89,651 Yuan. The per capita human capital in urban areas grew much faster than the one for rural.

Table LN-2.2 Per Capita Nominal and Real Human Capital by Urban-Rural for Liaoning

Year	Per capita nominal human capital (Thousands of 1985 Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	39.95	52.40	29.47	39.95	52.40	29.47
1986	44.79	58.53	32.54	42.16	54.70	30.99
1987	50.09	65.12	35.92	43.56	55.43	32.40
1988	55.35	71.59	39.25	40.71	50.95	30.54
1989	61.20	78.76	42.80	38.02	47.83	27.73
1990	67.58	86.69	46.46	40.54	51.06	28.92
1991	74.92	96.02	51.72	42.66	53.35	30.90
1992	83.13	106.60	57.50	44.65	54.79	33.57
1993	94.42	122.07	64.34	44.23	53.77	33.87
1994	105.93	137.58	71.71	39.97	48.06	31.23
1995	118.84	155.38	79.46	38.60	46.75	29.83
1996	134.09	176.22	87.71	40.36	49.00	30.83
1997	149.62	196.25	96.93	43.56	52.57	33.37
1998	166.38	218.09	106.45	48.63	58.54	37.13
1999	191.48	253.50	117.53	56.52	68.94	41.71
2000	218.90	291.18	130.16	64.43	79.18	46.33
2001	248.16	328.41	143.32	72.72	89.40	50.91
2002	275.62	360.14	157.86	81.45	99.12	56.81
2003	305.94	395.10	173.00	88.42	107.46	60.04
2004	347.97	446.16	190.61	96.60	118.04	62.23

Year	Per capita nominal human capital (Thousands of 1985 Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
2005	387.90	491.27	209.28	105.75	128.94	65.70
2006	437.62	546.60	234.91	117.65	141.90	72.58
2007	498.33	615.91	262.45	127.21	152.87	75.78
2008	576.37	706.97	294.42	140.37	168.07	80.59
2009	655.73	812.01	328.51	159.66	193.04	89.65

Figure LN-2.2 reflects the trend of per capita human capital measured in real terms and classified by urban and rural. As is shown in the graph, the size of the difference between urban and rural expanded rapidly after 1997, this is partly due to the long-tem stagnant status in the rural area before 2002. Based on five education categories, the ratio of urban to rural increased from 1.78 in 1985 to 2.15 in 2009, which indicates a rising size of urban-rural gap on per capita human capital. From 1985 to 2009, the annual growth rate was 5.43% for the urban area, and 4.64% for the rural area.

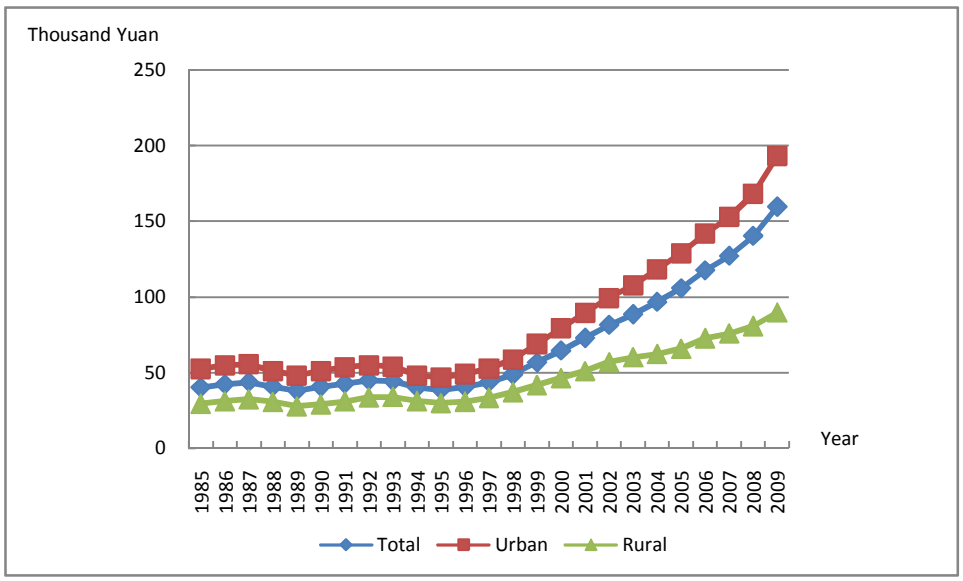


Figure LN-2.2 Per Capita Real Human Capital by Urban-Rural for Liaoning

Figure LN-2.3 shows the per capita human capital index for Liaoning. It's obvious that the per capita human capital has been rising much more rapidly since 1997.

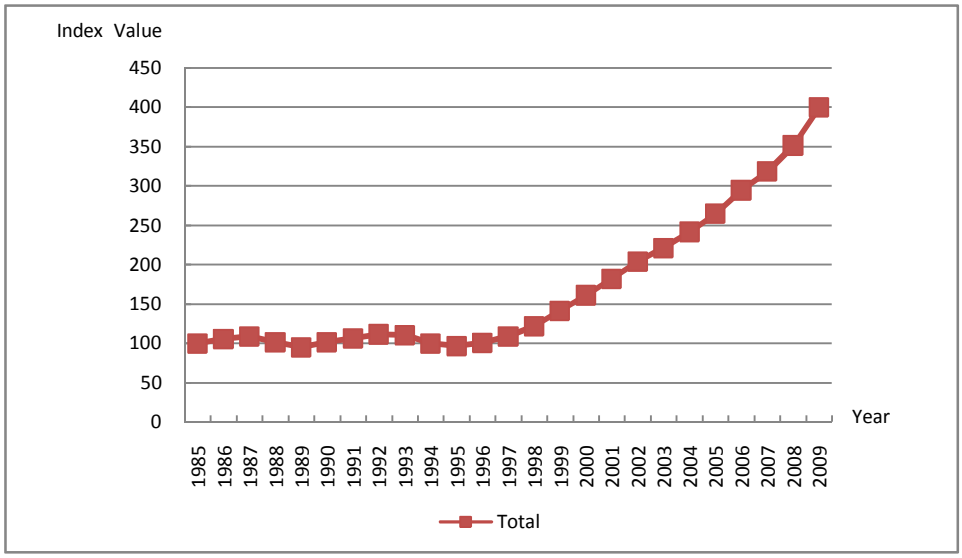


Figure LN-2.3 Per Capita Real Human Capital Index for Liaoning

3. Labor force human capital

3.1 Total labor force human capital

The labor force human capital represents the human capital of population that are over 15 years old, non-retired and out of school. The estimated approach of labor force human capital is the same as that of human capital we illustrated above. Based on the income parameter for Liaoning and the discount rate valued at 4.58%，the labor force human capital for Liaoning is reported in Table LN-3.1. The real values in this table

are calculated by using CPI as the deflator with respect to nominal values. We also calculated the ratio of labor force human capital measured in nominal terms to nominal GDP. The results are reported in the last column of Table LN-3.1.

Table LN-3.1 Labor Force Human Capital and Nominal GDP for Liaoning

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of nominal labor force human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	697		697		52	13.43
1986	791		745		61	13.07
1987	901		783		72	12.52
1988	1008		741		88	11.44
1989	1123		697		100	11.19
1990	1251		750		106	11.77
1991	1402		798		120	11.68
1992	1561		839		147	10.60
1993	1739		817		201	8.65
1994	1925		729		246	7.82
1995	2140		699		279	7.66
1996	2423		734		316	7.67
1997	2761		809		358	7.71
1998	3147		926		388	8.11
1999	3498		1042		417	8.39
2000	4091	3988	1211	1183	467	8.76
2001	4478	4389	1320	1295	503	8.90
2002	4878	4810	1450	1430	546	8.94

2003	5389	5357	1566	1556	600	8.98
2004	5840	5849	1630	1631	667	8.75
2005	6337	6353	1735	1738	805	7.87
2006	7260	7280	1961	1965	930	7.80
2007	8121	8151	2083	2089	1116	7.27
2008	9092	9135	2225	2234	1367	6.65
2009	10245	10321	2504	2521	1521	6.73

Note: The ratio of labor force human capital to GDP is based on the current values for that year.

The trends of labor force human capital in both real and nominal terms for Liaoning are presented in Figure LN-3.1. From 1985 to 2009, labor force human capital kept rising.

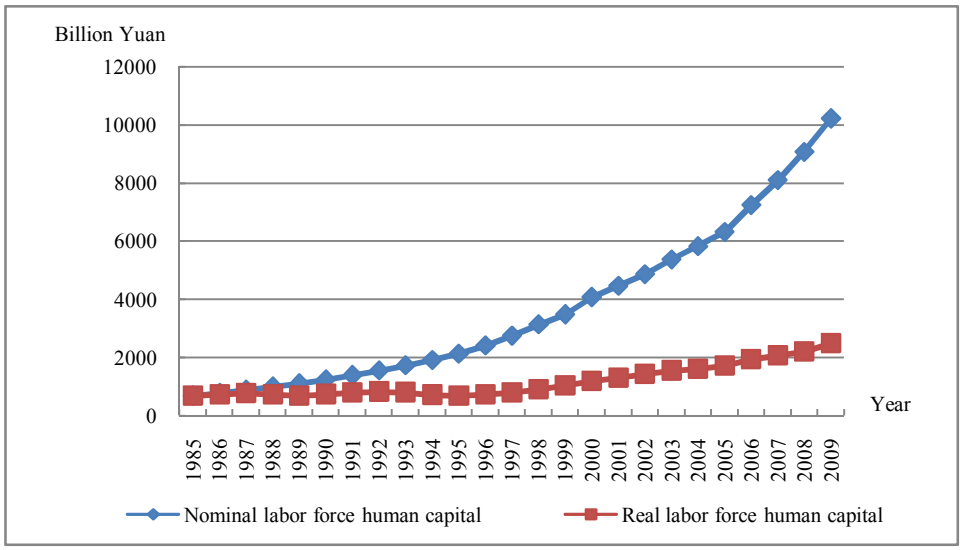


Figure LN-3.1 Nominal and Real Labor Force Human Capital for Liaoning

Similar to the analysis of human capital, in order to get a sense of the magnitude of the labor force human capital, we construct the ratio of labor

force human capital measured in nominal terms to nominal GDP. It's shown in Figure LN-3.2. The pattern of the ratio for labor force human capital is almost the same as that for human capital. The level of annual labor force human capital is much higher than that of GDP. The ratio of labor force human capital to GDP in Liaoning from 1985 to 2009 decreased as a whole, especially decreased at a considerable rate during 1990 to 1994. But from 1997 to 2003, the ratio increased slightly, and then decreased after that.

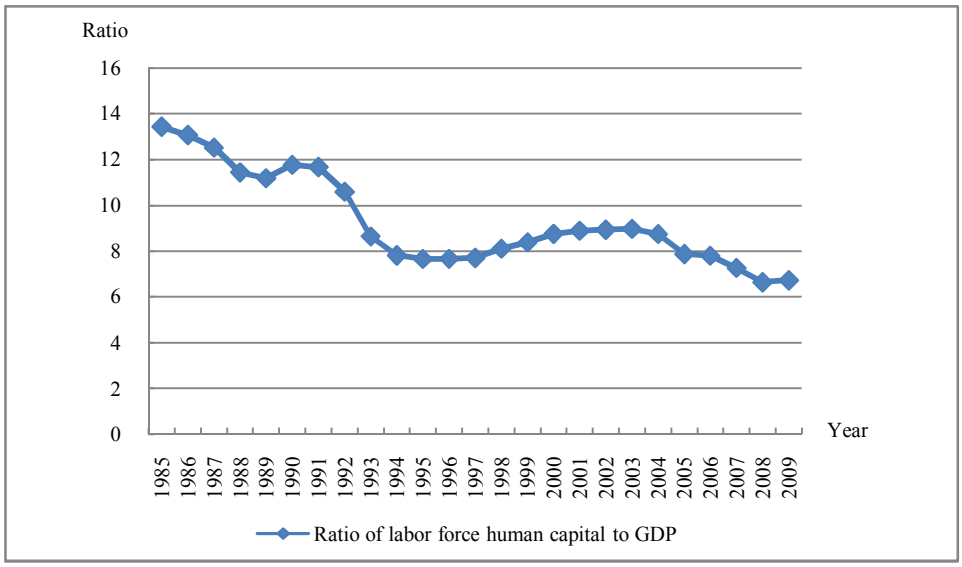


Figure LN-3.2 Ratio of Labor Force Human Capital to GDP for Liaoning

Table LN-3.2 shows the labor force human capital real values for urban and rural separately. The pattern of the labor force human capital is almost the same as that for human capital. The urban human capital remained larger than that for rural from 1985 to 2009.

Table LN-3.2 Nominal and Real Labor Force Human Capital by Urban-Rural for Liaoning

Year	Nominal labor force human capital (Billions of Yuan)			Real labor force human capital (Billions of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	697	400	297	697	400	297
1986	791	481	310	745	450	295
1987	901	580	320	783	494	289
1988	1008	659	350	741	469	272
1989	1123	747	376	697	454	244
1990	1251	849	402	750	500	250
1991	1402	946	456	798	526	272
1992	1561	1047	514	839	538	300
1993	1739	1155	584	817	509	308
1994	1925	1268	657	729	443	286
1995	2140	1397	743	699	420	279
1996	2423	1603	820	734	446	288
1997	2761	1850	911	809	496	314
1998	3147	2136	1011	926	573	353
1999	3498	2409	1089	1042	655	387
2000	4091	2916	1175	1211	793	418
2001	4478	3263	1215	1320	888	432
2002	4878	3613	1265	1450	995	455
2003	5389	4046	1343	1566	1100	466
2004	5840	4467	1373	1630	1182	448
2005	6337	4938	1399	1735	1296	439
2006	7260	5724	1536	1961	1486	475
2007	8121	6473	1648	2083	1607	476
2008	9092	7351	1741	2225	1748	477
2009	10245	8310	1935	2504	1976	528

Figure LN-3.3 shows the labor force human capital real values for urban and rural separately. The pattern of the labor force human capital is almost the same as that for human capital. The rural labor force human capital grows quite slowly and much less than the one for urban.

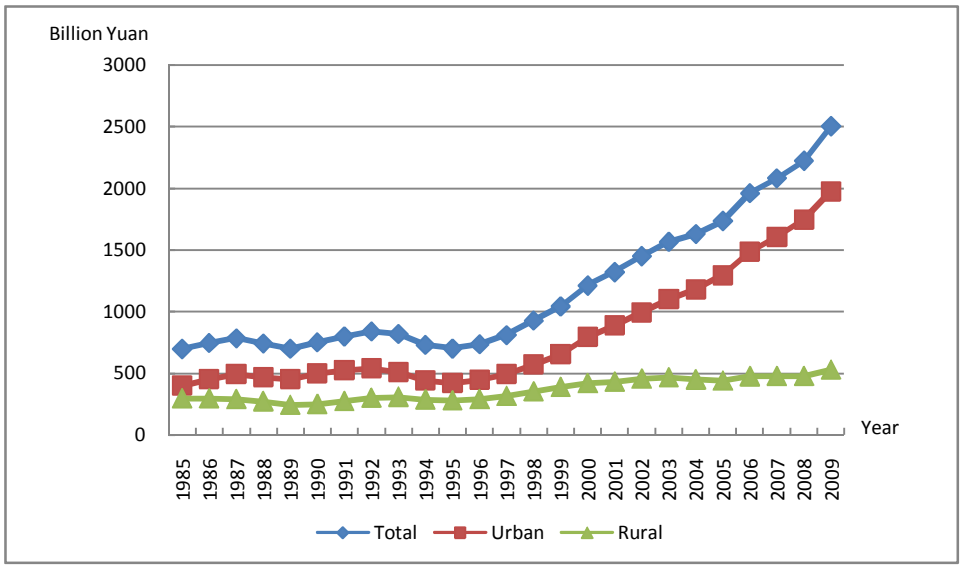


Figure LN-3.3 Real Labor force human capital by urban-rural for Liaoning

3.2 Average labor force human capital

Similar to the analysis of per capita human capital above, we calculate the average labor force human capital. Here the average labor force human capital means labor force human capital divided by the number of the population that are over 15 years old, non-retired and out of school.

Table LN-3.3 reports the real average labor force human capital classified by gender. And the average labor force human capital for female was smaller than that for male. More specifically, the number for male was about 1.66 times that for female in 2009.

Table LN-3.3 Nominal and Real Average Labor Force Human Capital by Gender for Liaoning

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	31.58	38.25	23.44	31.58	38.25	23.44
1986	35.63	43.65	26.07	33.55	41.08	24.57
1987	40.21	49.84	28.99	34.95	43.26	25.27
1988	43.68	54.57	31.77	32.09	40.01	23.43
1989	47.44	59.67	34.80	29.46	37.00	21.65
1990	51.68	65.60	38.02	31.00	39.30	22.84
1991	57.48	72.68	42.22	32.72	41.33	24.07
1992	63.67	80.21	46.75	34.20	43.01	25.17
1993	70.78	88.97	51.78	33.23	41.70	24.36
1994	78.30	98.02	57.33	29.65	37.09	21.74
1995	86.80	108.12	63.82	28.36	35.32	20.86
1996	96.98	121.40	70.61	29.38	36.75	21.39
1997	108.65	136.50	78.37	31.84	40.00	22.98
1998	121.64	153.33	87.23	35.79	45.12	25.66
1999	134.50	169.59	96.42	40.05	50.53	28.68
2000	155.01	195.29	110.70	45.89	57.84	32.75
2001	170.34	216.18	120.72	50.21	63.74	35.55
2002	186.78	238.97	131.15	55.52	71.04	38.97
2003	206.49	266.22	143.48	60.01	77.37	41.71
2004	227.80	295.00	157.41	63.60	82.34	43.96
2005	251.32	325.54	174.03	68.82	89.15	47.65
2006	282.33	365.04	195.21	76.24	98.59	52.71
2007	316.41	405.37	222.01	81.15	103.99	56.90
2008	356.21	450.94	255.19	87.16	110.42	62.36
2009	406.75	502.27	304.37	99.42	122.90	74.21

Table LN-3.4 reports the real average Labor force human capital classified by urban-rural separately. The average labor force human capital

was much smaller in rural area than in urban area. The number for urban was about 1.74 times that for rural in 2009.

Table LN-3.4 Nominal and Real Average Labor Force Human Capital by Urban-Rural for Liaoning

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	31.58	38.94	25.17	31.58	38.94	25.17
1986	35.63	44.27	27.34	33.55	41.38	26.04
1987	40.21	50.09	29.63	34.95	42.63	26.72
1988	43.68	54.06	32.07	32.09	38.48	24.96
1989	47.44	58.45	34.53	29.46	35.49	22.37
1990	51.68	63.49	37.11	31.00	37.39	23.10
1991	57.48	70.60	41.47	32.72	39.23	24.77
1992	63.67	78.20	46.21	34.20	40.20	26.98
1993	70.78	87.07	51.69	33.23	38.35	27.21
1994	78.30	96.34	57.50	29.65	33.65	25.04
1995	86.80	106.89	64.15	28.36	32.16	24.08
1996	96.98	119.94	70.59	29.38	33.35	24.81
1997	108.65	134.97	77.82	31.84	36.15	26.79
1998	121.64	151.65	85.80	35.79	40.70	29.93
1999	134.50	167.89	93.42	40.05	45.66	33.15
2000	155.01	196.28	101.85	45.89	53.38	36.25
2001	170.34	213.76	110.24	50.21	58.19	39.16
2002	186.78	232.06	119.96	55.52	63.87	43.17
2003	206.49	254.52	131.65	60.01	69.22	45.69
2004	227.80	279.21	142.47	63.60	73.87	46.51
2005	251.32	305.96	154.18	68.82	80.30	48.40
2006	282.33	339.25	173.67	76.24	88.07	53.66
2007	316.41	376.09	194.85	81.15	93.34	56.27
2008	356.21	419.17	217.97	87.16	99.65	59.66
2009	406.75	483.44	242.00	99.42	114.93	66.04

Chapter 9 Human capital for Shanghai

1. Total human capital

Human capital stocks of Shanghai are calculated using estimated income parameters and a 4.58% discount rate. The results are ported in Table SH-1.1. Column 1 and column 2 contain the nominal human capital; column 3 and column 4 contain the real human capital deflated by CPI (in 1985 Yuan).[51]

Table SH-1.1 Nominal and Real Human Capital, Nominal GDP for Shanghai

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	752		752		47	16.12
1986	864		813		49	17.61
1987	998		869		55	18.29
1988	1142		828		65	17.62
1989	1303		815		70	18.71
1990	1487		874		78	19.02
1991	1683		896		89	18.83
1992	1903		921		111	17.08
1993	2173		875		152	14.30

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

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1994	2440		793		199	12.26
1995	2813		770		250	11.25
1996	3199		802		296	10.82
1997	3715		906		344	10.80
1998	4288		1046		380	11.28
1999	5039		1210		419	12.03
2000	6076	6297	1424	1476	477	12.73
2001	7092	7263	1662	1702	521	13.61
2002	8039	8243	1875	1922	574	14.00
2003	9350	9623	2178	2242	669	13.97
2004	11055	11437	2521	2608	807	13.70
2005	12864	13602	2906	3073	925	13.91
2006	14739	16278	3290	3633	1057	13.94
2007	16982	18836	3675	4076	1249	13.59
2008	19807	22088	4051	4518	1407	14.08
2009	23417	26293	4809	5400	1505	15.57

Note: The ratio of human capital to GDP is based on the current values for that year.

Figure SH-1.1 graphs real and nominal human capital for Shanghai reported in Table SH-1.1. As is seen from the figure, both the nominal and real human capital rise steadily and nominal human capital grows faster than real human capital.

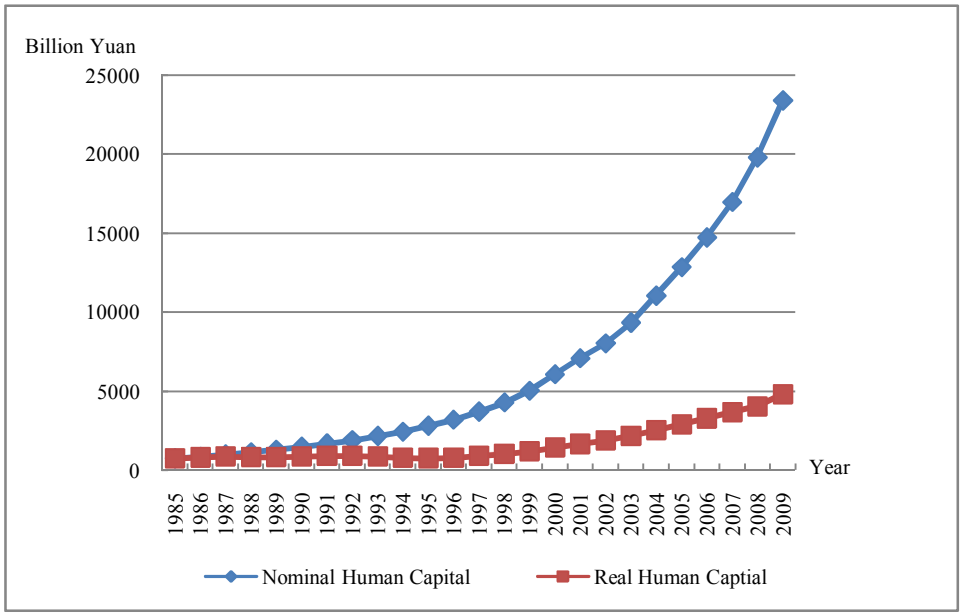


Figure SH-1.1 Nominal and Real Human Capital for Shanghai

In order to get a sense of the magnitude of the human capital in Beijing, we also present the ratio of nominal human capital to nominal GDP in Table SH-1.1.[52] Similar to physical capital, human capital plays an important role in GDP growth, so the ratio could also reflect human capital's influence on sustainable growth of GDP. As is shown in Figure SH-1.2, nominal human capital is substantially higher than nominal GDP for Shanghai. There are three stages in this series: Upwards from 1985 through1991, downwards from 1992 through 1997, and finally upward from 1998 through 2009.

[52] The reason for calculating the ratio at the nominal level is to avoid the differences between the real value of human capital and that of GDP caused by using different deflator indices.

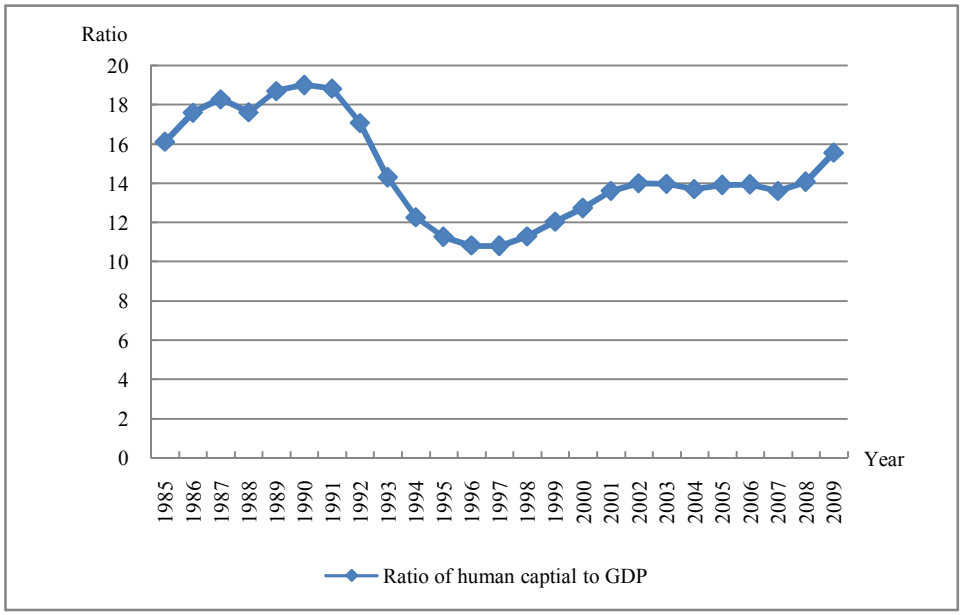


Figure SH-1.2 Ratio of Human Capital to GDP for Shanghai

In order to discuss the trend of human capital, we often need to adjust the nominal value into real value by using adjustment index. We calculate the real values here using CPI. Table SH-1.2 reports the human capital real values for Shanghai classified by gender. The results based on five education categories show that the human capital for Shanghai during 1985 to 2009 kept growing rapidly. More specifically, the human capital for Shanghai increased from 0.752 trillion Yuan to 4.81 trillion Yuan (calculated by 1985 comparable price), it had increased by around 6 times, the annual growth rate of human capital over this period increased to 7.73%.[53]

[53] 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.

From 1985 to 2009, male human capital in Shanghai increased from 0.466 trillion Yuan to 3.183 trillion Yuan, the human capital for female in Shanghai increased from 0.286 trillion Yuan to 1.626 trillion Yuan. During the same period, the annual growth rates of human capital were 8.01% and 7.24% for male and female respectively. The gender gap in the estimated human capital increased from 0.18 trillion Yuan in 1985 to 1.557 trillion Yuan in 2009. In 2009, the male human capital was about 2 times the amount of that for female in Shanghai.

Table SH-1.2 Real Human Capital by Gender for Shanghai[54]

Billions of 1985 Yuan

Year	Total	Male	Female
1985	752	466	286
1986	813	502	311
1987	869	535	333
1988	828	517	310
1989	815	512	303
1990	874	552	322
1991	896	566	330
1992	921	582	339
1993	875	554	321
1994	793	504	289
1995	770	487	284
1996	802	512	290
1997	906	582	324
1998	1046	673	373
1999	1210	775	436

[54] Some discrepancy may exist when summing up male and female, or urban and rural to get the total amount. This is mainly caused by rounding errors.

Year	Total	Male	Female
2000	1424	913	511
2001	1662	1067	596
2002	1875	1203	672
2003	2178	1397	782
2004	2521	1617	904
2005	2906	1873	1033
2006	3290	2131	1158
2007	3675	2407	1268
2008	4051	2669	1383
2009	4809	3183	1626

Figure SH-1.3 show that the human capital real values of male and female for Shanghai exhibited a rising trend from 1985 to 2009. Before 1997, different human capital all grew quite slowly, starting from 1997, both the growth of human capital of male and female accelerated, the gender gap, which had been fairly stable, then appeared to be expanding.

The situation that the human capital of male is higher than that of female is consistent with that at the national level. One reason is that older retirement age for male, male has longer time to generate income from market, and thus end up with a higher lifetime income relative to female.[55] Also the income gap between male and female keeps expanding, which directly results in widening gap of the human capital between them.

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

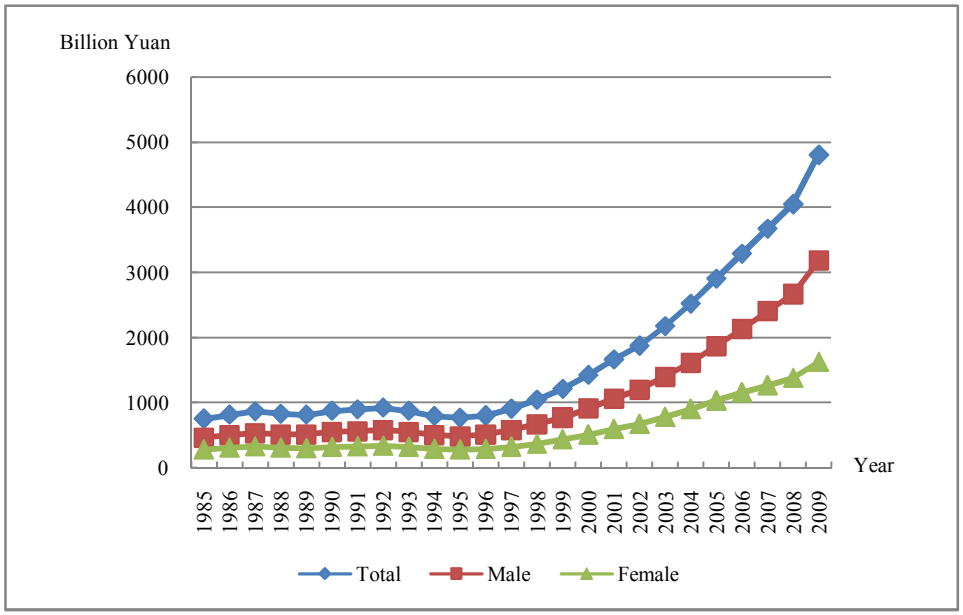


Figure SH-1.3 Real Human Capital by Gender for Shanghai

Human capital index could reflect the trend of human capital directly. Table SH-1.3 reports a set of indices of real human capital classified by gender for Shanghai from 1985 to 2009. We calculate them using 1985 as the base year and setting its value at 100.

Table SH-1.3 Real Human Capital Index for Shanghai (1985=100)

Year	Total	Male	Female
1985	100	100	100
1986	108.06	107.57	108.84
1987	115.45	114.82	116.43
1988	110.01	110.94	108.49
1989	108.31	109.74	105.98
1990	116.23	118.43	112.65
1991	119.10	121.34	115.45
1992	122.40	124.75	118.56
1993	116.28	118.83	112.13
1994	105.37	108.02	101.08

Year	Total	Male	Female
1995	102.35	104.35	99.09
1996	106.58	109.72	101.47
1997	120.39	124.75	113.28
1998	139.04	144.38	130.20
1999	160.84	166.13	152.39
2000	189.29	195.90	178.50
2001	220.92	228.87	208.21
2002	249.24	258.04	234.85
2003	289.51	299.66	273.23
2004	335.11	346.85	316.04
2005	386.28	401.76	361.06
2006	437.33	457.10	404.75
2007	488.50	516.30	443.20
2008	538.48	572.50	483.40
2009	639.24	682.75	568.33

Figure SH-1.4 shows the index of real human capital. It's obvious that the human capital has been rising much more rapidly since 1996.

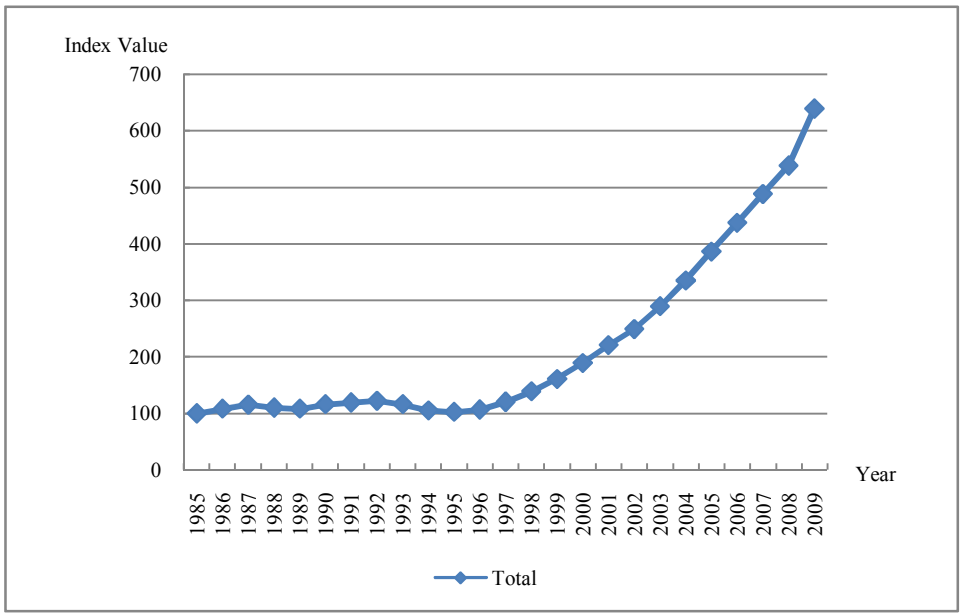


Figure SH-1.4 Real Total Human Capital Index for Shanghai

2. Per capita human capital

The increase in the human capital can be caused by population growth, demographic change (like retirement age), urbanization (like urban-rural migration), higher educational attainment, higher return to education, higher 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 human capital divided by non-retired population. Although the per capita human capital is influenced by the age distribution of the population, it could exclude the population factor influence to a large extent, thus it could serve as a better indicator of the average human capital.

Table SH-2.1 presents the trends of per capita human capital measured in nominal and real terms for Shanghai classified by gender. Per capita human capital of male remained higher than that of female. Per capita human capital real values for male increased from 86,286 Yuan to 533,811 Yuan, increasing by around 6 times; per capita human capital real values for female increased from 58,116 Yuan to 314,275 Yuan, increasing by around 5 times. From 1985 to 2009, the annual growth rate was 7.59% for male, and 7.03% for female.

Table SH-2.1 Per Capita Nominal and Real Human Capital by Gender for Shanghai

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	72.86	86.29	58.12	72.86	86.29	58.12
1986	83.00	97.97	66.59	78.07	92.17	62.64
1987	95.03	112.04	76.41	82.71	97.49	66.49
1988	107.95	127.68	85.86	78.23	92.51	62.23
1989	122.24	143.80	97.62	76.44	89.90	61.03
1990	139.60	163.48	111.62	82.09	96.15	65.64
1991	157.76	185.89	125.38	83.99	98.93	66.73
1992	178.76	211.88	140.98	86.50	102.52	68.22
1993	204.48	244.22	159.64	82.32	98.33	64.26
1994	230.37	277.75	177.63	74.84	90.24	57.71
1995	266.35	321.66	205.80	72.91	88.01	56.32
1996	300.28	365.06	228.74	75.26	91.49	57.34
1997	347.91	423.14	263.60	84.82	103.19	64.28
1998	401.13	487.09	304.16	97.85	118.79	74.15
1999	468.32	563.27	360.41	112.46	135.31	86.58
2000	553.32	661.07	428.44	129.68	154.93	100.41
2001	643.61	770.78	497.00	150.83	180.71	116.47
2002	727.19	873.35	559.42	169.61	203.73	130.47
2003	845.09	1017.68	648.74	196.86	237.15	151.11
2004	997.52	1204.17	762.56	227.37	274.63	173.90
2005	1157.83	1404.71	878.90	261.64	317.37	198.45
2006	1327.77	1618.02	998.07	296.36	361.05	222.73
2007	1526.99	1881.16	1124.86	330.49	407.19	243.44
2008	1776.48	2192.36	1300.50	363.28	448.38	266.03
2009	2102.98	2599.46	1530.21	431.82	533.81	314.27

Figure SH-2.1 shows that the per capita real human capital of male are higher than that of female for Shanghai from 1985 to 2009. Before 1997,

different human capital all grew quite slowly, starting from 1997, both the growth of human capital of male and female accelerated, the gender gap, which had been fairly stable, then appeared to be expanding.

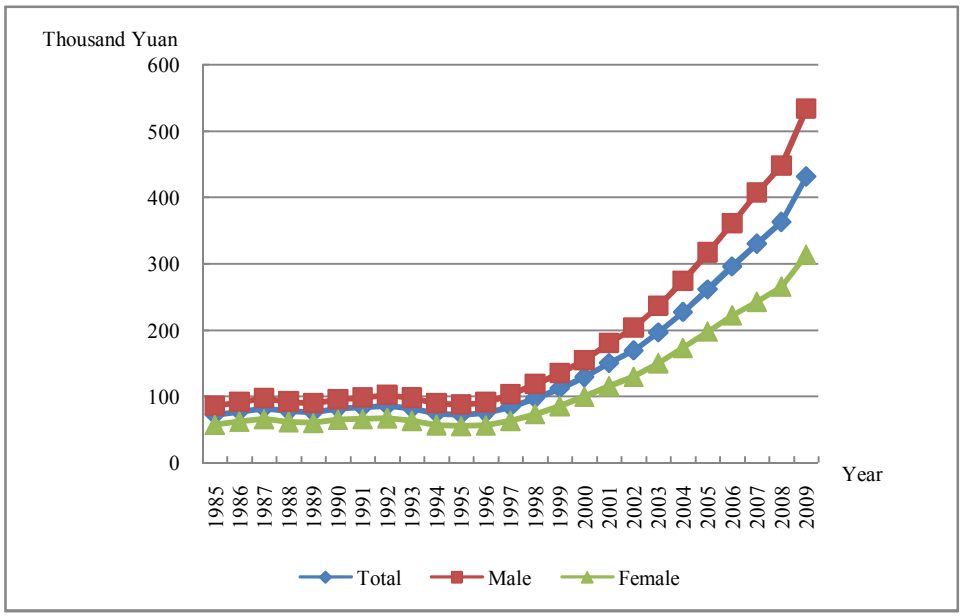


Figure SH-2.1 Per Capita Real Human Capital by Gender for Shanghai

Figure SH-2.2 shows the per capita human capital index for Shanghai. It's obvious that the per capita human capital has been rising much more rapidly since 1997.

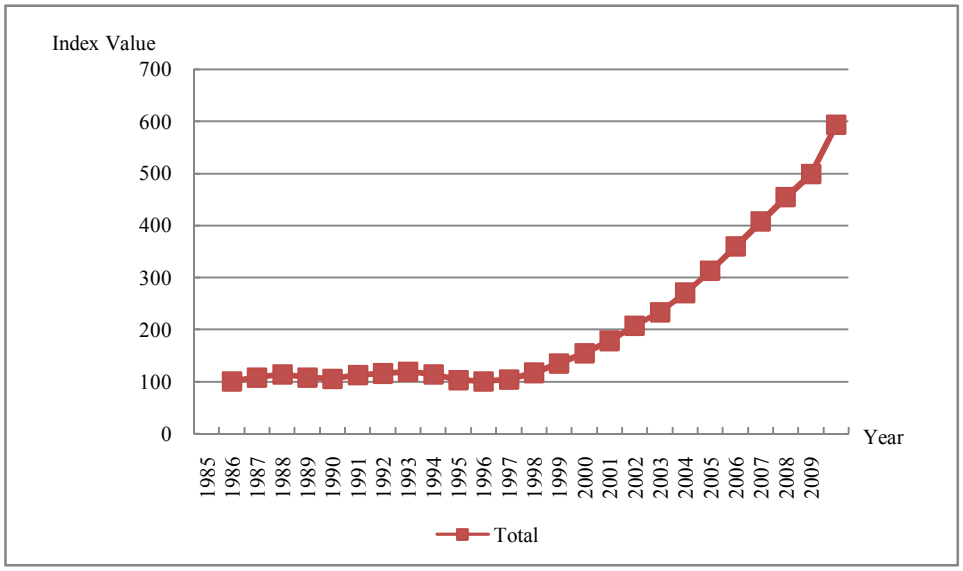


Figure SH-2.2 Per Capita Human Capital Index for Shanghai

3. Labor force human capital

3.1 Total labor force human capital

The labor force human capital represents the human capital of population that are over 15 years old, non-retired and out of school. The estimated approach of labor force human capital is the same as that of human capital we illustrated above. Based on the income parameter for Shanghai and the discount rate valued at 4.58%，the labor force human capital for Shanghai is reported in Table SH-3.1. The real values in this table are calculated by using CPI as the deflator with respect to nominal values. We also calculated the ratio of labor force human capital measured in nominal terms to nominal GDP. The results are reported in the last column of Table SH-3.1

Table SH-3.1 Labor Force Human Capital and Nominal GDP for Shanghai

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of labor force human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	396		396		47	8.48
1986	446		419		49	9.08
1987	502		437		55	9.21
1988	576		418		65	8.89
1989	653		408		70	9.37
1990	733		431		78	9.38
1991	810		431		89	9.06
1992	904		438		111	8.11
1993	1019		410		152	6.71
1994	1128		367		199	5.67
1995	1251		342		250	5.01
1996	1430		358		296	4.84
1997	1684		411		344	4.90
1998	2006		489		380	5.28
1999	2358		566		419	5.63
2000	2788	2752	653	645	477	5.84
2001	3252	3134	762	735	521	6.24
2002	3719	3637	867	848	574	6.48
2003	4345	4327	1012	1008	669	6.49
2004	5003	5089	1141	1161	807	6.20
2005	5909	6025	1335	1361	925	6.39
2006	6721	6869	1500	1533	1057	6.36
2007	7727	7914	1672	1712	1249	6.18
2008	8911	9145	1823	1871	1407	6.33
2009	10247	10547	2105	2166	1505	6.81

Note: The ratio of labor force human capital to GDP is based on the current values for that year.

The trends of labor force human capital in both real and nominal terms for Shanghai are presented in Figure SH-3.1. From 1985 to 2009, labor force human capital kept rising.

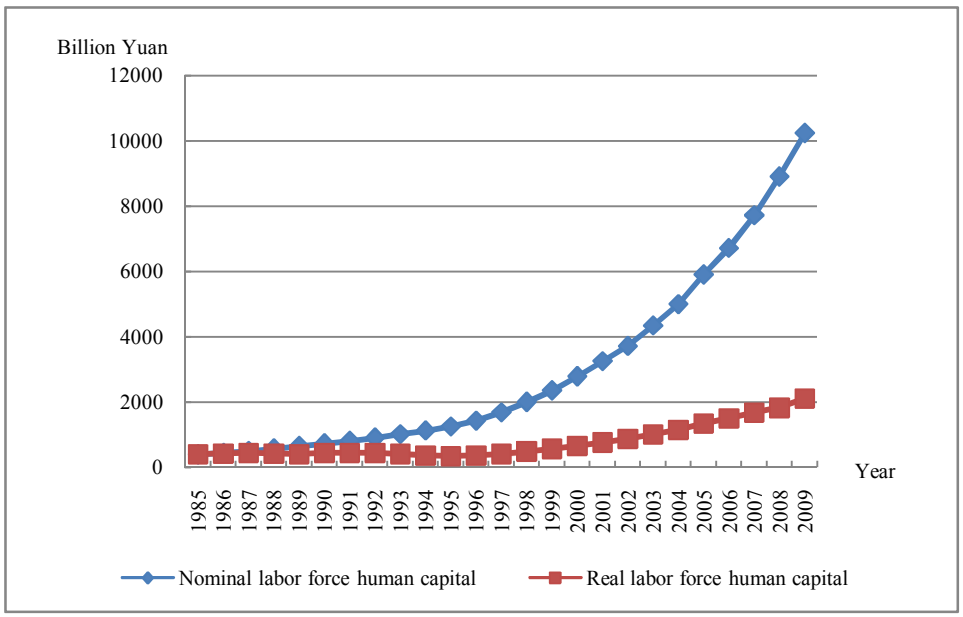


Figure SH-3.1 Nominal and Real Labor Force Human Capital for Shanghai

Similar to the analysis of human capital, in order to get a sense of the magnitude of the labor force human capital, we construct the ratio of labor force human capital measured in nominal terms to nominal GDP. It's shown in Figure SH-3.2. The pattern of the ratio for labor force human capital is almost the same as that for human capital. The level of annual labor force human capital is much higher than that of GDP. There was an increase from 1985 to 1987, the ratio of labor force human capital to GDP in Shanghai from 1990 to 1996 decreased at a considerable rate, after 1996, the ratio increased slightly.

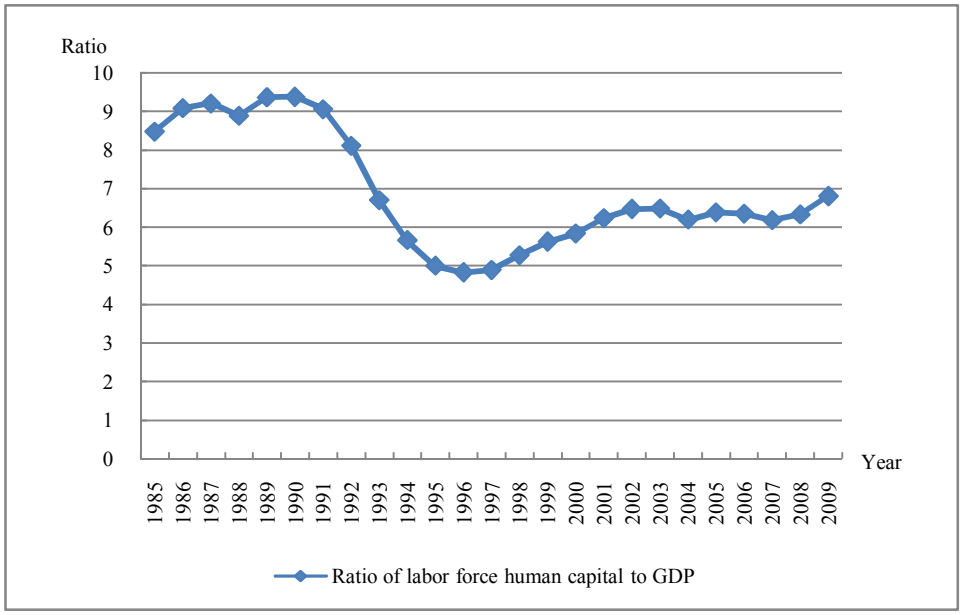


Figure SH-3.2 Ratio of Labor Force Human Capital to GDP for Shanghai

3.2 Average Labor force human capital

Similar to the analysis of per capita human capital above, we calculate the average labor force human capital. Here the average labor force human capital means labor force human capital divided by the number of the population that are over 15 years old, non-retired and out of school.

Table SH-3.2 reports the real average labor force human capital classified by gender. And the average labor force human capital for female was smaller than that for male. More specifically, the real value for male was about 1.71 times that for female in 2009.

Table SH-3.2 Nominal and Real Average Labor Force Human Capital by Gender for Shanghai

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	53.20	63.00	42.57	53.20	63.00	42.57
1986	59.52	70.87	47.17	55.98	66.69	44.39
1987	66.66	79.67	52.49	58.01	69.33	45.67
1988	75.81	90.69	59.14	54.93	65.69	42.85
1989	85.23	101.91	65.97	53.28	63.71	41.25
1990	95.88	114.67	73.53	56.38	67.43	43.24
1991	106.34	127.86	81.17	56.60	68.05	43.22
1992	118.96	143.96	90.15	57.56	69.66	43.63
1993	134.25	163.95	100.48	54.03	66.01	40.47
1994	149.72	184.47	110.97	48.66	59.94	36.05
1995	166.53	206.26	122.93	45.58	56.45	33.65
1996	189.68	235.69	138.64	47.54	59.07	34.75
1997	219.36	273.81	158.03	53.49	66.77	38.54
1998	254.93	318.27	182.61	62.14	77.62	44.53
1999	292.72	364.68	209.30	70.30	87.61	50.27
2000	333.73	414.59	239.11	78.21	97.15	56.05
2001	387.46	482.63	276.45	90.79	113.10	64.76
2002	441.95	550.99	315.69	103.07	128.49	73.63
2003	512.11	638.96	366.21	119.28	148.83	85.33
2004	588.47	735.41	420.06	134.21	167.70	95.80
2005	685.59	854.60	492.79	154.89	193.06	111.33
2006	779.07	973.21	557.25	173.87	217.24	124.38
2007	894.83	1116.08	640.81	193.63	241.37	138.63
2008	1034.42	1285.23	744.94	211.62	262.81	152.36
2009	1205.81	1493.07	871.19	247.63	306.62	178.94

Chapter 10 Human capital for Jiangsu

1. Total human capital

Human capital stocks of Jiangsu are calculated using estimated income parameters and a 4.58% discount rate. The results are ported in Table JS-1.1. Column 1 and column 2 contain the nominal human capital; column 3 and column 4 contain the real human capital deflated by CPI (in 1985 Yuan).[56]

Table JS-1.1 Nominal and Real Human Capital, Nominal GDP for Jiangsu

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	2862		2862		65	43.91
1986	3211		2994		74	43.10
1987	3604		3093		92	39.07
1988	4116		2900		121	34.05
1989	4723		2828		132	35.73
1990	5587		3243		142	39.44
1991	6343		3534		160	39.61
1992	7174		3762		214	33.59
1993	8181		3634		300	27.29
1994	9249		3331		406	22.80
1995	10453		3240		516	20.28
1996	12023		3416		600	20.02
1997	14237		3944		668	21.31
1998	16824		4652		720	23.37

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

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1999	19737		5487		770	25.64
2000	22630	22834	6240	6288	855	26.46
2001	25616	25860	7001	7058	946	27.09
2002	29148	29412	8020	8086	1061	27.48
2003	33818	34195	9183	9278	1244	27.18
2004	38500	38990	10040	10160	1500	25.66
2005	43200	43790	11016	11155	1860	23.23
2006	48970	49700	12267	12439	2174	22.52
2007	55810	56730	13384	13591	2602	21.45
2008	63440	64560	14430	14667	3098	20.48
2009	71800	73170	16397	16700	3446	20.84

Note: The ratio of human capital to GDP is based on the current values for that year.

Figure JS-1.1 graphs real and nominal human capital for Jiangsu reported in Table JS-1.1 As is seen from the figure, both the nominal and real human capital rise steadily and nominal human capital grows faster than real human capital.

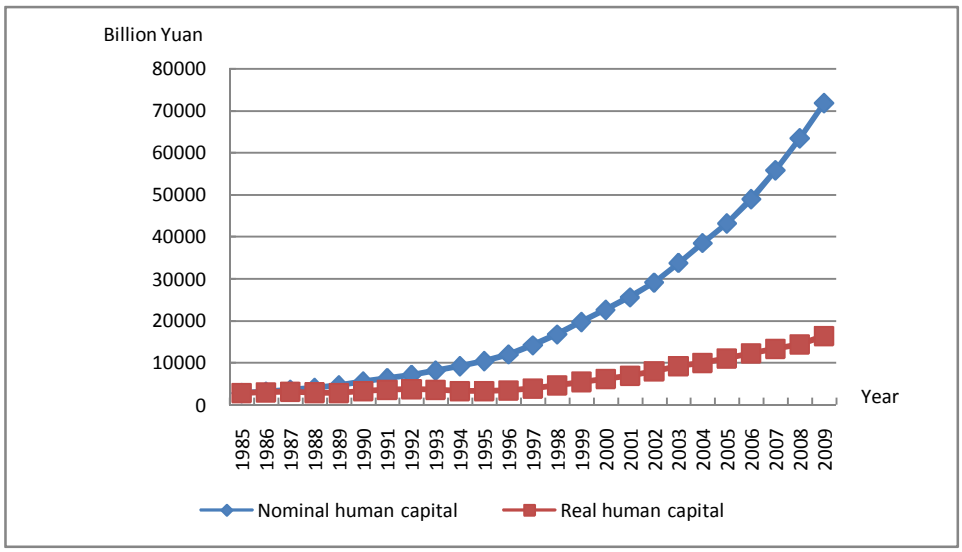


Figure JS-1.1 Nominal and Real Human Capital for Jiangsu

In order to get a sense of the magnitude of the human capital in Jiangsu, we also present the ratio of nominal human capital to nominal GDP in Table JS-1.1.[57] Similar to physical capital, human capital plays an important role in GDP growth, so the ratio could also reflect human capital's influence on sustainable growth of GDP. As is shown in Figure JS-1.2, nominal human capital is substantially higher than nominal GDP for Jiangsu. At the same time, the ratio of human capital to GDP in Jiangsu from 1991 to 1996 decreased at a considerable rate, after 1996, the ratio increased slowly and decreased again after 2001.

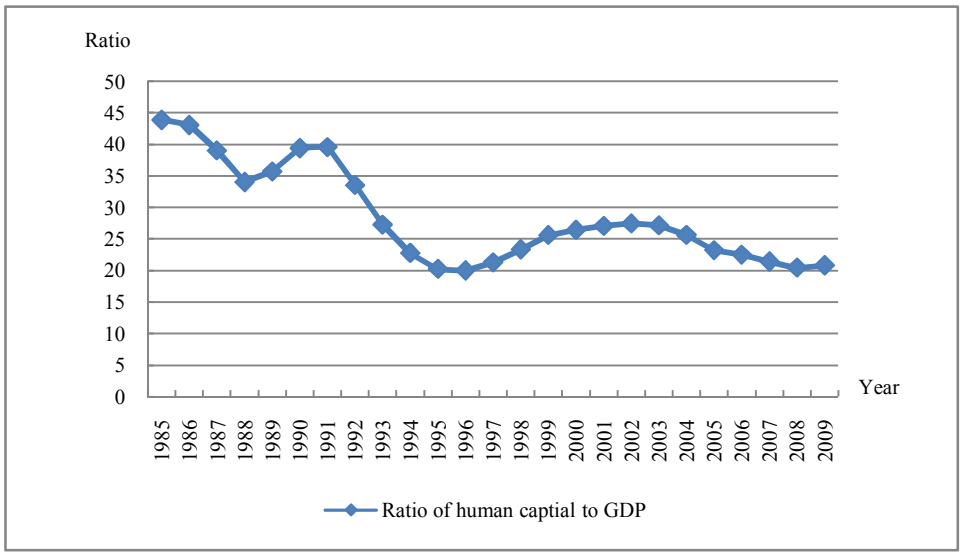


Figure JS-1.2 Ratio of Human Capital to GDP for Jiangsu

[57] The reason for calculating the ratio at the nominal level is to avoid the differences between the real value of human capital and that of GDP caused by using different deflator indices.

In order to discuss the trend of human capital, we calculate the real values here by CPI. Table JS-1.2 shows real human capital for Jiangsu by gender, and by urban or rural areas. The results based on five education categories show that the human capital for Jiangsu during 1985 to 2009 kept growing rapidly. More specifically, the human capital for Jiangsu increased from 2.9 trillion Yuan to 16.4 trillion Yuan (based on 1985), which had increased by 5 times., The annual growth rate of human capital over this period increased to 7.2%.[58]

From 1985 to 2009, male human capital in Jiangsu increased from 1.747 trillion Yuan to 10.954 trillion Yuan, the human capital for female in Jiangsu increased from 1.115 trillion Yuan to 5.448 trillion Yuan. During the same period, the annual growth rates of human capital were 7.6% and 6.6 % for male and female respectively. The gender gap in the estimated human capital increased from 0.632 trillion Yuan in 1985 to 5.506 trillion Yuan in 2009. In 2009, the male human capital was about 2 times the amount of that for female in Jiangsu.

From 1985 to 2009, rural human capital in Jiangsu increased from 2.015 trillion Yuan to 4.127 trillion Yuan, the urban human capital in Jiangsu increased from 0.847 trillion Yuan to 12.27 trillion Yuan. During the same period, the annual growth rates of human capital were 0.3% and

[58] 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.

11.1 % for rural and urban areas respectively. The urban-rural gap in the estimated human capital increased from -1.168 trillion Yuan in 1985 to 8.143 trillion Yuan in 2009. In 2009, the urban human capital was about 3 times the amount of rural human capital in Jiangsu.

Table JS-1.2 Real Human Capital by Gender and Urban-Rural for Jiangsu[59]

Billions of 1985 Yuan

Year	Total	Male	Female	Urban	Rural
1985	2862	1747	1115	847	2015
1986	2994	1856	1138	974	2020
1987	3093	1928	1165	991	2102
1988	2900	1818	1082	982	1918
1989	2828	1772	1057	1022	1806
1990	3243	2041	1202	1214	2029
1991	3534	2228	1307	1377	2157
1992	3762	2379	1383	1493	2269
1993	3634	2315	1319	1485	2149
1994	3331	2124	1206	1382	1949
1995	3240	2061	1179	1428	1812
1996	3416	2170	1246	1547	1869
1997	3944	2538	1406	1979	1965
1998	4652	2983	1669	2495	2157
1999	5487	3521	1966	3177	2310
2000	6240	4058	2182	3885	2355
2001	7001	4552	2447	4486	2515
2002	8020	5241	2780	5330	2690
2003	9183	6007	3176	6307	2876
2004	10040	6583	3457	7022	3018

[59] Some discrepancy may exist when summing up male and female, or urban and rural to get the total amount. This is mainly caused by rounding errors.

Year	Total	Male	Female	Urban	Rural
2005	11016	7225	3791	7834	3182
2006	12267	8098	4169	8885	3382
2007	13384	8866	4518	9872	3512
2008	14430	9582	4847	10800	3630
2009	16397	10954	5448	12270	4127

Figure JS-1.3 shows that real human capital by five education categories keeps growing, and it grew even faster during 1996-2009. One reason why real human capital for the male is higher than the female is the earlier retirement age for women (age 55 vs. age 60 for men based on China Labor Law). Accordingly, men have a longer time to generate income in the market. Another reason is higher educational attainment for men. Moreover, the male-female income gap has been enlarging. The results based on six education categories show similar trends.

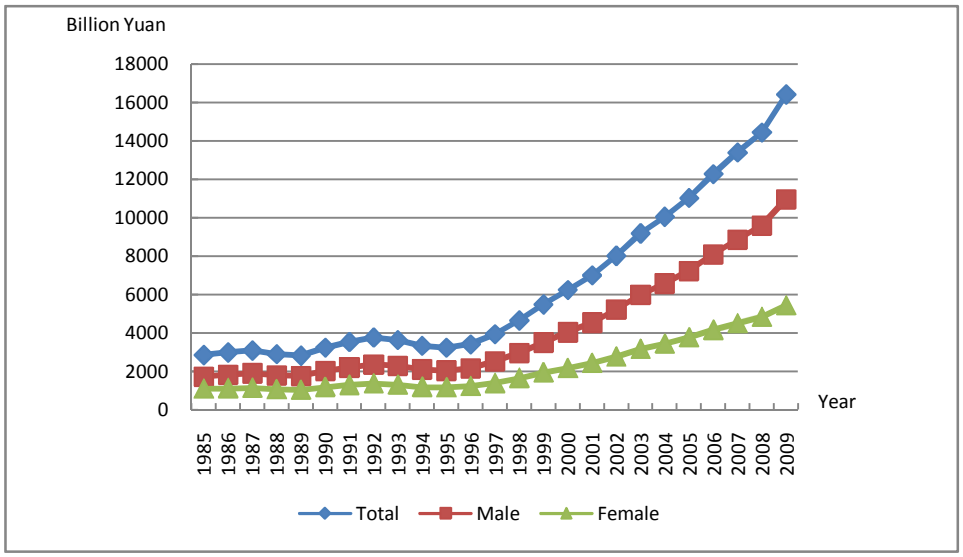


Figure JS-1.3 Real Human Capital by Gender for Jiangsu

Figure JS-1.4 shows the real human capital for urban and rural separately. Before 1997, the rural human capital was larger than the urban human capital. Since 1996, however, the real human capital in the urban area has been rising much more rapidly, while the real human capital in the rural area grew quite slowly, the urban human capital surpassed the rural human capital in 1997, and the urban-rural gap has the trend of expanding.

There are several reasons for such a trend. First, in the early years, the rural population was significantly larger than the urban population, and thus had larger amount of human capital. This change in the later years 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. Another reason is the increased education gap between the urban and rural population in the last two decades. Urban areas usually have a larger proportion of educated population than rural areas.

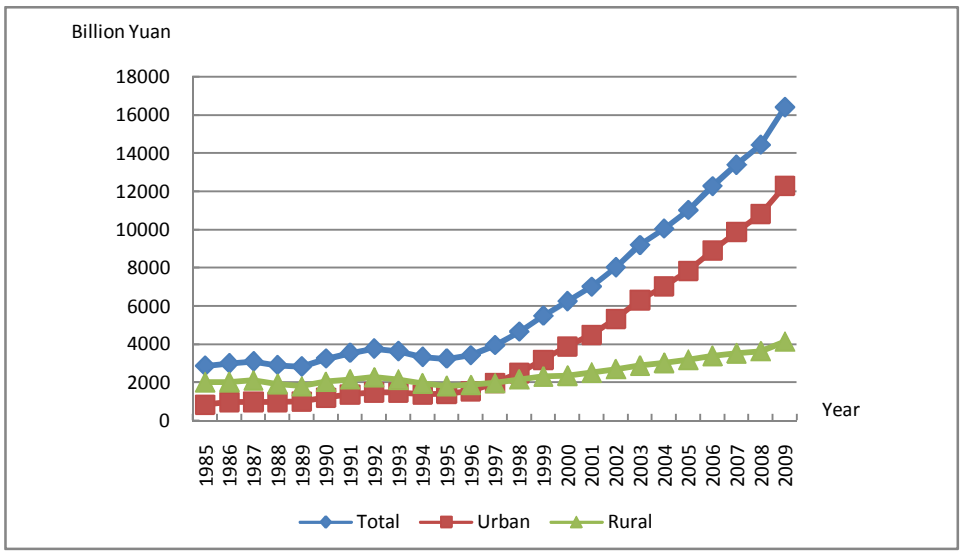


Figure JS-1.4 Real Human Capital by Urban-Rural for Jiangsu

Finally we calculate real human capital indices using 1985 as the baseline year. The results for each group are reported in Table JS-1.3.

Table JS-1.3 Real Human Capital Index for Jiangsu (1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	104.61	106.22	102.10	114.97	100.25
1987	108.05	110.38	104.49	116.94	104.32
1988	101.33	104.06	97.03	115.96	95.19
1989	98.81	101.43	94.83	120.66	89.63
1990	113.31	116.85	107.80	143.33	100.69
1991	123.48	127.55	117.22	162.57	107.05
1992	131.45	136.18	124.09	176.27	112.61
1993	126.97	132.51	118.34	175.32	106.65
1994	116.39	121.57	108.20	163.16	96.72
1995	113.21	117.96	105.78	168.60	89.93
1996	119.36	124.19	111.74	182.64	92.75
1997	137.81	145.28	126.17	233.65	97.52
1998	162.54	170.75	149.72	294.57	107.05
1999	191.72	201.55	176.33	375.09	114.64
2000	218.03	232.28	195.74	458.68	116.87
2001	244.62	260.56	219.53	529.63	124.81
2002	280.22	300.00	249.43	629.28	133.50
2003	320.86	343.85	284.89	744.63	142.73
2004	350.80	376.82	310.13	829.04	149.78
2005	384.91	413.57	340.09	924.91	157.92
2006	428.62	463.54	374.00	1049.00	167.84
2007	467.65	507.50	405.31	1165.53	174.29
2008	504.19	548.48	434.83	1275.09	180.15
2009	572.92	627.02	488.74	1448.64	204.81

Figure JS-1.5 shows the index of real total human capital for Jiangsu. Before 1997 the index grows quite steadily, but it accelerates after that year.

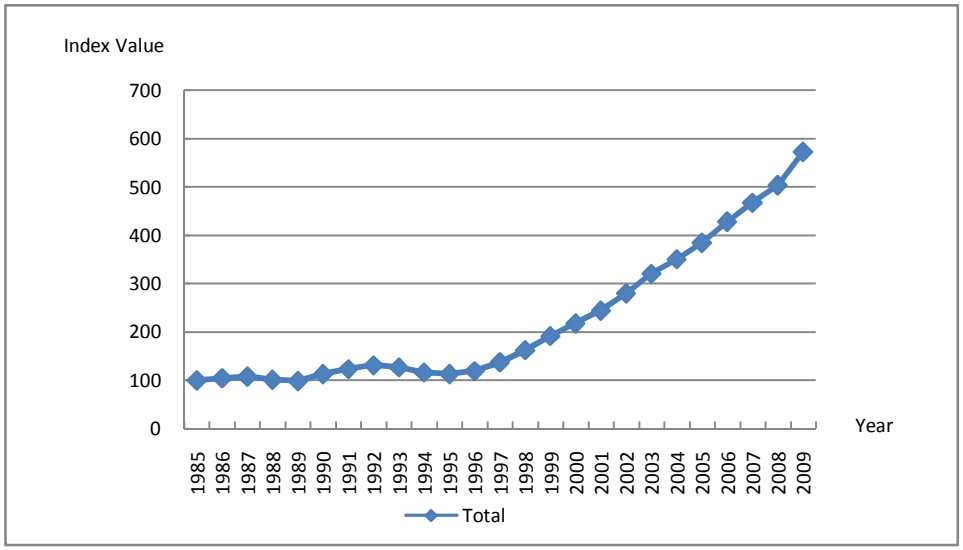


Figure JS-1.5 Real Human Capital Index for Jiangsu

2. Per capita human capital

An increase in real human capital can be caused by a number of factors, such as population growth, demographic changes (e.g., the size of retirement group), urban-rural 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, and higher rates of return to on-the-job training. In order to get further information on the dynamics of human capital, we calculate per capita real human capital, i.e., the ratio of real human capital to non-retired population.

Table JS-2.1 shows the per capita human capital by gender for Jiangsu. Based on the five education categories, per capita human capital real values for male increased from 59,670 Yuan to 333,949 Yuan, increased by around 5 times; per capita human capital real values for female increased from

42,606 Yuan to 184,067 Yuan, increased by around 3 times. From1985 to 2009, the annual growth rate was 7.1% for male, and 6.0% for female.

Table JS-2.1 Per Capita Nominal and Real Human Capital by Gender for Jiangsu

Year	Nominal per capita human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	51.62	59.67	42.61	51.62	59.67	42.61
1986	57.70	67.55	46.64	53.80	62.99	43.46
1987	64.35	75.65	51.56	55.22	64.92	44.28
1988	72.46	85.71	57.49	51.06	60.34	40.54
1989	81.97	97.07	65.04	49.08	58.15	38.95
1990	93.52	111.36	73.48	54.28	64.64	42.67
1991	105.10	125.95	81.91	58.56	70.13	45.72
1992	118.03	142.31	91.22	61.89	74.51	47.94
1993	134.20	163.44	102.02	59.61	72.48	45.45
1994	151.42	185.52	114.29	54.53	66.68	41.26
1995	170.66	209.89	128.57	52.90	64.98	39.92
1996	195.46	240.06	147.59	55.53	68.14	41.98
1997	230.71	285.20	171.44	63.91	78.94	47.58
1998	271.86	335.19	203.25	75.17	92.68	56.20
1999	318.58	391.60	238.91	88.57	108.92	66.34
2000	359.78	446.05	264.73	99.21	123.01	72.95
2001	407.42	507.00	298.39	111.35	138.62	81.48
2002	463.53	580.19	336.35	127.54	159.69	92.48
2003	537.00	673.65	388.09	145.82	183.10	105.27
2004	611.74	770.02	439.99	159.53	200.92	114.58
2005	687.37	869.15	491.75	175.28	221.75	125.25
2006	776.60	985.79	550.33	194.54	247.07	137.68
2007	884.96	1124.27	624.69	212.22	269.78	149.59
2008	1007.66	1277.69	711.21	229.20	290.83	161.51
2009	1150.66	1460.92	807.02	262.78	333.95	184.07

Figure JS-2.1 shows the trend of per capita real human capital by gender. Per capita real human capital shows a similar trend for males and females. Per capita real human capital for male and female both exhibit an accelerated growth after 1996. The male-female gap has been widening.

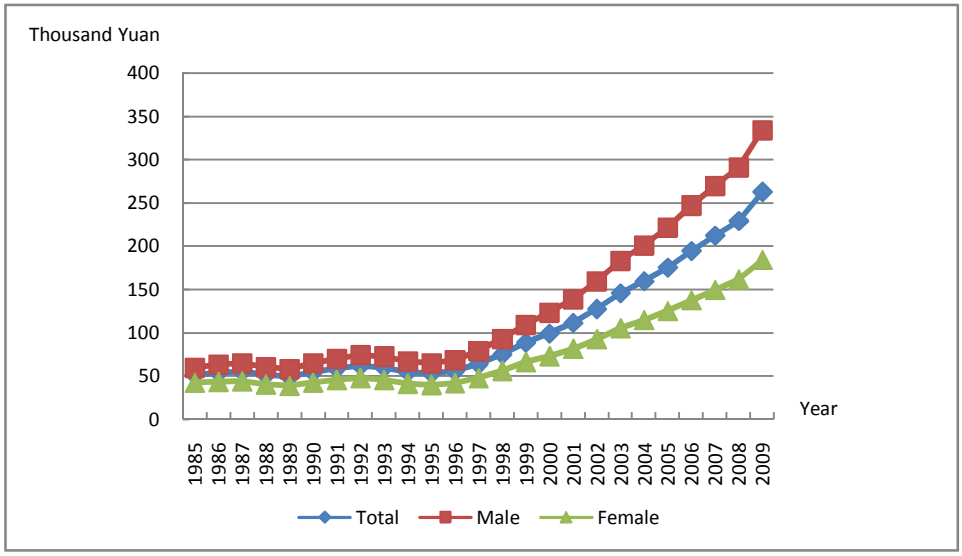


Figure JS-2.1 Per Capita Real Human Capital by Gender for Jiangsu

Table JS-2.2 reports the results of per capita human capital measured in nominal and real terms for Jiangsu by urban and rural separately. From 1985 to 2009, the per capita human capital in urban areas was significantly larger than that for rural. The per capita urban human capital increased from 93,075 Yuan to 368,957 Yuan, the per capita rural human capital increased from 43,448 Yuan to 141,234 Yuan. The per capita human capital in urban areas grew much faster than the one for rural.

Table JS-2.2 Per Capita Nominal and Real Human Capital by Urban-Rural for Jiangsu

Year	Nominal per capita human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	51.62	93.07	43.45	51.62	93.07	43.45
1986	57.70	101.85	47.86	53.80	95.72	44.44
1987	64.35	112.63	53.42	55.22	95.80	46.05
1988	72.46	125.24	59.37	51.06	86.89	42.16
1989	81.97	140.72	66.21	49.08	84.16	39.68
1990	93.52	163.42	74.41	54.28	94.52	43.29
1991	105.10	182.69	81.67	58.56	98.11	46.63
1992	118.03	208.54	89.80	61.89	102.93	49.11
1993	134.20	242.25	99.70	59.61	100.74	46.49
1994	151.42	274.11	110.69	54.53	90.97	42.41
1995	170.66	297.91	122.67	52.90	85.09	40.76
1996	195.46	353.83	135.27	55.53	91.21	41.97
1997	230.71	416.01	150.14	63.91	105.86	45.67
1998	271.86	494.33	166.87	75.17	125.79	51.27
1999	318.58	558.31	186.16	88.57	144.09	57.89
2000	359.78	567.79	208.61	99.21	146.53	64.81
2001	407.42	640.91	229.95	111.35	165.24	70.38
2002	463.53	715.63	255.46	127.54	187.50	78.03
2003	537.00	818.72	286.37	145.82	212.60	86.44
2004	611.74	923.30	321.83	159.53	231.20	92.87
2005	687.37	1010.60	361.05	175.28	248.10	101.74
2006	776.60	1130.06	400.46	194.54	273.06	110.96
2007	884.96	1274.02	447.08	212.22	295.72	118.21
2008	1007.66	1438.49	500.52	229.20	317.39	125.32
2009	1150.66	1665.34	561.40	262.78	368.96	141.23

Figure JS-2.2 shows trends in per capita real human capital in urban and rural areas. During the period of 1985-2009, per capita real human capital for urban and rural both exhibit an accelerated growth after 1996.

Based on the five education categories, the ratio of urban to rural increased from 2.14 in 1985 to 2.6 in 2009, the absolute size of the urban-rural gap has been on the rise. From 1985 to 2009, the annual growth rate was 5.7% for the urban area, and 4.9% for the rural area.

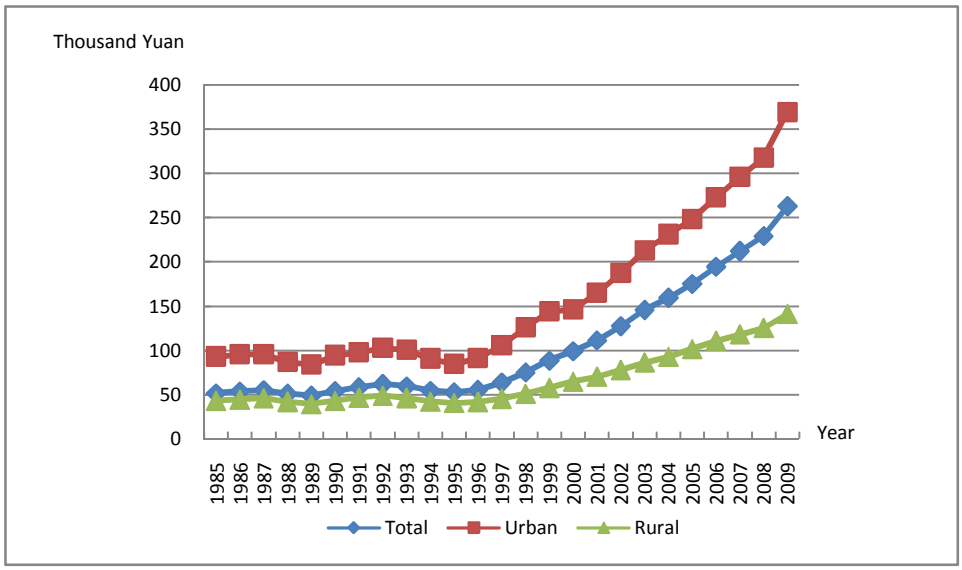


Figure JS-2.2 Per Capita Real Human Capital by Urban-Rural for Jiangsu

Figure JS-2.3 shows the per capita real human capital index for Jiangsu. As is seen from the graph below, per capita real human capital was essentially stable before 1996, but significant growth occurred after 1996.

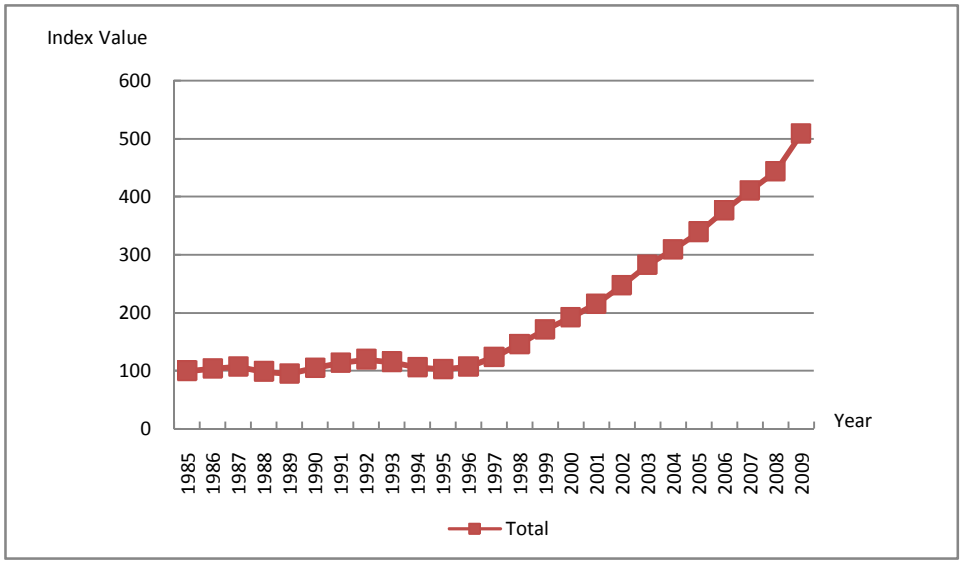


Figure JS-2.3 Per Capita Real Human Capital Index for Jiangsu

3. Labor force human capital

3.1 Total Labor force human capital

Labor force human capital represents the human capital of the population that is over 15 years old, non-retired and out-of-school. Labor force human capital is estimated in the same way as human capital. The labor force human capital is reported in Table JS-3.1. The real values in this table are calculated by deflating the nominal values with the CPI.

Table JS-3.1 Labor Force Human Capital and Nominal GDP for Jiangsu

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of labor force human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	1305		1305		65	20.02
1986	1508		1404		74	20.24
1987	1731		1488		92	18.77
1988	2019		1425		121	16.70
1989	2316		1387		132	17.52
1990	2619		1520		142	18.49
1991	2969		1660		160	18.54
1992	3328		1757		214	15.58
1993	3709		1663		300	12.37
1994	4111		1497		406	10.13
1995	4643		1452		516	9.01
1996	5028		1452		600	8.37
1997	5730		1617		668	8.58
1998	6550		1852		720	9.10
1999	7548		2143		770	9.81
2000	9477	9361	2640	2608	855	11.08
2001	10219	10125	2828	2801	946	10.81
2002	11255	11194	3133	3115	1061	10.61
2003	12454	12482	3427	3432	1244	10.01
2004	13818	13797	3647	3639	1500	9.21
2005	15547	15512	4003	3994	1860	8.36
2006	17792	17770	4506	4498	2174	8.18
2007	20208	20182	4902	4893	2602	7.77
2008	23005	22979	5295	5287	3098	7.43
2009	25589	25564	5928	5920	3446	7.43

Note: The ratio of labor force human capital to GDP is based on the current values for that year.

The trends in nominal and real labor force human capital are presented in Figure JS-3.1. Similar to the trend of human capital, from 1985 to 2009, labor force human capital both in nominal and real terms have kept on increasing.

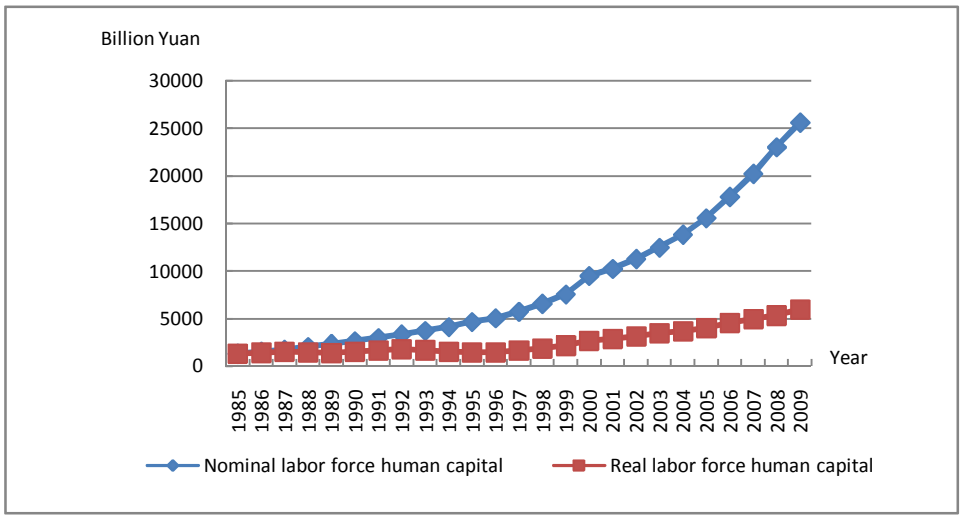


Figure JS-3.1 Nominal and Real Labor Force Human Capital for Jiangsu

We also calculate the ratio of labor force human capital to GDP. The results are reported in the last column of Table JS-3.1. As before, the ratio could reflect human capital's influence on sustainable growth of GDP, and may also reflect changes in human capital productivity and efficiency. Figure JS-3.2 shows the trend for the ratio. The pattern of the ratio for labor force human capital is almost the same as that for human capital. The level of nominal labor force human capital is much higher than that of nominal GDP. The ratio remains between 5 and 20 and generally shows a decreasing trend.

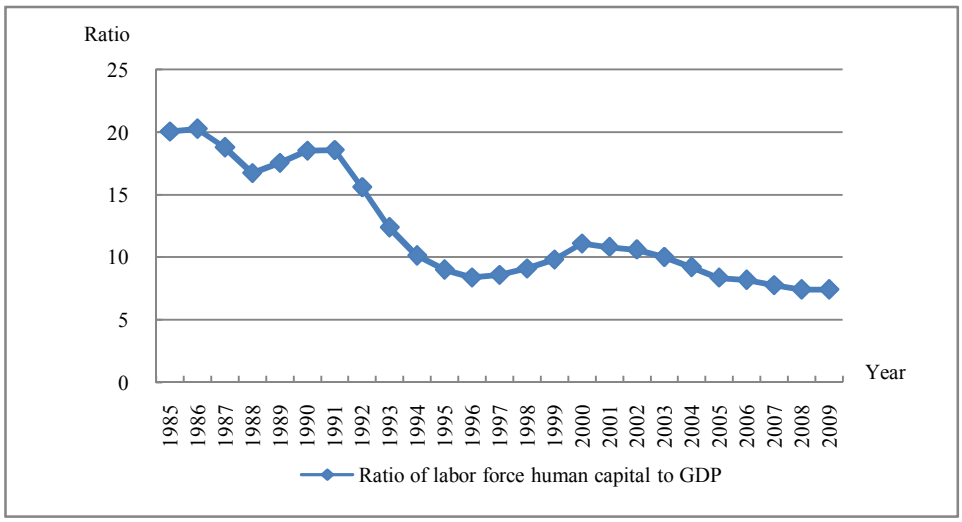


Figure JS-3.2 Ratio of Labor Force Human Capital to GDP for Jiangsu

Table JS-3.2 shows the nominal and real labor force human capital for urban and rural respectively. The pattern of real labor force human capital is almost the same as that of the real human capital. Urban real labor force human capital surpassed its rural counterpart for the first time in 2000. The urban-rural gap has increased from -0.741 trillion Yuan in 1985 to around 1.6 trillion Yuan in 2009.

Table JS-3.2 Nominal and Real Labor Force Human Capital by Urban-Rural for Jiangsu

Year	Nominal labor force human capital (Billions of Yuan)			Real labor force human capital (Billions of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	1305	282	1023	1305	282	1023
1986	1508	367	1141	1404	345	1059
1987	1731	432	1299	1488	368	1120
1988	2019	559	1460	1425	388	1037
1989	2316	705	1611	1387	421	965
1990	2619	827	1792	1520	478	1042
1991	2969	1019	1950	1660	547	1113

Year	Nominal labor force human capital (Billions of Yuan)			Real labor force human capital (Billions of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1992	3328	1173	2155	1757	579	1178
1993	3709	1316	2393	1663	547	1116
1994	4111	1516	2595	1497	503	994
1995	4643	1943	2700	1452	555	897
1996	5028	2060	2968	1452	531	921
1997	5730	2540	3190	1617	646	970
1998	6550	3059	3491	1852	779	1073
1999	7548	3877	3671	2143	1001	1142
2000	9477	5779	3698	2640	1491	1149
2001	10219	6228	3991	2828	1606	1222
2002	11255	7023	4232	3133	1840	1293
2003	12454	7880	4574	3427	2046	1381
2004	13818	8926	4892	3647	2235	1412
2005	15547	10400	5147	4003	2552	1451
2006	17792	11960	5832	4506	2890	1616
2007	20208	13660	6548	4902	3171	1731
2008	23005	15640	7365	5295	3451	1844
2009	25589	16980	8609	5928	3762	2166

Figure JS-3.3 shows real labor force human capital for urban and rural respectively. The pattern of labor force human capital is almost the same as that of real human capital. The urban labor force human capital surpassed the rural one in 2000 and has grown much faster ever since.

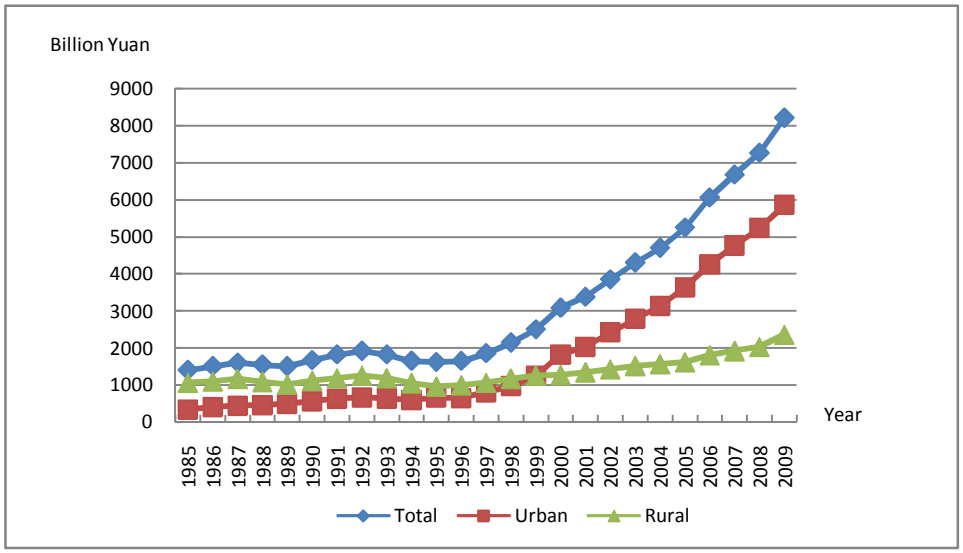


Figure JS-3.3 Real Labor Force Human Capital by Urban-Rural for Jiangsu

3.2 Average labor force human capital

Similar to the analysis of per capita human capital above, we calculate the average labor force human capital. Here the average labor force human capital means labor force human capital divided by the number of the population that are over 15 years old, non-retired and out of school.

Table JS-3.3 reports the real average labor force human capital by gender. Additionally, the table shows that the real average labor force human capital for female was smaller than that for male.

Table JS-3.3 Nominal and Real Average Labor Force Human Capital by Gender for Jiangsu

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	36.43	42.09	30.19	36.43	42.09	30.19
1986	40.90	47.65	33.42	38.07	44.38	31.11
1987	45.63	53.44	36.96	39.21	45.91	31.77
1988	51.72	61.08	41.31	36.50	43.09	29.17
1989	58.41	69.45	46.06	34.98	41.60	27.58
1990	64.73	77.35	50.58	37.57	44.93	29.37
1991	72.13	86.96	55.75	40.33	48.59	31.24
1992	79.80	96.71	61.32	42.13	50.99	32.47
1993	88.67	108.22	67.62	39.76	48.45	30.40
1994	98.12	120.36	74.59	35.74	43.77	27.24
1995	110.60	136.26	83.95	34.59	42.57	26.30
1996	120.82	149.64	90.63	34.89	43.17	26.21
1997	137.16	171.89	100.23	38.70	48.41	28.37
1998	154.81	195.04	112.30	43.76	55.05	31.80
1999	176.08	222.69	126.34	49.99	63.13	35.93
2000	212.40	269.78	150.24	59.17	75.07	41.95
2001	231.10	295.70	161.95	63.95	81.76	44.88
2002	256.05	329.69	177.40	71.28	91.70	49.43
2003	283.69	366.28	196.10	78.06	100.76	53.97
2004	316.93	410.00	218.58	83.65	108.21	57.67
2005	357.40	465.27	244.74	92.02	119.85	62.98
2006	401.63	524.36	272.64	101.72	132.86	68.98
2007	451.75	590.35	305.07	109.58	143.26	73.91
2008	510.35	666.01	343.98	117.47	153.35	79.08
2009	572.82	747.67	383.81	132.70	173.32	88.81

Table JS-3.4 reports the real average labor force human capital by area. The real average labor force human capital was much smaller in rural area than in urban area.

Table JS-3.4 Nominal and Real Average Labor Force Human Capital by Urban-Rural for Jiangsu

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	36.43	52.04	33.61	36.43	52.04	33.61
1986	40.90	58.48	37.32	38.07	54.97	34.65
1987	45.63	65.07	41.53	39.21	55.35	35.80
1988	51.72	74.18	46.39	36.50	51.47	32.94
1989	58.41	84.46	51.38	34.98	50.52	30.79
1990	64.73	94.38	56.56	37.57	54.59	32.91
1991	72.13	105.46	62.01	40.33	56.64	35.41
1992	79.80	118.43	67.92	42.13	58.46	37.14
1993	88.67	133.84	74.75	39.76	55.66	34.85
1994	98.12	150.10	81.47	35.74	49.82	31.21
1995	110.60	169.22	88.54	34.59	48.33	29.42
1996	120.82	185.32	97.41	34.89	47.77	30.22
1997	137.16	208.62	107.72	38.70	53.09	32.77
1998	154.81	233.35	119.49	43.76	59.38	36.71
1999	176.08	259.01	131.62	49.99	66.84	40.93
2000	212.40	302.11	145.36	59.17	77.97	45.16
2001	231.10	324.05	159.63	63.95	83.55	48.86
2002	256.05	352.96	175.72	71.28	92.48	53.68
2003	283.69	383.27	196.33	78.06	99.52	59.26
2004	316.93	424.37	217.40	83.65	106.27	62.73
2005	357.40	466.17	242.76	92.02	114.45	68.41
2006	401.63	516.09	276.57	101.72	124.70	76.63
2007	451.75	571.56	313.82	109.58	132.67	82.97
2008	510.35	638.70	357.24	117.47	140.92	89.44
2009	572.82	717.09	408.36	132.70	158.87	102.73

Chapter 11 Human capital for Anhui

1. Total human capital

Human capital stocks of Anhui are calculated using estimated income parameters and a 4.58% discount rate. The results are ported in Table AH-1.1. Column 1 and column 2 contain the nominal human capital; column 3 and column 4 contain the real human capital deflated by CPI (in 1985 Yuan).[60]

Table AH-1.1 Nominal and Real Human Capital, Nominal GDP for Anhui

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	1019		1019		33	30.78
1986	1151		1083		38	30.08
1987	1312		1135		44	29.66
1988	1506		1086		55	27.54
1989	1720		1054		62	27.91
1990	2011		1199		66	30.55
1991	2283		1294		66	34.40
1992	2588		1354		80	32.30
1993	2949		1341		104	28.43

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

1994	3335		1196		132	25.26
1995	3767		1180		181	20.80
1996	4436		1261		209	21.19
1997	5077		1426		235	21.63
1998	5746		1611		254	22.60
1999	6730		1922		271	24.81
2000	7961	7951	2255	2251	290	27.43
2001	9112	9111	2560	2559	325	28.07
2002	10363	10371	2939	2941	352	29.44
2003	11756	11775	3273	3276	392	29.97
2004	13373	13400	3558	3564	476	28.10
2005	15159	15190	3974	3981	535	28.33
2006	17526	17572	4535	4546	611	28.67
2007	20273	20331	4981	4993	736	27.54
2008	23386	23459	5405	5422	885	26.42
2009	27111	27213	6322	6344	1006	26.94

Note: The ratio of human capital to GDP is based on the current values for that year.

Figure Anhui-1.1 shows the real and nominal human capital for Anhui reported in Table AH-1.1. As is seen from the figure, both the nominal and real human capital rise steadily and nominal human capital grows faster than real human capital.

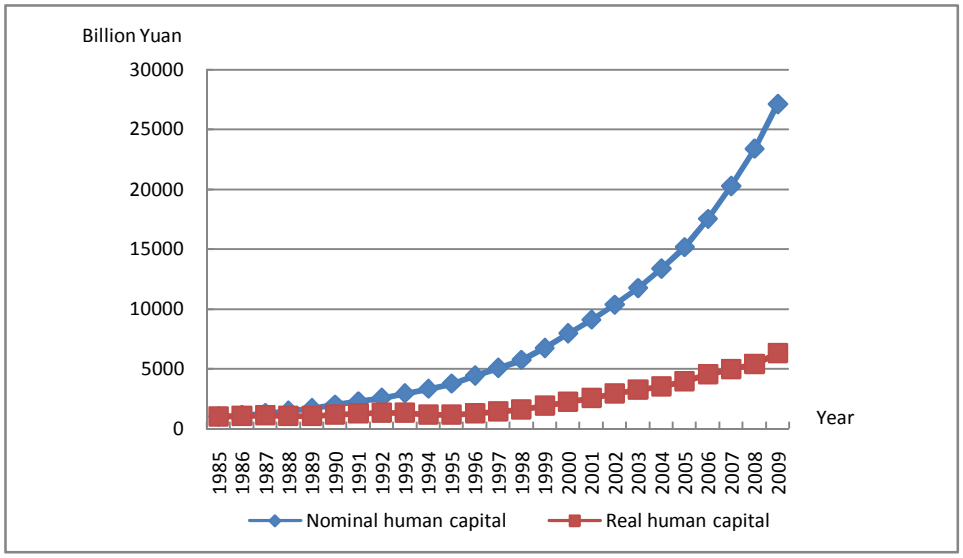


Figure AH-1.1 Nominal and Real Human Capital for Anhui

In order to get a sense of the magnitude of the human capital in Anhui Province, we also present the ratio of nominal human capital to nominal GDP in Table AH-1.1.[61] Similar to physical capital, human capital plays an important role in GDP growth, so the ratio could also reflect human capital's influence on sustainable growth of GDP. As is shown in Figure AH-1.2, nominal human capital is substantially higher than nominal GDP for Anhui. There was a decreasing trend during 1985 to 1995, although during 1989-1991 there is a short period rise. After 1995, the ratio increased slowly in a small scale.

[61] The reason for calculating the ratio at the nominal level is to avoid the differences between the real value of human capital and that of GDP caused by using different deflator indices.

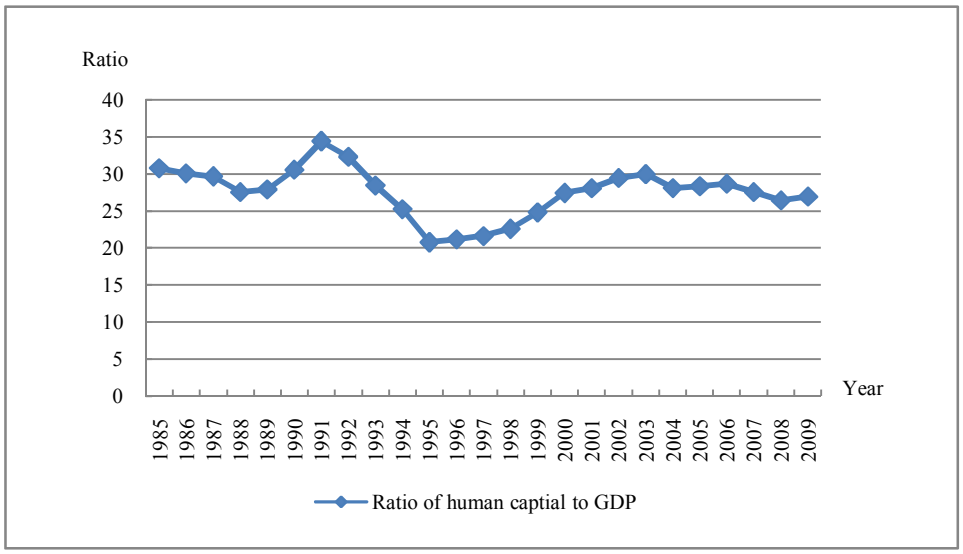


Figure AH-1.2 Ratio of Human Capital to GDP for Anhui

In order to discuss the trend of human capital, we calculate the real values here by CPI. Table AH-1.2 shows real human capital for Anhui by gender, and by urban or rural areas. The results based on five education categories show that the human capital for Anhui Province during 1985 to 2009 kept growing rapidly. More specifically, the human capital for Anhui Province increased from 1.019 trillion Yuan to 3.94 trillion Yuan (calculated by 1985 comparable price), the annual growth rate of human capital over this period increased to 7.6%.[62]

From 1985 to 2009, human capital for male in Anhui Province increased from 0.611 trillion Yuan to 4.07 trillion Yuan, the human capital for female in Anhui Province increased from 0.409 trillion Yuan to 2.252 trillion Yuan. During the same period, the annual growth rates of human capital were 7.9% and 7.1 % for male and female respectively. The gender

[62] 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.

gap in the estimated human capital increased from 0.202 trillion Yuan in 1985 to 1.818 trillion Yuan in 2009. In 2009, the human capital for male was about 1.8 times the amount of that for female in Anhui Province.

From 1985 to 2009, rural human capital in Anhui Province increased from 0.659 trillion Yuan to 2.057 trillion Yuan, the urban human capital in Anhui Province increased from 0.324 trillion Yuan to 4.265 trillion Yuan. During the same period, the annual growth rates of human capital were 4.52% and 10.7 % for rural and urban areas respectively. The urban-rural gap in the estimated human capital increased from -0.371 trillion Yuan in 1985 to 0.22 trillion Yuan in 2009. In 2009, the urban human capital was about 2 times the amount of that for rural in Anhui Province.

Table AH-1.2 Real Human Capital by Gender and Urban-Rural for Anhui[63]

Billions of 1985 Yuan

Year	Total	Male	Female	Urban	Rural
1985	1019	611	409	324	695
1986	1083	650	433	352	732
1987	1135	688	447	375	760
1988	1086	663	424	362	724
1989	1054	646	408	364	689
1990	1199	737	462	424	775
1991	1294	797	496	452	841
1992	1354	838	516	477	877
1993	1341	833	507	484	857
1994	1196	746	450	436	761

[63] Some discrepancy may exist when summing up male and female, or urban and rural to get the total amount. This is mainly caused by rounding errors.

1995	1180	736	444	429	751
1996	1261	789	473	519	743
1997	1426	895	530	598	828
1998	1611	1017	594	689	922
1999	1922	1222	701	916	1006
2000	2255	1439	815	1124	1131
2001	2560	1631	929	1348	1212
2002	2939	1872	1067	1611	1328
2003	3273	2088	1184	1858	1415
2004	3558	2270	1287	2094	1464
2005	3974	2532	1442	2415	1559
2006	4535	2908	1628	2825	1710
2007	4981	3197	1784	3177	1804
2008	5405	3464	1941	3551	1854
2009	6322	4070	2252	4265	2057

Figure AH-1.3 shows that real human capital by five education categories keeps growing, and it grew even faster during 1996-2009. One reason why male real human capital is higher than female real human capital is the earlier retirement age for women (age 55 vs. age 60 for men based on China Labor Law). Accordingly, men have a longer time to generate income in the labor market. Another reason is higher educational attainment for men. Moreover, the male-female income gap has been on expanding. The results based on six education categories show the similar trends.

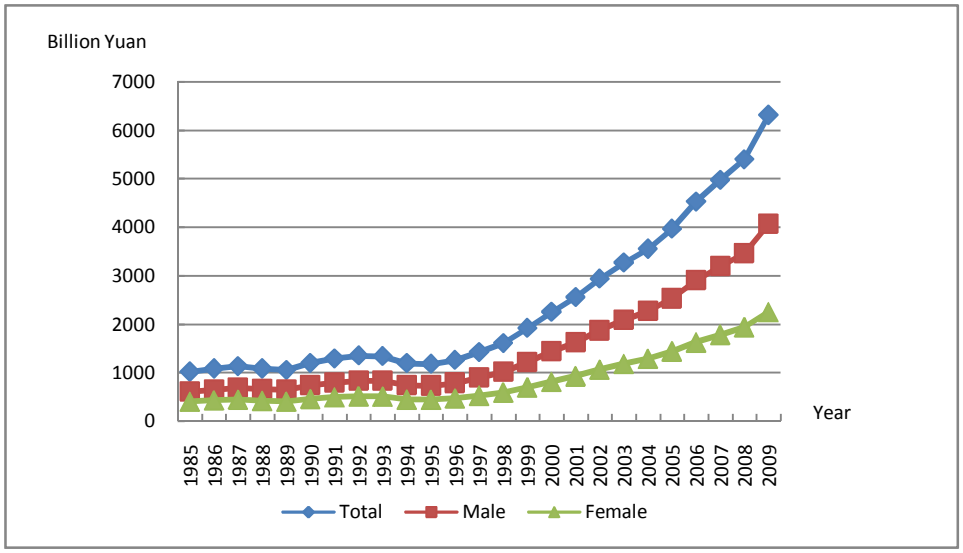


Figure AH-1.3 Real Human Capital by Gender for Anhui

Figure AH-1.4 shows the real human capital for urban and rural separately. As previously noted, before 2001, rural real human capital was larger than that in the urban area. Since 1997, however, the real human capital in the urban area has been rising much more rapidly, while the real human capital in the rural area grew quite slowly, the urban human capital surpassed the rural human capital in 2001, and the urban-rural gap has the trend of expanding.

There are several reasons for such a trend. First, in the early years, the rural population was significantly larger than the urban population, and thus had larger amount of human capital. This change in the later years 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. Another reason is the increased education gap between the urban and rural population. Urban areas usually have a larger proportion of educated population than rural areas.

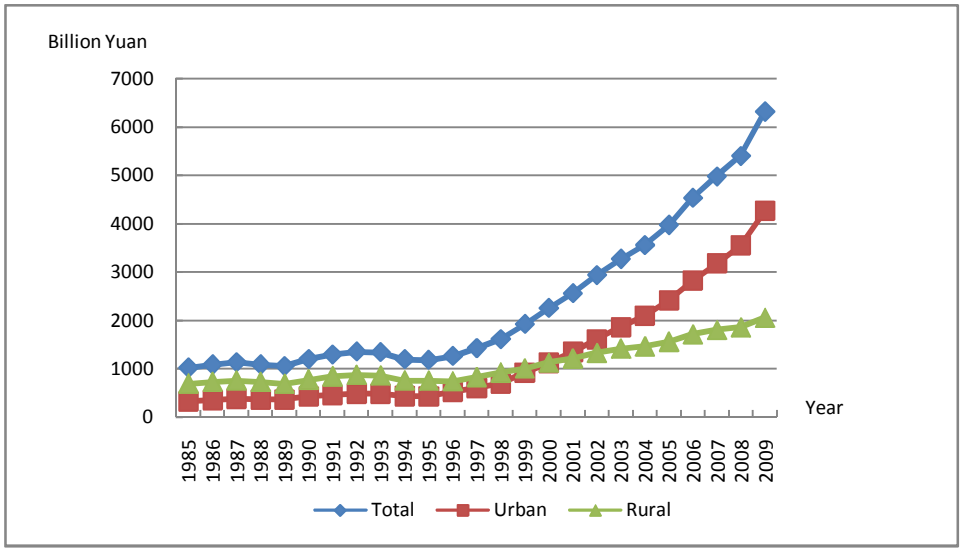


Figure AH-1.4 Real Human Capital by Urban-Rural for Anhui

Finally we calculate real human capital indices using 1985 as the baseline year. The results for each group are reported in Table AH-1.3.

Table AH-1.3 Real Human Capital Index for Anhui (1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	106.27	106.50	105.94	108.51	105.22
1987	111.31	112.59	109.37	115.55	109.34
1988	106.55	108.52	103.67	111.75	104.13
1989	103.35	105.75	99.78	112.34	99.17
1990	117.60	120.70	112.96	130.78	111.45
1991	126.90	130.59	121.40	139.51	121.02
1992	132.82	137.27	126.17	147.13	126.15
1993	131.51	136.46	124.12	149.23	123.25
1994	117.36	122.22	110.10	134.42	109.41
1995	115.74	120.49	108.66	132.29	108.03
1996	123.73	129.17	115.61	159.96	106.83
1997	139.86	146.61	129.75	184.45	119.06
1998	158.05	166.57	145.30	212.65	132.59

Year	Total	Male	Female	Urban	Rural
1999	188.57	200.05	171.50	282.63	144.71
2000	221.21	235.72	199.46	346.70	162.69
2001	251.13	267.13	227.23	415.79	174.34
2002	288.31	306.63	260.91	496.92	191.02
2003	321.07	341.93	289.73	573.10	203.54
2004	349.03	371.77	314.77	645.90	210.59
2005	389.84	414.69	352.67	744.91	224.25
2006	444.87	476.25	398.21	871.38	245.97
2007	488.62	523.58	436.42	979.95	259.49
2008	530.21	567.31	474.90	1095.31	266.69
2009	620.17	666.56	550.95	1315.55	295.89

Figure AH-1.5 shows the index of real total human capital for Anhui. Before 1997 the index grows quite steadily, but it accelerates after that year.

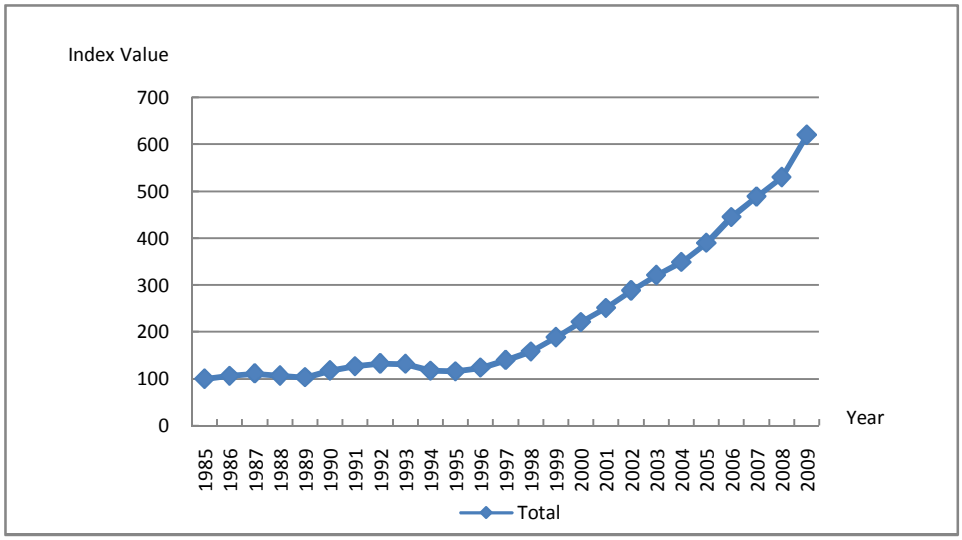


Figure AH-1.5 Real Human Capital Index for Anhui

2. Per capita human capital

An increase in real human capital can be caused by a number of factors, such as population growth, demographic changes (e.g., the size of retirement

group), urban-rural 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, and higher rates of return to on-the-job training. In order to get further information on the dynamics of human capital, we calculate per capita real human capital, i.e., the ratio of real human capital to non-retired population.

Table AH-2.1 shows the per capita human capital by gender for Anhui. Based on the five education categories, per capita human capital real values for male increased from 24,550 Yuan to 139,060 Yuan, increased by around 5 times; per capita human capital real values for female increased from 18,400 Yuan to 84,850 Yuan, increased by around 4 times. From1985 to 2009, the annual growth rate was 7.23% for male, and 6.35% for female.

Table AH-2.1 Per Capita Nominal and Real Human Capital by Gender for Anhui

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	21.69	24.55	18.48	21.69	24.55	18.48
1986	24.30	27.54	20.64	22.86	25.92	19.43
1987	27.36	31.28	22.93	23.65	27.04	19.83
1988	30.90	35.53	25.65	22.29	25.62	18.52
1989	34.84	40.13	28.83	21.35	24.58	17.66
1990	39.31	45.32	32.45	23.44	27.03	19.35
1991	44.16	51.18	36.19	25.02	28.98	20.52
1992	49.44	57.59	40.18	25.86	30.11	21.04

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
1993	56.14	65.65	45.34	25.52	29.83	20.63
1994	63.07	74.10	50.54	22.63	26.58	18.15
1995	70.77	83.54	56.43	22.17	26.15	17.70
1996	82.73	97.93	65.64	23.52	27.84	18.68
1997	93.88	111.66	73.96	26.36	31.33	20.79
1998	106.42	126.88	83.34	29.84	35.56	23.40
1999	124.42	149.30	96.44	35.54	42.63	27.56
2000	144.50	173.94	111.23	40.93	49.24	31.53
2001	165.38	199.84	126.92	46.46	56.13	35.67
2002	188.48	228.64	144.03	53.45	64.82	40.87
2003	214.83	261.68	163.27	59.81	72.81	45.47
2004	245.77	300.75	185.82	65.39	79.97	49.44
2005	279.02	343.44	209.84	73.15	90.00	55.03
2006	319.73	394.15	239.05	82.73	101.98	61.90
2007	367.07	451.76	274.84	90.19	110.98	67.52
2008	420.90	516.19	316.38	97.28	119.37	73.14
2009	485.75	596.38	363.88	113.27	139.06	84.85

Figure AH-2.1 shows the trend of per capita real human capital by gender. Per capita real human capital shows a similar trend for males and females. Per capita real human capital for male and female both exhibit an accelerated growth after 1996. The male-female gap has been widening.

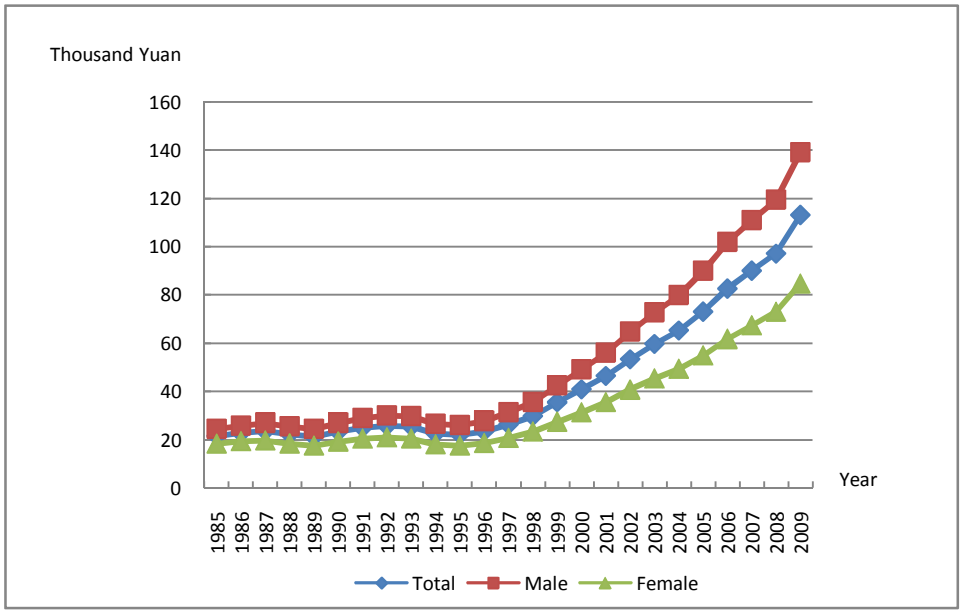


Figure AH-2.1 Per Capita Real Human Capital by Gender for Anhui

Table AH-2.2 reports the results of per capita human capital measured in nominal and real terms for Anhui Province by urban and rural separately. From 1985 to 2009, the per capita human capital in urban areas was significantly larger than that for rural. The per capita urban human capital increased from 43,460 Yuan to 176,480 Yuan, the per capita rural human capital increased from 17,580 Yuan to 64,990 Yuan. The per capita human capital in urban areas grew much faster than the one for rural.

Table AH-2.2 Per Capita Nominal and Real Human Capital by Urban-Rural for Anhui

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	21.69	43.46	17.58	21.69	43.46	17.58
1986	24.30	47.66	19.67	22.86	45.04	18.47
1987	27.36	53.25	22.04	23.65	45.80	19.11
1988	30.90	60.33	24.71	22.29	42.74	17.99
1989	34.84	67.80	27.66	21.35	41.51	16.95
1990	39.31	77.50	30.97	23.44	46.25	18.46
1991	44.16	87.58	34.59	25.02	48.66	19.80
1992	49.44	98.27	38.64	25.86	50.19	20.49
1993	56.14	112.12	43.42	25.52	50.06	19.95
1994	63.07	126.41	48.48	22.63	44.30	17.64
1995	70.77	141.45	54.33	22.17	42.77	17.38
1996	82.73	162.54	60.67	23.52	44.64	17.69
1997	93.88	186.11	67.90	26.36	50.15	19.67
1998	106.42	211.11	76.01	29.84	56.72	22.04
1999	124.42	233.58	85.20	35.54	64.30	25.20
2000	144.50	265.38	97.09	40.93	72.40	28.58
2001	165.38	302.27	107.57	46.46	82.47	31.26
2002	188.48	340.72	119.23	53.45	93.81	35.10
2003	214.83	384.84	132.41	59.81	104.08	38.33
2004	245.77	433.61	147.70	65.39	112.43	40.80
2005	279.02	478.84	165.79	73.15	122.93	44.94
2006	319.73	537.39	187.11	82.73	136.06	50.27
2007	367.07	603.35	211.77	90.19	145.07	54.08
2008	420.90	677.19	237.88	97.28	153.61	57.09
2009	485.75	769.33	269.21	113.27	176.48	64.99

Figure AH-2.2 shows trends in per capita real human capital in urban and rural areas. Per capita real human capital for urban and rural both

exhibit an accelerated growth after 1996. Based on the five education categories, the ratio of urban to rural increased from 2.47 in 1985 to 2.72 in 2009 and the absolute size of the urban-rural gap has been on the rise. From 1985 to 2009, the annual growth rate was 5.8% for the urban area, and 5.4% for the rural area.

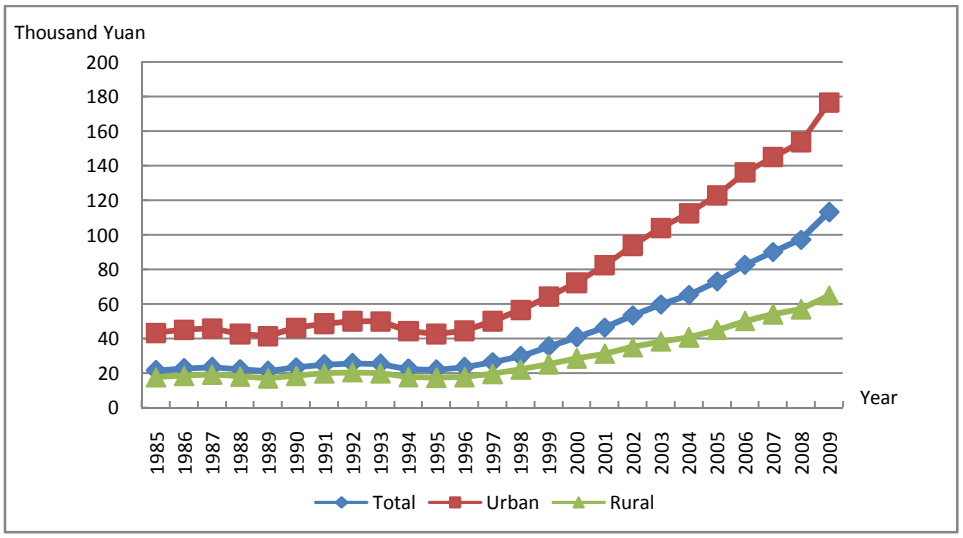


Figure AH-2.2 Per Capita Real Human Capital by Urban-Rural for Anhui

Figure AH-2.3 shows the per capita real human capital index for Anhui Province. As is seen from the graph below, per capita real human capital was essentially stable before 1996, but significant growth occurred after 1996.

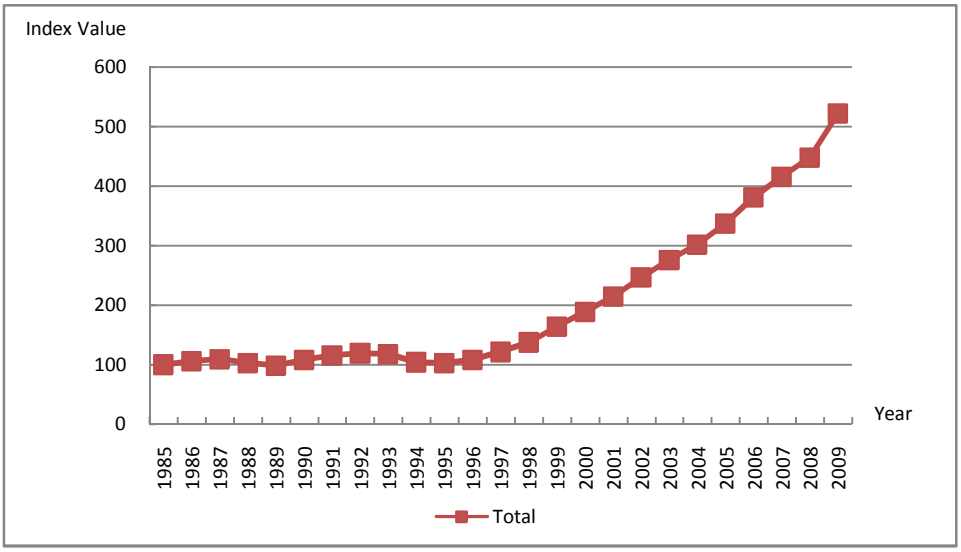


Figure AH-2.3 Per Capita Real Human Capital Index for Anhui

3. Labor force human capital

3.1 Total labor force human capital

Labor force human capital represents the human capital of the population that is over 15 years old, non-retired and out-of-school. Labor force human capital is estimated in the same way as human capital. The labor force human capital is reported in Table AH-3.1. The real values in this table are calculated by deflating the nominal values with the CPI.

Table AH-3.1 Labor Force Human Capital and Nominal GDP for Anhui

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of labor force human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	462		462		33	13.94
1986	543		511		38	14.19
1987	638		552		44	14.42
1988	753		544		55	13.76
1989	879		539		62	14.27
1990	1030		614		66	15.66
1991	1164		660		66	17.54
1992	1308		685		80	16.32
1993	1473		671		104	14.20
1994	1657		596		132	12.55
1995	1846		581		181	10.20
1996	2108		603		209	10.07
1997	2366		669		235	10.08
1998	2656		751		254	10.44
1999	3107		893		271	11.46
2000	3664	3606	1043	1027	290	12.63
2001	4004	3948	1131	1115	325	12.33
2002	4396	4348	1255	1241	352	12.49
2003	4847	4813	1358	1349	392	12.36
2004	5340	5321	1429	1424	476	11.22
2005	6038	6017	1590	1584	535	11.29
2006	6932	6910	1805	1799	611	11.34
2007	8160	8131	2019	2010	736	11.09
2008	9549	9514	2223	2214	885	10.79
2009	11360	11322	2664	2654	1006	11.29

Note: The ratio of labor force human capital to GDP is based on the current values for that year.

The trends in nominal and real labor force human capital are presented in Figure AH-3.1. Similar to the trend of human capital, from 1985 to 2009, labor force human capital both in nominal and real terms have kept increasing.

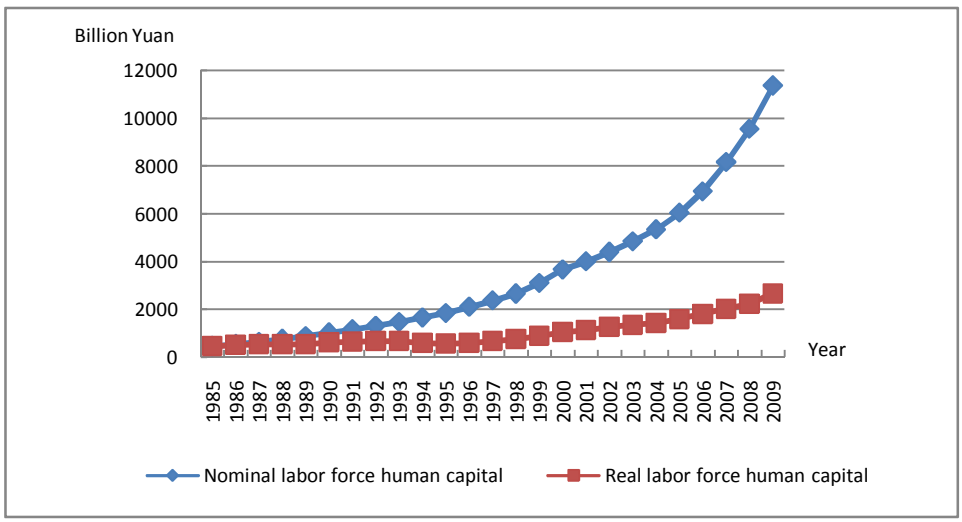


Figure AH-3.1 Nominal and Real Labor Force Human Capital for Anhui

We also calculate the ratio of labor force human capital to GDP. The results are reported in the last column of Table AH-3.1. As before, the ratio could reflect human capital's influence on sustainable growth of GDP, and may also reflect changes in human capital productivity and efficiency. Figure AH-3.2 shows the trend for the ratio. The pattern of the ratio for labor force human capital is almost the same as that for human capital. The level of nominal labor force human capital is much higher than that of nominal GDP. The ratio of labor force human capital to GDP increased

during 1985 to 1991, decreased dramatically from 1991 to 1996, and increased slowly after 1996.

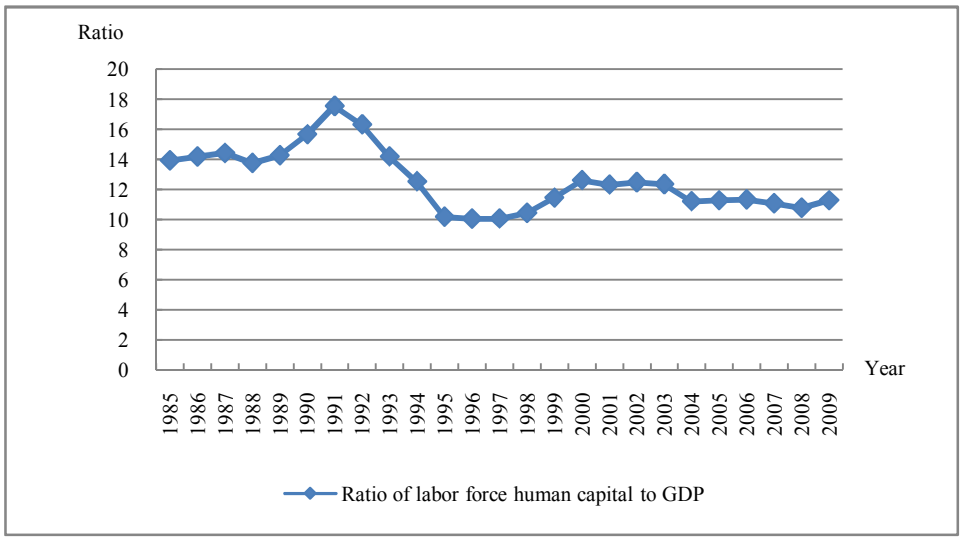


Figure AH-3.2 Ratio of Labor Force Human Capital to GDP for Anhui

Table AH-3.2 shows the nominal and real labor force human capital for urban and rural respectively. The pattern of real labor force human capital is almost the same as that of the real human capital. Urban real labor force human capital surpassed its rural counterpart for the first time in 2005. The urban-rural gap has increased from -0.217 trillion Yuan in 1985 to 0.343 trillion Yuan in 2009.

Table AH-3.2 Nominal and Real Labor Force Human Capital by Urban-Rural for Anhui

Year	Nominal labor force human capital (Billions of Yuan)			Real labor force human capital (Billions of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	462	122	339	462	122	339
1986	543	150	393	511	142	369
1987	638	184	454	552	159	393
1988	753	224	529	544	159	385
1989	879	270	610	539	165	374
1990	1030	324	706	614	194	421
1991	1164	360	804	660	200	461
1992	1308	400	908	685	204	481
1993	1473	451	1022	671	201	470
1994	1657	509	1148	596	178	418
1995	1846	563	1283	581	170	410
1996	2108	704	1404	603	193	409
1997	2366	792	1574	669	213	456
1998	2656	909	1747	751	244	507
1999	3107	1261	1846	893	347	546
2000	3664	1634	2030	1043	446	598
2001	4004	1824	2180	1131	498	634
2002	4396	2065	2331	1255	569	686
2003	4847	2346	2501	1358	635	724
2004	5340	2705	2635	1429	702	728
2005	6038	3259	2779	1590	837	753
2006	6932	3710	3222	1805	939	866
2007	8160	4399	3761	2019	1058	961
2008	9549	5267	4282	2223	1195	1028
2009	11360	6534	4826	2664	1499	1165

Figure AH-3.3 shows real labor force human capital for urban and rural respectively. The pattern of labor force human capital is almost the same as

that of real human capital. The urban labor force human capital surpassed the rural one in 2005 and has grown much faster ever since.

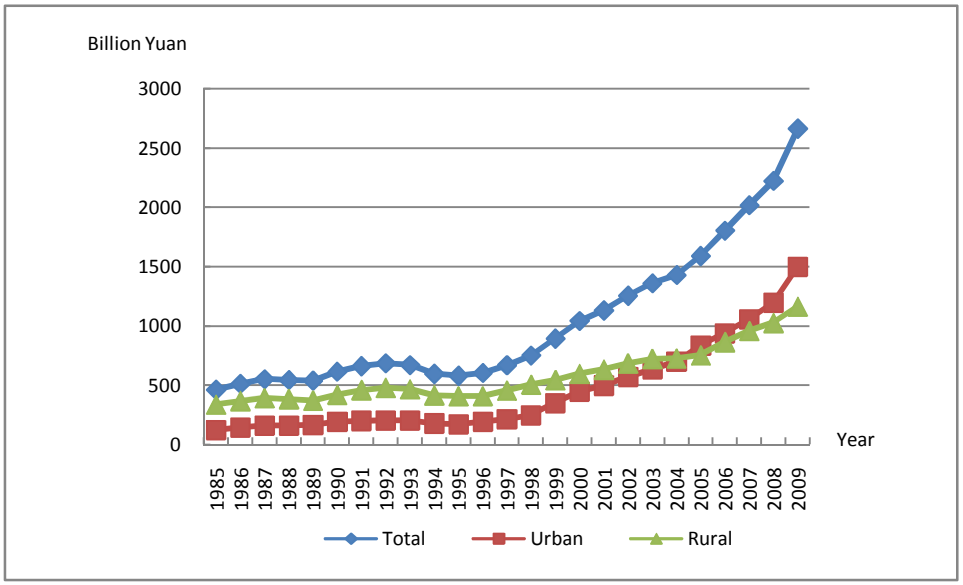


Figure AH-3.3 Real Labor Force Human Capital by Urban-Rural for Anhui

3.2 Average labor force human capital

Similar to the analysis of per capita human capital above, we calculate the labor force human capital per capita. Here the average labor force human capital means labor force human capital divided by the number of the population that are over 15 years old, non-retired and out of school.

Table AH-3.3 reports the real average labor force human capital by gender. Additionally, the table shows that the real average labor force human capital for female was smaller than that for male.

Table AH-3.3 Nominal and Real Average Labor Force Human Capital by Gender for Anhui

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	17.08	19.32	14.50	17.08	19.32	14.50
1986	19.40	22.06	16.36	18.24	20.76	15.38
1987	21.98	25.03	18.50	19.01	21.64	16.00
1988	24.98	28.66	20.79	18.04	20.69	15.02
1989	28.42	32.68	23.51	17.41	20.02	14.40
1990	32.05	36.96	26.35	19.11	22.04	15.71
1991	35.66	41.38	29.11	20.23	23.46	16.53
1992	39.43	46.04	31.96	20.67	24.12	16.77
1993	44.20	51.97	35.54	20.14	23.66	16.19
1994	49.12	58.12	39.14	17.66	20.89	14.09
1995	54.36	64.76	42.98	17.09	20.35	13.53
1996	61.67	73.77	48.35	17.63	21.09	13.84
1997	68.75	82.74	53.39	19.45	23.39	15.12
1998	77.01	93.09	59.30	21.77	26.29	16.78
1999	89.15	108.78	67.60	25.63	31.24	19.46
2000	102.64	126.28	76.36	29.23	35.92	21.78
2001	112.95	139.95	83.51	31.91	39.51	23.63
2002	124.92	155.71	91.81	35.66	44.41	26.25
2003	138.58	173.50	101.57	38.84	48.58	28.51
2004	154.36	194.70	112.50	41.31	52.05	30.16
2005	174.22	220.80	126.86	45.87	58.10	33.45
2006	197.61	251.31	142.25	51.45	65.37	37.09
2007	227.61	289.39	163.40	56.30	71.53	40.46
2008	262.32	333.95	187.87	61.07	77.68	43.76
2009	307.80	391.81	219.60	72.18	91.84	51.53

Table AH-3.4 reports the real average labor force human capital by area. The real average labor force human capital was much smaller in rural area than in urban area.

Table AH-3.4 Nominal and Real Average Labor Force Human Capital by Urban-Rural for Anhui

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	17.08	29.63	14.81	17.08	29.63	14.81
1986	19.40	33.37	16.69	18.24	31.54	15.67
1987	21.98	37.44	18.83	19.01	32.20	16.32
1988	24.98	42.74	21.27	18.04	30.28	15.48
1989	28.42	48.70	23.91	17.41	29.82	14.65
1990	32.05	55.47	26.84	19.11	33.10	16.00
1991	35.66	61.57	29.92	20.23	34.21	17.13
1992	39.43	68.19	33.30	20.67	34.82	17.66
1993	44.20	76.19	37.19	20.14	34.01	17.09
1994	49.12	84.37	41.32	17.66	29.56	15.03
1995	54.36	92.84	45.97	17.09	28.07	14.71
1996	61.67	103.78	51.28	17.63	28.50	14.96
1997	68.75	116.24	57.17	19.45	31.33	16.56
1998	77.01	130.08	63.56	21.77	34.95	18.43
1999	89.15	145.76	70.24	25.63	40.13	20.78
2000	102.64	168.48	78.08	29.23	45.97	22.98
2001	112.95	183.30	85.45	31.91	50.01	24.83
2002	124.92	200.67	93.47	35.66	55.25	27.52
2003	138.58	219.75	102.77	38.84	59.43	29.75
2004	154.36	241.68	112.19	41.31	62.67	30.99
2005	174.22	268.08	123.44	45.87	68.82	33.46
2006	197.61	294.89	143.34	51.45	74.66	38.51
2007	227.61	331.95	166.27	56.30	79.82	42.46
2008	262.32	376.16	190.90	61.07	85.32	45.82
2009	307.80	441.27	218.33	72.18	101.23	52.70

Chapter 12 Human capital for Shandong

1. Total human capital

Human capital stocks of Shandong are calculated using estimated income parameters and a 4.58% discount rate. The results are ported in Table SD-1.1. Column 1 and column 2 contain the nominal human capital; column 3 and column 4 contain the real human capital deflated by CPI (in 1985 Yuan).[64]

Table SD-1.1 Nominal and Real Human Capital, Nominal GDP for Shandong

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	2463		2463		68	36.19
1986	2772		2656		74	37.36
1987	3337		2958		89	37.40
1988	3668		2749		112	32.82
1989	4169		2653		129	32.22
1990	4964		3053		151	32.85
1991	5549		3250		181	30.65
1992	6303		3470		220	28.70
1993	7204		3525		277	26.00

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

1994	8181		3240		384	21.28
1995	9371		3159		495	18.92
1996	10371		3176		588	17.63
1997	11647		3462		654	17.82
1998	13112		3913		702	18.67
1999	14734		4414		749	19.66
2000	17001	17004	5061	5057	834	20.39
2001	18616	18625	5420	5421	920	20.25
2002	20984	21018	6134	6141	1028	20.42
2003	23581	23646	6803	6817	1208	19.52
2004	26609	26699	7398	7417	1502	17.71
2005	30947	31077	8456	8485	1837	16.85
2006	35110	35280	9484	9525	2190	16.03
2007	39910	40140	10316	10372	2578	15.48
2008	45440	45760	11152	11225	3093	14.69
2009	52440	52820	12848	12935	3390	15.47

Note: The ratio of human capital to GDP is based on the current values for that year.

Figure SD-1.1 shows real and nominal human capital for Shandong reported in Table SD-1.1 As is seen from the figure, both the nominal and real human capital rise steadily and nominal human capital grows faster than real human capital.

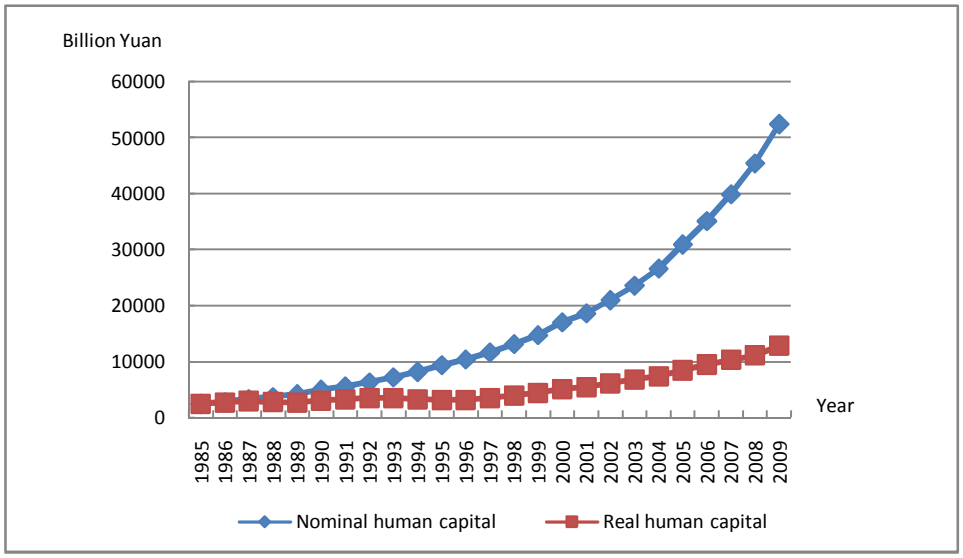


Figure SD-1.1 Nominal and Real Human Capital for Shandong

In order to get a sense of the magnitude of the human capital in Shandong, we also present the ratio of nominal human capital to nominal GDP in Table SD-1.1.[65] Similar to physical capital, human capital plays an important role in GDP growth, so the ratio could also reflect human capital's influence on sustainable growth of GDP. As is shown in Figure SD-1.2, nominal human capital is substantially higher than nominal GDP for Shandong. There was a decrease from 1990 to 1996. The ratio of human capital to GDP in Shandong from 1996 to 2001 increased slowly and after 2001, the ratio decreased slowly in a small scale.

[65] The reason for calculating the ratio at the nominal level is to avoid the differences between the real value of human capital and that of GDP caused by using different deflator indices.

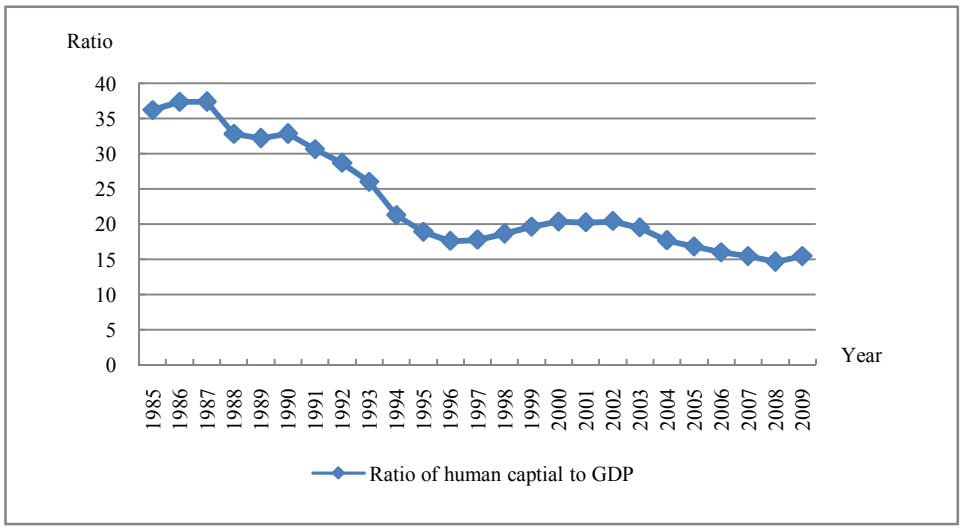


Figure SD-1.2 Ratio of Human Capital to GDP for Shandong

In order to discuss the trend of human capital, we calculate the real values here by CPI. Table SD-1.2 shows real human capital for Shandong by gender, and by urban or rural areas. The results based on five education categories show that the human capital for Shandong during 1985 to 2009 kept growing rapidly. More specifically, the human capital for Shandong increased from 2.46 trillion Yuan to 12.85 trillion Yuan (calculated by 1985 comparable price), which had increased by 4 times. The annual growth rate of human capital over this period increased to 6.88%.[66]

From 1985 to 2009, human capital for male in Shandong increased from 1.46trillion Yuan to 8.36 trillion Yuan, the human capital for female in Shandong increased from 0.99 trillion Yuan to 4.48 trillion Yuan. During the same period, the annual growth rates of human capital were 7.26% and 6.26 % for male and female respectively. The gender gap in the estimated

[66] 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.

human capital increased from 0.46 trillion Yuan in 1985 to 3.88 trillion Yuan in 2009. In 2009, the human capital for male was about 2 times the amount of that for female in Shandong.

From 1985 to 2009, rural human capital in Shandong increased from 1.66 trillion Yuan to 3.49 trillion Yuan, the urban human capital in Shandong increased from 0.83 trillion Yuan to 9.36 trillion Yuan. During the same period, the annual growth rates of human capital were 3.09% and 10.23 % for rural and urban areas respectively. The urban-rural gap in the estimated human capital increased from -0.86 trillion Yuan in 1985 to 5.87 trillion Yuan in 2009. In 2009, the human capital for urban areas was about 3 times the amount of that for rural areas in Shandong.

Table SD-1.2 Real Human Capital by Gender and Urban-Rural for Shandong[67]

Billions of 1985 Yuan

Year	Total	Male	Female	Urban	Rural
1985	2463	1464	999	803	1660
1986	2656	1580	1075	887	1769
1987	2958	1792	1167	1086	1872
1988	2749	1678	1071	989	1760
1989	2653	1626	1027	1009	1644
1990	3053	1884	1169	1219	1834
1991	3250	2022	1228	1374	1876
1992	3470	2163	1308	1489	1981
1993	3525	2208	1317	1533	1992
1994	3240	2042	1199	1434	1806
1995	3159	1998	1161	1425	1734

[67] Some discrepancy may exist when summing up male and female, or urban and rural to get the total amount. This is mainly caused by rounding errors.

1996	3176	2013	1163	1501	1675
1997	3462	2197	1266	1690	1772
1998	3913	2491	1422	1971	1942
1999	4414	2823	1592	2288	2126
2000	5061	3228	1832	2702	2359
2001	5420	3475	1947	3074	2346
2002	6134	3944	2190	3637	2497
2003	6803	4383	2420	4191	2612
2004	7398	4780	2618	4737	2661
2005	8456	5460	2995	5561	2895
2006	9484	6149	3335	6349	3135
2007	10316	6694	3623	7119	3197
2008	11152	7247	3905	7923	3229
2009	12848	8364	4484	9361	3487

Figure SD-1.3 shows that real human capital by five education categories keeps growing, and it grew even faster during 1996-2009. One reason why male real human capital is higher than female real human capital is the earlier retirement age for women (age 55 vs. age 60 for men based on China Labor Law). Accordingly, men have a longer time to generate income in the market. Another reason is higher educational attainment for men. Moreover, the male-female income gap has been on expanding. The results based on six education categories show the similar trends.

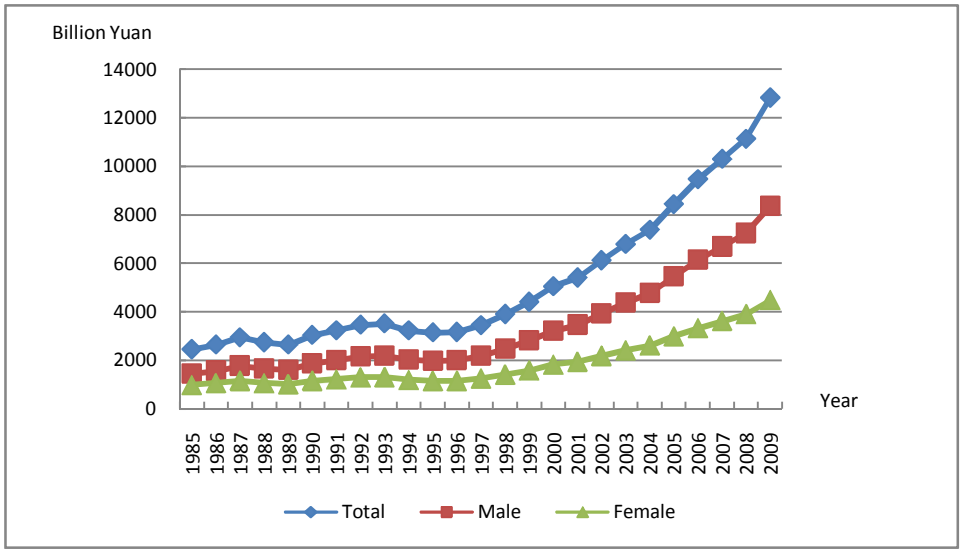


Figure SD-1.3 Real Human Capital by Gender for Shandong

Figure SD-1.4 shows the real human capital for urban and rural separately. As previously noted, before 1998, real human capital in rural areas was larger than that in urban areas. Since 1997, however, the real human capital in the urban area has been rising much more rapidly, while the real human capital in the rural area grew quite slowly. The urban human capital surpassed the rural human capital in 1998, and the urban-rural gap has the trend of expanding.

There are several reasons for such a trend. First, in the early years, the rural population was significantly larger than the urban population, and thus had larger amount of human capital. The change of increased urban population in the later years 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. Another reason is the enlarged education gap between the urban and rural population. Urban areas usually have a larger proportion of educated population than rural areas.

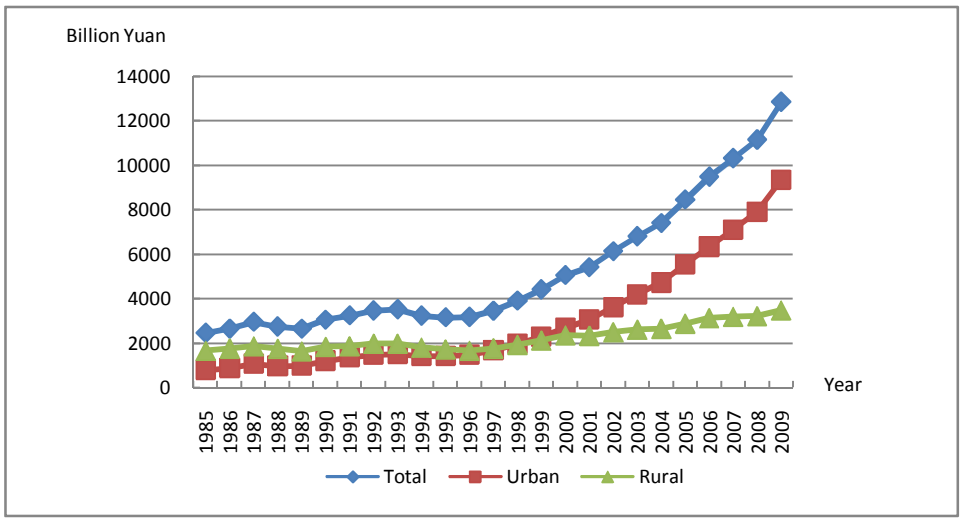


Figure SD-1.4 Real Human Capital by Urban-Rural for Shandong

Finally we calculate real human capital indices using 1985 as the baseline year. The results for each group are reported in Table SD-1.3.

Table SD-1.3 Real Human Capital Index for Shandong (1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	107.83	107.97	107.62	110.44	106.57
1987	120.10	122.42	116.83	135.26	112.77
1988	111.62	114.63	107.25	123.18	106.02
1989	107.72	111.11	102.78	125.67	99.04
1990	123.96	128.73	116.98	151.82	110.48
1991	131.96	138.15	122.93	171.13	113.01
1992	140.89	147.78	130.96	185.45	119.34
1993	143.12	150.86	131.89	190.93	120.00
1994	131.55	139.49	120.04	178.60	108.80
1995	128.26	136.55	116.19	177.48	104.46
1996	128.95	137.55	116.46	186.95	100.90
1997	140.57	150.12	126.72	210.49	106.75
1998	158.88	170.21	142.35	245.49	116.99

Year	Total	Male	Female	Urban	Rural
1999	179.22	192.89	159.35	284.97	128.07
2000	205.49	220.57	183.41	336.53	142.11
2001	220.07	237.44	194.88	382.86	141.33
2002	249.06	269.49	219.26	452.98	150.42
2003	276.22	299.49	242.25	521.98	157.35
2004	300.38	326.61	262.09	589.99	160.30
2005	343.34	373.08	299.83	692.61	174.40
2006	385.07	420.16	333.87	790.76	188.86
2007	418.86	457.40	362.70	886.66	192.59
2008	452.80	495.18	390.93	986.80	194.52
2009	521.66	571.51	448.89	1165.90	210.06

Figure SD-1.5 shows the index of real total human capital for Shandong. Before 1997 the index grows quite steadily; it accelerates after that year.

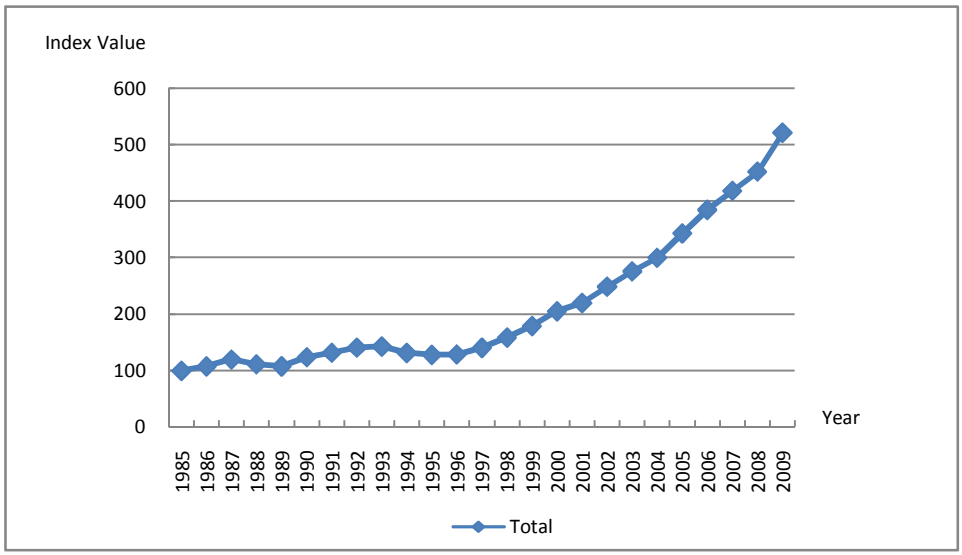


Figure SD-1.5 Real Human Capital Index for Shandong

2. Per capita human capital

An increase in real human capital can be caused by a number of factors, such as population growth, demographic changes (e.g., the size of retirement group), urban-rural 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, and higher rates of return to on-the-job training. In order to get further information on the dynamics of human capital, we calculate per capita real human capital, i.e., the ratio of real human capital to non-retired population.

Table SD-2.1 shows the per capita human capital by gender for Shandong. Based on the five education categories, per capita human capital real values for male increased from 42,120 Yuan to 204,661 Yuan, increased by around 4 times; per capita human capital real values for female increased from 31,587 Yuan to 120,616 Yuan, increased by around 3 times. From1985 to 2009, the annual growth rate was 6.59% for male, and 5.58% for female.

Table SD-2.1 Per Capita Nominal and Real Human Capital by Gender for Shandong

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	37.11	42.12	31.59	37.11	42.12	31.59
1986	41.51	47.11	35.33	39.77	45.13	33.85
1987	46.88	54.29	38.76	41.56	48.11	34.39
1988	52.51	61.01	43.08	39.35	45.67	32.34

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1989	58.92	68.64	48.12	37.50	43.65	30.65
1990	65.90	77.25	53.29	40.53	47.48	32.78
1991	74.60	86.01	61.19	43.69	50.35	35.87
1992	84.00	97.53	68.29	46.24	53.64	37.68
1993	95.35	111.40	76.77	46.66	54.43	37.65
1994	107.77	126.83	85.71	42.68	50.16	34.05
1995	121.94	145.95	94.95	41.11	49.14	32.08
1996	138.05	166.44	106.48	42.28	50.92	32.68
1997	153.86	185.52	118.63	45.73	55.11	35.32
1998	171.78	207.57	131.88	51.27	61.90	39.40
1999	192.18	233.33	146.35	57.57	69.88	43.88
2000	217.11	265.03	164.59	64.63	78.84	49.04
2001	247.71	303.70	186.37	72.12	88.39	54.32
2002	279.22	343.03	209.05	81.62	100.27	61.15
2003	314.46	387.44	234.49	90.72	111.76	67.65
2004	355.90	440.29	263.67	98.95	122.42	73.29
2005	400.51	495.23	297.09	109.44	135.36	81.10
2006	451.49	559.63	332.98	121.96	151.26	89.86
2007	512.26	636.32	376.65	132.41	164.58	97.30
2008	582.66	722.86	428.65	143.00	177.46	105.12
2009	671.93	834.82	492.50	164.63	204.66	120.62

Figure SD-2.1 shows the trend of per capita real human capital by gender. Per capita real human capital shows a similar trend for males and females. Per capita real human capital for male and female both exhibit an accelerated growth after 1996. The male-female gap has been widening.

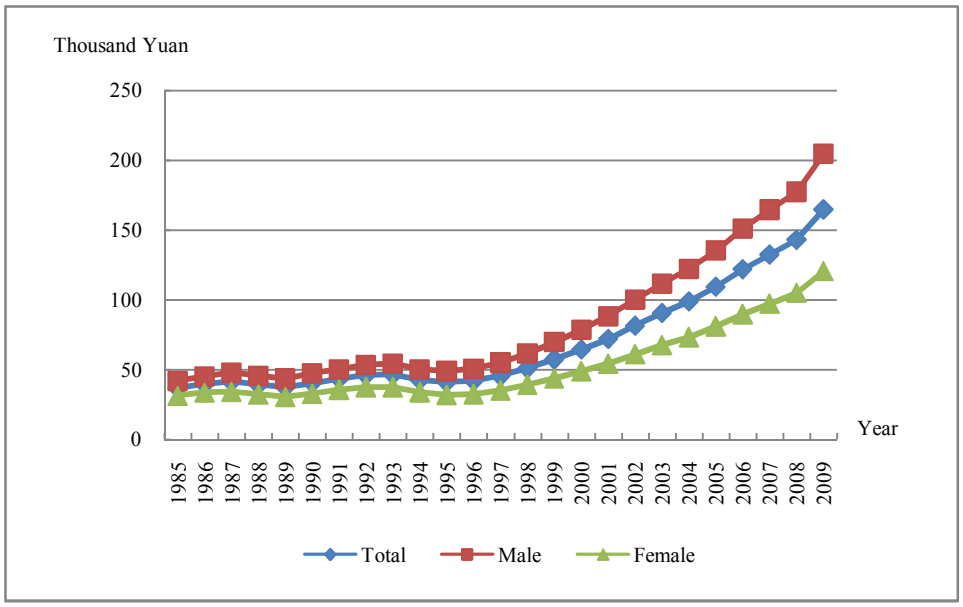


Figure SD-2.1 Per Capita Real Human Capital by Gender for Shandong

Table SD-2.2 reports the results of per capita human capital measured in nominal and real terms for Shandong by urban and rural areas separately. From 1985 to 2009, the per capita human capital in urban areas was significantly larger than that in rural areas. The per capita urban human capital increased from 56,318 Yuan to 217,385 Yuan and the per capita rural human capital increased from 31,826 Yuan to 99,858 Yuan. The per capita human capital in urban areas grew much faster than the one in rural areas.

Table SD-2.2 Per Capita Nominal and Real Human Capital by Urban-Rural for Shandong

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	37.11	56.32	31.83	37.11	56.32	31.83
1986	41.51	62.04	35.56	39.77	59.09	34.16
1987	46.88	68.11	39.55	41.56	59.46	35.37
1988	52.51	76.96	44.20	39.35	55.71	33.79
1989	58.92	85.95	49.17	37.50	53.77	31.62
1990	65.90	96.34	54.34	40.53	58.74	33.60
1991	74.60	109.94	59.95	43.69	63.12	35.64
1992	84.00	124.01	66.59	46.24	65.56	37.85
1993	95.35	140.66	74.79	46.66	64.89	38.40
1994	107.77	158.96	83.34	42.68	58.48	35.16
1995	121.94	181.09	93.51	41.11	57.04	33.46
1996	138.05	203.70	103.45	42.28	58.06	33.96
1997	153.86	228.42	112.92	45.73	63.09	36.20
1998	171.78	256.55	123.48	51.27	71.07	39.98
1999	192.18	288.50	134.86	57.57	79.93	44.29
2000	217.11	325.21	148.83	64.63	89.03	49.22
2001	247.71	367.77	163.99	72.12	99.58	52.96
2002	279.22	411.16	180.26	81.62	112.80	58.27
2003	314.46	458.44	197.98	90.72	124.90	63.06
2004	355.90	512.86	218.48	98.95	135.91	66.53
2005	400.51	575.63	241.54	109.44	150.89	71.82
2006	451.49	634.06	271.07	121.96	164.56	79.81
2007	512.26	709.97	302.43	132.41	177.52	84.56
2008	582.66	797.55	337.54	143.00	190.46	88.87
2009	671.93	909.76	379.59	164.63	217.39	99.86

Figure SD-2.2 shows trends in per capita real human capital in urban and rural areas. During the period of 1985-2009, per capita real human

capital for urban and rural both exhibit an accelerated growth after 1996. Based on five education categories, the ratio of urban to rural increased from 1.78 in 1985 to 2.18 in 2009, the absolute size of human capital has been on the rise. From 1985 to 2009, the annual growth rate was 5.63% for the urban area, and 4.76% for the rural area.

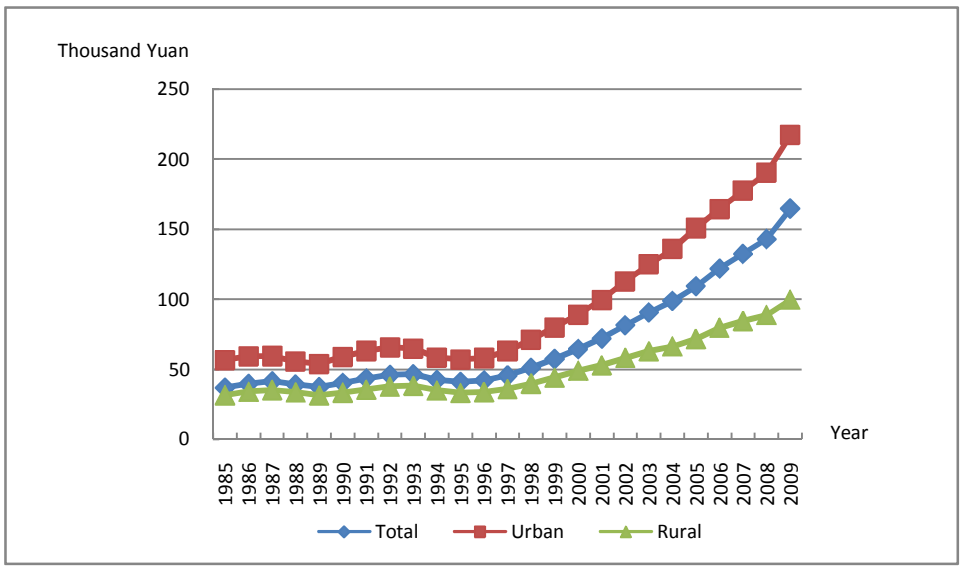


Figure SD-2.2 Per Capita Real Human Capital by Urban-Rural for Shandong

Figure SD-2.3 shows the per capita real human capital index for Shandong. As is seen from the graph below, per capita real human capital was essentially stable before 1996, but significant growth occurred after 1996.

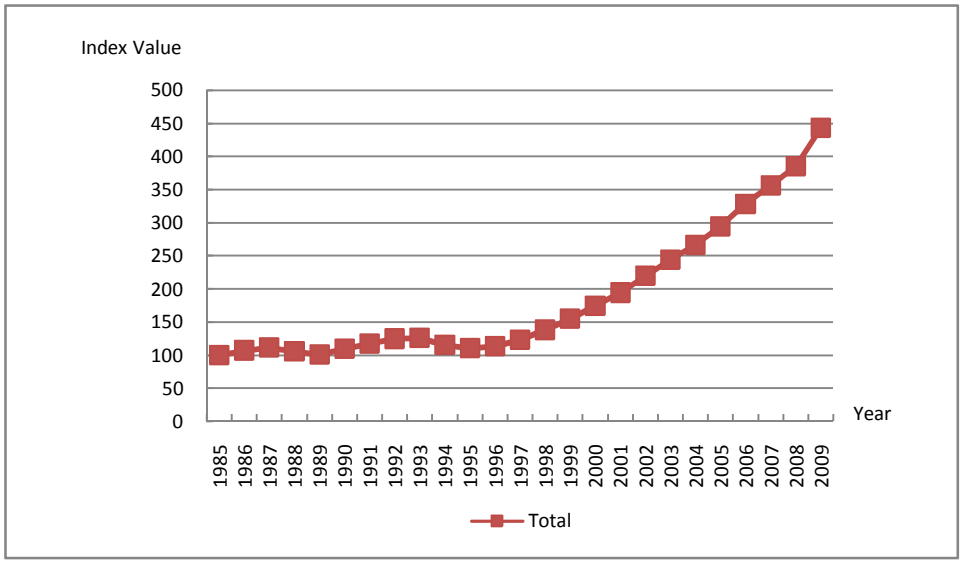


Figure SD-2.3 Per Capita Real Human Capital Index for Shandong

3. Labor force human capital

3.1 Total labor force human capital

Labor force human capital represents the human capital of the population that is over 15 years old, non-retired and out-of-school. Labor force human capital is estimated in the same way as human capital. The labor force human capital is reported in Table SD-3.1. The real values in this table are calculated by deflating the nominal values with the CPI.

Table SD-3.1 Labor Force Human Capital and Nominal GDP for Shandong

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of labor force human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	1067		1067		68	15.68
1986	1235		1183		74	16.64
1987	1553		1377		89	17.40
1988	1704		1277		112	15.24
1989	1975		1257		129	15.26
1990	2418		1487		151	16.00
1991	2510		1471		181	13.86
1992	2826		1558		220	12.87
1993	3195		1567		277	11.53
1994	3580		1422		384	9.31
1995	4121		1393		495	8.32
1996	4592		1412		588	7.80
1997	5286		1579		654	8.09
1998	6059		1818		702	8.63
1999	6828		2059		749	9.11
2000	8158	8038	2441	2405	834	9.78
2001	8436	8334	2476	2447	920	9.17
2002	9465	9381	2791	2767	1028	9.21
2003	10767	10711	3134	3117	1208	8.91
2004	12139	12127	3401	3396	1502	8.08
2005	14304	14285	3936	3929	1837	7.79
2006	16418	16415	4469	4464	2190	7.50
2007	18598	18598	4842	4838	2578	7.21
2008	21060	21074	5195	5196	3093	6.81
2009	24399	24421	6001	6003	3390	7.20

Note: The ratio of labor force human capital to GDP is based on the current values for that year.

The trends in nominal and real labor force human capital are presented in Figure SD-3.1. Similar to the trend of human capital, from 1985 to 2009, labor force human capital both in nominal and real terms have kept increasing.

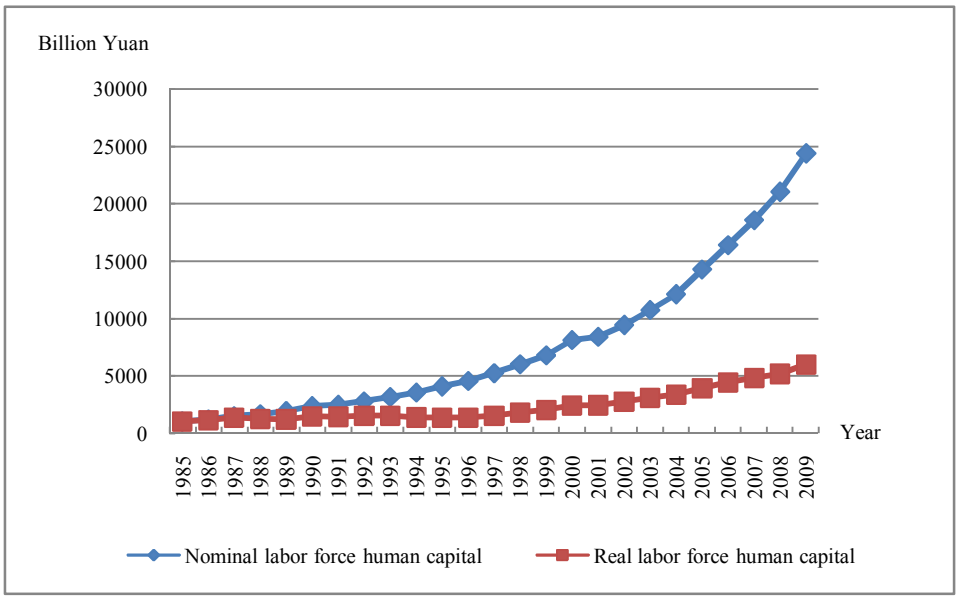


Figure SD-3.1 Nominal and Real Labor Force Human Capital for Shandong

We also calculate the ratio of labor force human capital to GDP. The results are reported in the last column of Table SD-3.1. As before, the ratio could reflect human capital's influence on sustainable growth of GDP, and may also reflect changes in human capital productivity and efficiency. Figure SD-3.2 shows the trend for the ratio. The pattern of the ratio for labor force human capital is almost the same as that for human capital. The level of nominal labor force human capital is much higher than that of nominal

GDP. The ratio remains between 6 and 18 and generally shows a decreasing trend.

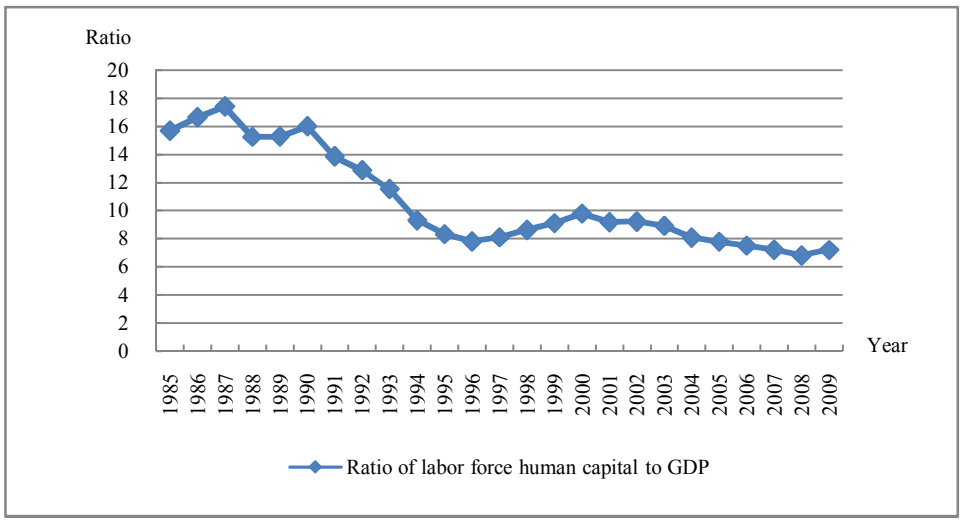


Figure SD-3.2 Ratio of Labor Force Human Capital to GDP for Shandong

Table SD-3.2 shows the nominal and real labor force human capital for urban and rural respectively. The pattern of real labor force human capital is almost the same as that of the real human capital. Urban real labor force human capital surpassed its rural counterpart for the first time in 2000. The urban-rural gap has increased from -0.479 trillion Yuan in 1985 to around 2.27 trillion Yuan in 2009.

Table SD-3.2 Nominal and Real Labor Force Human Capital by Urban-Rural for Shandong

Year	Nominal labor force human capital (Billions of Yuan)			Real labor force human capital (Billions of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	1067	294	773	1067	294	773
1986	1235	365	870	1183	348	836
1987	1553	550	1003	1377	480	897
1988	1704	611	1093	1277	442	836
1989	1975	751	1224	1257	470	787
1990	2418	963	1455	1487	587	900
1991	2510	1028	1482	1471	590	881
1992	2826	1214	1612	1558	642	916
1993	3195	1420	1775	1567	655	912
1994	3580	1642	1938	1422	604	818
1995	4121	1893	2228	1393	596	797
1996	4592	2200	2392	1412	627	785
1997	5286	2611	2675	1579	721	857
1998	6059	3086	2973	1818	855	963
1999	6828	3570	3258	2059	989	1070
2000	8158	4528	3630	2441	1240	1201
2001	8436	4756	3680	2476	1288	1188
2002	9465	5483	3982	2791	1504	1287
2003	10767	6403	4364	3134	1744	1390
2004	12139	7480	4659	3401	1982	1419
2005	14304	9014	5290	3936	2363	1573
2006	16418	10480	5938	4469	2721	1748
2007	18598	12180	6418	4842	3047	1795
2008	21060	14280	6780	5195	3410	1785
2009	24399	17310	7089	6001	4136	1865

Figure SD-3.3 shows real labor force human capital for urban and rural respectively. The pattern of labor force human capital is almost the same as

that of real human capital. The urban labor force human capital surpassed the rural one in 2000 and has grown much faster ever since.

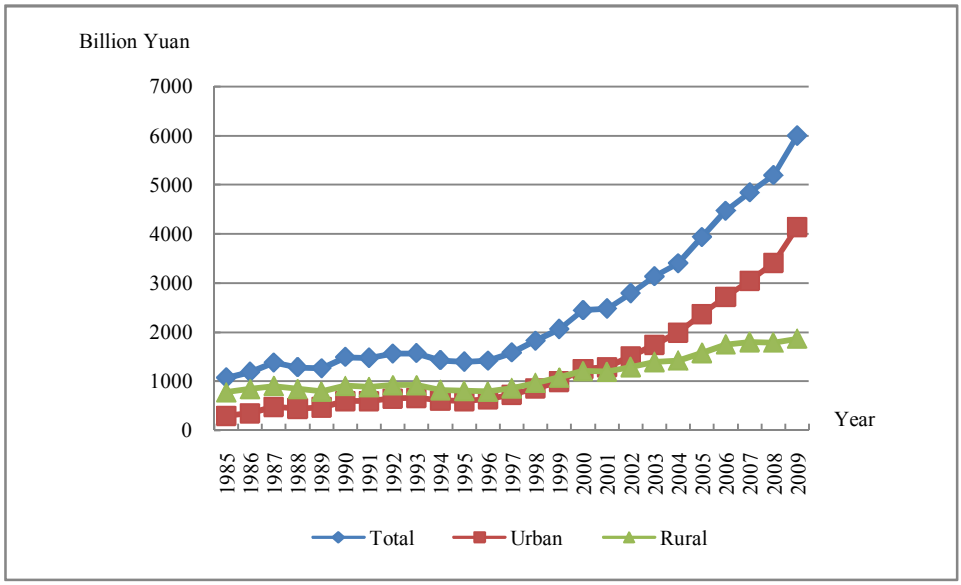


Figure SD-3.3 Real Labor Force Human Capital by Urban-Rural for Shandong

3.2 Average labor force human capital

Similar to the analysis of per capita human capital above, we calculate the labor force human capital per capita. Here the average labor force human capital means labor force human capital divided by the number of the population that are over 15 years old, non-retired and out of school.

Table SD-3.3 reports the real average labor force human capital by gender. Additionally, the table shows that the real average labor force human capital for female was smaller than that for male.

Table SD-3.3 Nominal and Real Average Labor Force Human Capital by Gender for Shandong

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	27.09	31.06	22.79	27.09	31.06	22.79
1986	30.59	35.33	25.47	29.31	33.85	24.41
1987	35.21	41.08	28.87	31.22	36.41	25.62
1988	39.41	46.11	32.11	29.55	34.53	24.14
1989	44.30	51.97	35.86	28.19	33.05	22.85
1990	49.71	58.76	39.79	30.57	36.12	24.48
1991	53.52	61.29	44.27	31.37	35.90	25.98
1992	60.18	69.68	49.00	33.17	38.36	27.08
1993	67.51	78.82	54.28	33.10	38.57	26.70
1994	75.22	88.58	59.78	29.87	35.10	23.83
1995	85.64	104.11	65.58	28.96	35.15	22.24
1996	95.96	117.57	72.60	29.51	36.10	22.38
1997	107.41	132.19	80.58	32.08	39.42	24.12
1998	119.73	148.13	89.05	35.92	44.39	26.76
1999	132.35	164.40	97.90	39.91	49.53	29.55
2000	151.07	188.11	110.89	45.20	56.21	33.22
2001	166.59	208.52	121.29	48.90	61.16	35.66
2002	184.86	232.26	133.62	54.51	68.45	39.46
2003	207.06	260.89	148.92	60.27	75.89	43.39
2004	231.22	293.05	164.74	64.78	82.07	46.19
2005	257.27	326.77	182.54	70.79	89.90	50.25
2006	291.62	371.81	204.78	79.38	101.16	55.75
2007	330.34	420.17	233.04	86.00	109.35	60.63
2008	375.40	476.12	264.57	92.60	117.48	65.24
2009	437.26	554.98	307.28	107.54	136.52	75.52

Table SD-3.4 reports the real average labor force human capital classified by urban-rural areas separately. The average labor force human capital was much smaller in rural area than in urban area. The labor force human capital per capita was much smaller in rural area than in urban area. The number for urban was about 1.9 times that for rural in 2009.

Table SD-3.4 Nominal and Real Average Labor Force Human Capital by Urban-Rural for Shandong

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	**Urban**	**Rural**	**Total**	**Urban**	**Rural**
1985	27.09	37.74	24.44	27.09	37.74	24.44
1986	30.59	42.59	27.35	29.31	40.56	26.27
1987	35.21	48.22	30.65	31.22	42.09	27.42
1988	39.41	54.38	34.17	29.55	39.36	26.12
1989	44.30	61.13	37.89	28.19	38.24	24.36
1990	49.71	69.08	41.93	30.57	42.12	25.92
1991	53.52	75.62	44.48	31.37	43.42	26.44
1992	60.18	84.51	49.41	33.17	44.68	28.08
1993	67.51	94.49	55.03	33.10	43.59	28.25
1994	75.22	104.67	60.77	29.87	38.51	25.64
1995	85.64	119.66	69.07	28.96	37.69	24.71
1996	95.96	133.68	76.01	29.51	38.11	24.95
1997	107.41	150.85	83.70	32.08	41.67	26.83
1998	119.73	169.53	91.82	35.92	46.97	29.73
1999	132.35	188.01	100.04	39.91	52.09	32.85
2000	151.07	217.71	109.45	45.20	59.60	36.20
2001	166.59	237.96	119.97	48.90	64.43	38.74

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	**Urban**	**Rural**	**Total**	**Urban**	**Rural**
2002	184.86	261.26	132.08	54.51	71.68	42.70
2003	207.06	288.71	146.39	60.27	78.66	46.63
2004	231.22	318.01	160.31	64.78	84.28	48.81
2005	257.27	352.62	176.71	70.79	92.43	52.55
2006	291.62	390.01	201.21	79.38	101.22	59.24
2007	330.34	436.41	226.11	86.00	109.12	63.22
2008	375.40	492.79	250.48	92.60	117.68	65.94
2009	437.26	573.94	277.15	107.54	137.14	72.91

Chapter 13 Human capital for Henan

1. Total human capital

Human capital stocks of Henan are calculated using estimated income parameters and a 4.58% discount rate. The results are ported in Table HeN-1.1. Column 1 and column 2 contain the nominal human capital; column 3 and column 4 contain the real human capital deflated by CPI (in 1985 Yuan).[68]

Table HeN-1.1 Nominal and Real Human Capital, Nominal GDP for Henan

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	1643		1643		45	36.36
1986	1876		1786		50	37.31
1987	2200		1975		61	36.08
1988	2484		1872		75	33.16
1989	2872		1806		85	33.76
1990	3383		2111		93	36.20
1991	3756		2306		105	35.92
1992	4270		2510		128	33.37
1993	4865		2588		166	29.30

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

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1994	5506		2347		222	24.84
1995	6364		2329		299	21.30
1996	7344		2417		363	20.21
1997	8521		2704		404	21.09
1998	9807		3185		431	22.76
1999	11318		3782		452	25.05
2000	13253	13021	4463	4378	505	26.23
2001	14925	14953	4974	4980	553	26.97
2002	16853	16880	5594	5601	604	27.92
2003	19359	19419	6314	6327	687	28.19
2004	22204	22276	6857	6875	855	25.96
2005	26200	26300	7912	7938	1059	24.75
2006	30720	30900	9127	9171	1236	24.85
2007	35580	35810	10003	10060	1501	23.70
2008	40920	41210	10722	10796	1802	22.71
2009	47770	48170	12575	12670	1948	24.52

Note: The ratio of labor force human capital to GDP is based on the current values for that year.

The trends of human capital measured in nominal and real terms are presented in Figure HeN-1.1. Both the nominal and real human capital exhibited rising trends.

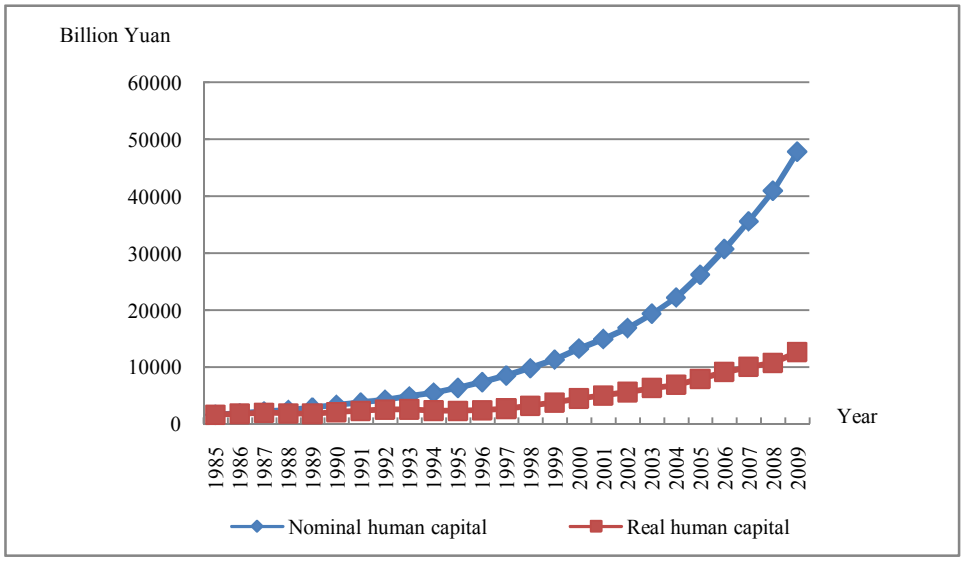


Figure HeN-1.1 Nominal and Real Human Capital for Henan

In order to get a sense of the magnitude of the human capital in Beijing, we also present the ratio of nominal human capital to nominal GDP in Table HeN-1.1.[69] Similar to physical capital, human capital plays an important role in GDP growth, so the ratio could also reflect human capital's influence on sustainable growth of GDP. As is shown in Figure HeN-1.2, nominal human capital is substantially higher than nominal GDP for Henan. The ratio of human capital to GDP in Henan from 1985 to 2009 decreased as a whole, it decreased at a considerable rate during 1990 and 1996. From 1996 to 2003, the ratio increased slowly in small scale, but decreased again after 1993.

[69] The reason for calculating the ratio at the nominal level is to avoid the differences between the real value of human capital and that of GDP caused by using different deflator indices.

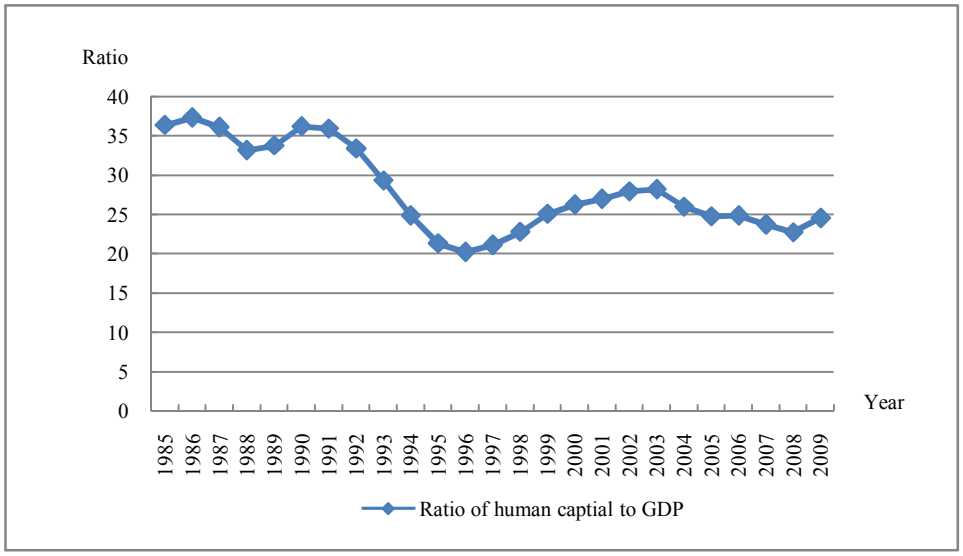


Figure HeN-1.2 Ratio of Human Capital to GDP for Henan

Real human capital calculated by five categories show different trends over time. We calculated the real values here using CPI. Table HeN-1.2 reports the human capital real values for Henan classified by gender and urban-rural. The results based on five education categories show that the human capital for Henan during 1985 to 2009 kept growing rapidly. More specifically, the human capital for Henan increased from 1.643 trillion Yuan to 12.575 trillion Yuan (calculated by 1985 comparable price), it had increased by 7 times, the annual growth rate of human capital over this period increased to 8.48%.[70]

From 1985 to 2009, male human capital in Henan increased from 0.987 trillion Yuan to 8.057 trillion Yuan, the human capital for female in Henan

[70] 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.

increased from 0.656 trillion Yuan to 4.517 trillion Yuan. During the same period, the annual growth rates of human capital were 8.75% and 8.04% for male and female respectively. The gender gap in the estimated human capital increased from 0.33 trillion Yuan in 1985 to 3.54 trillion Yuan in 2009. In 2009, the male human capital was about 1.78 times the amount of that for female in Henan.

From 1985 to 2009, rural human capital in Henan increased from 1.15 trillion Yuan to 4.353 trillionYuan; the urban human capital in Henan increased from 0.493 trillion Yuan to 8.222 trillion Yuan. During the same period, the annual growth rates of human capital were 5.55% and 11.73 % for rural and urban areas respectively. The urban-rural gap in the estimated human capital increased from -0.657 trillion Yuan in 1985 to 3.869 trillion Yuan in 2009. In 2009, the urban human capital was about 1.89 times the amount of that for rural in Henan.

Table HeN-1.2 Real Human Capital by Gender and Urban-Rural for Henan[71]

Billions of 1985 Yuan

Year	Total	Male	Female	Urban	Rural
1985	1643	987	656	493	1150
1986	1786	1079	708	530	1256
1987	1975	1200	775	580	1395
1988	1872	1142	731	547	1325
1989	1806	1107	699	561	1245

[71] Some discrepancy may exist when summing up male and female, or urban and rural to get the total amount. This is mainly caused by rounding errors.

Year	Total	Male	Female	Urban	Rural
1990	2111	1303	808	670	1441
1991	2306	1427	879	733	1573
1992	2510	1558	952	792	1718
1993	2588	1617	972	827	1761
1994	2347	1474	873	744	1603
1995	2329	1459	870	745	1584
1996	2417	1522	895	895	1522
1997	2704	1703	1001	1086	1618
1998	3185	2017	1168	1354	1831
1999	3782	2404	1378	1701	2081
2000	4463	2845	1617	2041	2422
2001	4974	3172	1801	2418	2556
2002	5594	3571	2024	2816	2778
2003	6314	4032	2280	3312	3002
2004	6857	4398	2459	3708	3149
2005	7912	5060	2852	4386	3526
2006	9127	5856	3270	5320	3807
2007	10003	6419	3586	6056	3947
2008	10722	6864	3858	6742	3980
2009	12575	8057	4517	8222	4353

Figure HeN-1.3 show that the human capital real values of male and female for Henan exhibited a rising trend from 1985 to 2009. Before 1996, different human capital all grew quite slowly, starting from 1996, both the growth of human capital of male and female accelerated, the gender gap, which had been fairly stable, then appeared to be expanding.

The situation that the human capital of male is higher than that of female is consistent with that at the national level. One reason is that older retirement age for male, male has longer time to generate income from

market, and thus end up with a higher lifetime income relative to female.[72] Also the income gap between male and female keeps expanding, which directly results in widening gap of the human capital between them.

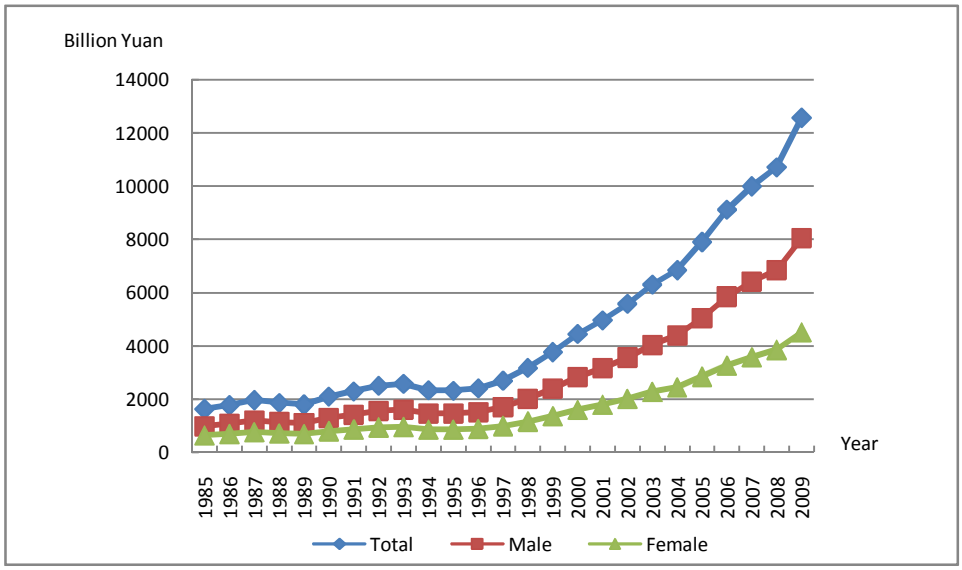


Figure HeN-1.3 Real Human Capital by Gender for Henan

Figure HeN-1.4 shows the human capital real values for urban and rural separately. Before 2002, the rural human capital was larger than that for urban. Starting from 2002, however, the urban human capital was rising much more rapidly while rural human capital kept growing quite slowly, which resulted in an increasingly larger gap between rural and urban. Thus we could see that human capital changes almost simultaneously with urban

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

human capital. Moreover, the gap showed a trend of further expansion as the human capital for urban increased much faster in later periods.

One reason that results in the gap between rural and urban is the rapid urbanization during the course of economic transition and a large scale migration of rural population to urban areas. Another one is the education gap between the rural and urban population.

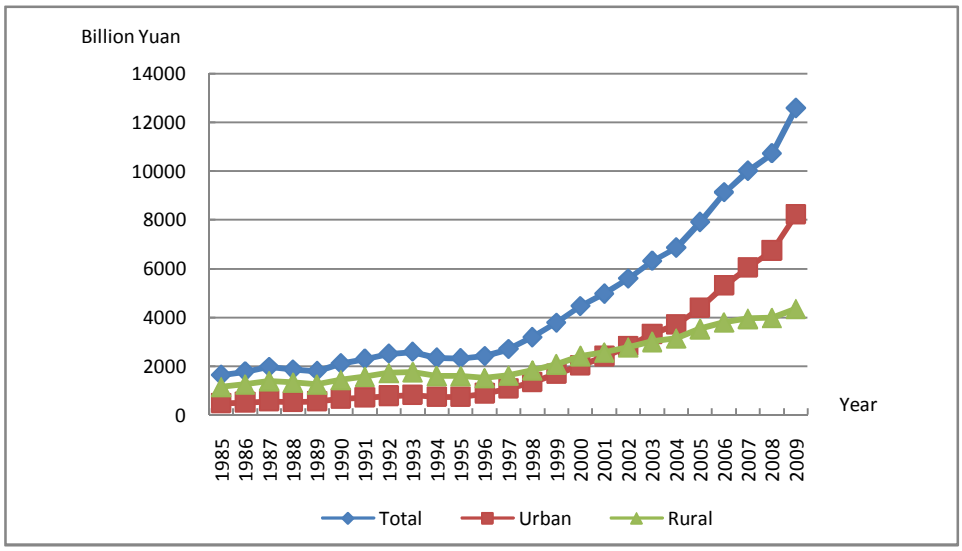


Figure HeN-1.4 Real Human Capital by Urban-Rural for Henan

Human capital indices reflect the trend of human capital directly. Table HeN-1.3 reports a set of indices of real human capital classified by gender and urban and rural for Henan from 1985 to 2009. We calculate them using 1985 as the base year and setting its value at 100.

Table HeN-1.3 Real Human Capital Index for Henan (1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	108.74	109.26	107.96	107.63	109.22
1987	120.22	121.54	118.20	117.70	121.30
1988	113.97	115.63	111.44	111.04	115.22
1989	109.97	112.12	106.64	113.95	108.26
1990	128.51	131.98	123.23	135.99	125.30
1991	140.36	144.55	134.04	148.70	136.78
1992	152.79	157.77	145.28	160.74	149.39
1993	157.58	163.75	148.27	167.97	153.13
1994	142.88	149.32	133.21	151.04	139.39
1995	141.76	147.75	132.66	151.16	137.74
1996	147.12	154.17	136.51	181.61	132.35
1997	164.62	172.49	152.77	220.46	140.70
1998	193.90	204.29	178.20	274.87	159.22
1999	230.24	243.49	210.28	345.31	180.96
2000	271.70	288.16	246.73	414.33	210.61
2001	302.81	321.28	274.81	490.86	222.26
2002	340.56	361.69	308.77	571.66	241.57
2003	384.39	408.39	347.83	672.35	261.04
2004	417.45	445.46	375.13	752.74	273.83
2005	481.68	512.51	435.09	890.38	306.61
2006	555.64	593.13	498.86	1079.98	331.04
2007	608.97	650.16	547.06	1229.40	343.22
2008	652.75	695.23	588.56	1368.66	346.09
2009	765.55	816.06	689.09	1669.10	378.52

Figure HeN-1.5 shows the index of real human capital. It's obvious that the human capital has been rising much more rapidly since 1997.

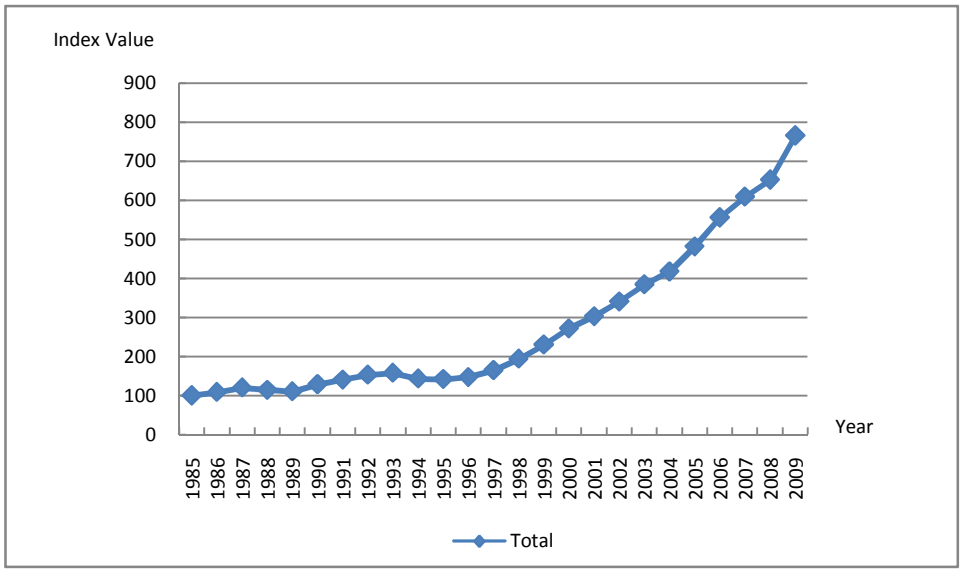


Figure HeN-1.5 Real Total Human Capital Index for Henan

2. Per capita human capital

The increase in the human capital can be caused by population growth, demographic change (like age at retirement), urbanization (like urban-rural migration), higher educational attainment, higher return to education, higher 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 human capital divided by non-retired population. Although the per capita human capital is influenced by the age distribution of the population, it could exclude the population factor influence to a large extent, thus it could serve as a better indicator of the average human capital.

Table HeN-2.1 presents the trends of per capita human capital measured in nominal and real terms for Henan classified by gender. Per capita human capital of male remained higher than that of female. Per capita human capital real values for male increased from 27,499 Yuan to 180,389 Yuan, increasing by around 6 times; per capita human capital real values for female increased from 19,898 Yuan to 112,560 Yuan, increasing by around 6 times. From 1985 to 2009, the annual growth rate was 7.84% for male, and 7.22% for female.

Table HeN-2.1 Per Capita Nominal and Real Human Capital by Gender for Henan

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	23.86	27.50	19.90	23.86	27.50	19.90
1986	26.84	31.06	22.23	25.55	29.56	21.18
1987	30.05	34.94	24.68	26.98	31.34	22.19
1988	34.10	39.72	27.90	25.70	29.89	21.08
1989	38.61	44.97	31.54	24.28	28.27	19.84
1990	43.47	50.74	35.30	27.12	31.66	22.03
1991	49.02	57.31	39.66	30.09	35.15	24.39
1992	55.22	64.68	44.52	32.46	37.96	26.24
1993	62.41	73.61	49.77	33.21	39.11	26.55
1994	70.27	83.43	55.42	29.95	35.52	23.69
1995	78.43	93.39	61.81	28.70	34.11	22.66
1996	91.42	107.54	72.82	30.08	35.34	24.02
1997	105.39	123.76	84.10	33.44	39.24	26.74
1998	120.61	142.63	95.17	39.17	46.27	30.97
1999	138.45	164.17	108.64	46.27	54.82	36.37
2000	158.78	191.90	121.70	53.47	64.54	41.06

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
2001	183.59	221.81	140.78	61.18	73.87	46.96
2002	207.06	249.91	158.91	68.73	82.94	52.80
2003	236.94	285.28	182.36	77.28	93.01	59.45
2004	271.80	326.98	208.85	83.94	101.01	64.45
2005	310.70	377.29	236.67	93.83	113.98	71.42
2006	363.83	442.74	275.93	108.10	131.58	81.90
2007	420.85	512.18	319.24	118.32	144.02	89.71
2008	483.42	587.44	367.47	126.67	154.01	96.26
2009	563.36	685.33	427.79	148.30	180.39	112.56

Figure HeN-2.1 shows that the per capita real human capital of male are higher than that of female for Henan from 1985 to 2009. Before 1997, different human capital all grew quite slowly, starting from 1997, both the growth of human capital of male and female accelerated, the gender gap was fairly stable and appeared to be expanding.

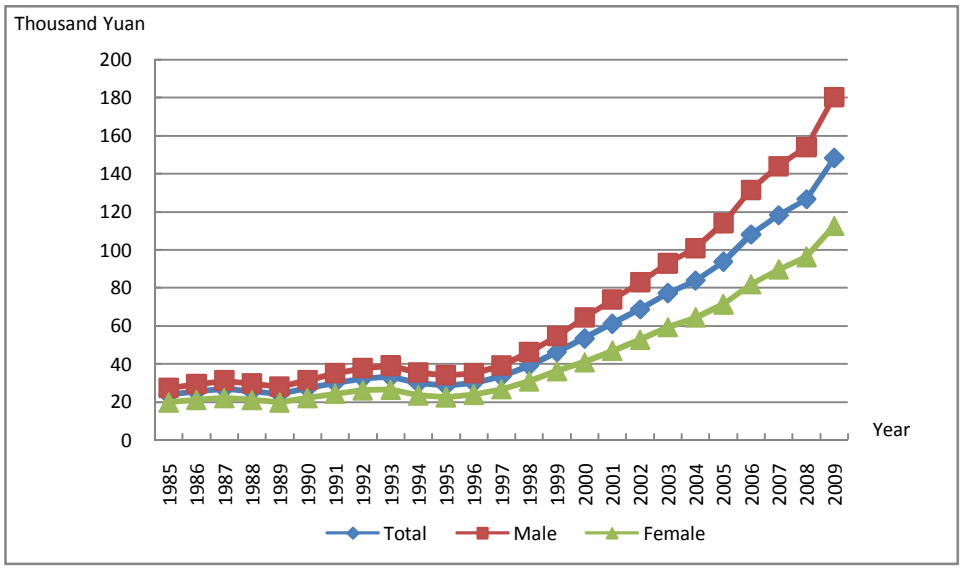


Figure HeN-2.1 Per Capita Real Human Capital by Gender for Henan

Table HeN-2.2 reports the results of per capita human capital measured in nominal and real terms for Henan classified by urban and rural separately. From 1986 to 2009, the per capita human capital in urban areas was significantly larger than that for rural. The per capita human capital of real values for urban increased from 47,848 Yuan to 254,426 Yuan; the per capita human capital of real values for rural increased from 19,641 Yuan to 83,026 Yuan. The per capita human capital in urban areas grew much faster than the one for rural.

Table HeN-2.2 Per Capita Nominal and Real Human Capital by Urban-Rural for Henan

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	**Urban**	**Rural**	**Total**	**Urban**	**Rural**
1985	23.86	47.85	19.64	23.86	47.85	19.64
1986	26.84	53.77	22.05	25.55	50.35	21.14
1987	30.05	60.38	24.65	26.98	52.44	22.44
1988	34.10	68.65	27.87	25.70	49.08	21.48
1989	38.61	78.10	31.32	24.28	48.59	19.79
1990	43.47	88.39	35.04	27.12	54.72	21.94
1991	49.02	100.91	39.09	30.09	59.44	24.48
1992	55.22	114.45	43.63	32.46	62.59	26.56
1993	62.41	129.49	49.08	33.21	64.04	27.08
1994	70.27	145.36	55.01	29.95	56.42	24.58
1995	78.43	162.93	61.21	28.70	54.10	23.51
1996	91.42	198.16	67.14	30.08	60.09	23.26
1997	105.39	227.65	74.97	33.44	67.41	25.00
1998	120.61	258.69	83.36	39.17	78.25	28.62

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1999	138.45	293.58	92.99	46.27	91.93	32.88
2000	158.78	334.64	105.95	53.47	105.74	37.77
2001	183.59	373.63	119.07	61.18	117.23	42.15
2002	207.06	408.95	132.55	68.73	128.57	46.65
2003	236.94	462.77	147.78	77.28	143.06	51.29
2004	271.80	520.38	166.59	83.94	152.63	54.85
2005	310.70	591.27	186.90	93.83	169.86	60.28
2006	363.83	680.87	210.62	108.10	193.28	66.92
2007	420.85	770.03	236.70	118.32	207.36	71.35
2008	483.42	866.85	264.57	126.67	219.18	73.92
2009	563.36	994.40	298.36	148.30	254.43	83.03

Figure HeN-2.2 reflects the trend of per capita human capital measured in real terms and classified by urban and rural. As is shown in the graph, the size of the difference between urban and rural expanded rapidly after 1997, this is partly due to the long-tem stagnant status in the rural area before 2002. Based on five education categories, the ratio of urban to rural increased from 2.44 in 1985 to 3.06 in 2009, which indicates a rising size of urban-rural gap on per capita human capital. From 1985 to 2009, the annual growth rate was 6.96% for the urban area, and 6.01% for the rural area.

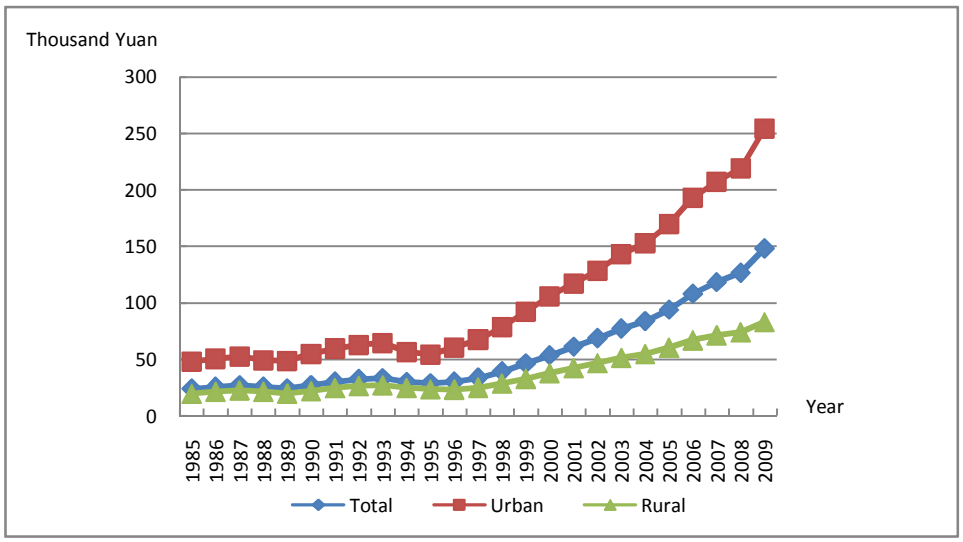


Figure HeN-2.2 Per Capita Real Human Capital by Urban-Rural for Henan

Similarly, we construct a set of per capita real human capital indices with its corresponding value in 1985 set as 100.

Figure HeN-2.3 shows the per capita human capital index for Henan. It's obvious that the per capita human capital has been rising much more rapidly since 1997.

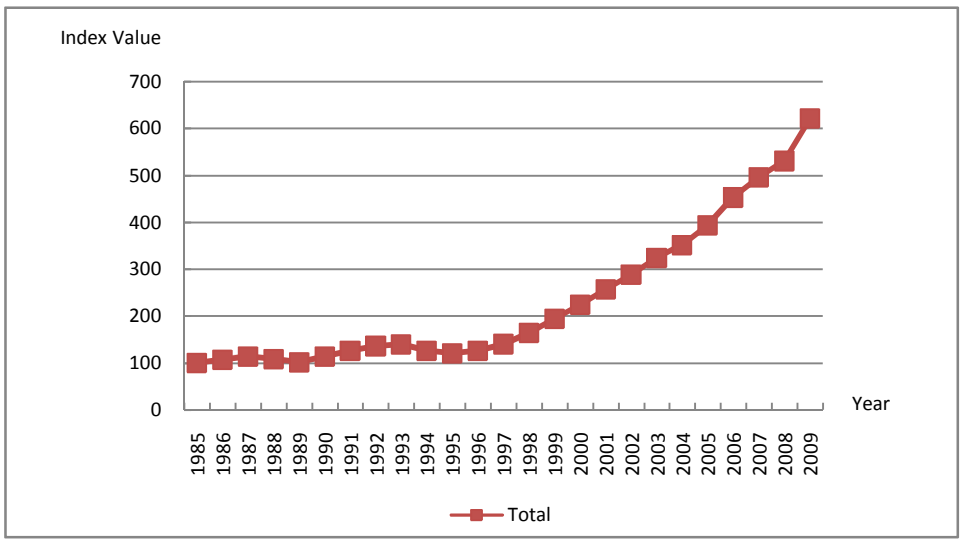


Figure HeN-2.3 Per Capita Real Human Capital Index for Henan

3. Labor force human capital

3.1 Total labor force human capital

The labor force human capital represents the human capital of population that are over 15 years old, non-retired and out of school. The estimated approach of labor force human capital is the same as that of human capital we illustrated above. Based on the income parameter for Henan and the discount rate valued at 4.58%，the labor force human capital for Henan is reported in Table HeN-3.1. The real values in this table are calculated by using CPI as the deflator with respect to nominal values. We also calculated the ratio of labor force human capital measured in nominal terms to nominal GDP. The results are reported in the last column of Table HeN-3.1.

Table HeN-3.1 Labor Force Human Capital and Nominal GDP for Henan

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of labor force human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	721		721		45	15.97
1986	840		801		50	16.70
1987	1007		906		61	16.52
1988	1125		851		75	15.02
1989	1331		838		85	15.65
1990	1629		1017		93	17.42

1991	1764		1087		105	16.87
1992	1984		1173		128	15.50
1993	2234		1196		166	13.45
1994	2496		1074		222	11.26
1995	2891		1070		299	9.68
1996	3027		1014		363	8.33
1997	3415		1103		404	8.45
1998	3896		1290		431	9.04
1999	4396		1499		452	9.73
2000	5065	4896	1739	1679	505	10.02
2001	5556	5497	1885	1865	553	10.04
2002	6304	6247	2126	2107	604	10.44
2003	7450	7402	2467	2451	687	10.85
2004	8500	8479	2664	2657	855	9.94
2005	10607	10569	3246	3233	1059	10.02
2006	12127	12097	3661	3649	1236	9.81
2007	13861	13822	3963	3950	1501	9.23
2008	15643	15609	4166	4155	1802	8.68
2009	18038	17999	4809	4797	1948	9.26

Note: The ratio of human capital to GDP is based on the current values for that year.

The trends of labor force human capital in both real and nominal terms for Henan are presented in Figure HeN-3.1. From 1985 to 2009, labor force human capital kept rising.

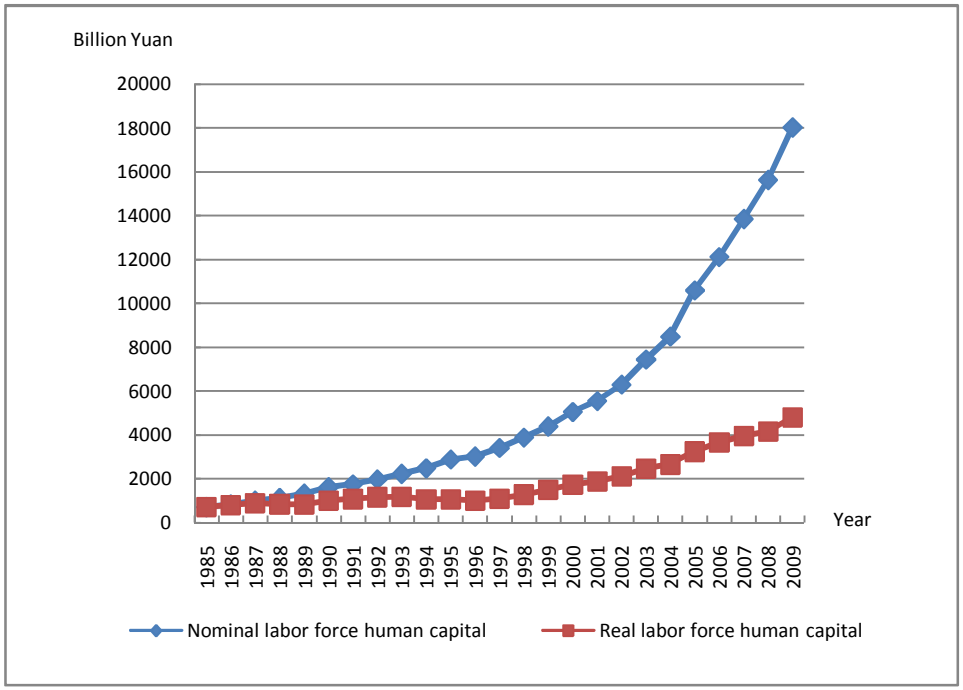


Figure HeN-3.1 Nominal and Real Labor Force Human Capital for Henan

Similar to the analysis of human capital, in order to get a sense of the magnitude of the labor force human capital, we construct the ratio of labor force human capital measured in nominal terms to nominal GDP. It's shown in Figure HeN-3.2. The pattern of the ratio for labor force human capital is almost the same as that for human capital. The level of annual labor force human capital is much higher than that of GDP. The ratio of human capital to GDP in Henan decreased at a considerable rate from 1990 to 1996. From 1996 to 2003, the ratio increased slightly, but it decreased overall again from 2003 to 2009.

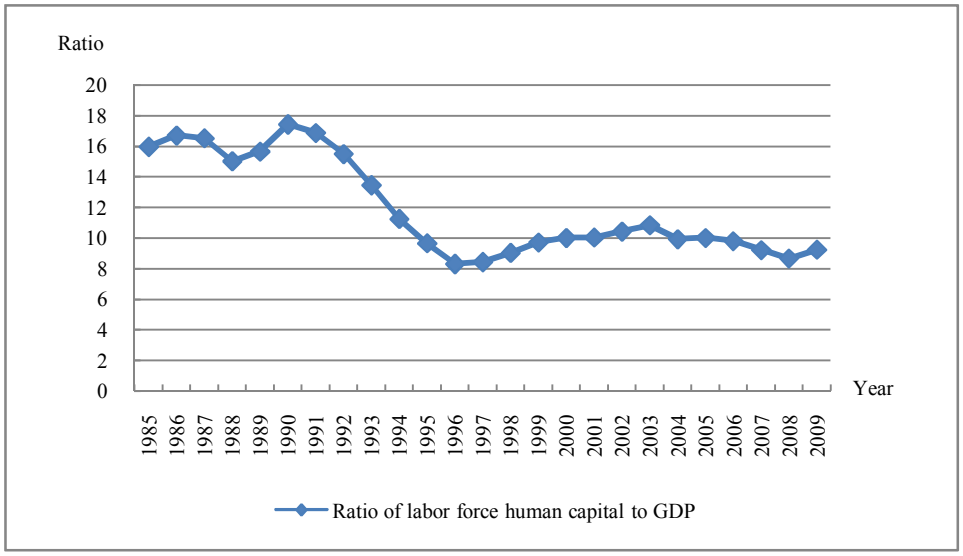


Figure HeN-3.2 Ratio of Labor Force Human Capital to GDP for Henan

Table HeN-3.2 shows the labor force human capital real values for urban and rural separately. The pattern of the labor force human capital is almost the same as that for human capital. The urban human capital remained larger than that for rural from 1985 to 2009.

Table HeN-3.2 Nominal and Real Labor Force Human Capital by Urban-Rural for Henan

Year	Nominal labor force human capital (Billions of Yuan)			Real labor force human capital (Billions of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	721	178	543	721	178	543
1986	840	209	631	801	196	605
1987	1007	251	756	906	218	688
1988	1125	294	831	851	210	641
1989	1331	361	971	838	224	614
1990	1629	449	1180	1017	278	739

Year	Nominal labor force human capital (Billions of Yuan)			Real labor force human capital (Billions of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1991	1764	487	1277	1087	287	800
1992	1984	553	1431	1173	302	871
1993	2234	627	1607	1196	310	887
1994	2496	701	1795	1074	272	802
1995	2891	790	2101	1070	263	807
1996	3027	814	2213	1014	247	767
1997	3415	952	2463	1103	282	821
1998	3896	1155	2741	1290	349	941
1999	4396	1394	3002	1499	437	1062
2000	5065	1664	3401	1739	526	1213
2001	5556	2034	3522	1885	638	1247
2002	6304	2468	3836	2126	776	1350
2003	7450	3134	4316	2467	969	1498
2004	8500	3756	4744	2664	1102	1562
2005	10607	4948	5659	3246	1421	1825
2006	12127	5698	6429	3661	1618	2043
2007	13861	6691	7170	3963	1802	2161
2008	15643	7705	7938	4166	1948	2218
2009	18038	9366	8672	4809	2396	2413

Figure HeN-3.3 shows the labor force human capital real values for urban and rural separately. The pattern of the labor force human capital is almost the same as that for human capital. The rural labor force human capital is larger than the one for urban during 1985 and 2009, but the gap is shrinking because the labor force urban human capital grows rapidly than the one for rural, especially after year 1997.

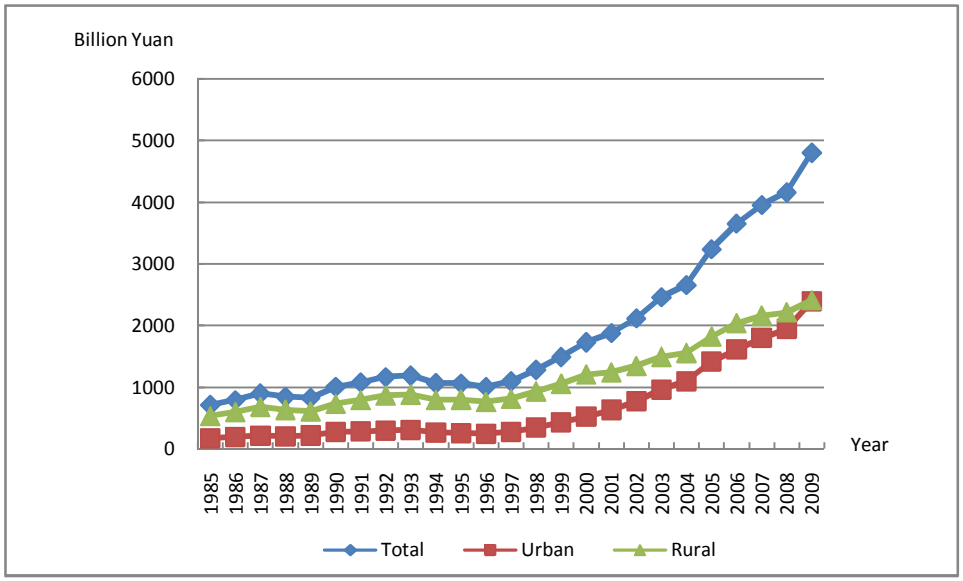


Figure HeN-3.3 Real Labor Force Human Capital by Urban-Rural for Henan

3.2 Average labor force human capital

Similar to the analysis of per capita human capital above, we calculate the average labor force human capital. Here the average labor force human capital means labor force human capital divided by the number of the population that are over 15 years old, non-retired and out of school.

Table HeN-3.3 reports the real average labor force human capital classified by gender. And the average labor force human capital for female was smaller than that for male. More specifically, the number for male was about 1.74 times that for female in 2009.

Table HeN-3.3 Nominal and Real Average Labor Force Human Capital by Gender for Henan

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	18.19	20.99	15.18	18.19	20.99	15.18
1986	20.50	23.84	16.93	19.54	22.71	16.14
1987	23.09	26.92	18.98	20.78	24.21	17.10
1988	26.27	30.77	21.38	19.87	23.25	16.20
1989	29.86	34.99	24.19	18.80	22.02	15.23
1990	33.73	39.56	27.19	21.06	24.70	16.98
1991	37.53	44.21	30.08	23.12	27.21	18.56
1992	41.79	49.36	33.37	24.72	29.15	19.79
1993	46.67	55.53	36.87	24.99	29.72	19.80
1994	51.71	61.97	40.50	22.26	26.64	17.47
1995	57.07	68.71	44.42	21.11	25.39	16.47
1996	61.54	72.57	48.91	20.61	24.27	16.41
1997	68.97	81.44	54.68	22.28	26.29	17.69
1998	77.49	91.97	60.98	25.67	30.44	20.22
1999	86.67	103.20	67.89	29.54	35.14	23.16
2000	99.06	121.40	75.12	34.00	41.63	25.81
2001	111.96	137.86	84.36	37.99	46.74	28.66
2002	126.53	156.68	94.52	42.67	52.80	31.91
2003	145.34	180.57	107.85	48.12	59.76	35.74
2004	164.46	204.89	121.40	51.54	64.16	38.09
2005	189.76	237.06	139.27	58.07	72.50	42.67
2006	216.31	271.74	156.96	65.30	82.00	47.42
2007	247.25	310.41	178.85	70.69	88.69	51.18
2008	279.21	350.51	201.51	74.36	93.28	53.70
2009	323.43	405.71	233.04	86.23	108.17	62.17

Table HeN-3.4 reports the real average labor force human capital classified by urban-rural separately. The average labor force human capital was much smaller in rural area than in urban area. The number for urban was about 1.99 times that for rural.

Table HeN-3.4 Nominal and Real Average Labor Force Human Capital by Urban-Rural for Henan

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	18.19	31.51	15.98	18.19	31.51	15.98
1986	20.50	35.46	17.98	19.54	33.20	17.23
1987	23.09	39.73	20.26	20.78	34.51	18.44
1988	26.27	45.64	22.84	19.87	32.63	17.61
1989	29.86	52.41	25.71	18.80	32.61	16.25
1990	33.73	59.95	28.87	21.06	37.12	18.08
1991	37.53	66.68	32.19	23.12	39.28	20.16
1992	41.79	74.03	35.76	24.72	40.49	21.77
1993	46.67	82.83	39.85	24.99	40.96	21.99
1994	51.71	91.41	44.15	22.26	35.48	19.73
1995	57.07	100.55	49.10	21.11	33.39	18.87
1996	61.54	108.80	53.08	20.61	32.99	18.39
1997	68.97	121.84	59.08	22.28	36.08	19.70
1998	77.49	136.23	65.63	25.67	41.21	22.54
1999	86.67	151.13	72.27	29.54	47.32	25.56
2000	99.06	174.56	81.84	34.00	55.16	29.17
2001	111.96	195.16	89.96	37.99	61.23	31.85
2002	126.53	218.02	99.45	42.67	68.54	35.00
2003	145.34	249.48	111.61	48.12	77.12	38.73
2004	164.46	276.47	124.49	51.54	81.09	40.99
2005	189.76	315.23	140.79	58.07	90.56	45.41
2006	216.31	350.37	161.64	65.30	99.46	51.36
2007	247.25	392.15	183.91	70.69	105.60	55.44
2008	279.21	434.66	207.48	74.36	109.90	57.97
2009	323.43	504.35	233.45	86.23	129.04	64.96

Chapter 14 Human capital for Hubei

1. Total human capital

Human capital stocks of Hubei are calculated using estimated income parameters and a 4.58% discount rate. The results are ported in Table HB-1.1. Column 1 and column 2 contain the nominal human capital; column 3 and column 4 contain the real human capital deflated by CPI (in 1985 Yuan).[73]

Table HB-1.1 Nominal and Real Human Capital, Nominal GDP for Hubei

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	1221		1221		40	30.82
1986	1397		1326		44	31.59
1987	1610		1421		52	31.09
1988	1901		1411		63	30.34
1989	2172		1388		72	30.29
1990	2493		1531		82	30.24
1991	2827		1654		91	30.95
1992	3193		1708		109	29.34
1993	3666		1657		133	27.65
1994	4166		1498		170	24.49
1995	4744		1421		211	22.49

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

1996	5547		1517		250	22.19
1997	6355		1684		286	22.25
1998	7391		1987		311	23.73
1999	8505		2338		323	26.34
2000	9889	9926	2732	2741	355	27.89
2001	11016	11064	3036	3048	388	28.39
2002	12164	12218	3359	3373	421	28.87
2003	13470	13535	3639	3655	476	28.31
2004	14801	14884	3810	3829	563	26.27
2005	16637	16725	4161	4181	659	25.25
2006	18852	18958	4640	4665	762	24.75
2007	21583	21734	5066	5099	933	23.12
2008	24834	25028	5492	5534	1133	21.92
2009	28593	28837	6352	6404	1296	22.06

Note: The ratio of human capital to GDP is based on the current values for that year.

Figure HB-1.1 graphs real and nominal human capital for Hubei in Table HB-1.1 As shown, both the nominal and real human capital rise steadily, but the nominal human capital grows faster than the real one.

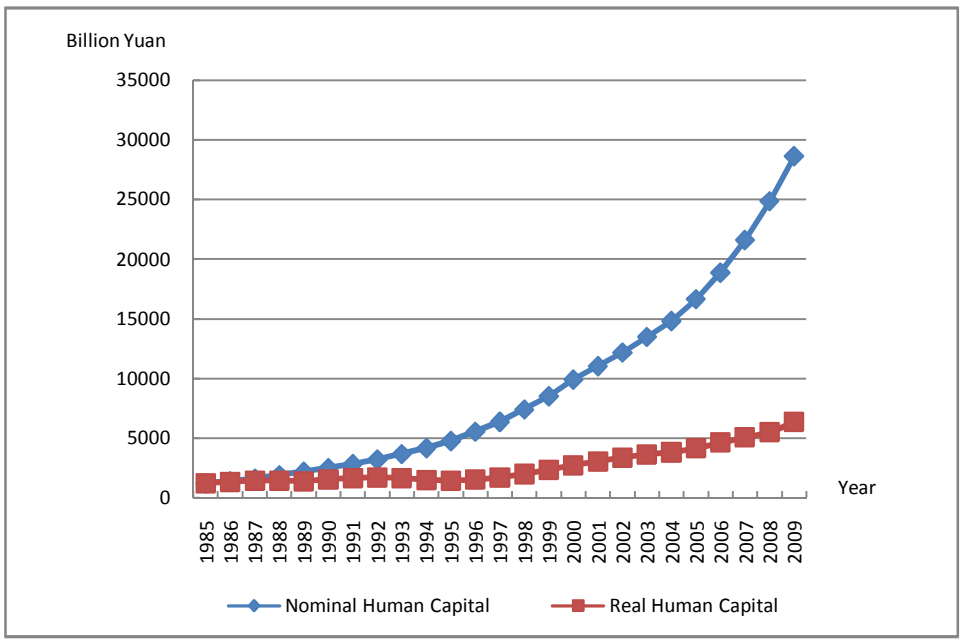


Figure HB-1.1 Nominal and Real Human Capital for Hubei

Table HB-1.1 presents the ratio of nominal human capital to nominal GDP.[74] The ratio reflects human capital's influence on sustainable growth of GDP. As shown in Figure HB-1.2, nominal human capital is substantially higher than nominal GDP for Hubei. From1985 to 1991, the ratio approximately remained the same, and then kept dropping steadily between 1991 and 1996. After 1996, it increased gradually and then decreased from 2002 to 2009.

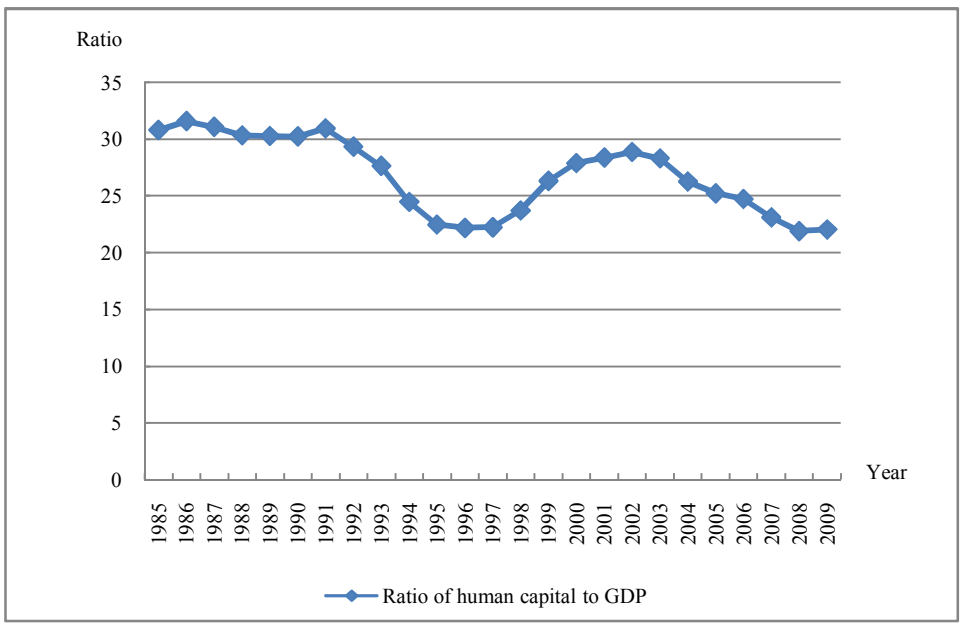


Figure HB-1.2 Ratio of Human Capital to GDP for Hubei

Table HB-1.2 shows real human capital for Hubei by gender and area. The results based on five education categories show that the human capital

[74] The reason for calculating the ratio at the nominal level is to avoid the differences between the real value of human capital and that of GDP caused by using different deflator indices.

for Hubei during 1985 to 2009 grew rapidly. More specifically, the human capital for Hubei increased from 1.22 trillion Yuan to 6.35 (calculated by 1985 price). The annual growth rate of human capital over this period increased to 6.87%.[75]

From 1985 to 2009, male human capital in Hubei increased from 0.740 trillion Yuan to 4.174, and the human capital for female in Hubei increased from 0.481 trillion Yuan to 2.177. During the same period, the annual growth rate of human capital was 7.21% and 6.29 % for male and female respectively. The gender gap in the estimated human capital increased from 0.259 trillion Yuan in 1985 to 1.997 in 2009. In 2009, the male human capital was about twice as big as that of female in Hubei.

From 1985 to 2009, rural human capital in Hubei increased from 0.659 trillion Yuan to 1.735; the urban human capital in Hubei increased from 0.562 trillion Yuan to 4.617. During the same period, the annual growth rate of human capital was 4.03% and 8.77% for rural and urban areas respectively.

The urban-rural gap in the estimated human capital increased from -0.097 trillion Yuan in 1985 to 2.882 in 2009. In 2009, the urban human capital was about 2.7 times as big as rural in Hubei.

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

Table HB-1.2 Real Human Capital by Gender and Urban-Rural for Hubei[76]

Billions of 1985 Yuan

Year	Total	Male	Female	Urban	Rural
1985	1221	740	481	562	659
1986	1326	803	523	615	711
1987	1421	871	550	673	748
1988	1411	875	536	703	707
1989	1388	867	521	722	666
1990	1531	962	569	808	723
1991	1654	1044	610	867	786
1992	1708	1082	626	893	815
1993	1657	1058	599	886	772
1994	1498	963	536	801	697
1995	1421	910	512	765	657
1996	1517	974	544	860	657
1997	1684	1088	596	989	695
1998	1987	1287	700	1225	762
1999	2338	1518	820	1499	839
2000	2732	1773	959	1787	945
2001	3036	1962	1074	1998	1038
2002	3359	2177	1183	2238	1121
2003	3639	2357	1282	2438	1201
2004	3810	2457	1353	2576	1234
2005	4161	2724	1437	2830	1331
2006	4640	3042	1599	3188	1452
2007	5066	3324	1742	3538	1528
2008	5492	3600	1892	3927	1565
2009	6352	4174	2177.2	4617	1735

Figure HB-1.3 shows that real human capital by five education categories accelerated during 1996-2009. One possible reason that men's

[76] Discrepancies are due to rounding errors.

real human capital is higher than women's is because the men generally retire later than women in China (age 55 vs. age 60 for men based on China Labor Law). Hence, men generally have a longer work history and more life-time earnings than women. Another possibility could be that men typically have more education than women. It is also noteworthy that the male-female income gap has been widening. The results based on six education categories show similar trends.

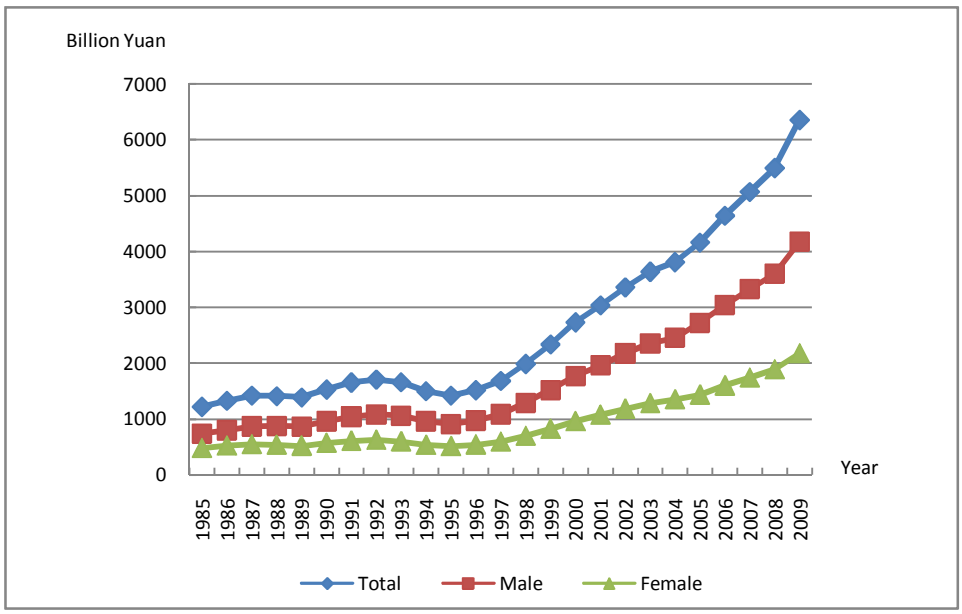


Figure HB-1.3 Real Human Capital by Gender for Hubei

Figure HB-1.4 shows the real human capital for urban and rural separately. Before 1988, the rural human capital was larger than the urban human capital. Since 1996, however, the real human capital in the urban

area has been rising fast, while the real human capital in the rural area grew quite slowly. As a result, the urban-rural gap has been enlarged.

There are several possible reasons for such a trend. First, in the early years, the rural population was significantly larger than the urban population, and thus had larger amount of human capital. This was changed in later years as a result of rapid urbanization and a large scale rural-to-urban migration. Second, urban area usually has more education than rural.

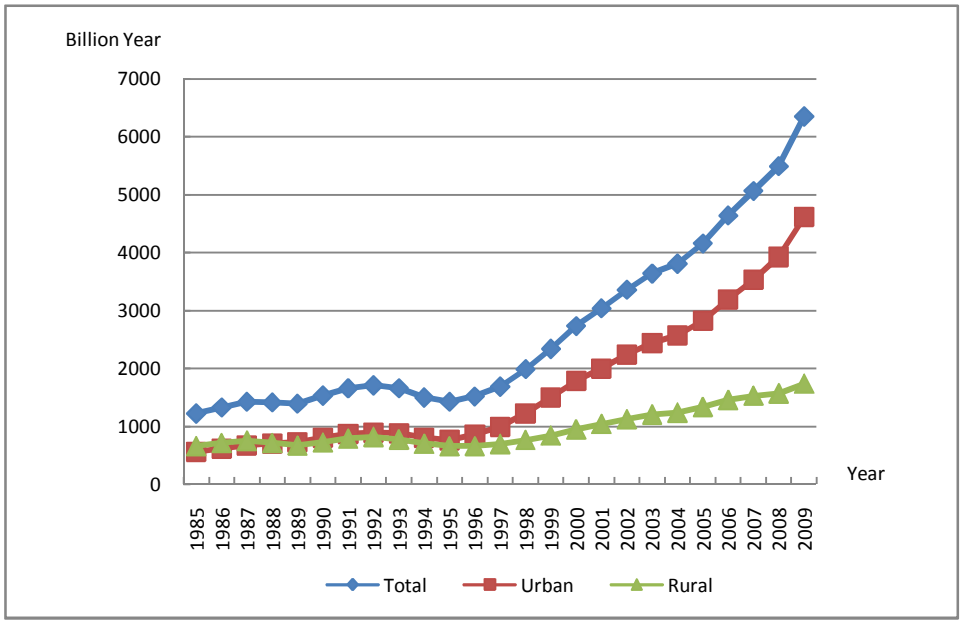


Figure HB-1.4 Real Human Capital by Urban-Rural for Hubei

Finally we calculate real human capital indices using 1985 as the baseline year. The results for each group are reported in Table HB-1.3.

Table HB-1.3 Real Human Capital Index for Hubei (1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	108.56	108.44	108.71	109.47	107.78
1987	116.40	117.70	114.38	119.86	113.45
1988	115.52	118.17	111.41	125.19	107.28
1989	113.65	117.12	108.29	128.53	100.97
1990	125.38	130.04	118.19	143.88	109.62
1991	135.43	141.01	126.83	154.40	119.26
1992	139.87	146.17	130.16	159.01	123.57
1993	135.72	142.93	124.59	157.62	117.06
1994	122.68	130.05	111.31	142.54	105.75
1995	116.38	122.90	106.32	136.08	99.59
1996	124.24	131.54	112.99	153.04	99.70
1997	137.89	146.97	123.88	176.09	105.34
1998	162.72	173.83	145.52	218.05	115.58
1999	191.44	205.08	170.42	266.82	127.21
2000	223.77	239.54	199.29	318.08	143.39
2001	248.63	265.05	223.22	355.64	157.44
2002	275.08	294.11	245.96	398.36	170.03
2003	298.01	318.51	266.49	433.96	182.16
2004	312.01	331.96	281.31	458.53	187.17
2005	340.76	368.09	298.59	503.74	201.88
2006	379.99	411.07	332.36	567.46	220.23
2007	414.87	449.13	362.11	629.76	231.76
2008	449.76	486.42	393.35	699.00	237.37
2009	520.19	563.98	452.55	821.82	263.16

Figure HB-1.5 shows the index of real human capital. It is obvious that the human capital has been rising much more rapidly since 1995.

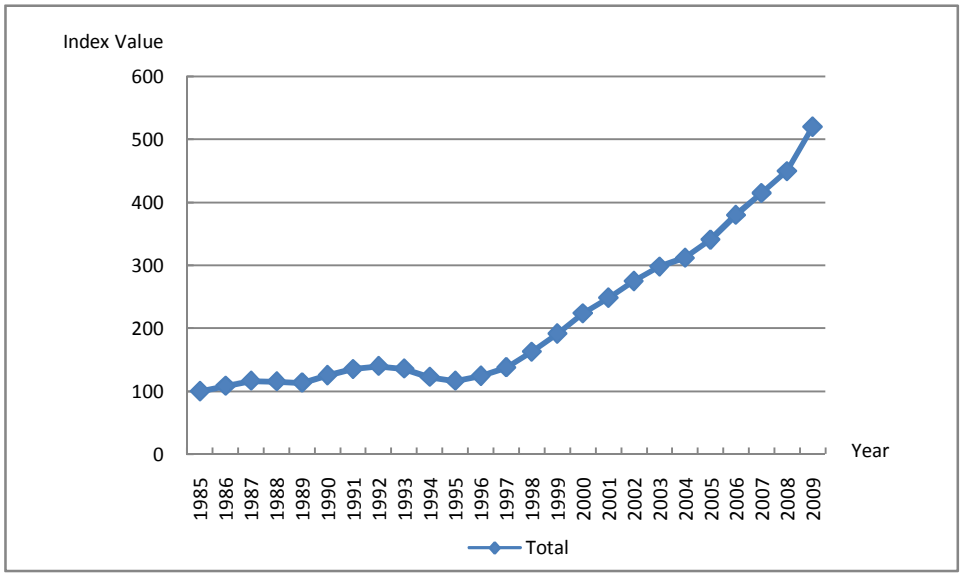


Figure HB-1.5 Real Human Capital Index for Hubei

2. Per capita human capital

An increase in real human capital can be caused by a number of factors, such as population growth, demographic changes (e.g., the size of retirement group), urban-rural 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, and higher rates of return to on-the-job training. In order to get further information on the dynamics of human capital, we calculate per capita human capital, i.e., the ratio of real human capital to non-retired population.

Table HB-2.1 shows the per capita human capital by gender for Hubei. Based on the 5 education categories, per capita real human capital increased

from 31,640 Yuan to 148,060 Yuan for men and from 22,790 Yuan to 89,780 Yuan for women. From1985 to 2009, the annual growth rate was 6.43% for male and 5.71% for female.

Table HB-2.1 Per Capita Nominal and Real Human Capital by Gender for Hubei

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	27.44	31.64	22.79	27.44	31.64	22.79
1986	30.74	35.48	25.51	29.18	33.68	24.22
1987	34.84	40.89	28.23	30.76	36.09	24.93
1988	40.44	47.64	32.44	30.01	35.32	24.10
1989	45.60	53.76	36.40	29.13	34.34	23.27
1990	50.75	60.00	40.26	31.17	36.84	24.72
1991	56.62	67.08	44.68	33.12	39.22	26.16
1992	63.09	75.27	49.29	33.75	40.23	26.40
1993	71.59	86.05	55.21	32.37	38.85	25.00
1994	80.70	97.39	61.63	29.02	34.96	22.22
1995	90.56	109.00	69.57	27.13	32.61	20.88
1996	105.11	127.18	80.12	28.75	34.73	21.97
1997	120.28	146.28	90.75	31.87	38.71	24.09
1998	139.70	170.01	105.17	37.56	45.66	28.31
1999	160.85	195.81	120.84	44.21	53.79	33.25
2000	186.35	226.31	140.44	51.49	62.50	38.82
2001	207.41	250.99	157.41	57.16	69.16	43.39
2002	230.10	279.52	173.63	63.54	77.21	47.96
2003	256.10	311.81	192.84	69.19	84.23	52.09
2004	283.25	343.82	214.59	72.91	88.54	55.23
2005	315.93	385.64	235.18	79.02	96.48	58.82
2006	358.58	438.88	265.97	88.26	108.08	65.47
2007	411.74	503.75	305.51	96.65	118.24	71.67
2008	473.54	578.70	351.98	104.72	128.03	77.80
2009	545.24	666.43	404.24	121.13	148.06	89.78

Figure HB-2.1 shows the trend of per capita real human capital by gender. Per capita real human capital shows a similar trend for both male and female. Both exhibit an accelerated growth after 1996. Yet, the male-female gap has been widening.

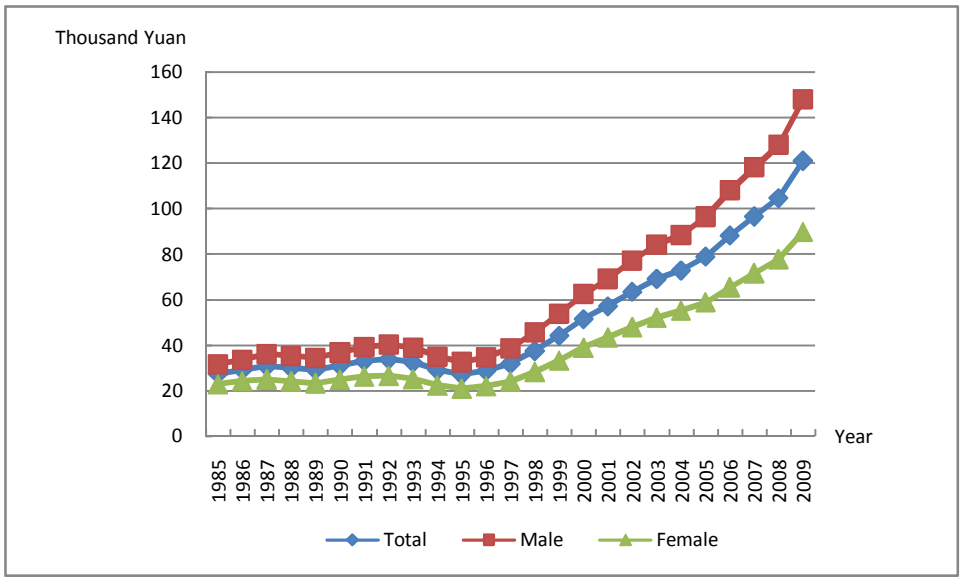


Figure HB-2.1 Per Capita Real Human Capital by Gender for Hubei

Table HB-2.2 reports the results of per capita real human capital for Hubei by area. From 1985 to 2009, the per capita human capital in urban areas was significantly larger than that for rural. The urban per capita human capital increased from 54,740 Yuan to 190,090 Yuan, and the rural per capita human capital increased from 19,230 Yuan to 61,630 Yuan. The per capita human capital in urban areas grew much faster than rural.

Table HB-2.2 Per Capita Nominal and Real Human Capital by Urban-Rural for Hubei

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	27.44	54.74	19.23	27.44	54.74	19.23
1986	30.74	60.51	21.52	29.18	57.08	20.53
1987	34.84	66.91	24.09	30.76	58.07	21.60
1988	40.44	77.21	26.94	30.01	55.61	20.62
1989	45.60	84.95	30.12	29.13	53.63	19.50
1990	50.75	93.00	33.58	31.17	56.94	20.68
1991	56.62	103.59	37.31	33.12	59.72	22.18
1992	63.09	114.74	41.56	33.75	59.87	22.86
1993	71.59	128.00	46.55	32.37	56.21	21.77
1994	80.70	143.67	52.06	29.02	49.68	19.62
1995	90.56	160.32	58.34	27.13	46.16	18.34
1996	105.11	182.70	65.01	28.75	47.74	18.94
1997	120.28	205.42	72.86	31.87	52.31	20.49
1998	139.70	237.63	81.19	37.56	61.81	23.06
1999	160.85	269.78	90.53	44.21	72.20	26.16
2000	186.35	308.75	102.17	51.49	82.63	30.06
2001	207.41	343.87	112.50	57.16	91.66	33.17
2002	230.10	377.96	124.36	63.54	101.56	36.37
2003	256.10	418.43	136.93	69.19	109.58	39.54
2004	283.25	459.07	151.36	72.91	115.05	41.30
2005	315.93	508.94	168.62	79.02	124.19	44.55
2006	358.58	574.93	189.93	88.26	138.36	49.24
2007	411.74	660.40	212.90	96.65	151.79	52.52
2008	473.54	754.80	238.23	104.72	164.45	54.72
2009	545.24	866.35	268.38	121.13	190.09	61.63

Figure HB-2.2 shows trends in per capita real human capital in urban and rural areas. During the period of 1985-2009, both urban and rural exhibit an accelerated growth after 1996. Based on 5 education categories, the ratio of urban to rural increased from 2.84 in 1985 to 3.08 in 2009, which indicates a rising size of urban-rural gap on per capita human capital. From 1985 to 2009, the annual growth rate was 5.19% for the urban area, and 4.85% for the rural area.

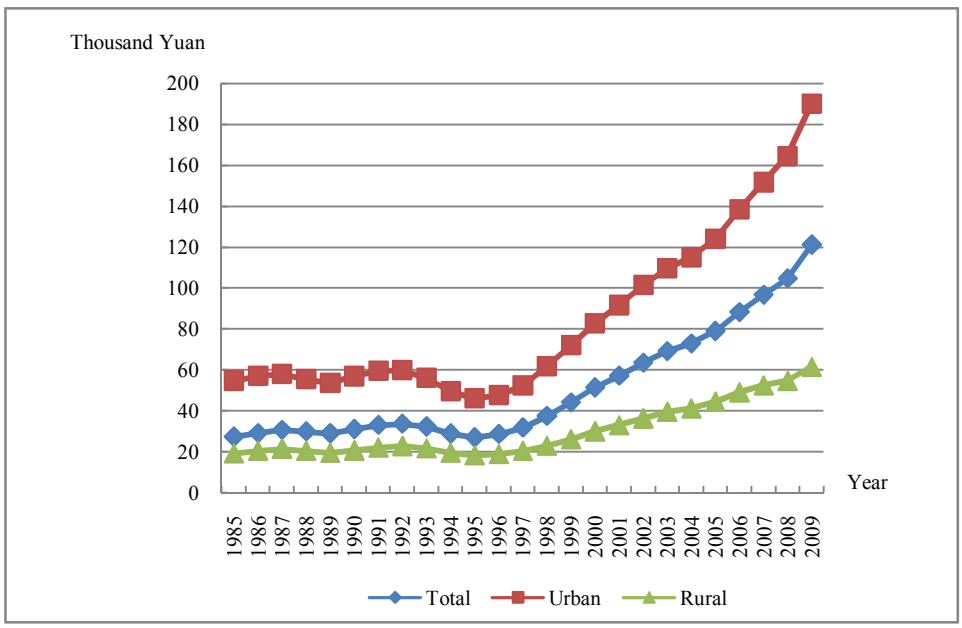


Figure HB-2.2 Per Capita Real Human Capital by Urban-Rural for Hubei

Figure HB-2.3 shows the per capita real human capital index for Hubei. As seen from the graph below, per capita real human capital was essentially stable before 1996, but significant growth occurred after 1996.

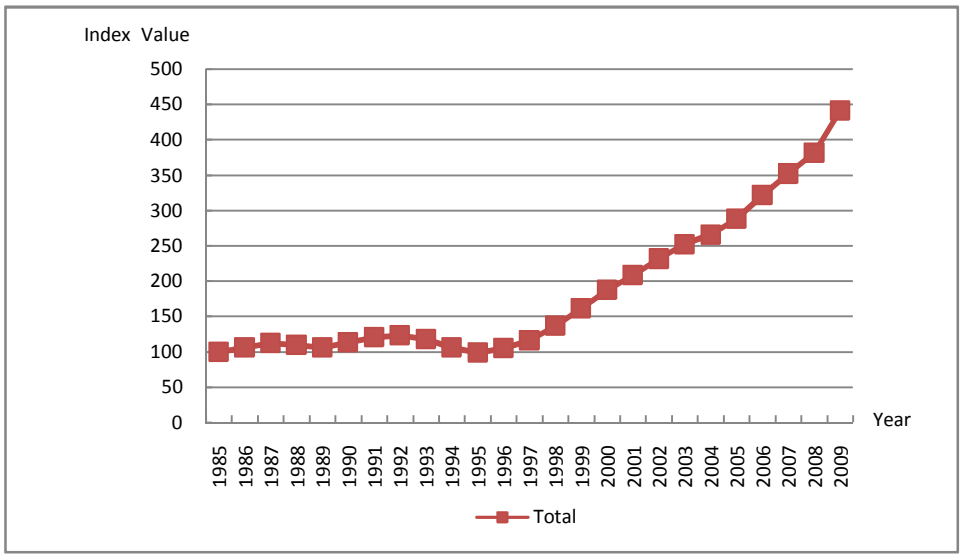


Figure HB-2.3 Per Capita Real Human Capital Index for Hubei

3. Labor force human capital

3.1 Total labor force human capital

Labor force human capital represents the human capital among the population who are over 15 years old, not retired and out-of-school. Labor force human capital is estimated in the same way as before. The labor force human capital is reported in Table HB-3.1. The real values in this table are calculated by deflating the nominal values with the CPI.

Table HB-3.1 Labor Force Human Capital and Nominal GDP for Hubei

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of labor force human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	541		541		40	13.66
1986	635		603		44	14.35
1987	749		662		52	14.46
1988	879		655		63	14.03
1989	1038		664		72	14.47
1990	1240		761		82	15.04
1991	1387		813		91	15.19
1992	1572		843		109	14.45
1993	1799		815		133	13.57
1994	2004		723		170	11.78
1995	2232		671		211	10.58
1996	2610		717		250	10.44
1997	3037		808		286	10.63
1998	3549		958		311	11.40
1999	4127		1138		323	12.78
2000	4855	4770	1346	1323	355	13.69
2001	5290	5214	1466	1445	388	13.63
2002	5811	5750	1613	1596	421	13.79
2003	6471	6444	1760	1752	476	13.60
2004	7120	7120	1844	1843	563	12.64
2005	8128	8124	2043	2042	659	12.33
2006	9072	9065	2246	2243	762	11.91
2007	10014	10010	2366	2364	933	10.73
2008	11301	11299	2512	2511	1133	9.98
2009	13179	13176	2940	2939	1296	10.17

Note: The ratio of labor force human capital to GDP is based on the current values for that year.

The trends in nominal and real labor force human capital are presented in Figure HB-3.1. Similar to the trend of total human capital, from 1985 to 2009, both nominal and real labor force human capital have kept increasing.

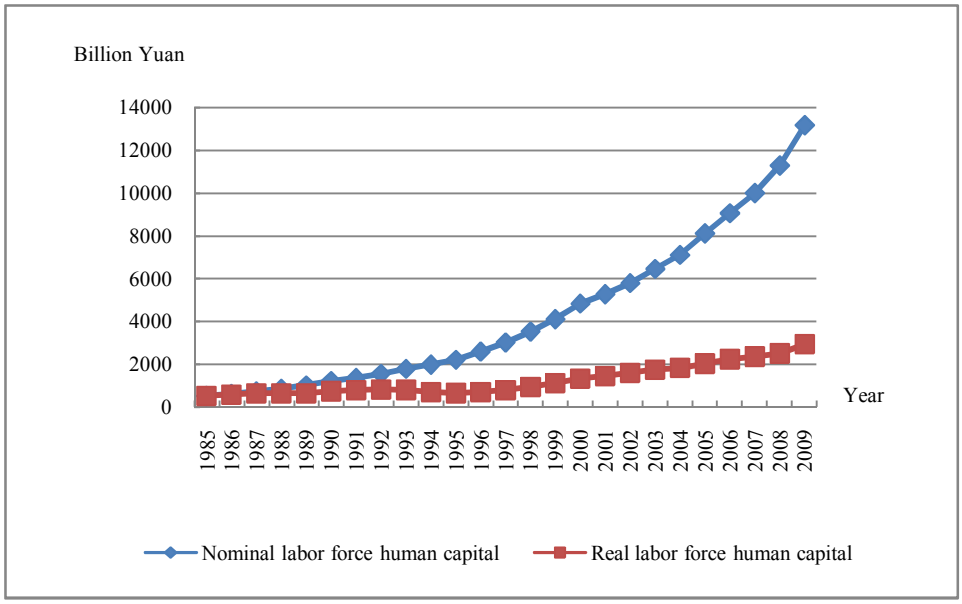


Figure HB-3.1 Nominal and Real Labor Force Human Capital for Hubei

We also calculate the ratio of nominal labor force human capital to nominal GDP. The results are reported in the last column of Table HB-3.1. As before, the ratio could reflect human capital's influence on sustainable growth of GDP, and may also reflect changes in human capital productivity and efficiency. Figure HB-3.2 shows the trend for the ratio. The pattern of the ratio for labor force human capital is almost the same as that for total human capital. The level of nominal labor force human capital is much higher than that of nominal GDP. The ratio of nominal labor force human capital to nominal GDP increases slightly from 1985 to 1991, followed by a

drastic drop from 1992 to 1996. After a rebound from 1997 to 2003, it experiences a rapid drop again.

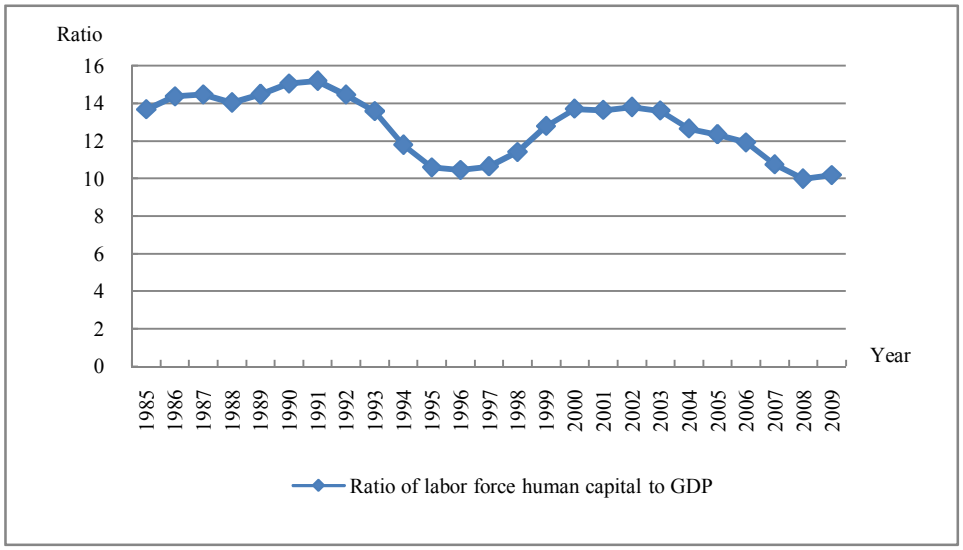


Figure HB-3.2 Ratio of Labor Force Human Capital to GDP for Hubei

Figure HB-3.2 shows the nominal and real labor force human capital for urban and rural respectively. The pattern of real labor force human capital is almost the same as that of the real total human capital. Urban real labor force human capital surpassed its rural counterpart for the first time in 1996.

Table HB-3.2 Nominal and Real Labor Force Human Capital by Urban-Rural for Hubei

Year	Nominal labor force human capital (Billions of Yuan)			Real labor force human capital (Billions of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	541	209	332	541	209	332
1986	635	253	382	603	238	364

1987	749	317	432	662	275	387
1988	879	393	486	655	283	372
1989	1038	493	544	664	311	352
1990	1240	612	628	761	375	387
1991	1387	676	712	813	390	423
1992	1572	776	796	843	405	438
1993	1799	916	883	815	402	413
1994	2004	1028	976	723	356	368
1995	2232	1148	1084	671	331	341
1996	2610	1438	1172	717	376	341
1997	3037	1730	1307	808	441	368
1998	3549	2098	1451	958	546	412
1999	4127	2538	1589	1138	679	459
2000	4855	3079	1776	1346	824	523
2001	5290	3320	1970	1466	885	581
2002	5811	3635	2176	1613	977	636
2003	6471	4032	2439	1760	1056	704
2004	7120	4456	2664	1844	1117	727
2005	8128	5157	2971	2043	1258	785
2006	9072	5708	3364	2246	1374	872
2007	10014	6212	3802	2366	1428	938
2008	11301	7038	4263	2512	1533	979
2009	13179	8440	4739	2940	1852	1088

Figure HB-3.3 shows real labor force human capital for urban and rural respectively. The pattern of labor force human capital is almost the same as that of real total human capital. The urban labor force human capital surpassed the rural one in 1996 and has grown much faster afterwards.

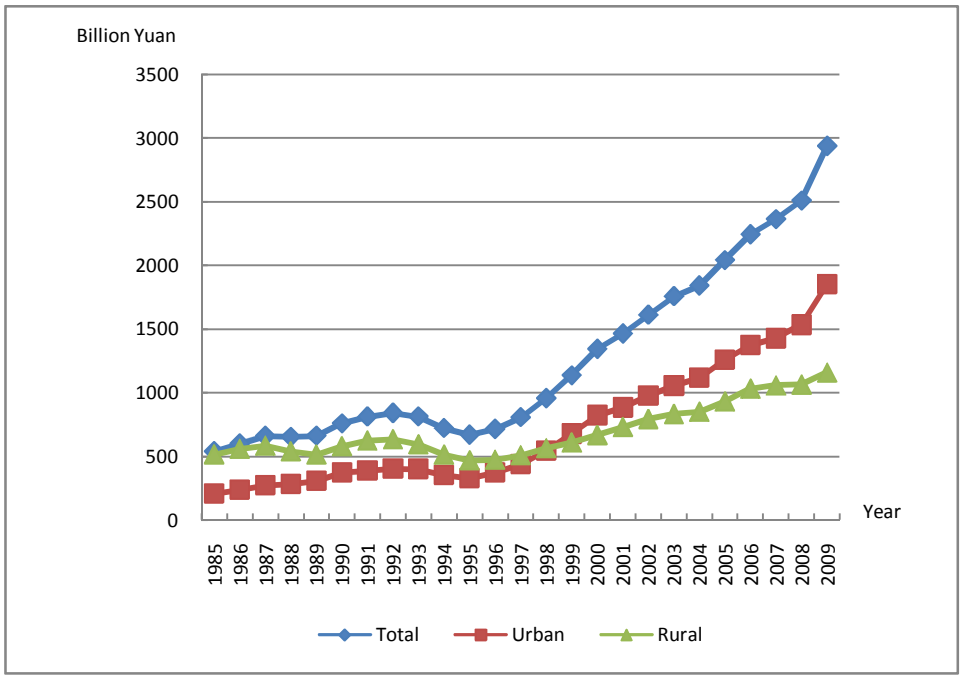


Figure HB-3.3 Real Labor Force Human Capital by Urban-Rural for Hubei

3.2 Average labor force human capital

Similar to the analysis of per capita human capital above, we calculate the average labor force human capital. Here the average labor force human capital means labor force human capital divided by the number of people who are over 15 years old, not retired and out of school.

Table HB-3.3 reports the real average labor force human capital by gender. The table shows that the real average labor force human capital for female was smaller than that for male.

Table HB-3.3 Nominal and Real Average Labor Force Human Capital by Gender for Hubei

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	20.99	24.35	17.26	20.99	24.35	17.26
1986	23.66	27.58	19.33	22.47	26.19	18.36
1987	27.06	31.92	21.76	23.93	28.22	19.26
1988	30.92	36.57	24.61	23.04	27.22	18.37
1989	35.35	41.92	27.89	22.62	26.80	17.85
1990	40.05	47.60	31.36	24.59	29.22	19.27
1991	44.28	52.73	34.56	25.93	30.88	20.27
1992	49.17	58.92	38.04	26.36	31.56	20.43
1993	55.35	66.85	42.31	25.09	30.26	19.21
1994	61.14	74.07	46.52	22.07	26.70	16.83
1995	67.11	81.48	50.88	20.18	24.47	15.34
1996	77.59	94.97	57.90	21.31	26.05	15.95
1997	88.71	109.12	65.53	23.61	29.00	17.48
1998	101.60	125.46	74.34	27.42	33.83	20.10
1999	116.03	143.56	84.47	32.00	39.58	23.32
2000	133.19	165.58	96.13	36.94	45.90	26.69
2001	144.93	180.34	104.50	40.16	49.94	28.98
2002	159.00	198.41	113.91	44.13	55.06	31.65
2003	175.28	219.29	125.09	47.68	59.62	34.06
2004	192.27	240.82	136.74	49.80	62.32	35.43
2005	213.58	267.77	151.25	53.68	67.30	38.04
2006	238.25	299.07	168.48	58.98	74.01	41.73
2007	264.83	333.27	185.76	62.57	78.72	43.90
2008	298.49	375.76	209.08	66.35	83.55	46.49
2009	346.40	436.62	241.08	77.28	97.40	53.80

Table HB-3.4 reports the real average labor force human capital by area. The real average labor force human capital was much smaller in rural area than in urban area.

Table HB-3.4 Nominal and Real Average Labor Force Human Capital by Urban-Rural for Hubei

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	20.99	36.08	16.57	20.99	36.08	16.57
1986	23.66	40.35	18.61	22.47	38.07	17.76
1987	27.06	45.10	20.89	23.93	39.14	18.74
1988	30.92	51.51	23.42	23.04	37.10	17.92
1989	35.35	58.04	26.14	22.62	36.64	16.92
1990	40.05	64.72	29.17	24.59	39.63	17.96
1991	44.28	71.65	32.43	25.93	41.31	19.28
1992	49.17	79.39	35.93	26.36	41.42	19.76
1993	55.35	88.09	39.95	25.09	38.68	18.68
1994	61.14	96.38	44.09	22.07	33.33	16.61
1995	67.11	104.75	48.66	20.18	30.16	15.29
1996	77.59	120.41	54.14	21.31	31.46	15.77
1997	88.71	136.95	60.58	23.61	34.87	17.03
1998	101.60	156.08	67.67	27.42	40.60	19.22
1999	116.03	176.65	75.11	32.00	47.27	21.70
2000	133.19	201.42	83.88	36.94	53.90	24.68
2001	144.93	218.97	92.45	40.16	58.37	27.26
2002	159.00	239.11	101.90	44.13	64.25	29.80
2003	175.28	262.19	113.04	47.68	68.66	32.64
2004	192.27	286.27	124.08	49.80	71.74	33.86
2005	213.58	316.77	136.46	53.68	77.30	36.05
2006	238.25	349.11	155.05	58.98	84.01	40.20
2007	264.83	385.26	175.46	62.57	88.55	43.28
2008	298.49	430.25	197.93	66.35	93.74	45.46
2009	346.40	502.39	223.17	77.28	110.23	51.25

Chapter 15 Human capital for Hunan

1. Total human capital

Human capital stocks of Hunan are calculated using estimated income parameters and a 4.58% discount rate. The results are ported in Table HuN-1.1. Column 1 and column 2 contain the nominal human capital; column 3 and column 4 contain the real human capital deflated by CPI (in 1985 Yuan).[77]

Table HuN-1.1 Nominal and Real Human Capital, Nominal GDP for Hunan

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	1315		1315		35	37.56
1986	1466		1391		40	36.87
1987	1655		1435		47	35.24
1988	1917		1326		58	32.82
1989	2185		1273		64	34.10
1990	2518		1462		74	33.82
1991	2815		1570		83	33.78
1992	3140		1598		99	31.82
1993	3520		1534		124	28.28

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

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1994	3951		1372		165	23.95
1995	4447		1296		213	20.86
1996	5141		1385		254	20.24
1997	5934		1553		285	20.83
1998	6833		1779		303	22.58
1999	7870		2033		321	24.48
2000	9186	9178	2339	2336	355	25.87
2001	10268	10260	2637	2634	383	26.80
2002	11529	11529	2973	2973	415	27.77
2003	12863	12868	3231	3231	466	27.60
2004	14524	14529	3481	3482	564	25.74
2005	16124	16123	3775	3775	651	24.76
2006	18569	18576	4285	4286	757	24.53
2007	21370	21383	4660	4664	920	23.23
2008	24546	24582	5036	5043	1116	22.00
2009	28072	28102	5781	5789	1306	21.50

Note: The ratio of human capital to GDP is based on the current values for that year.

Figure HN-1.1 graphs real and nominal human capital for Hunan reported in Table HN-1.1 As shown, both the nominal and real human capital rise steadily and nominal human capital grows faster than the real one.

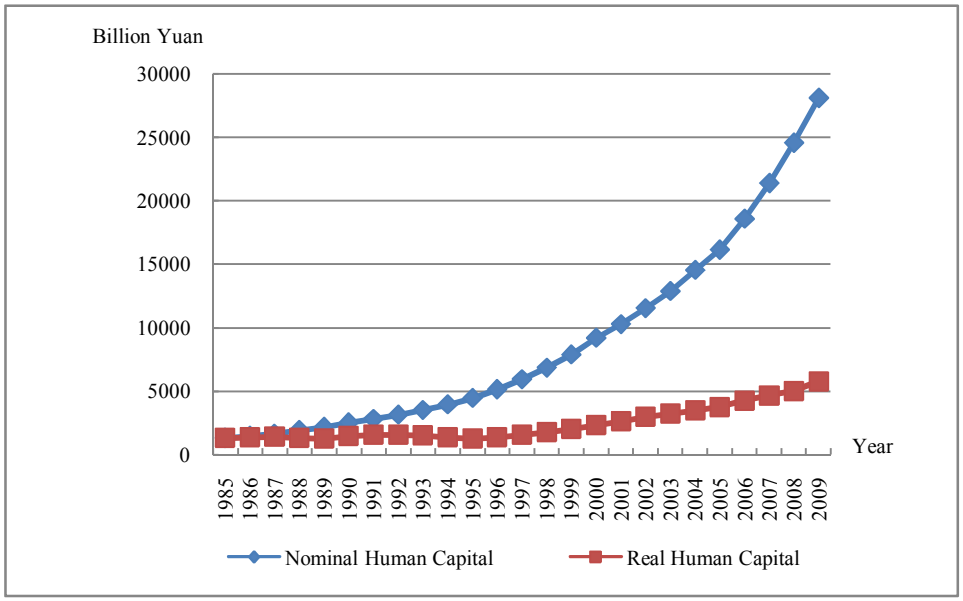


Figure HuN-1.1 Nominal and Real Human Capital for Hunan

In order to get a sense of the magnitude of the human capital in Hunan, we also present the ratio of nominal human capital to nominal GDP in Table HuN-1.1.[78] .The ratio could reflect human capital's influence on sustainable growth of GDP. As is shown in Figure HuN-1.2, nominal human capital is substantially higher than nominal GDP for Hunan. From 1985 to 1988, the ratio of human capital to GDP in Hunan kept dropping and remained nearly the same from 1989 to 1991. After 1991, however, the ratio decreased rapidly, but it increased again and kept growing steadily until 2003. There was a steady decrease between 2003 and 2009. The decreasing ratio of

[78] The reason for calculating the ratio at the nominal level is to avoid the differences between the real value of human capital and that of GDP caused by using different deflator indices.

human capital to GDP may also indicate possible constraints on the future GDP growth.

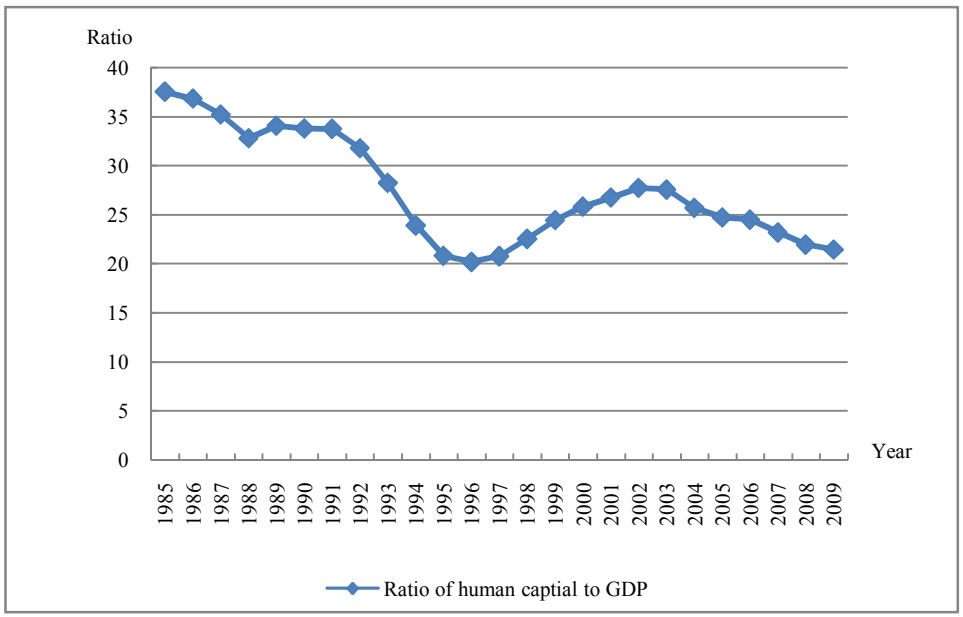


Figure HuN-1.2 Ratio of Human Capital to GDP for Hunan

In order to discuss the trend of human capital, we calculate the real values here by CPI. Table HuN-1.2 shows real human capital for Hunan by gender and area. The results based on five education categories show that the human capital for Hunan during 1985 to 2009 grew rapidly. More specifically, the human capital for Hunan increased from 1.32 trillion Yuan to 5.78 trillion Yuan (calculated by 1985 comparable price), it had increased

by 4 times，the annual growth rate of human capital over this period increased to 6.17%.[79]

From 1985 to 2009, male human capital in Hunan increased from 0.794 trillion Yuan to 3.745 trillion Yuan, the human capital for female in Beijing increased from 0.521 trillion Yuan to 1.398 trillion Yuan. During the same period, the annual growth rates of human capital were 6.46% and 5.68 % for male and female respectively. The gender gap in the estimated human capital increased from 0.273 trillion Yuan in 1985 to 1.709 trillion Yuan in 2009. In 2009, the male human capital was about 1.8 times the amount of that for female in Hunan.

From 1985 to 2009, rural human capital in Hunan increased from 0.976 trillion Yuan to 1.852 trillion Yuan, the urban human capital in Hunan increased from 0.339 trillion Yuan to 3.929 trillion Yuan. During the same period, the annual growth rates of human capital were 2.67% and 10.21 % for rural and urban areas respectively. The urban-rural gap in the estimated human capital increased from 0.637 trillion Yuan in 1985 to 2.077 trillion Yuan in 2009. In 2009, the urban human capital was about 2 times the amount of that for rural in Hunan.

[79] 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.

Table HuN-1.2 Real Human Capital by Gender and Urban-Rural for Hunan[80]

Billions of 1985 Yuan

Year	Total	Male	Female	Urban	Rural
1985	1315	794	521	339	976
1986	1391	840	552	348	1043
1987	1435	876	559	354	1081
1988	1326	812	514	351	974
1989	1273	783	491	355	919
1990	1462	902	560	425	1037
1991	1570	970	599	458	1112
1992	1598	989	608	464	1134
1993	1534	953	580	458	1076
1994	1372	854	517	428	944
1995	1296	811	485	416	880
1996	1385	871	515	511	874
1997	1553	982	571	634	919
1998	1779	1131	648	792	987
1999	2033	1298	736	990	1043
2000	2339	1500	839	1194	1145
2001	2637	1687	949	1386	1251
2002	2973	1898	1074	1617	1356
2003	3231	2060	1171	1840	1391
2004	3481	2217	1264	2077	1404
2005	3775	2418	1357	2301	1474
2006	4285	2758	1527	2674	1611
2007	4660	3007	1654	3013	1647
2008	5036	3253	1784	3362	1674
2009	5781	3745	2036	3929	1852

[80] Some discrepancy may exist when summing up male and female, or urban and rural to get the total amount. This is mainly caused by rounding errors.

Figure HuN-1.3 shows that real human capital by five education categories keeps growing, and it grew even faster during 1996-2009. One reason male real human capital is higher than female real human capital is the earlier retirement age for women (age 55 vs. age 60 for men based on China Labor Law). Accordingly, men have a longer time to generate income in the market. Another reason is higher educational attainment for men. Moreover, the male-female income gap has been on expanding. The results based on six education categories show similar trends.

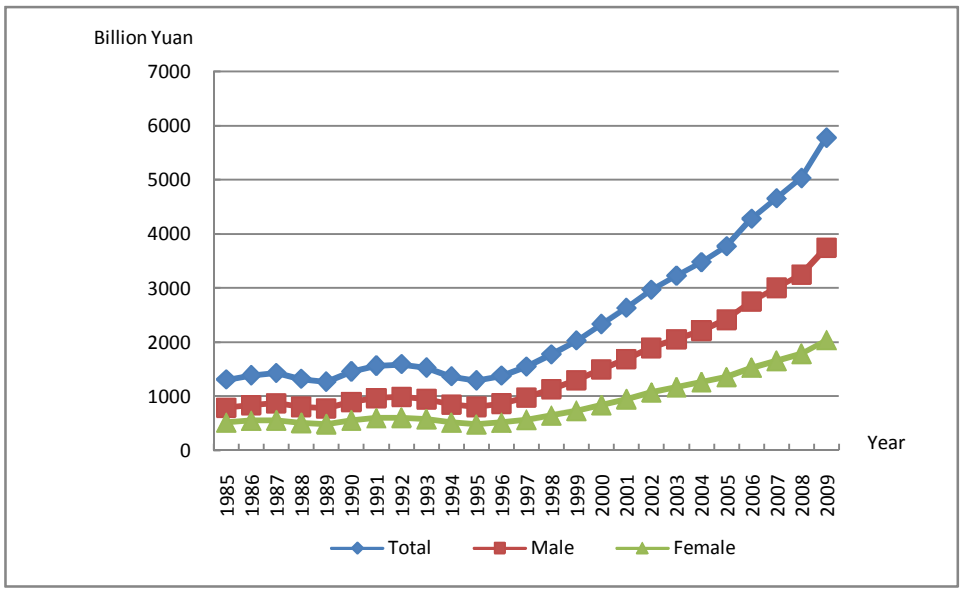


Figure HuN-1.3 Real Human Capital by Gender for Hunan

Figure HuN-1.4 shows the real human capital for urban and rural separately. Before 2000, the rural human capital was larger than the urban human capital. Since 1996, however, the real human capital in the urban

area has been rising much more rapidly, while the real human capital in the rural area grew quite slowly, the urban human capital surpassed the rural human capital in 2000, and the urban-rural gap has the trend of expanding.

There are several reasons for such a trend. First, in the early years, the rural population was significantly larger than the urban population, and thus had larger amount of human capital. This change in the later years 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. Another reason is the education gap between the urban and rural population. Urban areas usually have a larger proportion of educated population than rural areas.

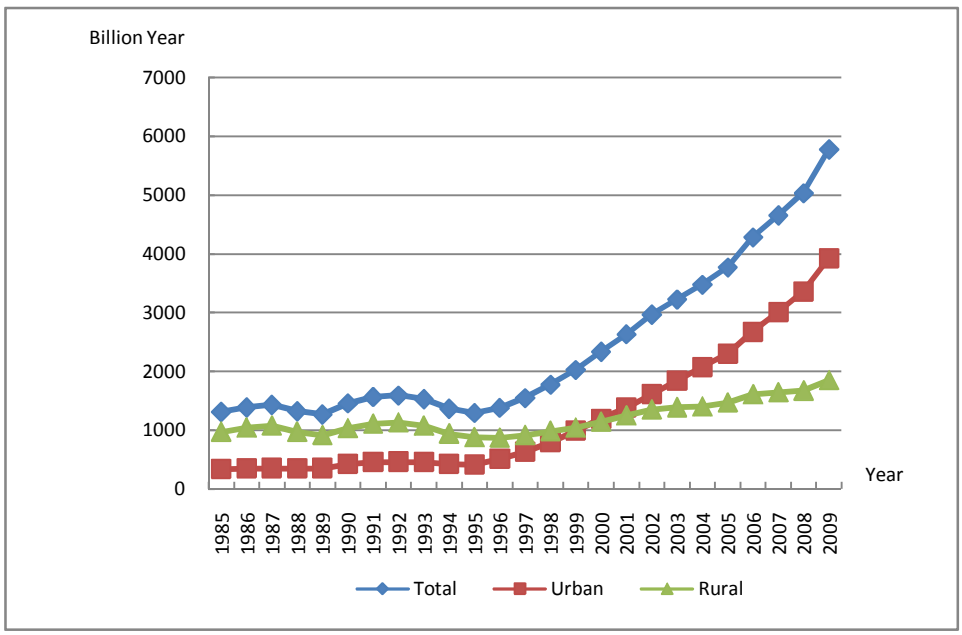


Figure HuN-1.4 Real Human Capital by Urban-Rural for Hunan

Finally we calculate real human capital indices using 1985 as the baseline year. The results for each group are reported in Table HuN-1.3.

Table HuN-1.3 Real Human Capital Index for Hunan (1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	105.84	105.83	105.93	102.80	106.90
1987	109.18	110.37	107.41	104.55	110.79
1988	100.84	102.24	98.69	103.72	99.84
1989	96.87	98.59	94.26	104.66	94.17
1990	111.19	113.70	107.43	125.32	106.28
1991	119.41	122.23	115.05	135.09	113.97
1992	121.53	124.64	116.82	136.81	116.22
1993	116.69	120.11	111.42	135.15	110.28
1994	104.35	107.62	99.35	126.18	96.77
1995	98.60	102.17	93.18	122.90	90.16
1996	105.39	109.68	98.87	150.89	89.60
1997	118.15	123.71	109.70	187.07	94.22
1998	135.33	142.52	124.39	233.83	101.13
1999	154.66	163.47	141.26	292.21	106.90
2000	177.94	188.98	161.12	352.42	117.35
2001	200.61	212.60	182.28	409.09	128.22
2002	226.17	239.17	206.20	477.27	138.98
2003	245.80	259.57	224.75	543.09	142.56
2004	264.82	279.26	242.72	613.05	143.90
2005	287.18	304.67	260.52	679.16	151.07
2006	325.98	347.49	293.24	789.26	165.11
2007	354.51	378.86	317.49	889.32	168.80
2008	383.11	409.85	342.49	992.33	171.57
2009	439.79	471.84	390.94	1159.68	189.81

Figure HuN-1.5 shows the index of real human capital. It's obvious that the human capital has been rising much more rapidly since 1995.

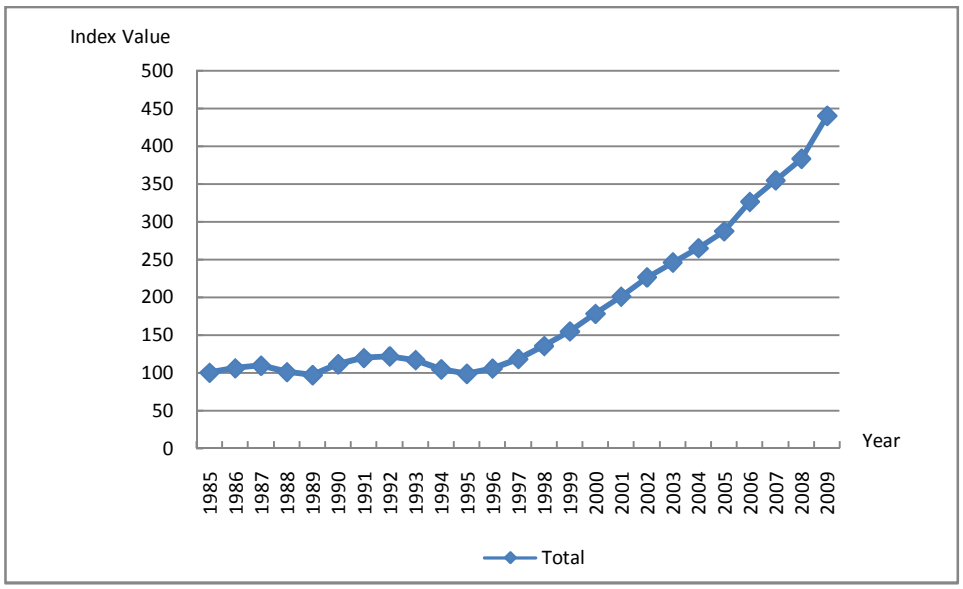


Figure HuN-1.5 Real Human Capital Index for Hunan

2. Per capita human capital

An increase in real human capital can be caused by a number of factors, such as population growth, demographic changes (e.g., the size of retirement group), urban-rural 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, and higher rates of return to on-the-job training. In order to get further information on

the dynamics of human capital, we calculate per capita real human capital, i.e., the ratio of real human capital to non-retired population.

Table HuN-2.1 shows the per capita human capital by gender for Hunan. Based on the five education categories, per capita human capital real values for male increased from 29,500 Yuan to 122,190 Yuan, increasing by around 4 times; per capita human capital real values for female increased from 22,050 Yuan to 74,270 Yuan, increasing by around 2 times. From1985 to 2009, the annual growth rate was 5.92% for male, and 5.06% for female.

Table HuN-2.1 Per Capita Nominal and Real Human Capital by Gender for Hunan

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	26.02	29.50	22.05	26.02	29.50	22.05
1986	28.85	32.70	24.46	27.38	31.05	23.22
1987	32.33	37.08	26.91	28.04	32.16	23.37
1988	36.40	41.95	30.12	25.17	28.98	20.83
1989	40.83	47.09	33.68	23.79	27.43	19.64
1990	45.74	52.89	37.54	26.55	30.70	21.81
1991	50.82	58.89	41.58	28.34	32.82	23.19
1992	56.44	65.68	45.91	28.71	33.40	23.39
1993	63.32	74.01	51.17	27.59	32.22	22.32
1994	70.89	83.08	57.06	24.61	28.83	19.82
1995	79.13	93.31	63.08	23.06	27.19	18.40
1996	91.10	108.07	71.96	24.55	29.11	19.41
1997	104.88	124.74	82.32	27.45	32.65	21.56
1998	120.67	144.09	93.95	31.42	37.51	24.47
1999	139.07	165.99	108.11	35.93	42.88	27.94

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
2000	159.64	191.43	123.14	40.65	48.75	31.34
2001	177.88	213.69	137.06	45.68	54.87	35.19
2002	199.52	240.78	153.14	51.45	62.08	39.48
2003	223.44	271.70	170.20	56.12	68.23	42.76
2004	252.37	308.90	191.05	60.49	74.02	45.79
2005	280.40	342.65	211.82	65.65	80.22	49.59
2006	319.83	392.12	239.93	73.81	90.50	55.37
2007	367.18	449.99	275.12	80.07	98.15	59.99
2008	420.67	516.13	314.69	86.31	105.85	64.59
2009	483.50	593.22	360.58	99.57	122.19	74.27

Figure HuN-2.1 shows the trend of per capita real human capital by gender. Per capita real human capital shows a similar trend for males and females. Per capita real human capital for male and female both exhibit an accelerated growth after 1996. The male-female gap has been widening.

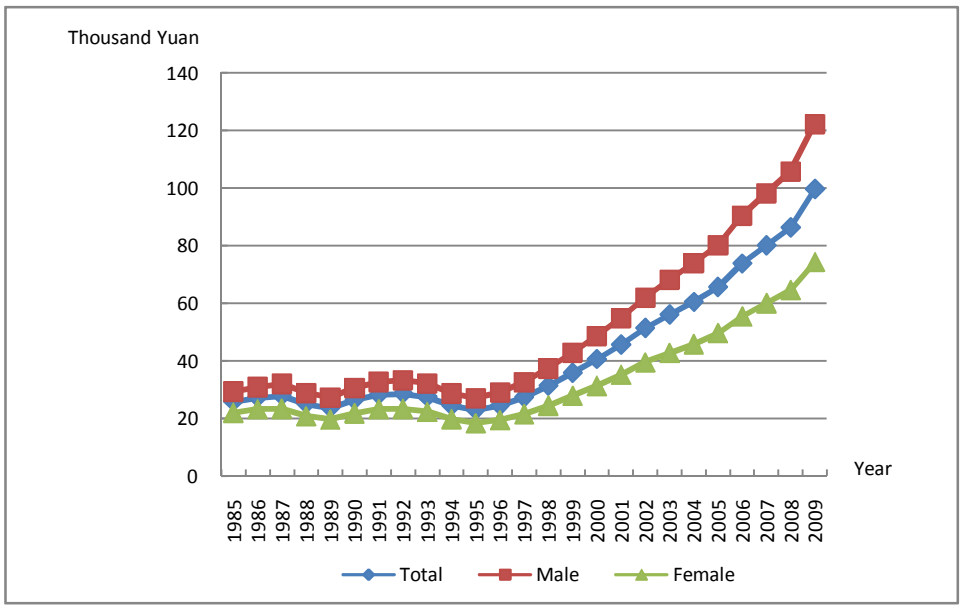


Figure HuN-2.1 Per Capita Real Human Capital by Gender for Hunan

Table HuN-2.2 reports the results of per capita human capital measured in nominal and real terms for Hunan classified by urban and rural separately. From 1985 to 2009, the per capita human capital in urban areas was significantly larger than that for rural. The per capita urban human capital increased from 50,710 Yuan to 154,370 Yuan, the per capita rural human capital increased from 22,270 Yuan to 56,820 Yuan. The per capita human capital in urban areas grew much faster than the one for rural.

Table HuN-2.2 Per Capita Nominal and Real Human Capital by Urban-Rural for Hunan

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	26.02	50.71	22.27	26.02	50.71	22.27
1986	28.85	56.26	24.83	27.38	53.38	23.58
1987	32.33	63.66	27.73	28.04	54.27	24.21
1988	36.40	72.69	30.78	25.17	49.29	21.42
1989	40.83	81.55	34.17	23.79	47.15	19.97
1990	45.74	88.34	38.07	26.55	50.77	22.21
1991	50.82	98.54	42.14	28.34	53.88	23.68
1992	56.44	108.75	46.61	28.71	52.39	24.27
1993	63.32	120.56	51.87	27.59	49.47	23.21
1994	70.89	135.15	57.47	24.61	44.44	20.47
1995	79.13	149.83	63.88	23.06	41.72	19.04
1996	91.10	170.98	70.65	24.55	44.41	19.46
1997	104.88	193.21	78.55	27.45	48.72	21.11
1998	120.67	218.65	87.19	31.42	54.86	23.41
1999	139.07	247.49	96.79	35.93	62.34	25.63

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	**Urban**	**Rural**	**Total**	**Urban**	**Rural**
2000	159.64	276.57	109.17	40.65	68.78	28.51
2001	177.88	305.03	119.90	45.68	76.70	31.53
2002	199.52	339.95	131.79	51.45	85.82	34.87
2003	223.44	374.36	144.38	56.12	93.20	36.69
2004	252.37	416.07	159.25	60.49	99.51	38.29
2005	280.40	457.45	175.11	65.65	107.15	40.96
2006	319.83	509.86	197.21	73.81	117.55	45.58
2007	367.18	576.52	221.88	80.07	126.35	47.97
2008	420.67	650.69	249.22	86.31	134.78	50.17
2009	483.50	742.83	280.99	99.57	154.37	56.82

Figure HuN-2.2 shows trends in per capita real human capital in urban and rural areas. During the period of 1985-2009, per capita real human capital for urban and rural both exhibit an accelerated growth after 1996. Based on five education categories, the ratio of urban to rural increased from 2.28 in 1985 to 2.71 in 2009, the absolute size of human capital has been on the rise. From 1985 to 2009, the annual growth rate was 4.63% for the urban area, and 3.9% for the rural area.

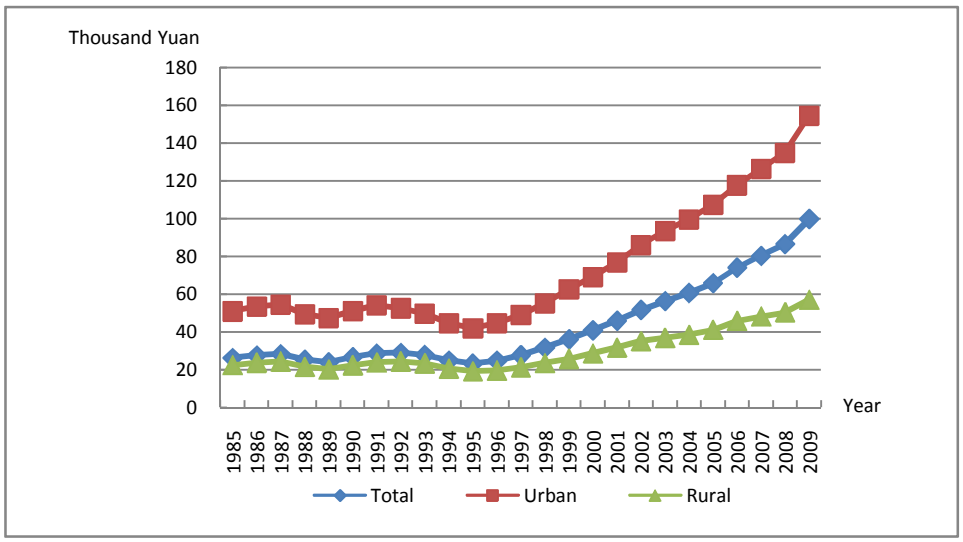


Figure HuN-2. 2 Per Capita Real Human Capital by Urban-Rural for Hunan

Figure HuN-2.3 shows the per capita real human capital index for Hunan. As is seen from the graph below, per capita real human capital was essentially stable before 1996, but significant growth occurred after 1996.

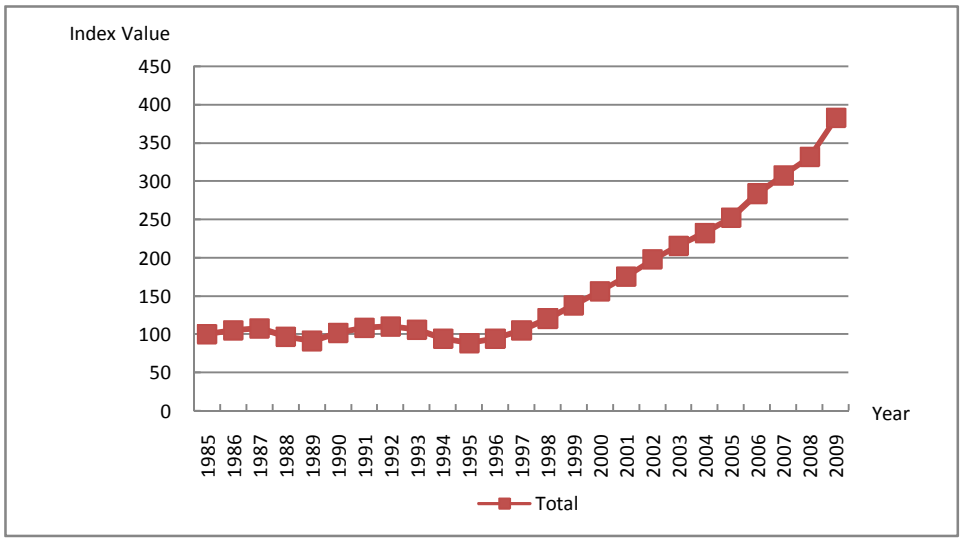


Figure HuN-2.3 Per Capita Real Human Capital Index for Hunan

3. Labor force human capital

3.1 Total labor force human capital

Labor force human capital represents the human capital of the population that is over 15 years old, non-retired and out-of-school. Labor force human capital is estimated in the same way as human capital. The labor force human capital is reported in Table HuN-3.1. The real values in this table are calculated by deflating the nominal values with the CPI.

Table HuN-3.1 Labor Force Human Capital and Nominal GDP for Hunan

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of labor force human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	599		599		35	17.13
1986	687		652		40	17.26
1987	786		684		47	16.75
1988	916		635		58	15.69
1989	1052		614		64	16.42
1990	1233		717		74	16.56
1991	1378		770		83	16.53
1992	1537		786		99	15.57
1993	1723		755		124	13.84
1994	1902		664		165	11.53
1995	2110		618		213	9.90
1996	2404		651		254	9.46
1997	2786		733		285	9.78
1998	3274		857		303	10.82
1999	3809		988		321	11.85

2000	4493	4411	1148	1128	355	12.65
2001	4952	4874	1276	1256	383	12.92
2002	5482	5416	1420	1402	415	13.20
2003	6196	6149	1559	1547	466	13.30
2004	6949	6931	1667	1662	564	12.32
2005	7925	7901	1855	1849	651	12.17
2006	9104	9081	2101	2096	757	12.03
2007	10306	10280	2244	2239	920	11.20
2008	11679	11654	2389	2384	1116	10.47
2009	13521	13486	2778	2772	1306	10.35

Note: The ratio of labor force human capital to GDP is based on the current values for that year.

The trends in nominal and real labor force human capital are presented in Figure HuN-3.1. Similar to the trend of human capital, from 1985 to 2009, labor force human capital both in nominal and real terms have kept on increasing.

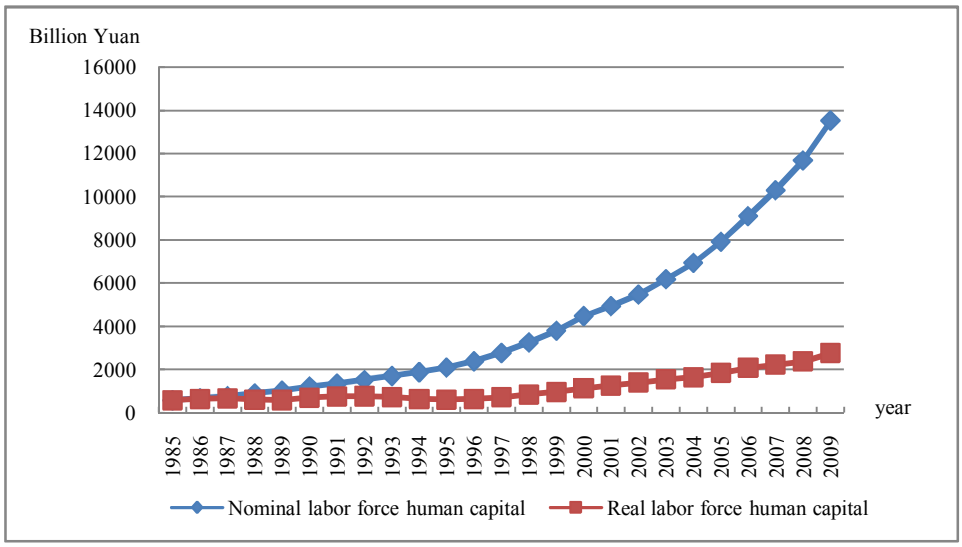


Figure HuN-3.1 Nominal and Real Labor Force Human Capital for Hunan

We also calculate the ratio of labor force human capital to GDP. The results are reported in the last column of Table GS-3.1. As before, the ratio could reflect human capital's influence on sustainable growth of GDP, and may also reflect changes in human capital productivity and efficiency. Figure GS-3.2 shows the trend for the ratio. The pattern of the ratio for labor force human capital is almost the same as that for human capital. The level of nominal labor force human capital is much higher than that of nominal GDP. The ratio of labor force human capital to GDP in Hunan from 1990 to 1996 decreases at a considerable rate, it rebounds from 1997 to 2003 and drops again afterwards.

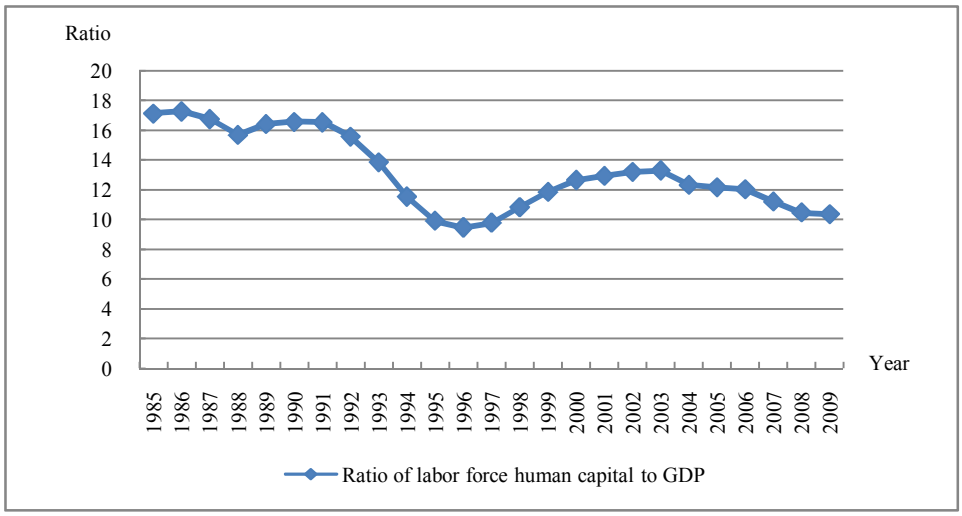


Figure HuN-3.2 Ratio of Labor Force Human Capital to GDP for Hunan

Figure HuN-3.2 shows the labor force human capital real values for urban and rural separately. The pattern of the labor force human capital is almost the same as that for human capital. Urban real labor force human capital surpassed its rural counterpart for the first time in 2004.

Table HuN-3.2 Nominal and Real Labor Force Human Capital by Urban-Rural for Hunan

Year	Nominal labor force human capital (Billions of Yuan)			Real labor force human capital (Billions of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	599	103	496	599	103	496
1986	687	119	567	652	113	539
1987	786	145	641	684	124	560
1988	916	172	744	635	117	518
1989	1052	205	847	614	119	495
1990	1233	281	952	717	162	555
1991	1378	311	1067	770	170	600
1992	1537	361	1176	786	174	613
1993	1723	431	1292	755	177	578
1994	1902	504	1398	664	166	498
1995	2110	583	1527	618	162	455
1996	2404	735	1669	651	191	460
1997	2786	944	1842	733	238	495
1998	3274	1229	2045	857	308	549
1999	3809	1580	2229	988	398	590
2000	4493	2018	2475	1148	502	646
2001	4952	2265	2687	1276	570	707
2002	5482	2569	2913	1420	649	771
2003	6196	2986	3210	1559	743	816
2004	6949	3504	3445	1667	838	828
2005	7925	4060	3865	1855	951	904
2006	9104	4785	4319	2101	1103	998
2007	10306	5573	4733	2244	1221	1023
2008	11679	6533	5146	2389	1353	1036
2009	13521	7920	5601	2778	1646	1132

Figure HuN-3.3 shows real labor force human capital for urban and rural respectively. The pattern of labor force human capital is almost the same as that of real human capital. The urban labor force human capital surpassed the rural one in 2004 and has grown much faster since 1996.

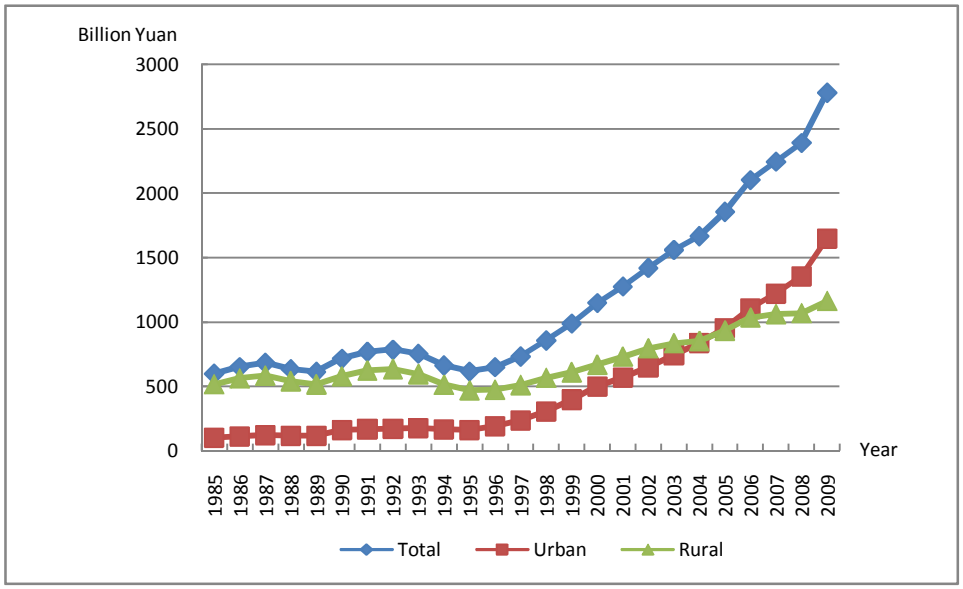


Figure HuN-3.3 Real Labor Force Human Capital by Urban-Rural for Hunan

3.2 Average Labor force human capital

Similar to the analysis of per capita human capital above, we calculate the average labor force human capital per capita. Here the average labor force human capital means labor force human capital divided by the number of the population that are over 15 years old, non-retired and out of school.

Table HuN-3.3 reports the real average labor force human capital by gender. Additionally, the table shows that the real average labor force human capital for female was smaller than that for male.

Table HuN-3.3 Nominal and Real Average Labor Force Human Capital by Gender for Hunan

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	20.19	22.88	17.11	20.19	22.88	17.11
1986	22.62	25.73	19.08	21.48	24.44	18.11
1987	25.56	29.28	21.34	22.22	25.44	18.55
1988	28.46	32.76	23.54	19.72	22.68	16.31
1989	31.83	36.70	26.21	18.57	21.40	15.29
1990	36.04	41.80	29.36	20.95	24.30	17.07
1991	39.80	46.27	32.34	22.23	25.84	18.07
1992	43.94	51.39	35.42	22.48	26.28	18.14
1993	49.03	57.67	39.16	21.48	25.25	17.17
1994	54.10	64.12	42.72	18.87	22.36	14.92
1995	59.51	70.87	46.68	17.42	20.74	13.66
1996	67.34	80.90	52.04	18.23	21.89	14.09
1997	76.76	92.49	58.88	20.20	24.34	15.50
1998	88.01	106.70	66.77	23.05	27.94	17.49
1999	100.44	122.20	75.58	26.06	31.70	19.61
2000	114.58	140.38	85.05	29.28	35.87	21.74
2001	126.16	154.82	93.66	32.51	39.89	24.14
2002	138.98	171.65	102.34	35.99	44.44	26.50
2003	155.29	192.53	114.02	39.08	48.45	28.70
2004	172.60	215.16	126.34	41.39	51.59	30.30
2005	191.24	238.50	140.28	44.76	55.82	32.84
2006	217.45	272.59	157.94	50.19	62.92	36.46
2007	246.64	308.95	178.90	53.70	67.28	38.95
2008	279.90	350.56	202.77	57.26	71.71	41.48
2009	325.94	408.84	234.90	66.97	83.99	48.26

Table HuN-3.4 reports the real average labor force human capital by area. The real average labor force human capital was much smaller in rural area than in urban area.

Table HuN-3.4 Nominal and Real Average Labor Force Human Capital by Urban-Rural for Hunan

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	20.19	32.43	18.73	20.19	32.43	18.73
1986	22.62	36.75	20.95	21.48	34.87	19.90
1987	25.56	42.00	23.46	22.22	35.80	20.48
1988	28.46	46.55	26.19	19.72	31.57	18.23
1989	31.83	51.94	29.11	18.57	30.03	17.01
1990	36.04	58.43	32.34	20.95	33.58	18.87
1991	39.80	64.48	35.76	22.23	35.26	20.10
1992	43.94	71.12	39.41	22.48	34.26	20.52
1993	49.03	79.20	43.48	21.48	32.50	19.45
1994	54.10	87.53	47.52	18.87	28.78	16.93
1995	59.51	96.20	51.98	17.42	26.78	15.49
1996	67.34	108.08	57.76	18.23	28.07	15.91
1997	76.76	122.69	64.45	20.20	30.94	17.32
1998	88.01	139.65	72.09	23.05	35.04	19.36
1999	100.44	157.62	79.93	26.06	39.71	21.17
2000	114.58	178.39	88.73	29.28	44.36	23.17
2001	126.16	194.39	97.29	32.51	48.88	25.58
2002	138.98	213.34	106.58	35.99	53.86	28.20
2003	155.29	235.11	117.64	39.08	58.54	29.90
2004	172.60	258.40	129.06	41.39	61.80	31.03
2005	191.24	285.13	142.29	44.76	66.79	33.28
2006	217.45	317.59	160.99	50.19	73.22	37.21
2007	246.64	355.32	181.42	53.70	77.87	39.22
2008	279.90	397.75	203.68	57.26	82.39	41.00
2009	325.94	466.32	228.62	66.97	96.91	46.23

Chapter 16 Human capital for Guangdong

1. Total human capital

Human capital stocks of Guangdong are calculated using estimated income parameters and a 4.58% discount rate. The results are ported in Table GD-1.1. Column 1 and column 2 contain the nominal human capital; column 3 and column 4 contain the real human capital deflated by CPI (in 1985 Yuan).[81]

Table GD-1.1 Nominal and Real Human Capital, Nominal GDP for Guangdong

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	3931		3931		58	68.08
1986	4340		4134		67	65.02
1987	4814		4117		85	56.86
1988	5098		3369		116	44.12
1989	5767		3120		138	41.75
1990	6763		3752		156	43.38
1991	7525		4121		189	39.75
1992	8491		4329		245	34.69
1993	9665		4055		347	27.86

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

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1994	10942		3773		462	23.69
1995	12554		3793		593	21.16
1996	14588		4117		684	21.34
1997	17361		4801		777	22.33
1998	20592		5784		853	24.14
1999	24763		7070		925	26.77
2000	28877	29015	8097	8133	1074	26.88
2001	33096	33313	9334	9392	1204	27.49
2002	38389	38682	10965	11048	1350	28.43
2003	43637	44006	12369	12474	1584	27.54
2004	49777	50260	13716	13849	1886	26.39
2005	55244	55799	14902	15051	2256	24.49
2006	63300	64018	16768	16958	2659	23.81
2007	72160	73070	18433	18661	3178	22.71
2008	81480	82580	19706	19972	3680	22.14
2009	96890	98300	23992	24329	3948	24.54

Note: The ratio of human capital to GDP is based on the current values for that year.

Figure GD-1.1 shows real and nominal human capital for Guangdong reported in Table GD-1.1 As is seen from the figure, both the nominal and real human capital rise steadily and nominal human capital grows faster than real human capital.

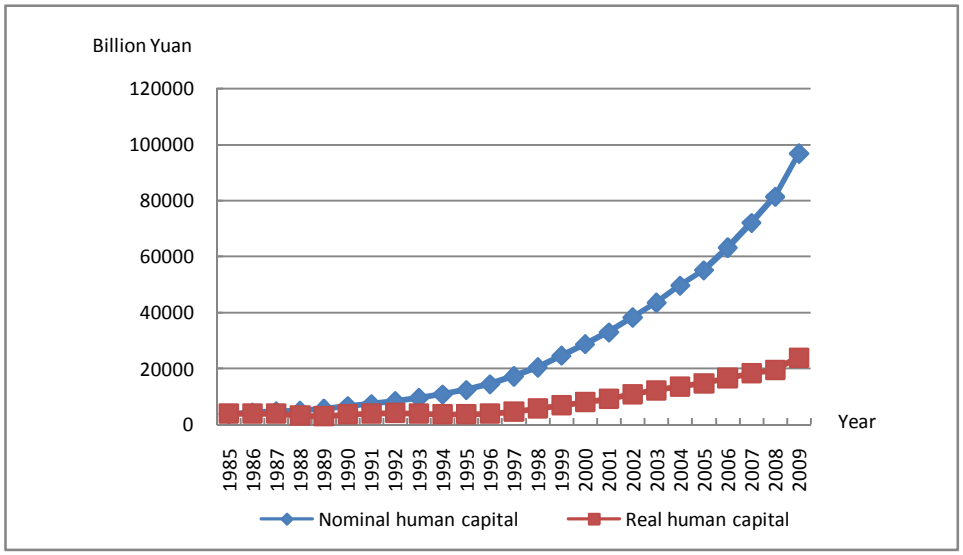


Figure GD-1.1 Nominal and Real Human Capital for Guangdong

In order to get a sense of the magnitude of the human capital in Guangdong, we also present the ratio of nominal human capital to nominal GDP in Table GD-1.1.[82] Similar to physical capital, human capital plays an important role in GDP growth, so the ratio could also reflect human capital's influence on sustainable growth of GDP. As is shown in Figure GD-1.2, nominal human capital is substantially higher than nominal GDP for Guangdong. The ratio of human capital to GDP in Guangdong from 1990 to 1995 decreased at a considerable rate, the ratio increased slowly from 1995 to 2000.

[82] The reason for calculating the ratio at the nominal level is to avoid the differences between the real value of human capital and that of GDP caused by using different deflator indices.

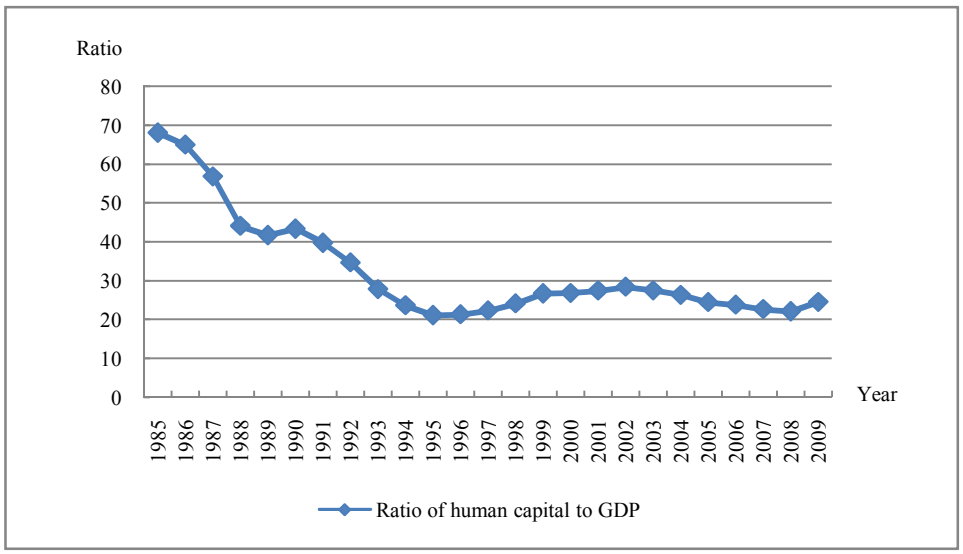


Figure GD-1.2 Ratio of Human Capital to GDP for Guangdong

In order to discuss the trend of human capital, we calculate the real values here by CPI. Table GD-1.2 shows real human capital for Guangdong by gender, and by urban or rural areas. The results based on five education categories show that the human capital for Guangdong during 1985 to 2009 kept growing rapidly. More specifically, the human capital for Guangdong increased from 3.9 trillion Yuan to 23.99 trillion Yuan (calculated by 1985 comparable price), which had increased by 5 times. The annual growth rate of human capital over this period increased to 7.53%.[83]

From 1985 to 2009, human capital for male in Guangdong increased from 2.507 trillion Yuan to 14.332 trillion Yuan, the human capital for female in Guangdong increased from 1.424 trillion Yuan to 8.652 trillion

[83] 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.

Yuan. During the same period, the annual growth rates of human capital were 7.54% and 7.51 % for male and female respectively. The gender gap in the estimated human capital increased from 1.083 trillion Yuan in 1985 to 6.68 trillion Yuan in 2009. In 2009, the male human capital was about 1.8 times the amount of that for female in Guangdong.

From 1985 to 2009, rural human capital in Guangdong increased from 1.791 trillion Yuan to 3.342 trillion Yuan, the urban human capital in Guangdong increased from 2.14 trillion Yuan to 20.65 trillion Yuan. During the same period, the annual growth rates of human capital were 2.5% and 9.45 % for rural and urban areas respectively. The urban-rural gap in the estimated human capital increased from 0.349 trillion Yuan in 1985 to 17.308 trillion Yuan in 2009. In 2009, human capital in urban areas was about 6 times the amount of that in rural areas in Guangdong.

Table GD-1.2 Real Human Capital by Gender and Urban-Rural for Guangdong[84]

Year	Total	Male	Female	Urban	Rural
1985	3931	2507	1424	2140	1791
1986	4134	2647	1488	2268	1866
1987	4117	2644	1474	2246	1871
1988	3369	2155	1214	1865	1504
1989	3120	1985	1134	1759	1361
1990	3752	2378	1375	2166	1586

[84] Some discrepancy may exist when summing up male and female, or urban and rural to get the total amount. This is mainly caused by rounding errors.

Year	Total	Male	Female	Urban	Rural
1991	4121	2615	1506	2389	1732
1992	4329	2752	1577	2533	1796
1993	4055	2587	1468	2408	1647
1994	3773	2418	1355	2291	1482
1995	3793	2437	1355	2444	1349
1996	4117	2645	1472	2709	1408
1997	4801	3089	1713	3319	1482
1998	5784	3724	2060	4179	1605
1999	7070	4547	2522	5316	1754
2000	8097	5207	2890	6228	1869
2001	9334	6009	3325	7319	2015
2002	10965	7057	3909	8771	2194
2003	12369	8053	4322	10020	2349
2004	13716	8942	4779	11280	2436
2005	14902	9682	5222	12380	2522
2006	16768	10950	5820	14050	2718
2007	18433	12029	6400	15590	2843
2008	19706	12860	6845	16800	2906
2009	23992	15332	8652	20650	3342

Figure GD-1.3 shows that real human capital by five education categories keeps growing, and it grew even faster during 1996-2009. One reason why male real human capital is higher than female real human capital is the earlier retirement age for women (age 55 vs. age 60 for men based on China Labor Law). Accordingly, men have a longer time to generate income in the market. Another reason is higher educational attainment for men. Moreover, the male-female income gap has been on expanding. The results based on six education categories show the similar trends.

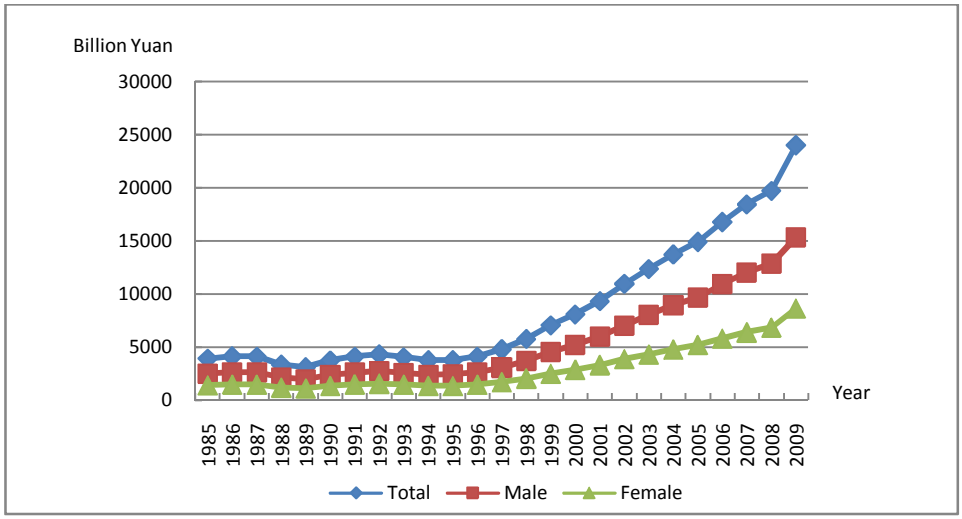


Figure GD-1.3 Real Human Capital by Gender for Guangdong

Figure GD-1.4 shows the real human capital for urban and rural areas separately. The urban human capital remained larger than that for rural from 1985 to 2009. Before 1997, human capital for urban areas was about 1-2 times the amount of that for rural areas. Since 1996, however, the real human capital in the urban area has been rising much more rapidly, while the real human capital in the rural area grew quite slowly, which results in a larger urban-rural gap.

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. Another reason is the enlarged education gap between the urban and rural population. Urban areas usually have a larger proportion of educated population than rural areas.

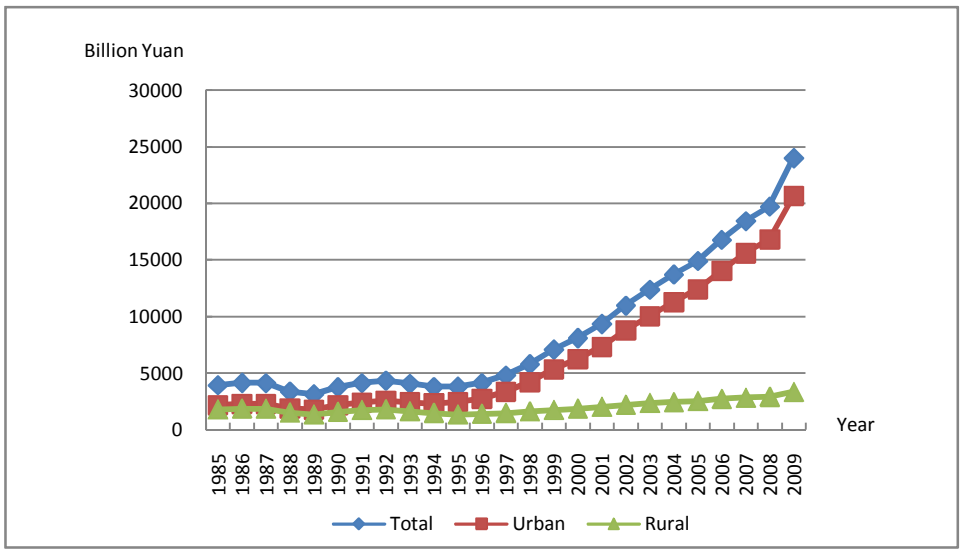


Figure GD-1.4 Real Human Capital by Urban-Rural for Guangdong

Finally we calculate real human capital indices using 1985 as the baseline year. The results for each group are reported in Table GD-1.3.

Table GD-1.3 Real Human Capital Index for Guangdong (1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	105.16	105.58	104.44	105.98	104.19
1987	104.73	105.46	103.46	104.95	104.47
1988	85.70	85.94	85.23	87.15	83.98
1989	79.37	79.19	79.62	82.20	75.99
1990	95.45	94.83	96.53	101.21	88.55
1991	104.83	104.31	105.72	111.64	96.71
1992	110.12	109.77	110.72	118.36	100.28
1993	103.15	103.19	103.05	112.52	91.96
1994	95.98	96.43	95.16	107.06	82.75
1995	96.49	97.21	95.16	114.21	75.32
1996	104.73	105.52	103.37	126.59	78.62
1997	122.13	123.21	120.28	155.09	82.75

1998	147.14	148.54	144.61	195.28	89.61
1999	179.85	181.37	177.11	248.41	97.93
2000	205.98	207.70	202.95	291.03	104.36
2001	237.45	239.69	233.47	342.01	112.51
2002	278.94	281.49	274.44	409.86	122.50
2003	314.65	321.22	303.45	468.22	131.16
2004	348.92	356.68	335.58	527.10	136.01
2005	379.09	386.20	366.64	578.50	140.82
2006	426.56	436.78	408.68	656.54	151.76
2007	468.91	479.82	449.35	728.50	158.74
2008	501.30	512.96	480.60	785.05	162.26
2009	610.33	611.57	607.50	964.95	186.60

Figure GD-1.5 shows the index of real total human capital for Guangdong. Before 1997 the index grows quite steadily; it accelerates after that year.

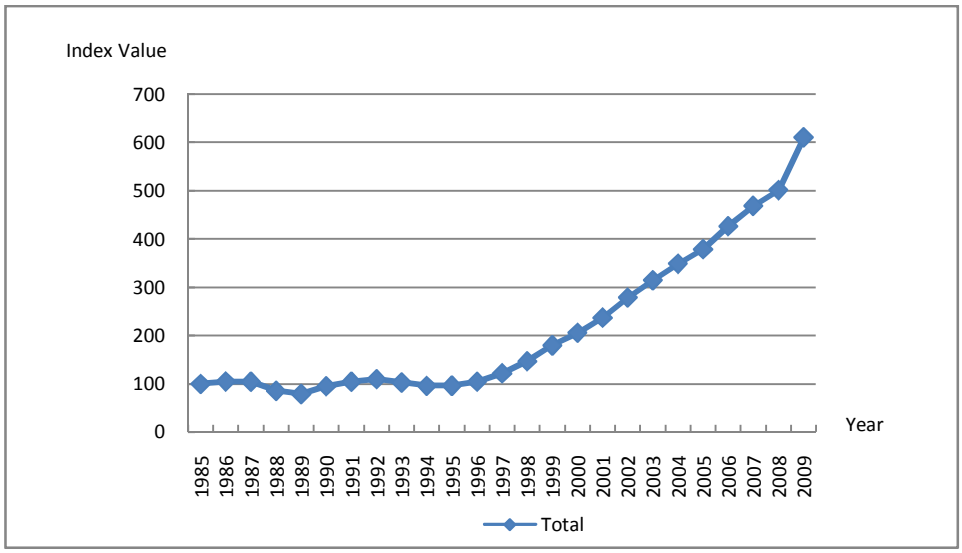


Figure GD-1.5 Real Human Capital Index for Guangdong

2. Per capita human capital

An increase in real human capital can be caused by a number of factors, such as population growth, demographic changes (e.g., the size of retirement group), urban-rural 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, and higher rates of return to on-the-job training. In order to get further information on the dynamics of human capital, we calculate per capita real human capital, i.e., the ratio of real human capital to non-retired population.

Table GD-2.1 shows the per capita human capital by gender for Guangdong. Based on the five education categories, per capita human capital real values for male increased from 69,878 Yuan to 327,342 Yuan, increased by around 4 times. Per capita human capital real values for female increased from 55,978 Yuan to 240,971 Yuan, increased by around 3 times. From1985 to 2009, the annual growth rate was 6.74% for male, and 6.08% for female.

Table GD-2.1 Per Capita Nominal and Real Human Capital by Gender for Guangdong

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	69.88	81.36	55.98	69.88	81.36	55.98
1986	77.25	90.36	61.39	73.59	86.10	58.48

1987	85.68	100.44	67.80	73.27	85.89	58.00
1988	95.43	112.58	75.11	63.07	74.36	49.65
1989	105.43	125.01	82.74	57.04	67.59	44.78
1990	117.35	139.90	91.77	65.11	77.60	50.93
1991	130.55	156.41	101.42	71.50	85.58	55.59
1992	145.63	175.01	112.56	74.25	89.17	57.46
1993	164.13	198.74	125.54	68.86	83.29	52.75
1994	184.05	224.12	139.48	63.46	77.23	48.15
1995	209.59	256.78	157.49	63.32	77.53	47.61
1996	238.55	292.76	178.94	67.32	82.60	50.54
1997	277.71	342.08	207.37	76.80	94.56	57.39
1998	323.49	399.05	240.84	90.86	112.07	67.69
1999	377.30	464.27	282.09	107.72	132.50	80.55
2000	426.20	525.85	317.81	119.50	147.45	89.10
2001	486.40	600.47	362.19	137.18	169.35	102.12
2002	558.40	688.98	416.09	159.49	196.84	118.81
2003	630.29	787.30	459.61	178.66	223.31	130.29
2004	713.85	893.07	519.07	196.70	246.23	143.03
2005	789.15	987.17	575.50	212.87	266.31	155.18
2006	890.10	1118.64	643.10	235.78	296.42	170.31
2007	1005.38	1262.13	727.54	256.82	322.34	185.73
2008	1122.40	1406.94	813.38	271.45	340.28	196.67
2009	1321.95	1655.91	974.11	327.34	410.07	240.97

Figure GD-2.1 shows the trend of per capita real human capital by gender. Per capita real human capital shows a similar trend for males and females. Per capita real human capital for male and female both exhibit an accelerated growth after 1996. The male-female gap has been widening.

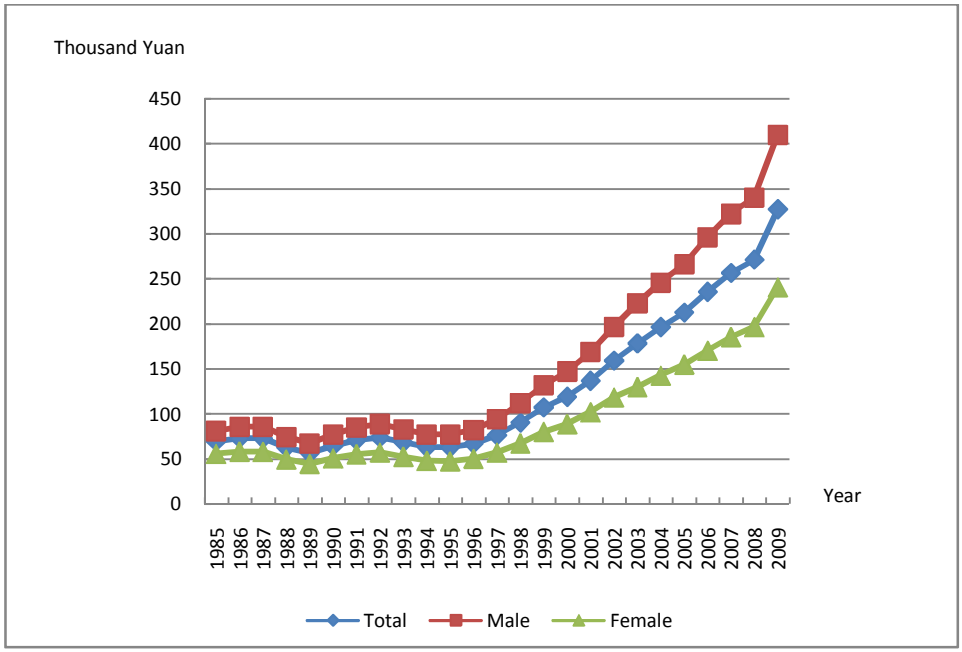


Figure GD-2.1 Per Capita Real Human Capital by Gender for Guangdong

Table GD-2.2 reports the results of per capita human capital measured in nominal and real terms for Guangdong by urban and rural separately. From 1985 to 2009, the per capita human capital in urban areas was significantly larger than that for rural. The per capita urban human capital increased from 108,766 Yuan to 419,698 Yuan, the rural per capita human capital increased from 48,999 Yuan to 138,607 Yuan. The per capita human capital in urban areas grew much faster than the one in rural areas.

Table GD-2.2 Per Capita Nominal and Real Human Capital by Urban-Rural for Guangdong

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	69.88	108.77	49.00	69.88	108.77	49.00
1986	77.25	120.67	53.78	73.59	115.25	51.07
1987	85.68	134.78	59.16	73.27	114.13	51.21
1988	95.43	150.82	65.00	63.07	98.61	43.52
1989	105.43	167.47	70.76	57.04	89.83	38.71
1990	117.35	188.20	77.12	65.11	103.64	43.22
1991	130.55	209.09	84.77	71.50	112.56	47.56
1992	145.63	233.79	93.02	74.25	116.10	49.28
1993	164.13	263.93	102.82	68.86	107.43	45.16
1994	184.05	296.24	113.44	63.46	99.66	40.68
1995	209.59	326.40	124.92	63.32	97.09	38.85
1996	238.55	372.72	137.99	67.32	103.41	40.30
1997	277.71	422.01	153.41	76.80	114.68	44.14
1998	323.49	476.89	170.77	90.86	131.84	50.08
1999	377.30	542.30	189.89	107.72	152.36	57.00
2000	426.20	592.40	211.37	119.50	162.85	63.45
2001	486.40	671.29	232.33	137.18	186.03	70.02
2002	558.40	768.49	255.06	159.49	215.99	77.96
2003	630.29	859.09	281.30	178.66	239.77	85.64
2004	713.85	964.90	311.28	196.70	262.48	91.39
2005	789.15	1051.58	342.17	212.87	280.45	97.81
2006	890.10	1171.16	382.13	235.78	306.82	107.52
2007	1005.38	1307.23	424.54	256.82	330.25	115.41
2008	1122.40	1443.04	471.82	271.45	345.55	121.23
2009	1321.95	1711.01	527.43	327.34	419.70	138.61

Figure GD-2.2 shows trends in per capita real human capital in urban and rural areas. During the period of 1985-2009, per capita real human

capital for urban and rural both exhibit an accelerated growth after 1996. Based on five education categories, the ratio of urban to rural increased from 2.22 in 1985 to 3.03 in 2009 and the absolute size of urban-rural gap has been on the rise. From 1985 to 2009, the annual growth rate was 5.63% for the urban area, and 4.33% for the rural area.

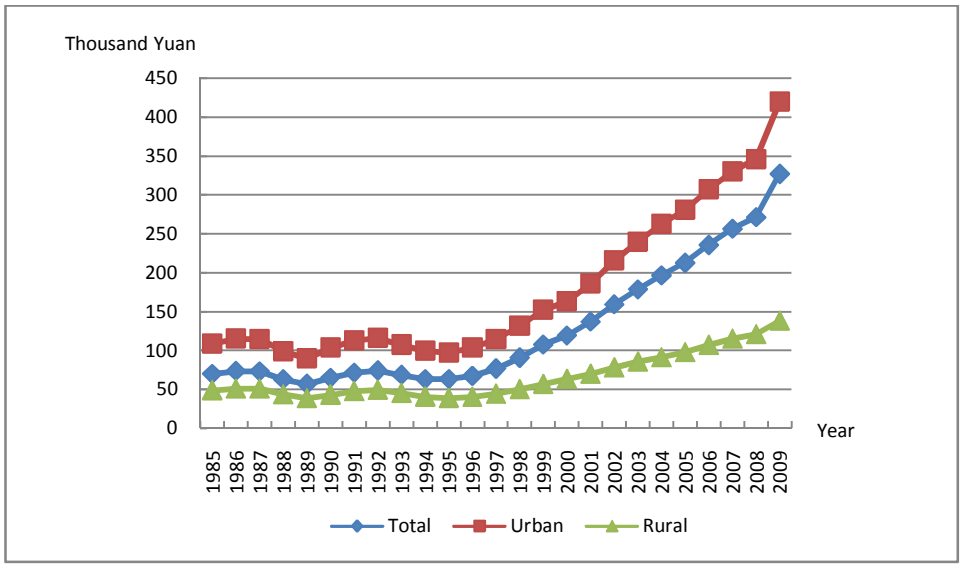


Figure GD-2.2 Per Capita Real Human Capital by Urban-Rural for Guangdong

Figure GD-2.3 shows the per capita real human capital index for Guangdong. As is seen from the graph below, per capita real human capital was essentially stable before 1996, but significant growth occurred after 1996.

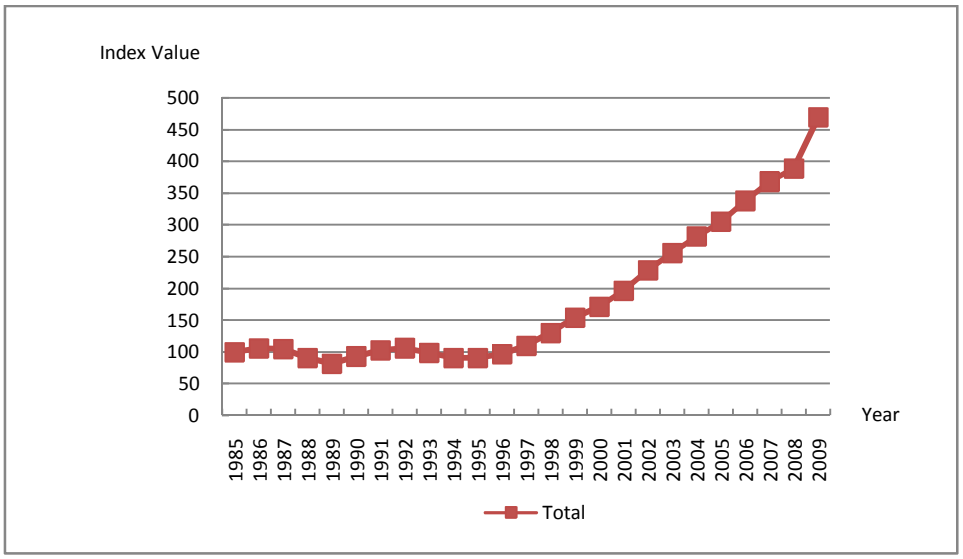


Figure GD-2.3 Per Capita Real Human Capital Index for Guangdong

3. Labor force human capital

3.1 Total labor force human capital

Labor force human capital represents the human capital of the population that is over 15 years old, non-retired and out-of-school. Labor force human capital is estimated in the same way as human capital. The labor force human capital is reported in Table GD-3.1. The real values in this table are calculated by deflating the nominal values with the CPI.

Table GD-3.1 Labor Force Human Capital and Nominal GDP for Guangdong

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of labor force human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	1694		1694		58	29.34
1986	1875		1786		67	28.09
1987	2072		1773		85	24.48
1988	2199		1453		116	19.03
1989	2535		1371		138	18.35
1990	2992		1660		156	19.19
1991	3311		1813		189	17.49
1992	3672		1873		245	15.00
1993	4051		1700		347	11.68
1994	4393		1516		462	9.51
1995	4957		1498		593	8.35
1996	5868		1657		684	8.59
1997	7215		1994		777	9.28
1998	8883		2493		853	10.41
1999	10924		3115		925	11.81
2000	13342	13255	3733	3709	1074	12.42
2001	14699	14641	4140	4123	1204	12.21
2002	16623	16615	4745	4742	1350	12.31
2003	18791	18861	5324	5344	1584	11.86
2004	20784	20832	5724	5736	1886	11.02
2005	23031	23094	6208	6223	2256	10.21
2006	26126	26199	6917	6937	2659	9.83
2007	29199	29298	7457	7482	3178	9.19
2008	32796	32920	7933	7962	3680	8.91
2009	34165	34284	8473	8503	3948	8.65

Note: The ratio of labor force human capital to GDP is based on the current values for that year.

The trends in nominal and real labor force human capital are presented in Figure GD-3.1. Similar to the trend of human capital, from 1985 to 2009, labor force human capital both in nominal and real terms have kept increasing.

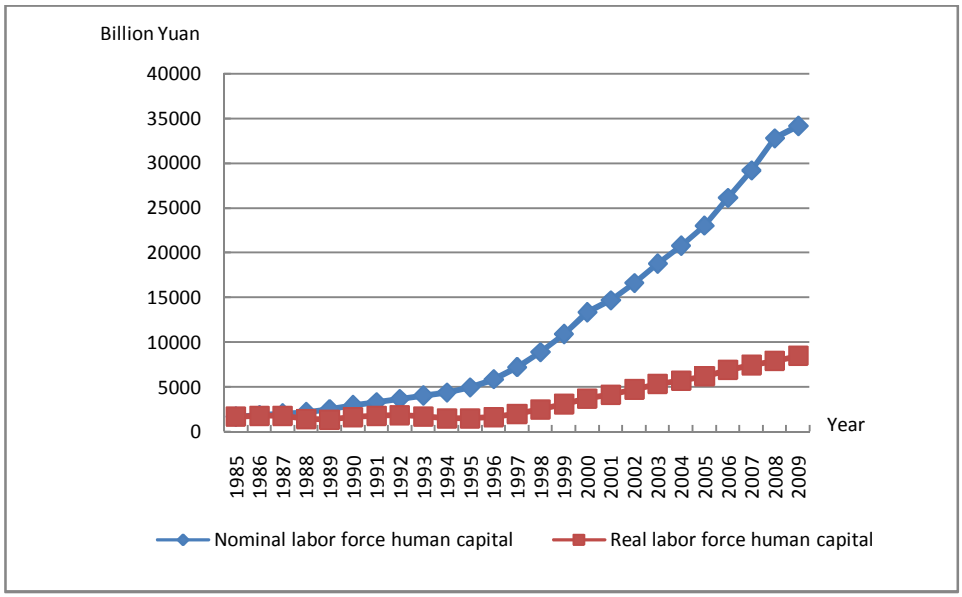


Figure GD-3.1 Nominal and Real Labor Force Human Capital for Guangdong

We also calculate the ratio of labor force human capital to GDP. The results are reported in the last column of Table GD-3.1. As before, the ratio could reflect human capital's influence on sustainable growth of GDP, and may also reflect changes in human capital productivity and efficiency. Figure GD-3.2 shows the trend for the ratio. The pattern of the ratio for labor force human capital is almost the same as that for human capital. The level of nominal labor force human capital is much higher than that of

nominal GDP. The ratio remains between 8 and 30 and generally shows a decreasing trend.

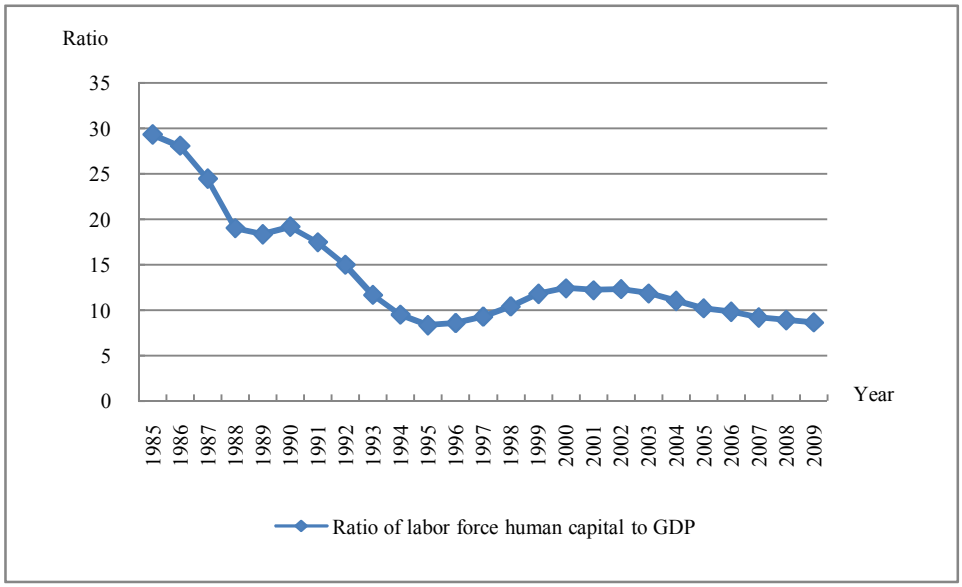


Figure GD-3.2 Ratio of Labor Force Human Capital to GDP for Guangdong

Table GD-3.2 shows the nominal and real labor force human capital for urban and rural respectively. The pattern of real labor force human capital is almost the same as that of the real human capital. The human capital for urban areas remains larger than that for rural areas from 1985 to 2009.

Table GD-3.2 Nominal and Real Labor Force Human Capital by Urban-Rural for Guangdong

Year	Per capita nominal human capital (Billions of Yuan)			Per capita real human capital (Billions of 1985 Yuan)		
	Total	**Urban**	**Rural**	**Total**	**Urban**	**Rural**
1985	1694	897	797	1694	897	797
1986	1875	992	883	1786	948	839
1987	2072	1093	979	1773	926	848
1988	2199	1192	1007	1453	779	674

1989	2535	1420	1115	1371	761	610
1990	2992	1735	1257	1660	955	705
1991	3311	1941	1370	1813	1045	768
1992	3672	2185	1487	1873	1085	788
1993	4051	2446	1605	1700	996	705
1994	4393	2686	1707	1516	904	612
1995	4957	3224	1733	1498	959	539
1996	5868	3906	1962	1657	1084	573
1997	7215	5106	2109	1994	1387	607
1998	8883	6631	2252	2493	1833	660
1999	10924	8522	2402	3115	2394	721
2000	13342	10760	2582	3733	2958	775
2001	14699	11970	2729	4140	3318	822
2002	16623	13710	2913	4745	3854	891
2003	18791	15650	3141	5324	4368	956
2004	20784	17530	3254	5724	4769	955
2005	23031	19620	3411	6208	5233	975
2006	26126	22360	3766	6917	5857	1060
2007	29199	25030	4169	7457	6324	1133
2008	32796	28210	4586	7933	6755	1178
2009	34165	28840	5325	8473	7074	1399

Figure GD-3.3 shows real labor force human capital for urban and rural areas respectively. The pattern of labor force human capital is almost the same as that of real human capital. The urban labor force human capital remains larger than the rural one during 1985 to 2009.

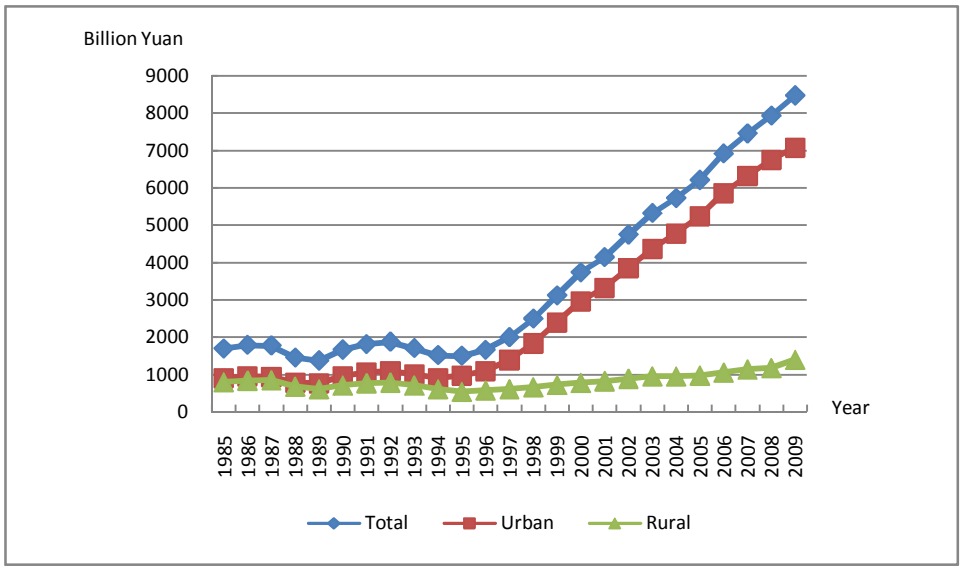


Figure GD-3.3 Real Labor Force Human Capital by Urban-Rural for Guangdong

3.2 Average labor force human capital

Similar to the analysis of per capita human capital above, we calculate the labor force human capital per capita. Here the average labor force human capital means labor force human capital divided by the number of the population that are over 15 years old, non-retired and out of school.

Table GD-3.3 reports the real average labor force human capital by gender. Additionally, the table shows that the real average labor force human capital for female was smaller than that for male.

Table GD-3.3 Nominal and Real Average Labor Force Human Capital by Gender for Guangdong

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	50.94	59.24	40.52	50.94	59.24	40.52
1986	56.38	65.93	44.45	53.71	62.80	42.34
1987	62.17	72.96	48.64	53.20	62.45	41.61
1988	69.06	81.47	53.94	45.64	53.86	35.66
1989	76.73	90.96	60.01	41.51	49.21	32.47
1990	85.30	101.73	66.65	47.32	56.44	36.99
1991	93.85	112.65	72.79	51.40	61.66	39.90
1992	102.81	123.92	79.36	52.43	63.16	40.53
1993	113.25	137.74	86.40	47.54	57.77	36.33
1994	123.19	150.65	93.43	42.51	51.95	32.27
1995	139.30	171.64	104.84	42.10	51.85	31.71
1996	160.07	198.28	119.13	45.20	55.96	33.66
1997	189.26	235.34	140.02	52.30	65.03	38.73
1998	223.57	278.79	165.13	62.75	78.23	46.36
1999	259.52	323.82	191.82	74.00	92.33	54.71
2000	298.10	372.98	219.51	83.41	104.36	61.42
2001	327.13	412.43	237.94	92.15	116.15	67.03
2002	364.18	461.12	263.33	103.94	131.58	75.13
2003	407.95	519.87	292.22	115.59	147.25	82.78
2004	453.34	579.40	322.66	124.86	159.61	88.84
2005	503.42	644.97	356.54	135.70	173.86	96.11
2006	557.47	718.52	390.10	147.59	190.28	103.27
2007	613.90	791.79	428.42	156.78	202.18	109.40
2008	677.57	872.90	472.36	163.90	211.17	114.23
2009	741.68	954.36	526.48	183.94	236.75	130.47

Table GD-3.4 reports the real average labor force human capital by area. The real average labor force human capital was much smaller in rural area than in urban area.

Table GD-3.4 Nominal and Real Average Labor Force Human Capital by Urban-Rural for Guangdong

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	50.94	70.17	38.98	50.94	70.17	38.98
1986	56.38	77.94	42.94	53.71	74.44	40.78
1987	62.17	86.37	47.31	53.20	73.13	40.95
1988	69.06	97.03	51.36	45.64	63.44	34.39
1989	76.73	109.66	55.39	41.51	58.82	30.30
1990	85.30	123.81	59.77	47.32	68.18	33.50
1991	93.85	135.84	65.23	51.40	73.13	36.59
1992	102.81	148.95	70.81	52.43	73.97	37.51
1993	113.25	163.60	77.06	47.54	66.59	33.85
1994	123.19	177.59	83.29	42.51	59.74	29.87
1995	139.30	196.36	90.42	42.10	58.41	28.12
1996	160.07	227.70	100.62	45.20	63.18	29.38
1997	189.26	264.09	112.25	52.30	71.77	32.29
1998	223.57	304.41	124.86	62.75	84.16	36.62
1999	259.52	344.68	138.09	74.00	96.84	41.45
2000	298.10	386.46	153.19	83.41	106.24	45.98
2001	327.13	418.91	166.05	92.15	116.09	50.04
2002	364.18	464.78	180.46	103.94	130.63	55.16
2003	407.95	518.00	198.00	115.59	144.57	60.28
2004	453.34	572.61	214.82	124.86	155.77	63.07
2005	503.42	630.33	234.48	135.70	168.11	67.03
2006	557.47	686.49	264.02	147.59	179.85	74.29
2007	613.90	745.87	296.46	156.78	188.43	80.59
2008	677.57	815.25	332.29	163.90	195.22	85.38
2009	741.68	900.84	378.62	183.94	220.97	99.50

Chapter 17 Human capital for Guizhou

1. Total human capital

Human capital stocks of Guizhou are calculated using estimated income parameters and a 4.58% discount rate. The results are ported in Table GZ-1.1. Column 1 and column 2 contain the nominal human capital; column 3 and column 4 contain the real human capital deflated by CPI (in 1985 Yuan).[85]

Table GZ-1.1 Nominal and Real Human Capital, Nominal GDP for Guizhou

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	593		593		12	47.88
1986	669		633		14	47.95
1987	783		683		17	47.28
1988	858		627		21	40.53
1989	978		603		24	41.48
1990	1153		698		26	44.30
1991	1195		696		30	40.40
1992	1359		733		34	39.99
1993	1562		726		42	37.39

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

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1994	1782		675		52	33.97
1995	2057		641		64	32.34
1996	2350		668		72	32.49
1997	2712		745		81	33.66
1998	3107		852		86	36.20
1999	3562		984		94	37.99
2000	4264	4278	1183	1187	103	41.40
2001	4582	4591	1247	1249	113	40.43
2002	5200	5213	1429	1432	124	41.82
2003	5889	5906	1598	1602	143	41.29
2004	6697	6726	1746	1753	168	39.92
2005	7284	7318	1880	1890	198	36.81
2006	8077	8112	2050	2059	227	35.57
2007	9097	9141	2173	2184	274	33.18
2008	10301	10359	2290	2304	333	30.90
2009	11599	11667	2613.5	2629	391	29.64

Note: The ratio of human capital to GDP is based on the current values for that year.

Figure GZ-1.1 graphs real and nominal human capital for Guizhou reported in Table GZ-1.1 As is seen from the figure, both the nominal and real human capital rise steadily and nominal human capital grows faster than real human capital.

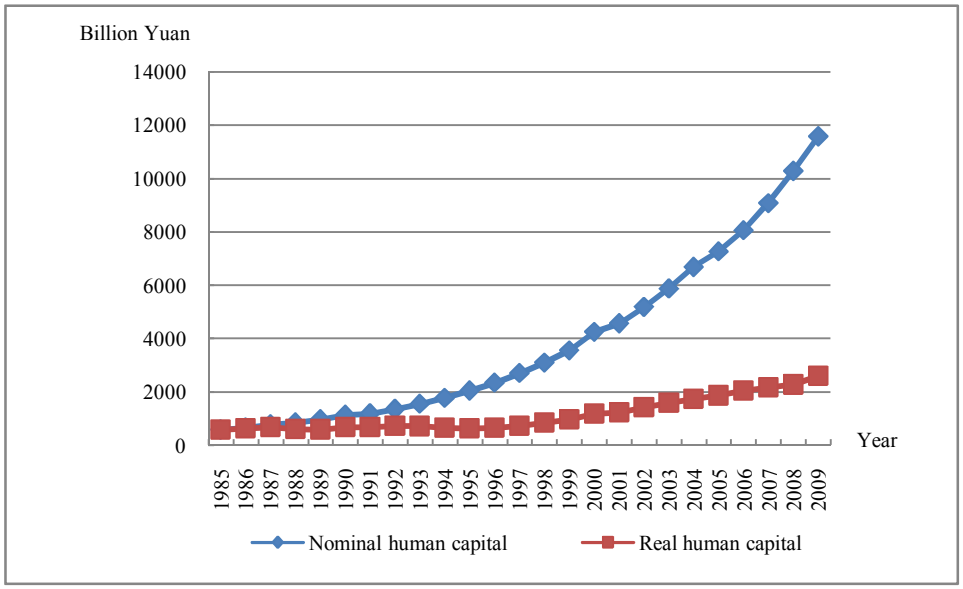


Figure GZ-1.1 Nominal and Real Human Capital for Guizhou

In order to get a sense of the magnitude of the human capital in Guizhou, we also present the ratio of nominal human capital to nominal GDP in Table GZ-1.1.[86] Similar to physical capital, human capital plays an important role in GDP growth, so the ratio could also reflect human capital's influence on sustainable growth of GDP. As is shown in Figure GZ-1.2, nominal human capital is substantially higher than nominal GDP for Guizhou. There are three stages in this series: Downwards from 1985 through 1995, upwards from 1996 through 2000, and finally downward from 2002 through 2009.

[86] The reason for calculating the ratio at the nominal level is to avoid the differences between the real value of human capital and that of GDP caused by using different deflator indices.

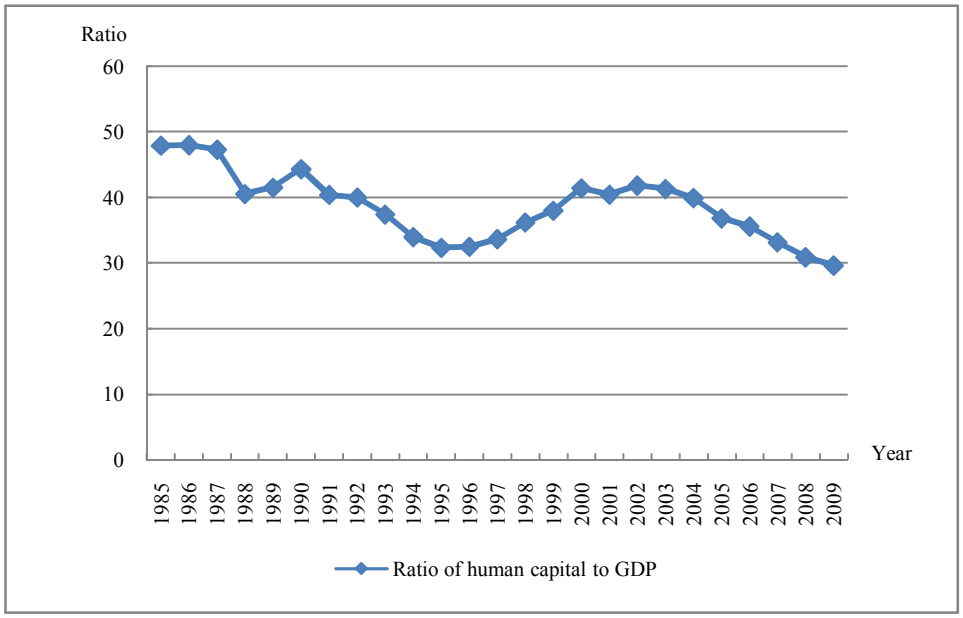


Figure GZ-1.2 Ratio of Human Capital to GDP for Guizhou

In order to discuss the trend of human capital, we calculate the real values here by CPI. Table GZ-1.2 shows real human capital for Guizhou by gender, and by urban or rural areas. The results based on five education categories show that the human capital for Guizhou during 1985 to 2009 kept growing rapidly. More specifically, the human capital for Guizhou increased from 0.59 trillion Yuan to 2.61 trillion Yuan (calculated by 1985 comparable price), it had increased by 3 times, the annual growth rate of human capital over this period increased to 6.18%.[87]

From 1985 to 2009, male human capital in Guizhou increased from 0.368 trillion Yuan to 1.635 trillion Yuan, the human capital for female in Guizhou increased from 0.226 trillion Yuan to 0.979 trillion Yuan. During the same period, the annual growth rates of human capital were 6.21% and

[87] 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.

6.11% for male and female respectively. The gender gap in the estimated human capital increased from 0.142 trillion Yuan in 1985 to 0.656 trillion Yuan in 2009. In 2009, the male human capital was about 1.7 times the amount of that for female in Guizhou.

From 1985 to 2009, rural human capital for Guizhou increased from 0.230 trillion Yuan to 0.638 trillion Yuan, the urban human capital in Guizhou increased from 0.363 trillion Yuan to 1.985 trillion Yuan. During the same period, the annual growth rates of human capital were 4.19% and 7.08% for rural and urban areas respectively. The urban-rural gap in the estimated human capital increased from 0.133 trillion Yuan in 1985 to 1.357 trillion Yuan in 2009. In 2009, the urban human capital was about 3 times the amount of that for rural in Guizhou. In an all, both gender and urban-rural gap of real human capital in Guizhou were expanding from 1985 to 2009.

Table GZ-1.2 Real Human Capital by Gender and Urban-Rural for Guizhou[88]

Billions of 1985 Yuan

Year	Total	Male	Female	Urban	Rural
1985	593	368	226	363	230
1986	633	393	241	388	245
1987	683	424	260	433	250
1988	627	388	239	374	252
1989	603	374	229	370	233
1990	698	434	263	446	252
1991	696	430	266	401	295
1992	733	455	278	425	308
1993	726	451	274	429	296

[88] Some discrepancy may exist when summing up male and female, or urban and rural to get the total amount. This is mainly caused by rounding errors.

Year	Total	Male	Female	Urban	Rural
1994	675	422	253	407	267
1995	641	398	243	402	239
1996	668	416	252	422	246
1997	745	466	280	480	265
1998	852	535	317	557	295
1999	984	623	362	656	328
2000	1183	742	441	818	365
2001	1247	782	465	851	397
2002	1429	896	532	991	437
2003	1598	1002	595	1129	469
2004	1746	1095	652	1259	487
2005	1880	1173	707	1386	494
2006	2050	1285	765	1512	538
2007	2173	1363	810	1620	553
2008	2290	1435	855	1727	563
2009	26134	1635	979	1985	629

Figure GZ-1.3 shows that real human capital by five education categories keeps growing, and it grew even faster during 1996-2009. One reason male real human capital is higher than female real human capital is the earlier retirement age for women (age 55 vs. age 60 for men based on China Labor Law). Accordingly, men have a longer time to generate income in the market. Another reason is higher educational attainment for men. Moreover, the male-female income gap has been on expanding. The results based on six education categories show similar trends.

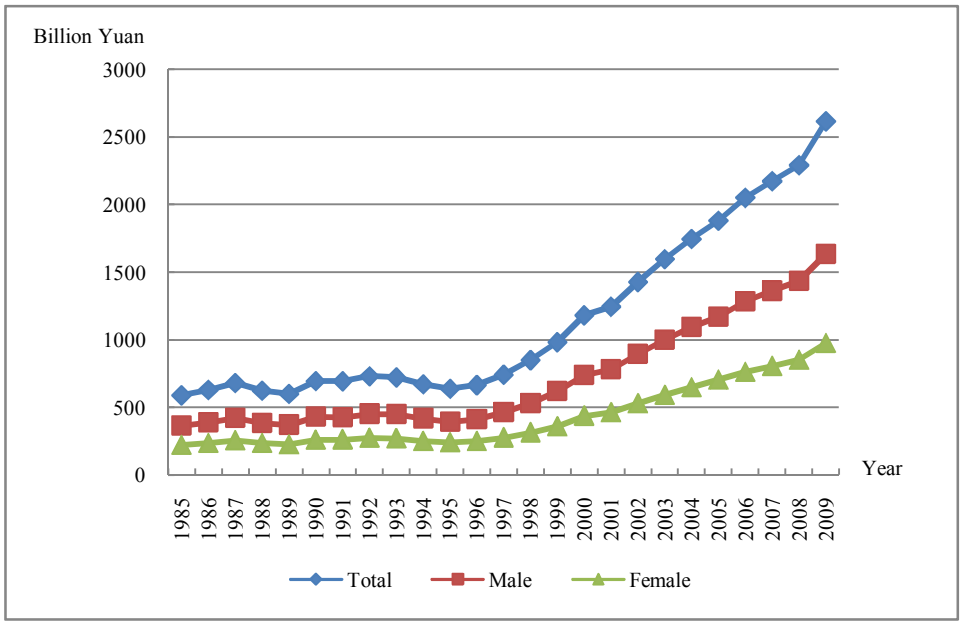


Figure GZ-1.3 Real Human Capital by Gender for Guizhou

Figure GZ-1.4 shows the real human capital for urban and rural separately. The urban human capital remained larger than that for rural from 1985 to 2009. Before 1997, the urban human capital was about 1.5-2 times the amount of that for rural. Since 1997, however, the real human capital in the urban area has been rising much more rapidly, while the real human capital in the rural area grew quite slowly, which results in a larger urban-rural gap.

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. Another reason is the education gap between the urban and rural population. Urban areas usually have a larger proportion of educated population than rural areas.

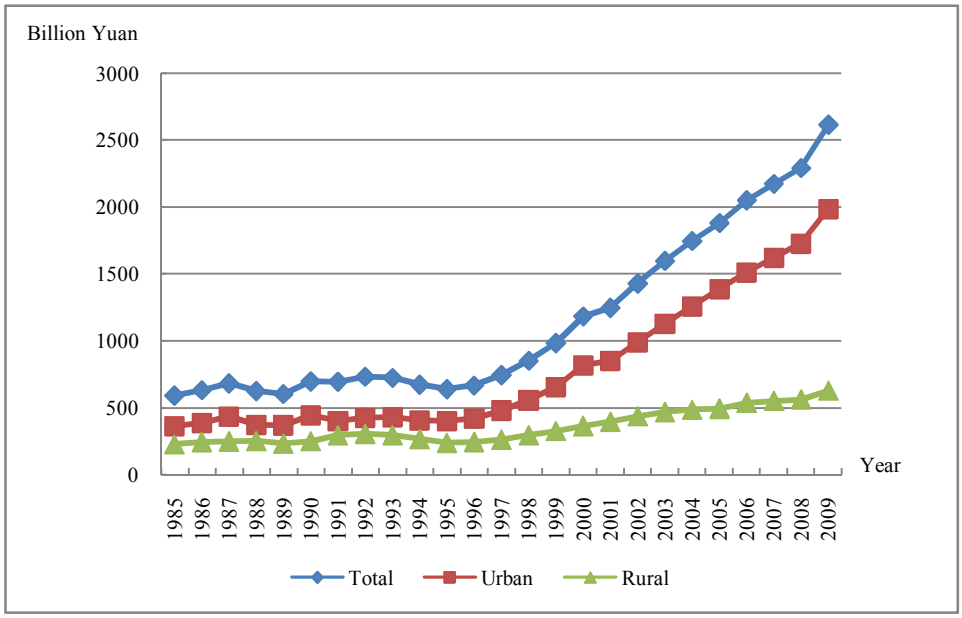


Figure GZ-1.4 Real Human Capital by Urban-Rural for Guizhou

Finally we calculate real human capital indices using 1985 as the baseline year. The results for each group are reported in Table GZ-1.3.

Table GZ-1.3 Real Human Capital Index for Guizhou (1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	106.71	106.77	106.64	106.80	106.56
1987	115.17	115.23	115.16	119.27	108.69
1988	105.63	105.49	105.89	103.08	109.65
1989	101.70	101.77	101.61	101.93	101.35
1990	117.58	118.14	116.71	122.82	109.30
1991	117.31	117.02	117.82	110.38	128.25
1992	123.53	123.66	123.40	117.02	133.81
1993	122.32	122.76	121.63	118.20	128.81
1994	113.69	114.74	112.01	112.17	116.08
1995	108.01	108.10	107.90	110.68	103.78

1996	112.61	113.08	111.87	116.27	106.82
1997	125.62	126.65	124.02	132.27	115.12
1998	143.62	145.39	140.74	153.36	128.25
1999	165.92	169.32	160.43	180.73	142.55
2000	199.43	201.88	195.50	225.33	158.54
2001	210.18	212.67	206.19	234.17	172.32
2002	240.81	243.79	235.99	272.94	190.09
2003	269.29	272.59	263.92	310.85	203.69
2004	294.29	297.69	289.07	346.64	211.65
2005	316.91	319.12	313.50	381.61	214.78
2006	345.53	349.58	339.17	416.30	233.81
2007	366.19	370.79	358.99	446.04	240.16
2008	386.04	390.29	379.04	475.50	244.85
2009	440.50	444.60	433.93	546.53	273.14

Figure GZ-1.5 shows the index of real total human capital for Guizhou. Before 1997 the index grows quite steadily; it accelerates after that year.

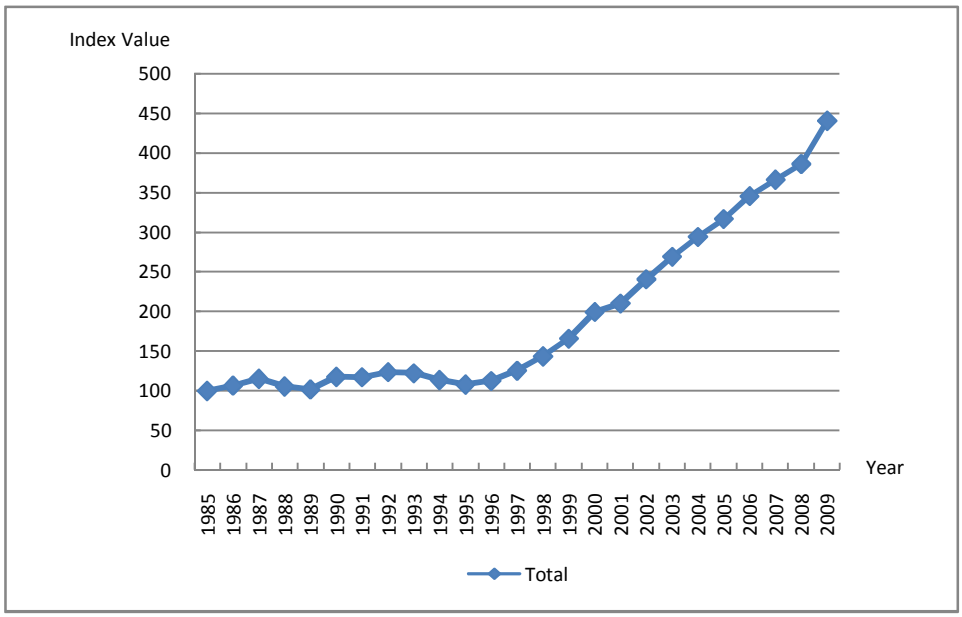


Figure GZ-1.5 Real Human Capital Index for Guizhou

2. Per capita human capital

An increase in real human capital can be caused by a number of factors, such as population growth, demographic changes (e.g., the size of retirement group), urban-rural 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, and higher rates of return to on-the-job training. In order to get further information on the dynamics of human capital, we calculate per capita real human capital, i.e., the ratio of real human capital to non-retired population.

Table GZ-2.1 shows the per capita human capital by gender for Guizhou. Based on the five education categories, per capita human capital real values for male increased from 25,910 Yuan to 94,730 Yuan, increasing by around 3 times; per capita human capital real values for female increased from 17,260 Yuan to 65,450 Yuan, increasing by around 3 times. From1985 to 2009, the annual growth rate was 5.40% for male, and 5.55% for female.

Table GZ-2.1 Per Capita Nominal and Real Human Capital by Gender for Guizhou

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	21.77	25.91	17.26	21.77	25.91	17.26
1986	24.21	28.87	19.16	22.91	27.30	18.14
1987	27.93	33.39	22.04	24.39	29.12	19.29

1988	29.86	35.40	23.76	21.80	25.79	17.42
1989	33.68	39.78	26.90	20.77	24.48	16.65
1990	38.52	45.50	30.71	23.31	27.49	18.64
1991	39.39	46.17	31.79	22.93	26.84	18.56
1992	44.34	51.98	35.73	23.91	27.98	19.32
1993	50.48	59.19	40.61	23.45	27.46	18.91
1994	57.09	67.22	45.58	21.61	25.42	17.29
1995	64.90	75.87	52.46	20.21	23.63	16.35
1996	73.34	86.10	58.95	20.85	24.46	16.78
1997	83.63	98.24	67.02	22.98	26.97	18.44
1998	94.81	111.42	75.77	26.00	30.52	20.81
1999	107.58	126.79	85.29	29.73	35.01	23.60
2000	124.16	145.38	99.62	34.45	40.33	27.66
2001	135.51	159.03	108.48	36.88	43.25	29.56
2002	153.11	180.09	122.28	42.07	49.44	33.62
2003	173.10	203.81	138.01	46.96	55.27	37.47
2004	196.91	231.78	157.20	51.34	60.44	41.01
2005	223.17	261.85	179.23	57.61	67.60	46.26
2006	248.58	292.51	198.46	63.09	74.26	50.38
2007	281.43	330.28	225.34	67.21	78.92	53.80
2008	318.16	371.93	256.13	70.74	82.70	56.90
2009	360.13	420.24	290.74	81.14	94.73	65.45

Figure GZ-2.1 shows the trend of per capita real human capital by gender. Per capita real human capital shows a similar trend for males and females. Per capita real human capital for male and female both exhibit an accelerated growth after 1996. The male-female gap has been widening.

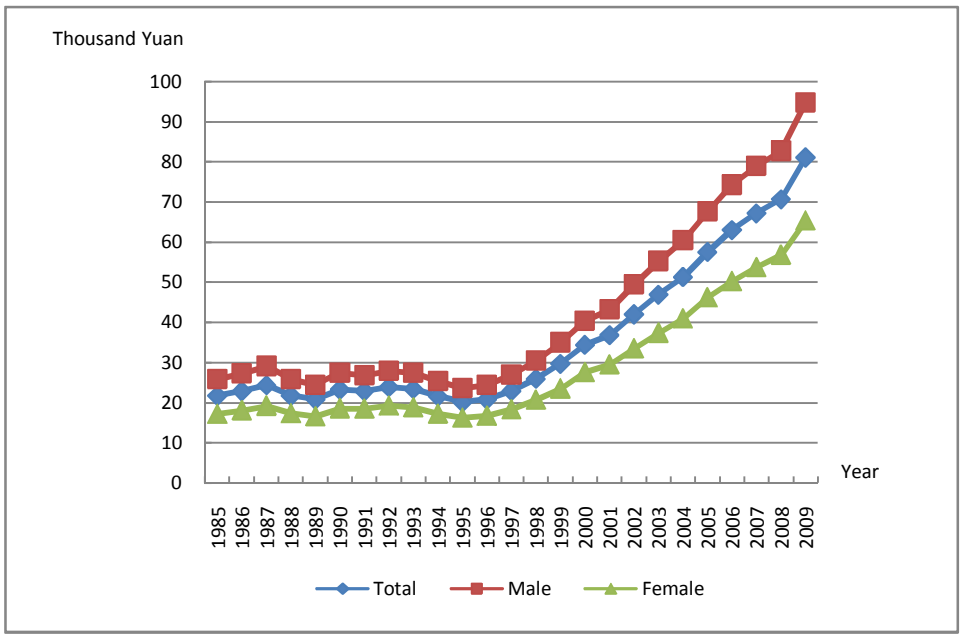


Figure GZ-2.1 Per Capita Real Human Capital by Gender for Guizhou

Table GZ-2.3 reports the results of per capita human capital measured in nominal and real terms for Guizhou by urban and rural separately. From 1985 to 2009, the per capita human capital in urban areas was significantly larger than that for rural. The per capita urban human capital increased from 44,630 Yuan to 193,620 Yuan, the per capita rural human capital increased from 12,040 Yuan to 28,620 Yuan. The per capita human capital in urban areas grew much faster than the one for rural.

Table GZ-2.2 Per Capita Nominal and Real Human Capital by Urban-Rural for Guizhou

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	21.77	44.63	12.04	21.77	44.63	12.04
1986	24.21	49.39	13.30	22.91	46.41	12.71
1987	27.93	54.50	14.77	24.39	46.69	13.35
1988	29.86	61.23	16.30	21.80	43.17	12.57
1989	33.68	68.22	17.99	20.77	40.80	11.67
1990	38.52	76.32	19.88	23.31	45.15	12.55
1991	39.39	87.78	22.00	22.93	49.98	13.21
1992	44.34	99.15	24.38	23.91	51.93	13.70
1993	50.48	113.81	27.12	23.45	51.48	13.11
1994	57.09	129.30	30.06	21.61	47.94	11.76
1995	64.90	146.54	33.30	20.21	45.46	10.45
1996	73.34	167.37	36.66	20.85	46.95	10.67
1997	83.63	192.55	40.51	22.98	52.24	11.40
1998	94.81	219.91	44.64	26.00	59.36	12.62
1999	107.58	250.76	49.20	29.73	68.45	13.95
2000	124.16	278.51	54.50	34.45	76.63	15.42
2001	135.51	314.11	59.70	36.88	84.40	16.71
2002	153.11	357.16	65.37	42.07	97.04	18.42
2003	173.10	405.73	71.62	46.96	109.25	19.79
2004	196.91	464.35	78.71	51.34	120.81	20.65
2005	223.17	516.32	86.41	57.61	133.53	22.20
2006	248.58	582.52	95.79	63.09	148.28	24.13
2007	281.43	660.86	106.48	67.21	158.85	24.98
2008	318.16	747.90	118.26	70.74	168.01	25.50
2009	360.13	849.80	131.47	81.14	193.62	28.62

Figure GZ-2.2 shows trends in per capita real human capital in urban and rural areas. During the period of 1985-2009, per capita real human

capital for urban and rural both exhibit an accelerated growth after 1996. Based on five education categories, the ratio of urban to rural increased from 3.71 in 1985 to 6.77 in 2009, the absolute size of urban-rural gap has been on the rise. From 1985 to 2009, the annual growth rate was 6.11% for the urban area, and 3.61% for the rural area.

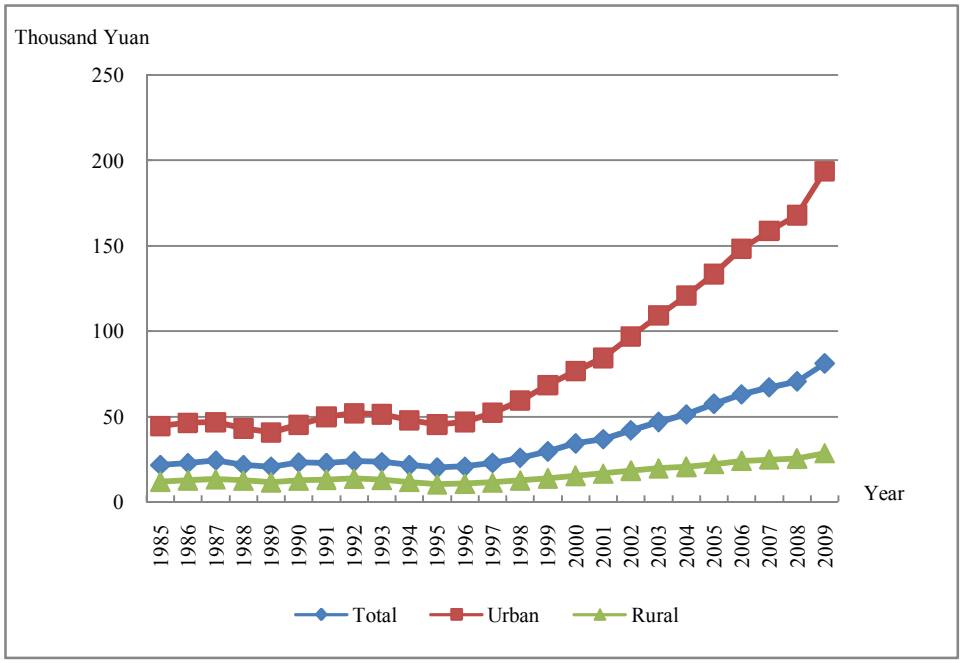


Figure GZ-2.2 Per Capita Real Human Capital by Urban-Rural for Guizhou

Figure GZ-2.3 shows the per capita real human capital index for Guizhou. As is seen from the graph below, per capita real human capital was essentially stable before 1996, but significant growth occurred after 1996.

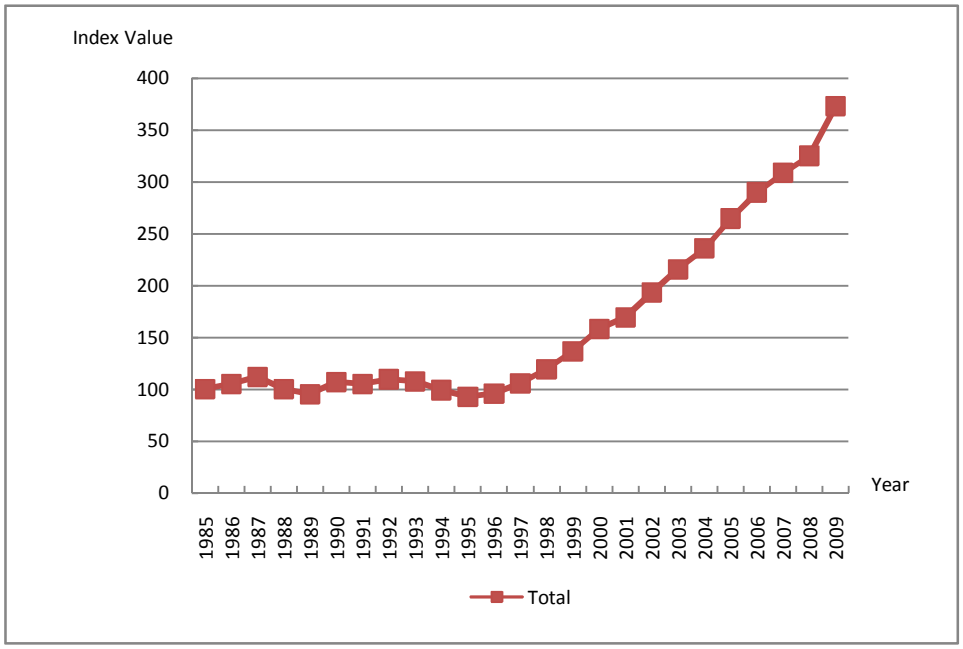


Figure GZ-2.3 Per Capita Real Human Capital Index for Guizhou

3. Labor force human capital

3.1 Total labor force human capital

Labor force human capital represents the human capital of the population that is over 15 years old, non-retired and out-of-school. Labor force human capital is estimated in the same way as human capital. The labor force human capital is reported in Table GZ-3.1. The real values in this table are calculated by deflating the nominal values with the CPI.

Table GZ-3.1 Labor Force Human Capital and Nominal GDP for Guizhou

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of labor force human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	251		251		12	20.21
1986	290		274		14	20.76
1987	348		304		17	21.00
1988	399		292		21	18.83
1989	475		293		24	20.16
1990	582		352		26	22.36
1991	603		352		30	20.39
1992	691		373		34	20.32
1993	787		366		42	18.83
1994	887		337		52	16.91
1995	1008		314		64	15.84
1996	1123		320		72	15.53
1997	1270		350		81	15.76
1998	1439		396		86	16.76
1999	1625		450		94	17.34
2000	1963	1385	546	392	103	19.06
2001	2020	1521	551	426	113	17.82
2002	2201	1661	607	468	124	17.70
2003	2427	1821	660	503	143	17.01
2004	2645	1952	690	512	168	15.77
2005	2842	1977	733	508	198	14.36
2006	3137	2242	795	565	227	13.81
2007	3462	2516	825	590	274	12.63
2008	3894	2840	862	612	333	11.68
2009	4389	3190	984	694	391	11.22

Note: The ratio of labor force human capital to GDP is based on the current values for that year.

The trends in nominal and real labor force human capital are presented in Figure GZ-3.1. Similar to the trend of human capital, from 1985 to 2009, labor force human capital both in nominal and real terms have kept on increasing.

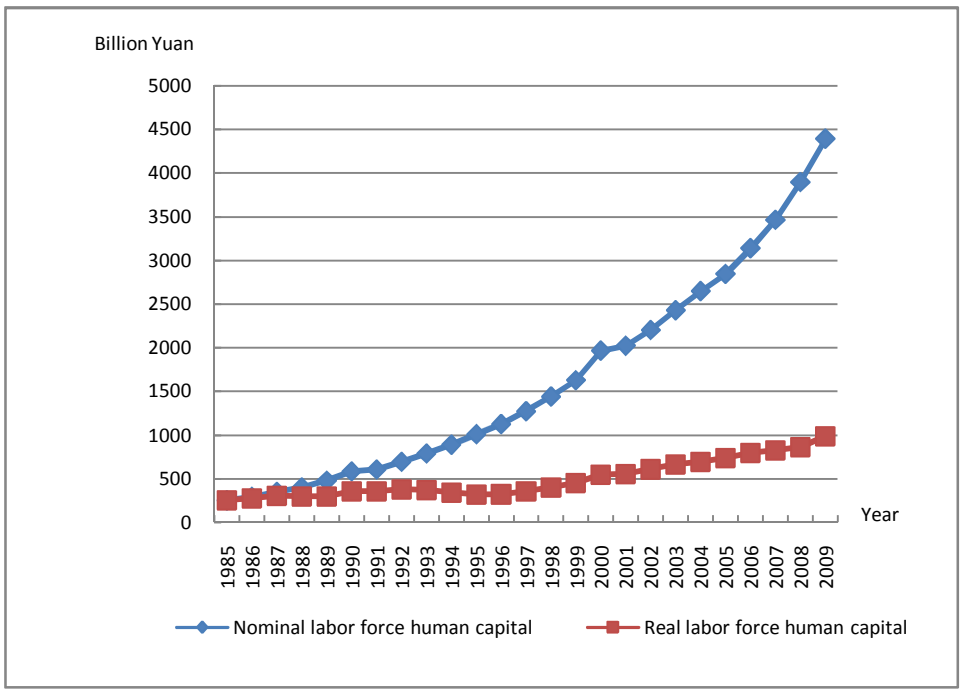


Figure GZ-3.1 Nominal and Real Labor Force Human Capital for Guizhou

We also calculate the ratio of labor force human capital to GDP. The results are reported in the last column of Table GZ-3.1. As before, the ratio could reflect human capital's influence on sustainable growth of GDP, and may also reflect changes in human capital productivity and efficiency. Figure GZ-3.2 shows the trend for the ratio. The pattern of the ratio for labor force human capital is almost the same as that for human capital. The

level of nominal labor force human capital is much higher than that of nominal GDP. The ratio remains between 10 and 21 and generally shows a decreasing trend.

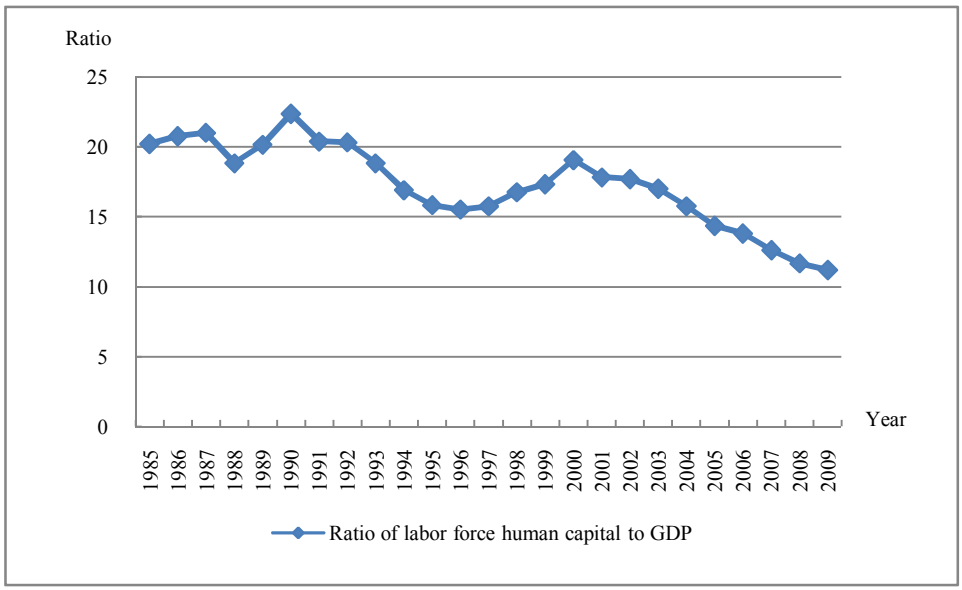


Figure GZ-3.2 Ratio of Labor Force Human Capital to GDP for Guizhou

Figure GZ-3.3 shows the nominal and real labor force human capital for urban and rural respectively. The pattern of real labor force human capital is almost the same as that of the real human capital. The urban human capital remains larger than that for rural from 1985 to 2009.

Table GZ-3.2 Real Labor Force Human Capital by Urban-Rural for Guizhou

Year	Nominal labor force human capital (Billions of Yuan)			Real labor force human capital (Billions of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	251	148	102	251	148	102
1986	290	172	117	274	162	112
1987	348	219	128	304	188	116
1988	399	242	157	292	170	121
1989	475	298	177	293	178	115
1990	582	381	200	352	226	126
1991	603	340	263	352	194	158
1992	691	391	299	373	205	168
1993	787	448	339	366	203	164
1994	887	507	380	337	188	149
1995	1008	584	423	314	181	133
1996	1123	653	470	320	183	137
1997	1270	746	524	350	202	148
1998	1439	858	581	396	232	164
1999	1625	988	637	450	270	181
2000	1963	1265	698	546	348	198
2001	2020	1253	767	551	337	215
2002	2201	1363	838	607	370	236
2003	2427	1508	919	660	406	254
2004	2645	1660	985	690	432	259
2005	2842	1845	997	733	477	256
2006	3137	2004	1133	795	510	285
2007	3462	2190	1272	825	526	298
2008	3894	2459	1435	862	552	309
2009	4389	2775	1614	984	632	351

Figure GZ-3.3 shows real labor force human capital for urban and rural respectively. The pattern of labor force human capital is almost the same as

that of real human capital. The rural labor force human capital grows relatively slower and is much less than the urban one.

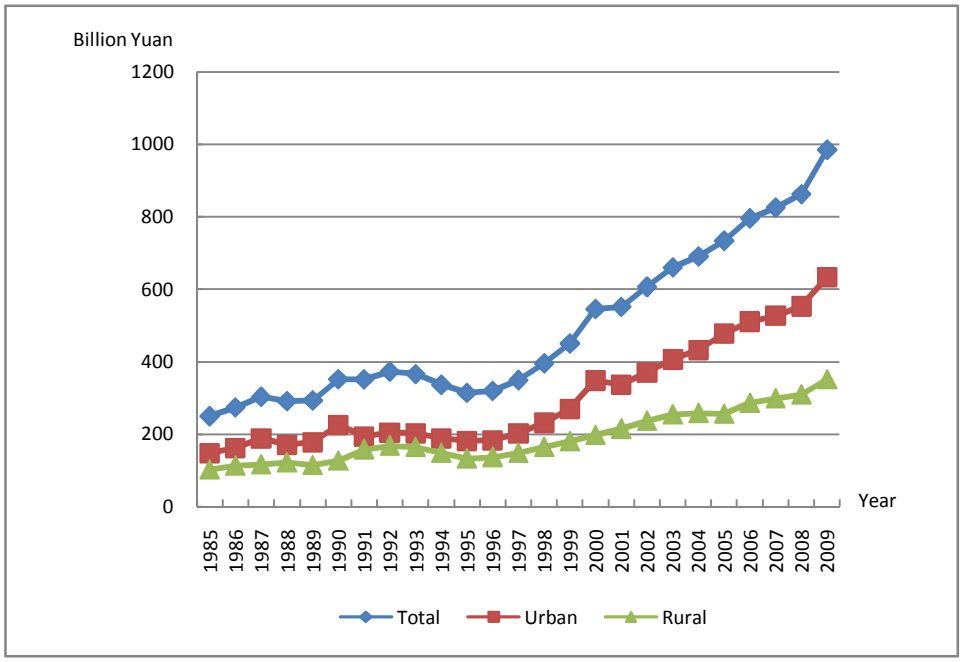


Figure GZ-3.3 Real Labor Force Human Capital by Urban-Rural for Guizou

3.2 Average labor force human capital

Similar to the analysis of per capita human capital above, we calculate the average labor force human capital. Here the average labor force human capital means labor force human capital divided by the number of the population that are over 15 years old, non-retired and out of school.

Table GZ-3.3 reports the real average labor force human capital classified by gender. And the average labor force human capital for female

was smaller than that for male. More specifically, the number for male was about 1.5 times that for female in 2009.

Table GZ-3.3 Nominal and Real Average Labor Force Human Capital by Gender for Guizhou

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	18.08	21.53	14.14	18.08	21.53	14.14
1986	20.13	23.93	15.86	19.05	22.65	15.02
1987	23.39	27.92	18.37	20.44	24.38	16.09
1988	25.34	30.04	20.05	18.53	21.92	14.71
1989	28.94	34.20	22.91	17.86	21.06	14.18
1990	33.38	39.37	26.42	20.20	23.80	16.03
1991	33.47	39.22	26.85	19.51	22.84	15.68
1992	37.38	43.86	29.91	20.19	23.66	16.20
1993	41.84	49.25	33.32	19.49	22.91	15.56
1994	46.45	54.75	36.92	17.63	20.76	14.04
1995	51.83	61.14	41.16	16.16	19.05	12.83
1996	57.44	67.86	45.45	16.36	19.32	12.97
1997	64.12	75.95	50.46	17.66	20.91	13.92
1998	71.81	85.47	55.96	19.75	23.49	15.42
1999	80.23	95.71	62.08	22.23	26.50	17.22
2000	93.11	111.69	71.27	25.88	31.02	19.83
2001	98.25	117.81	75.49	26.82	32.13	20.64
2002	106.94	128.64	82.06	29.47	35.42	22.64
2003	117.33	141.43	90.02	31.91	38.44	24.51
2004	128.69	155.39	98.58	33.59	40.55	25.74
2005	144.45	174.77	110.57	37.27	45.09	28.53
2006	158.85	192.15	121.36	40.28	48.73	30.76
2007	175.24	211.25	134.48	41.75	50.35	32.01
2008	195.48	234.43	150.93	43.26	51.91	33.36
2009	220.05	262.87	170.92	49.32	58.96	38.25

Table GZ-3.4 reports the real average labor force human capital by area. The real average labor force human capital was much smaller in rural area than in urban area.

Table GZ-3.4 Nominal and Real Average Labor Force Human Capital by Urban-Rural for Guizhou

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	18.08	32.23	11.06	18.08	32.23	11.06
1986	20.13	35.86	12.25	19.05	33.70	11.71
1987	23.39	40.28	13.62	20.44	34.51	12.31
1988	25.34	45.64	15.07	18.53	32.18	11.62
1989	28.94	51.70	16.62	17.86	30.92	10.79
1990	33.38	58.41	18.39	20.20	34.56	11.61
1991	33.47	65.18	20.54	19.51	37.11	12.34
1992	37.38	73.03	22.82	20.19	38.25	12.82
1993	41.84	82.20	25.38	19.49	37.18	12.27
1994	46.45	91.69	28.01	17.63	34.00	10.96
1995	51.83	102.20	30.85	16.16	31.71	9.68
1996	57.44	114.59	33.92	16.36	32.15	9.87
1997	64.12	129.35	37.33	17.66	35.09	10.51
1998	71.81	145.92	41.04	19.75	39.39	11.60
1999	80.23	163.66	44.82	22.23	44.67	12.70
2000	93.11	184.32	49.10	25.88	50.72	13.89
2001	98.25	202.02	53.42	26.82	54.28	14.95
2002	106.94	222.09	58.03	29.47	60.34	16.35
2003	117.33	245.81	63.16	31.91	66.19	17.45
2004	128.69	271.05	68.28	33.59	70.52	17.91
2005	144.45	300.36	73.69	37.27	77.68	18.93
2006	158.85	335.28	82.26	40.28	85.34	20.72
2007	175.24	372.38	91.70	41.75	89.51	21.51
2008	195.48	417.79	102.25	43.26	93.85	22.04
2009	220.05	475.51	114.40	49.32	108.34	24.91

Chapter 18 Human capital for Gansu

1. Total human capital

Human capital stocks of Gansu are calculated using estimated income parameters and a 4.58% discount rate. The results are ported in Table GS-1.1. Column 1 and column 2 contain the nominal human capital; column 3 and column 4 contain the real human capital deflated by CPI (in 1985 Yuan).[89]

Table GS-1.1 Nominal and Real Human Capital, Nominal GDP for Gansu

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	373		373		12	30.26
1986	425		399		14	30.20
1987	483		422		16	30.28
1988	545		403		19	28.42
1989	617		386		22	28.43
1990	705		428		24	29.04
1991	795		458		27	29.28
1992	894		482		32	28.12
1993	1020		477		37	27.40

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

Year	Nominal human capital (Billions of Yuan)		Real human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1994	1163		438		45	25.63
1995	1320		416		56	23.67
1996	1495		428		72	20.68
1997	1713		477		79	21.59
1998	1949		548		89	21.96
1999	2241		645		96	23.44
2000	2542	2545	734	734	105	24.14
2001	2899	2908	803	806	113	25.76
2002	3351	3363	929	932	123	27.20
2003	3855	3871	1057	1062	140	27.54
2004	4394	4416	1177	1183	169	26.02
2005	4949	4970	1303	1309	193	25.59
2006	5748	5782	1495	1505	228	25.24
2007	6491	6538	1601	1614	270	24.01
2008	7305	7363	1666	1680	318	23.00
2009	8409	8484	1896.3	1914.6	339	24.82

Note: The ratio of human capital to GDP is based on the current values for that year.

Figure GS-1.1 graphs real and nominal human capital for Gansu reported in Table GS-1.1 As is seen from the figure, both the nominal and real human capital rise steadily and nominal human capital grows faster than real human capital.

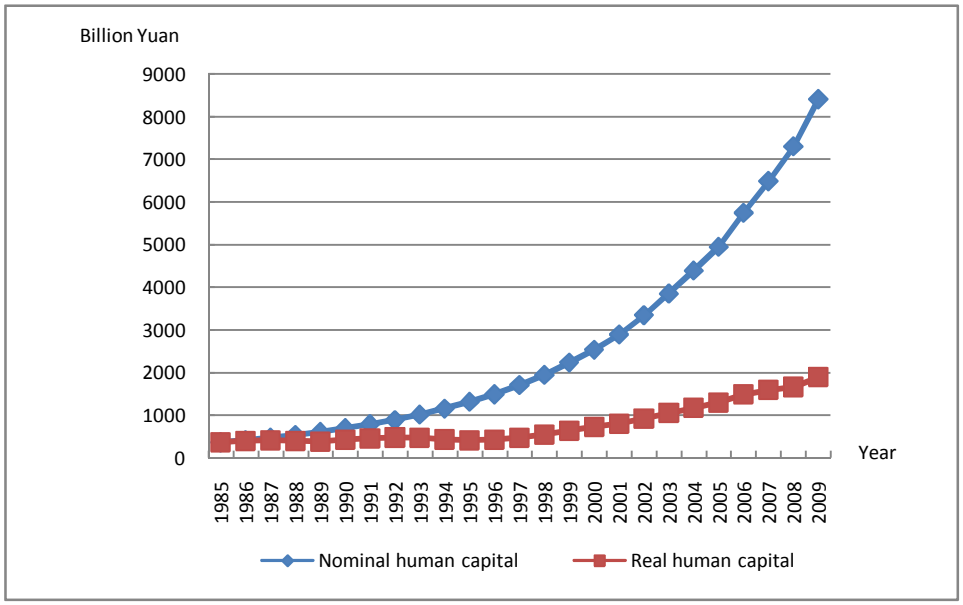


Figure GS-1.1 Nominal and Real Human Capital for Gansu

In order to get a sense of the magnitude of the human capital in Gansu, we also present the ratio of nominal human capital to nominal GDP in Table GS-1.1.[90] Similar to physical capital, human capital plays an important role in GDP growth, so the ratio could also reflect human capital's influence on sustainable growth of GDP. As is shown in Figure GS-1.2, nominal human capital is substantially higher than nominal GDP for Gansu. From 1985 to 1991, the ratio of human capital to GDP in Gansu almost remained the same except a slight drop in 1988 and 1989. The ratio decreased at a considerable rate after 1992 and then kept growing steadily from 1996 to 2003. After a slow decrease between 2003 and 2008, the ratio of human capital to GDP measured in nominal terms rise to 24.82 in 2009.

[90] The reason for calculating the ratio at the nominal level is to avoid the differences between the real value of human capital and that of GDP caused by using different deflator indices.

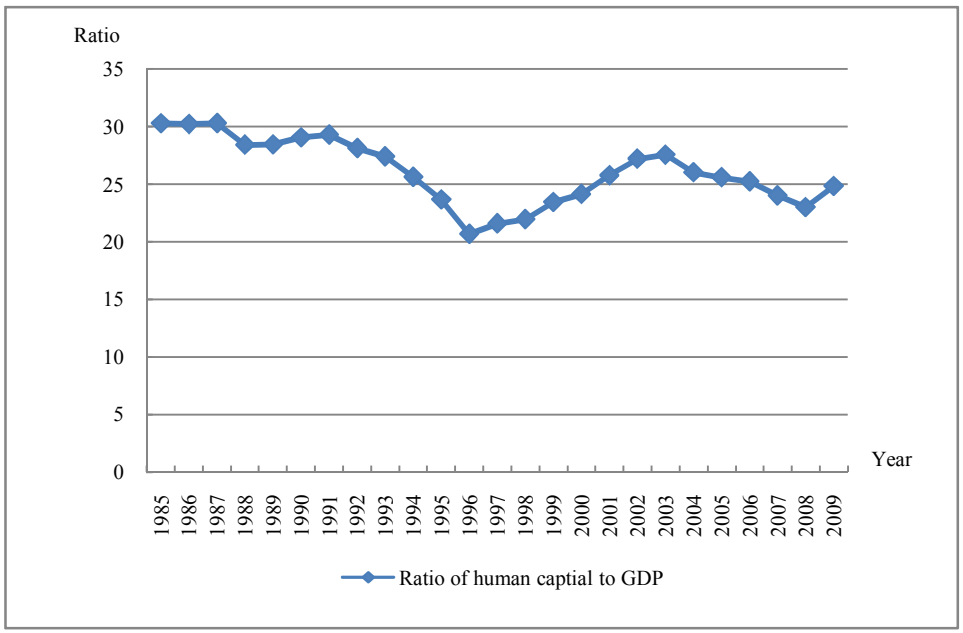


Figure GS-1.2 Ratio of Human Capital to GDP for Gansu

In order to discuss the trend of human capital, we calculate the real values here by CPI. Table GS-1.2 shows real human capital for Gansu by gender, and by urban or rural areas. The results based on five education categories show that the human capital for Gansu during 1985 to 2009 kept growing rapidly. More specifically, the human capital for Gansu increased from 0.373 trillion Yuan to 1.8963 trillion Yuan (calculated by 1985 comparable price), it had increased by 4 times. The annual growth rate of human capital over this period increased to 6.78%.

From 1985 to 2009, male human capital in Gansu increased from 0.225 trillion Yuan to 1.1643 trillion Yuan, while the human capital for female in Gansu increased from 0.148 trillion Yuan to 0.7323 trillion Yuan. During the same period, the annual growth rates of human capital were 6.85% and

6.67% for male and female respectively. The gender gap in the estimated human capital increased from 0.077 trillion Yuan in 1985 to 0.432 trillion Yuan in 2009. In 2009, the male human capital was about 1.6 times the amount of that for female in Gansu.

From 1985 to 2009, rural human capital in Gansu increased from 0.189 trillion Yuan to 0.5313 trillion Yuan, the urban human capital in Gansu increased from 0.185 trillion Yuan to 1.365 trillion Yuan. During the same period, the annual growth rates of human capital were 4.30% and 8.32% for rural and urban areas respectively. The urban-rural gap in the estimated human capital increased from -0.004 trillion Yuan in 1985 to 0.8337 trillion Yuan in 2009. In 2009, the urban human capital was about 2.6 times the amount of that for rural in Gansu. In an all, both gender and urban-rural gap of real human capital in Gansu were expanding from 1985 to 2009.

Table GS-1.2 Real Human Capital by Gender and Urban-Rural for Gansu[91]

Billions of 1985 Yuan

Year	Total	Male	Female	Urban	Rural
1985	373	225	148	185	189
1986	399	242	157	202	197
1987	422	257	165	215	207
1988	403	247	156	202	201
1989	386	238	148	194	193

[91] Some discrepancy may exist when summing up male and female, or urban and rural to get the total amount. This is mainly caused by rounding errors.

Year	Total	Male	Female	Urban	Rural
1990	428	264	164	217	210
1991	458	283	176	232	227
1992	482	298	185	244	239
1993	477	295	182	244	232
1994	438	271	167	225	213
1995	416	256	160	215	201
1996	428	264	163	222	206
1997	477	296	181	250	226
1998	548	339	209	290	258
1999	645	400	245	349	295
2000	734	455	279	403	331
2001	803	497	307	455	349
2002	929	577	352	551	378
2003	1057	653	404	651	406
2004	1177	727	450	753	423
2005	1303	800	503	865	438
2006	1495	919	577	1022	473
2007	1601	983	619	1111	490
2008	1666	1023	644	1170	496
2009	1896	1164	732	1365	531

Figure GS-1.3 shows that real human capital by five education categories keeps growing, and it grew even faster during 1996-2009. One reason male real human capital is higher than female real human capital is the earlier retirement age for women (age 55 vs. age 60 for men based on China Labor Law). Accordingly, men have a longer time to generate income in the market. Another reason is higher educational attainment for men. Moreover, the male-female income gap has been on expanding. The results based on six education categories show similar trends.

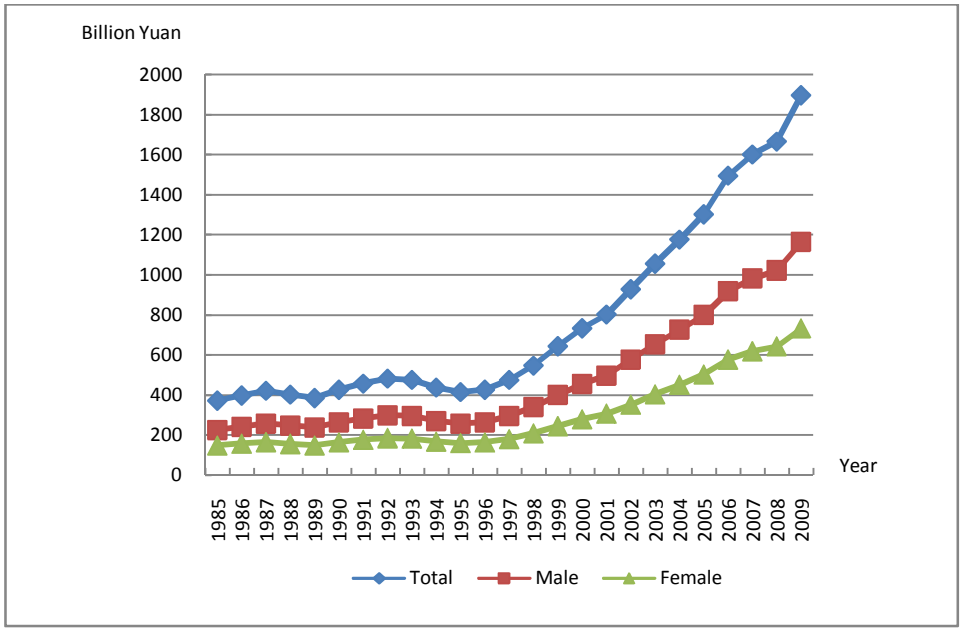


Figure GS-1.3 Real Human Capital by Gender for Gansu

Figure GS-1.4 shows the real human capital for urban and rural separately. Before 1997, the amount of real human capital in both areas was quite close. Since 1997, however, the real human capital in the urban area has been rising much more rapidly, while the real human capital in the rural area grew quite slowly, which results in a larger urban-rural gap.

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. Another reason is the education gap between the urban and rural population. Urban areas usually have a larger proportion of educated population than rural areas.

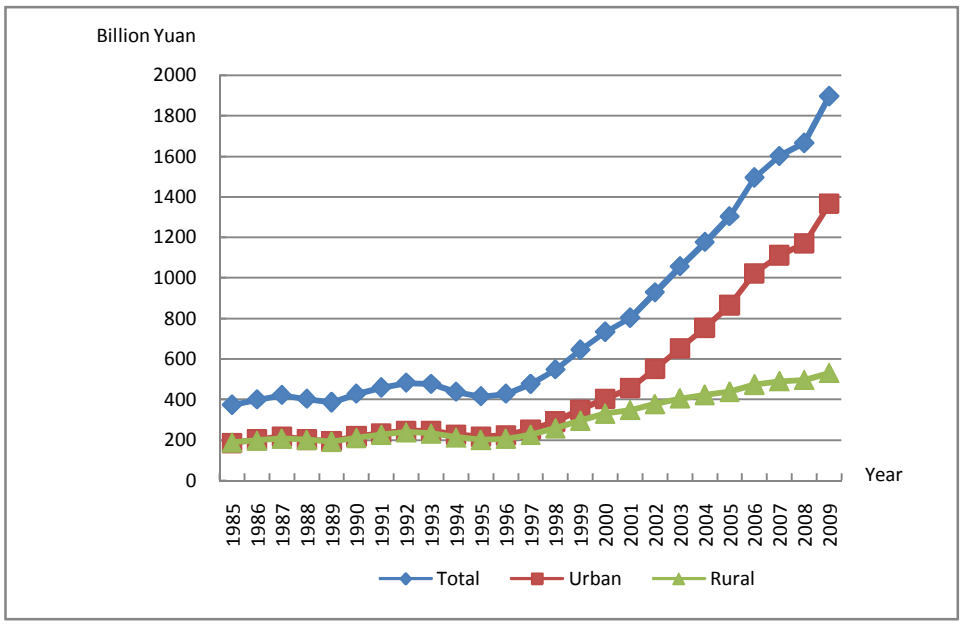


Figure GS-1.4 Real Human Capital by Urban-Rural for Gansu

Finally we calculate real human capital indices using 1985 as the baseline year. The results for each group are reported in Table GS-1.3.

Table GS-1.3 Real Human Capital Index for Gansu (1985=100)

Year	Total	Male	Female	Urban	Rural
1985	100	100	100	100	100
1986	106.88	107.47	105.97	109.26	104.56
1987	112.99	114.22	111.17	116.41	109.64
1988	107.82	109.69	104.95	109.21	106.46
1989	103.40	105.64	100.03	104.88	101.96
1990	114.49	117.20	110.38	117.66	111.39
1991	122.76	125.64	118.41	125.57	120.02
1992	129.19	132.27	124.49	132.12	126.32
1993	127.64	130.98	122.58	132.29	123.09
1994	117.22	120.27	112.59	121.83	112.71
1995	111.30	113.78	107.55	116.52	106.20

1996	114.54	117.51	110.05	120.04	109.16
1997	127.64	131.51	121.78	135.59	119.86
1998	146.73	150.80	140.54	157.20	136.49
1999	172.63	177.64	164.93	189.27	156.36
2000	196.46	202.00	188.03	218.20	175.21
2001	215.16	220.80	206.63	246.42	184.59
2002	248.74	256.40	237.08	298.43	200.16
2003	283.05	290.36	271.91	352.87	214.78
2004	315.16	322.89	303.44	408.13	224.26
2005	348.93	355.51	338.88	468.58	231.94
2006	400.48	408.31	388.80	553.63	250.74
2007	428.82	436.76	416.69	601.84	259.64
2008	446.20	454.44	433.67	633.80	262.76
2009	507.85	517.47	493.36	739.44	281.41

Figure GS-1.5 shows the index of real total human capital for Gansu. Before 1997 the index grows quite steadily; it accelerates after that year.

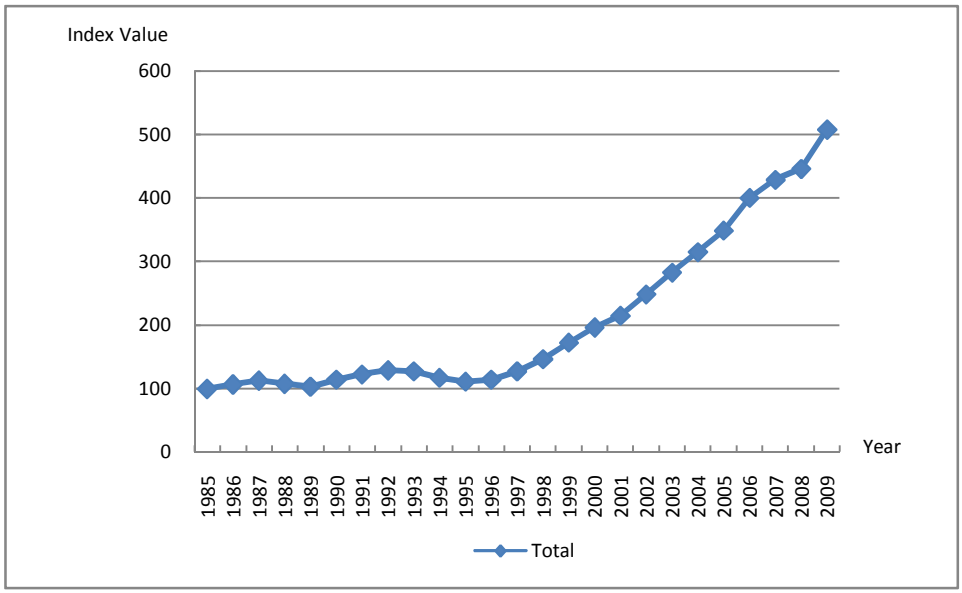


Figure GS-1.5 Real Human Capital Index for Gansu

2. Per capita human capital

An increase in real human capital can be caused by a number of factors, such as population growth, demographic changes (e.g., the size of retirement group), urban-rural 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, and higher rates of return to on-the-job training. In order to get further information on the dynamics of human capital, we calculate per capita real human capital, i.e., the ratio of real human capital to non-retired population.

Table GS-2.1 shows the per capita human capital by gender forGansu. Based on the five education categories, per capita human capital real values for male increased from 22,030 Yuan to 100,670 Yuan, increasing by around 4 times; per capita human capital real values for female increased from 15,460 Yuan to 65,130 Yuan, increasing by around 3 times. From1985 to 2009, the annual growth rate was 6.33% for male, and 5.99% for female.

Table GS-2.1 Per Capita Nominal and Real Human Capital by Gender for Gansu

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	18.85	22.03	15.46	18.85	22.03	15.46
1986	21.40	25.06	17.47	20.09	23.53	16.40
1987	24.16	28.40	19.60	21.10	24.80	17.14

1988	27.05	31.84	21.84	19.98	23.46	16.17
1989	30.28	35.56	24.44	18.96	22.24	15.35
1990	33.80	39.78	27.21	20.49	24.09	16.53
1991	37.63	44.28	30.29	21.71	25.51	17.51
1992	41.92	49.27	33.78	22.63	26.55	18.28
1993	47.34	55.75	38.01	22.12	26.02	17.80
1994	53.22	62.61	42.77	20.04	23.54	16.15
1995	59.42	69.79	47.94	18.71	21.95	15.12
1996	66.69	78.38	53.68	19.08	22.40	15.40
1997	75.76	89.23	60.72	21.07	24.79	16.93
1998	85.58	100.52	68.90	24.05	28.22	19.39
1999	97.78	114.45	78.97	28.12	32.89	22.73
2000	110.46	129.40	89.14	31.88	37.33	25.76
2001	125.61	148.08	100.81	34.81	41.02	27.96
2002	144.57	172.68	114.13	40.07	47.86	31.64
2003	166.13	199.17	130.94	45.55	54.62	35.90
2004	189.23	229.24	147.75	50.68	61.43	39.53
2005	216.25	262.62	168.94	56.93	69.22	44.40
2006	251.46	304.87	196.71	65.42	79.41	51.12
2007	284.09	344.00	222.58	70.08	84.96	54.82
2008	321.50	389.14	252.09	73.33	88.86	57.40
2009	368.67	445.82	289.31	83.14	100.67	65.13

Figure GS-2.1 shows the trend of per capita real human capital by gender. Per capita real human capital shows a similar trend for males and females. Per capita real human capital for male and female both exhibit an accelerated growth after 1996. The male-female gap has been widening.

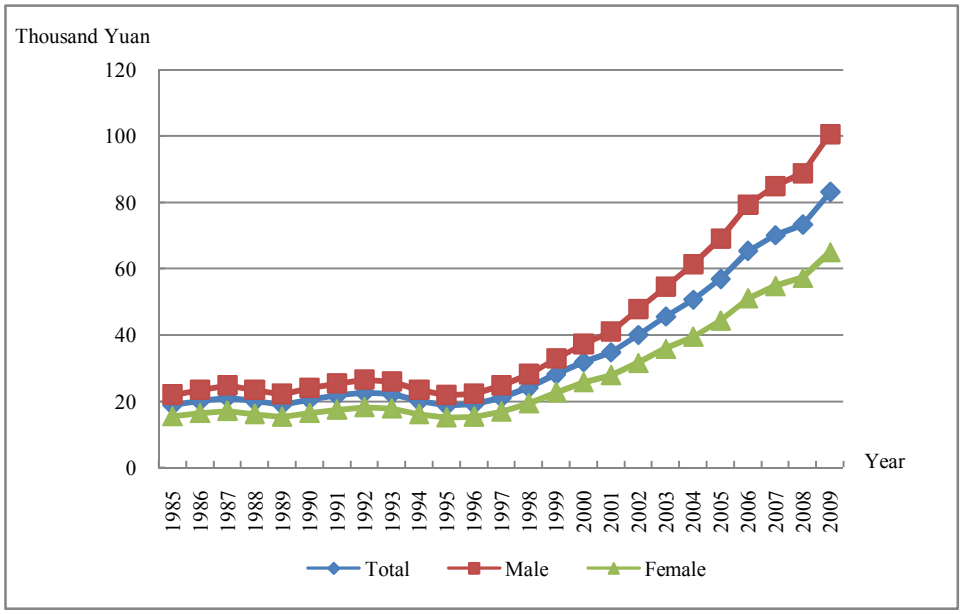


Figure GS-2.1 Per Capita Real Human Capital by Gender for Gansu

Table GS-2.2 reports the results of per capita human capital measured in nominal and real terms for Gansu by urban and rural separately. From 1985 to 2009, the per capita human capital in urban areas was significantly larger than that for rural. The per capita urban human capital increased from 46,820 Yuan to 178,920 Yuan, the per capita rural human capital increased from 11,900 Yuan to 35,000 Yuan. The per capita human capital in urban areas grew much faster than the one for rural.

Table GS-2.2 Per Capita Nominal and Real Human Capital by Urban-Rural for Gansu

Year	Per capita nominal human capital (Thousands of Yuan)			Per capita real human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	18.85	46.82	11.90	18.85	46.82	11.90
1986	21.40	51.81	13.33	20.09	48.42	12.57

1987	24.16	57.30	14.94	21.10	49.41	13.23
1988	27.05	63.73	16.74	19.98	45.56	12.78
1989	30.28	71.03	18.70	18.96	42.96	12.14
1990	33.80	79.50	20.86	20.49	47.19	12.94
1991	37.63	87.98	23.25	21.71	49.40	13.80
1992	41.92	97.48	25.86	22.63	51.01	14.42
1993	47.34	110.17	28.95	22.12	50.05	13.94
1994	53.22	124.08	32.33	20.04	45.24	12.61
1995	59.42	138.73	36.04	18.71	42.54	11.68
1996	66.69	155.50	40.35	19.08	43.23	11.92
1997	75.76	177.56	45.28	21.07	48.02	13.01
1998	85.58	200.60	50.76	24.05	54.80	14.74
1999	97.78	230.67	56.94	28.12	64.82	16.84
2000	110.46	259.33	63.87	31.88	73.47	18.87
2001	125.61	293.73	71.33	34.81	80.79	19.97
2002	144.57	331.11	79.30	40.07	91.71	22.01
2003	166.13	373.59	87.92	45.55	102.55	24.06
2004	189.23	417.78	97.41	50.68	113.21	25.56
2005	216.25	470.04	107.34	56.93	125.86	27.35
2006	251.46	541.21	119.86	65.42	143.21	30.12
2007	284.09	606.90	133.20	70.08	152.65	31.48
2008	321.50	690.11	147.73	73.33	160.72	32.12
2009	368.67	774.88	164.46	83.14	178.92	35.00

Figure GS-2.2 shows trends in per capita real human capital in urban and rural areas. During the period of 1985-2009, per capita real human capital for urban and rural both exhibit an accelerated growth after 1996. Based on five education categories, the ratio of urban to rural increased from 3.93 in 1985 to 5.11 in 2009, the absolute size of urban-rural gap has been on the rise. From 1985 to 2009, the annual growth rate was 5.59% for the urban area, and 4.50% for the rural area.

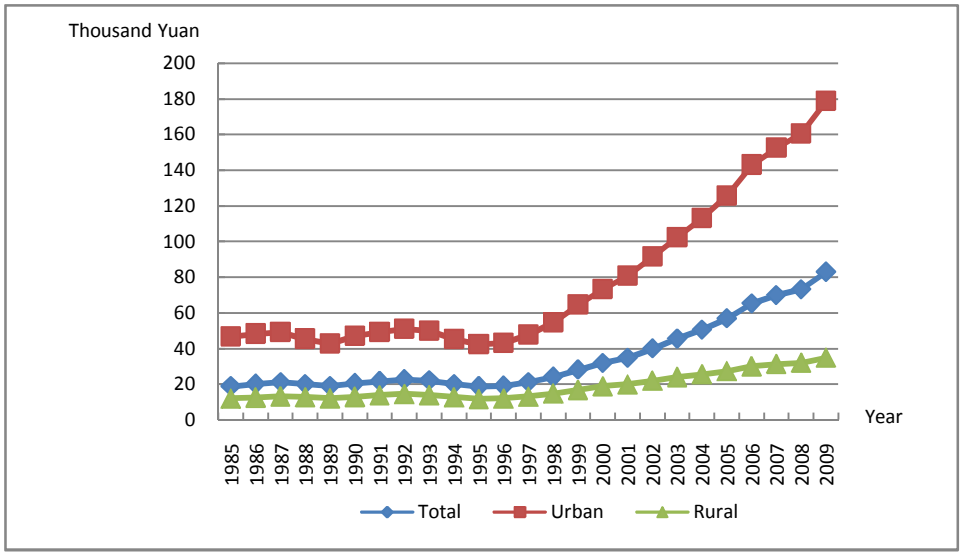


Figure GS-2.2 Per Capita Real Human Capital by Urban-Rural for Gansu

Figure GS-2.3 shows the per capita real human capital index for Gansu. As is seen from the graph below, per capita real human capital was essentially stable before 1996, but significant growth occurred after 1996.

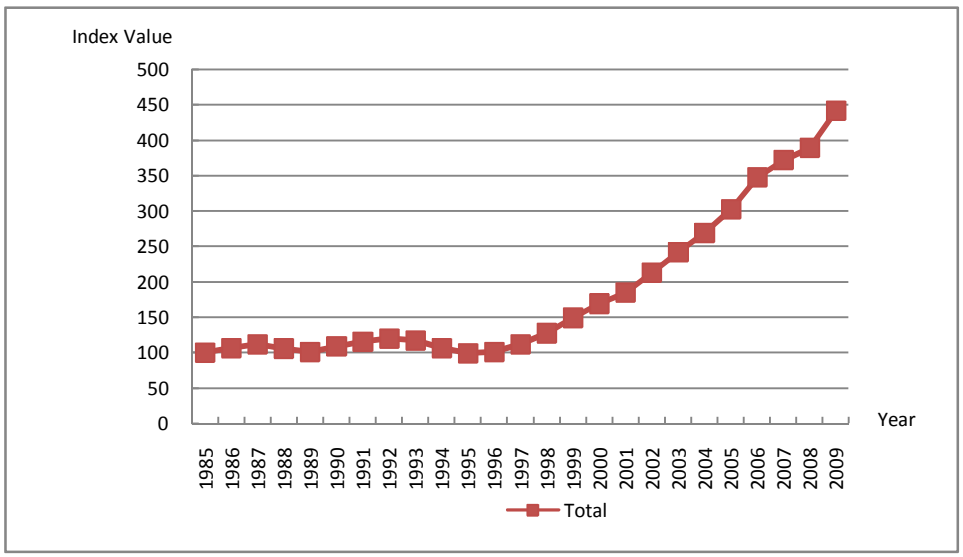


Figure GS-2.3 Per Capita Real Human Capital Index for Gansu

3. Labor force human capital

3.1 Total labor force human capital

Labor force human capital represents the human capital of the population that is over 15 years old, non-retired and out-of-school. Labor force human capital is estimated in the same way as human capital. The labor force human capital is reported in Table GS-3.1. The real values in this table are calculated by deflating the nominal values with the CPI.

Table GS-3.1 Labor Force Human Capital and Nominal GDP for Gansu

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of labor force human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1985	182		182		12	14.75
1986	207		195		14	14.73
1987	238		208		16	14.91
1988	280		207		19	14.59
1989	330		207		22	15.21
1990	387		235		24	15.95
1991	442		255		27	16.30
1992	496		268		32	15.61
1993	561		262		37	15.08
1994	624		235		45	13.76
1995	697		220		56	12.50
1996	777		223		72	10.75
1997	878		245		79	11.06
1998	993		280		89	11.18

Year	Nominal labor force human capital (Billions of Yuan)		Real labor force human capital (Billions of 1985 Yuan)		Nominal GDP (Billions of Yuan)	Ratio of labor force human capital to GDP
	By five education categories	By six education categories	By five education categories	By six education categories		
1999	1113		321		96	11.64
2000	1284	1261	371	365	105	12.20
2001	1452	1432	403	397	113	12.90
2002	1640	1623	455	450	123	13.31
2003	1888	1876	518	514	140	13.49
2004	2118	2115	566	565	169	12.55
2005	2368	2363	622	620	193	12.25
2006	2652	2649	688	687	228	11.65
2007	2929	2927	719	718	270	10.83
2008	3231	3229	732	731	318	10.17
2009	3557	3554	794	794	339	10.50

Note: The ratio of labor force human capital to GDP is based on the current values for that year.

The trends in nominal and real labor force human capital are presented in Figure GS-3.1. Similar to the trend of human capital, from 1985 to 2009, labor force human capital both in nominal and real terms have kept on increasing.

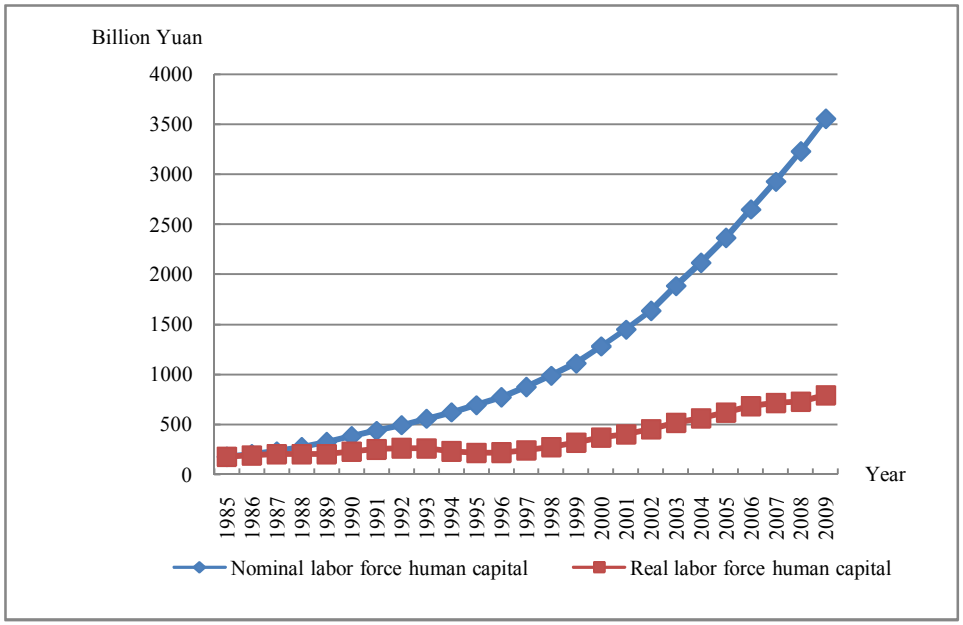


Figure GS-3.1 Nominal and Real Labor Force Human Capital for Gansu

We also calculate the ratio of labor force human capital to GDP. The results are reported in the last column of Table GS-3.1. As before, the ratio could reflect human capital's influence on sustainable growth of GDP, and may also reflect changes in human capital productivity and efficiency. Figure GS-3.2 shows the trend for the ratio. The pattern of the ratio for labor force human capital is almost the same as that for human capital. The level of nominal labor force human capital is much higher than that of nominal GDP. After a slight increase during 1985 to 1991, the ratio of labor force human capital to GDP in Gansu decreases at a considerable rate from 1991 to 1996. From 1996 to 2003 the ratio rises slowly in small scale and then it goes down again.

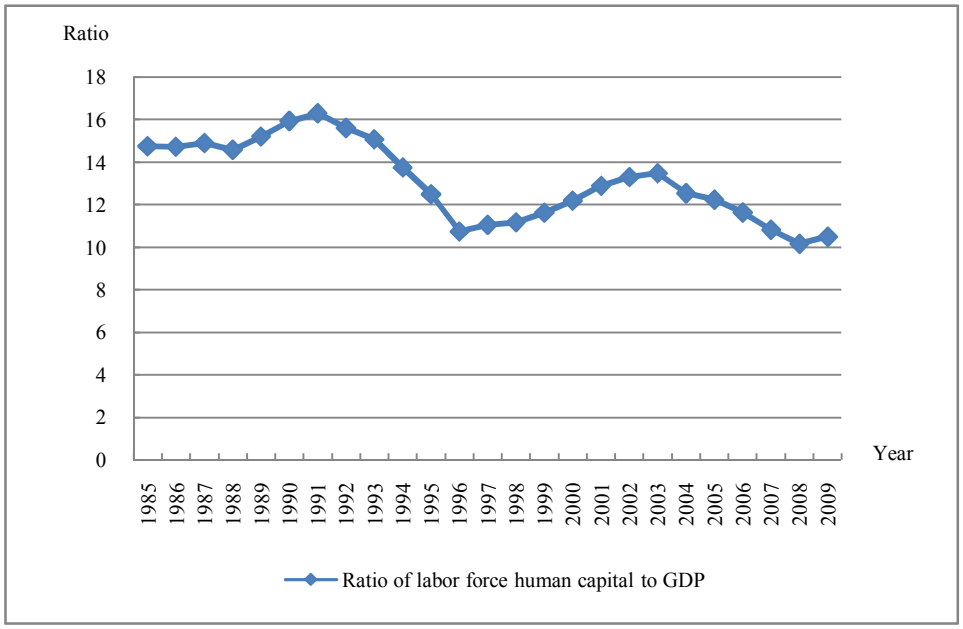


Figure GS-3.2 Ratio of Labor Force Human Capital to GDP for Gansu

Figure GS-3.2 shows the nominal and real labor force human capital for urban and rural respectively. The pattern of real labor force human capital is almost the same as that of the real human capital. Urban real labor force human capital surpassed its rural counterpart for the first time in 1999.

Table GS-3.2 Nominal and Real Labor Force Human Capital by Urban-Rural for Gansu

Year	Nominal labor force human capital (Billions of Yuan)			Real labor force human capital (Billions of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	182	83	99	182	83	99
1986	207	97	110	195	91	104
1987	238	114	124	208	98	110
1988	280	136	144	207	97	110
1989	330	165	165	207	100	107

1990	387	196	192	235	116	119
1991	442	224	218	255	126	129
1992	496	253	243	268	132	136
1993	561	290	271	262	132	131
1994	624	321	303	235	117	118
1995	697	357	340	220	110	110
1996	777	395	382	223	110	113
1997	878	449	429	245	121	123
1998	993	510	483	280	139	140
1999	1113	575	538	321	162	159
2000	1284	684	601	371	194	178
2001	1452	769	682	403	212	191
2002	1640	887	752	455	246	209
2003	1888	1053	835	518	289	229
2004	2118	1209	909	566	328	239
2005	2368	1394	974	622	373	248
2006	2652	1583	1069	688	419	269
2007	2929	1732	1197	719	436	283
2008	3231	1884	1347	732	439	293
2009	3557	2061	1496	794.2	476	318

Figure GS-3.3 shows real labor force human capital for urban and rural respectively. The pattern of labor force human capital is almost the same as that of real human capital. The urban labor force human capital surpassed the rural one in 1999 and has grown much faster ever since.

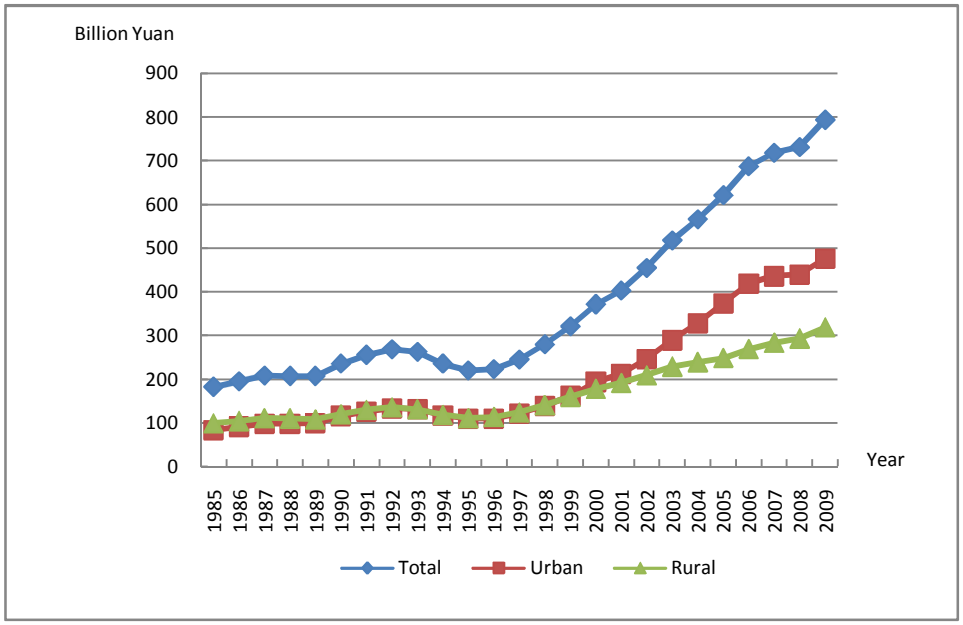


Figure GS-3.3 Real Labor Force Human Capital by Urban-Rural for Gansu

3.2 Average labor force human capital

Similar to the analysis of per capita human capital above, we calculate the average labor force human capital. Here the average labor force human capital means labor force human capital divided by the number of the population that are over 15 years old, non-retired and out of school.

Table GS-3.3 reports the real average labor force human capital by gender. Additionally, the table shows that the real average labor force human capital for female was smaller than that for male.

Table GS-3.3 Nominal and Real Average Labor Force Human Capital by Gender for Gansu

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Male	Female	Total	Male	Female
1985	15.52	18.18	12.57	15.52	18.18	12.57
1986	17.62	20.72	14.17	16.55	19.46	13.31
1987	19.92	23.51	15.88	17.42	20.55	13.90
1988	22.68	26.82	18.01	16.78	19.82	13.36
1989	25.89	30.61	20.53	16.24	19.16	12.90
1990	29.29	34.69	23.08	17.78	21.02	14.03
1991	32.60	38.64	25.70	18.82	22.27	14.87
1992	36.13	42.84	28.51	19.52	23.11	15.44
1993	40.56	48.25	31.85	18.96	22.53	14.93
1994	44.62	53.06	35.12	16.82	19.97	13.28
1995	49.12	58.30	38.83	15.48	18.35	12.26
1996	54.35	64.64	42.79	15.58	18.50	12.29
1997	60.99	72.91	47.46	16.99	20.29	13.26
1998	68.10	81.20	53.30	19.18	22.84	15.04
1999	75.76	90.63	58.86	21.83	26.08	16.99
2000	86.69	103.93	66.97	25.06	30.01	19.38
2001	96.38	116.44	74.18	26.73	32.28	20.59
2002	108.33	132.30	82.59	30.03	36.68	22.90
2003	123.02	151.91	92.93	33.73	41.65	25.47
2004	137.21	171.38	102.47	36.67	45.86	27.34
2005	153.48	194.14	113.37	40.28	51.04	29.66
2006	171.71	218.07	125.88	44.52	56.62	32.52
2007	188.64	239.38	138.24	46.28	58.87	33.78
2008	208.14	264.19	152.51	47.14	59.97	34.38
2009	228.20	289.51	167.23	50.95	64.85	37.15

Table GS-3.4 reports the real average labor force human capital by area. The real average labor force human capital was much smaller in rural area than in urban area.

Table GS-3.4 Nominal and Real Average Labor Force Human Capital by Urban-Rural for Gansu

Year	Nominal average labor force human capital (Thousands of Yuan)			Real average labor force human capital (Thousands of 1985 Yuan)		
	Total	Urban	Rural	Total	Urban	Rural
1985	15.52	35.18	10.55	15.52	35.18	10.55
1986	17.62	39.00	11.86	16.55	36.45	11.19
1987	19.92	43.12	13.36	17.42	37.18	11.83
1988	22.68	48.79	15.05	16.78	34.88	11.49
1989	25.89	55.55	16.90	16.24	33.60	10.97
1990	29.29	62.73	18.97	17.78	37.23	11.77
1991	32.60	69.38	21.09	18.82	38.96	12.52
1992	36.13	76.36	23.34	19.52	39.96	13.02
1993	40.56	85.85	25.91	18.96	39.00	12.48
1994	44.62	94.09	28.65	16.82	34.30	11.17
1995	49.12	103.03	31.69	15.48	31.59	10.27
1996	54.35	114.18	35.24	15.58	31.74	10.41
1997	60.99	129.15	39.30	16.99	34.92	11.29
1998	68.10	143.89	43.76	19.18	39.31	12.71
1999	75.76	159.93	48.50	21.83	44.95	14.34
2000	86.69	183.97	54.13	25.06	52.12	15.99
2001	96.38	205.31	60.30	26.73	56.47	16.89
2002	108.33	228.08	66.91	30.03	63.17	18.57
2003	123.02	255.94	74.33	33.73	70.26	20.34
2004	137.21	282.95	81.43	36.67	76.68	21.37
2005	153.48	311.19	88.97	40.28	83.33	22.67
2006	171.71	341.12	98.97	44.52	90.26	24.87
2007	188.64	370.88	110.26	46.28	93.28	26.06
2008	208.14	412.57	122.92	47.14	96.08	26.73
2009	228.20	439.50	137.26	50.95	101.48	29.21

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 0-5 receive no schooling
National, urban and rural population by age and sex: 1982-2009	• *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 2007-2009* edited by Department of Demographic and Employment Statistics of National Bureau of Statistics	
Mortality rate by age and sex: 1986,1989-1990, 1994-2009	• *China Demographic Statistics Yearbook：1988-2009*	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: 1980-2009	• *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 1993-1996* edited by the Plan and Development Department of National Educational Committee	*Educational Statistics Yearbook of China. 1980-1986,1988, 1992* are downloaded from http://www.pinggu.org/bbs/thread-140641-2-1.html

	• *Educational Statistics yearbook of China 1997* edited by the Plan and Development Department of National Educational Ministry • *Educational Statistics yearbook of China.1998-2009* edited by the Plan and Development Department of National Educational Ministry	
National, urban and rural population and birth rate for each year	• *China Statistics Yearbook 2010.* • *Statistics Summary for 55 years in China.* China Statistics Press	
Students by age and grade of primary and junior school: 20032009	• *Educational Statistics yearbook of China.2003-2010* edited by the Plan and Development Department of National Educational Ministry	

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 investigate 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). 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 1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009.

(3) Chinese Household Income Project (CHIP)

Chinese Household Income 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. The 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 rural households, information of assets and debts, sales and consumption of 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 area. The years surveyed include 1988, 1995 and 2002, 2007.

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.[92] 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 2010*. Thus, some adjustments need to be made to the population data by age, sex and educational attainment. The adjustment is implemented by the

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

following method. The 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 2010* to the total urban population in the census data. A similar formula 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.

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 2000.

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 1983 to 2003, we only have the total new enrollment of college and university and the total females in college and university. To get the female enrollments in college and university, we assume that the proportion of female is the same as in college and university enrollments.

From 2004 to 2009, the female enrollment data for university and college is available in the statistic yearbooks.

2.2.3 New enrollment data of urban and rural areas

The new enrollments by gender in urban and rural areas in each educational level are not available. We assume that the proportions of female enrollment in urban and rural areas 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 2009, the new enrollments of vocational high school are 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:

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

where $L(y,e,a,s)$ is the population in year y with education level e, age a and sex s. $d(y,a,s)$ 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.

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

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

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

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

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 in Grade 1 of primary school

Select the students in Grade 1 of primary school from the CHNS sample, and classify them according to age. The last two rows in Table A.1 show that the students in Grade 1 of 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 in Grade 1 of primary school of age 5-10 (Table A.2).

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

The number of students in Grade 1 of junior middle school can be obtained by the same fashion, as shown in Table A.3. These students are mainly aged 11-16, with the share over 95% except for 1993. In 1993, the number of students in Grade 1 of 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 in Grade 1 of senior middle school, college and university.

The number of students in Grade 1 of senior middle school, college and university in CHNS sample is too small to estimate the age distributions. The number of students in Grade 1 of senior middle school is shown in

Table A.5, and there are only 81 students in Grade 1 of 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 in 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 in Grade 1 of senior middle school, male students in Grade 1 of college and university, and female students in Grade 1 of 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: 2003-2009* 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 2009.

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: 2006-2009

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 total urban and rural population data of 2006, 2007, 2008, 2009 that is released in *China Statistics Yearbook 2010*.

The method of adjustment is as follows: we use the total population reported in *China Statistics Yearbook 2010*, deduct 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 2006 to 2009 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 annual change of each year equals that from 2004 to 2005.

4. Some specific problems

4.1 National, rural and urban population at age zero: 1985-2009

4.1.1 National population at age zero

The total population at the end of the year 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 2010*. 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 population 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 by the survival rate of those aged zero at the corresponding year gives the population at age zero at the end of the year.

(Definition: 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.)

4.1.2 Rural and urban population at age zero

The data used include total national population for each year from 1983 to 2009, birth rate for each year from 1983 to 2009, national, rural and urban population by age and gender from the population sampling surveys for 1987 and each year from 1989 to 2009.

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 in 1989 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 death rate of those aged 65 and over

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.

4.3 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.

4.4 STATA programming

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

Tables and figures of appendix A

Table A.1 Number of Students in Grade 1 of 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 in Grade 1 of 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 in Grade 1 of Junior Middle 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
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 in Grade 1 of Junior Middle 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
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 in Grade 1 of 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 Age Distribution of Students in Each Grade: Assumption

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 in Grade 1 of Senior Middle School

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

Table A.9 Age Distribution of Students in Grade 1 of College and University

Age	Male	Female
17	0.288	0.288
18	0.378	0.378
19	0.205	0.205
20	0.129	0.129
21	0.288	0.288

TableA.10 Age Distribution of New Entrants in Senior Middle School, 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 in university, 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 New Enrollments by Educational Level, 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

Appendix B Mincer parameters

Main Equation:

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

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) Main job and Second job salaries;

(2) Other cash income from work;

(3) Pension;

(4) Estimated market value of received items;

(5) Various subsidies;

(6) 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, CHIP, CHNS to obtain all urban and rural parameters by gender and then get the annual results by weighting the available datasets sample sizes for that year. When all three data sets are available for a sample year, we drop CHNS and use UHS and CHIP estimates because of the relatively low quality of CHNS income measures, then they are weighted by respective sample size.

(2) We use UHS to get urban parameters for 1986-1997.

(3) We use CHIP to get urban and rural parameters for 1988, 1995, 2002 and 2007.

(4) We use CHNS to obtain urban parameters[93] for 2000, 2004, 2006, 2009, and rural parameters for 1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009.

For example, for the intercept term,

We estimate the urban intercept $\alpha^u 88$ (UHS) using UHS 1988, with the sample size of $n^u 88$ (UHS). We also could get the urban and rural intercepts $\alpha^u 88$ (CHIP), $\alpha^r 88$ (CHIP), with the sample sizes of $n^u 88$(CHIP), $n^r 88$(CHIP) respectively. Then the annual urban and rural intercepts are:

[93] We have urban datasets of UHS for 1989, 1991, 1993 and 1997, so we don't use the CHNS datasets of the above years for urban parameter estimation

$$a^u 88 = \frac{a^u 88(UHS) \times n^u 88(UHS)}{n^u 88(UHS) + n^u 88(CHIP)} + \frac{a^u 88(CHIP) \times n^u 88(CHIP)}{n^u 88(UHS) + n^u 88(CHIP)}$$

$$a^r 88 = a^r 88(CHIP)$$

The same principle is applied to estimating other relevant parameters for urban and rural areas.

1.6 Parameter α

$$\ln(inc) = \alpha + \beta \cdot Sch + \gamma \cdot Exp + \delta \cdot Exp^2$$

$\hat{y} = a \times e^{\hat{\ln y}}$, 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: $\hat{y} = a \times \hat{m}_i$ and keep a.

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

(5) $\hat{y} = a \times e^{\hat{\ln y}}$.

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.

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 in 1988, 1991, 1993, 1997, 2000, 2004, 2006, 2009. Numbers of households participated in the first five waves are 3,795, 3,616, 3,441, 3,875, and 4,403 respectively.

The CHIP (Chinese Household Income Project) data include 9,009 urban households and 10,258 rural households. Basic information are collected for both the sample households and their members, focusing on income and wage, sources of income and household expenditure. For rural households, information on assets and debts, sales and consumption of products, and purchase of production means are also collected. The rural survey covers 28 provinces, only excluding Xinjiang and Tibet ; and the urban survey covers 10 provinces (Beijing, Shanxi, Liaoning, Jiangsu, Anhui, Henan, Hubei, Guangdong, Yunan and Gansu). The years surveyed include 1988, 1995, 2002, and 2007.

Table B.1 shows the distribution of the three datasets across years.

3. Key variables

3.1. UHS

3.1.1 Definition of income

1) Salaries from working in the state-owned, collective or other instituteons;

2) Other income from working units;

3) Private employment income;

4) Income from re-employment after retirement;

5) Other employment income;

6) Other working income;

7) Pension;

8) Price subsidies;

9) Household avocation production income.

3.1.2 Years of schooling

(1)**1986-1991**

LEVEL	e
College	16
Professional school	11
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

3.1.3 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, short term contract

workers, the retired, job seekers, the disabled, homemakers, students in school, workers waiting for job assignment, students waiting to enter a higher level school, etc.

3.2 CHIP

3.2.1 Definition of income

Urban income definitions:

In 1988 it includes: employment salary and subsidies, other income from work units, pension;

In 1995 it includes: employment salary and subsidies, other income from work units, other goods from work units, pension;

The same principle is applied in CHIP 2002 and CHIP 2007.

Rural income definitions:

Sum of individual income and household income;

In 1988 individual part includes: regular income, pension, other cash income and other goods from work units; household income part is net household income from agriculture.

In 1995 individual part includes: regular income (such as salary, bonus, subsidies), pension, other cash income and received goods from work units; household income part is net household income from agriculture.

In 2002 individual part includes: wages, pensions, subsidies, received goods from work units; household income part is net household income from agriculture.

In 2007 it only has the total household income, including both non-rural income and rural income.

3.2.2 Years of schooling

(1)**1988**

LEVEL	e
College and above	16
Professional school	15
Middle level professional, technical or vocational school	11
Upper middle school	12
Lower middle school	9
Junior middle school	6
4 or more years of elementary school	4
1-3 years of elementary school	2
Illiterate or semi-illiterate	0

(2)**1995**

LEVEL	e
College and above	16
Professional school	15
Middle level professional school	11
Upper middle school	12
Lower middle school	9
Elementary school	6
Illiterate or semi-illiterate	0

(3)**2002**

LEVEL	e
College and above	16
Professional school	15
Middle level professional, technical or vocational school	11
Upper middle school	12
Lower middle school	9
Elementary school	6
Illiterate or semi-illiterate	0

(4)**2007**

LEVEL	e
Graduate school	18
College and above	16
Professional school	15
Middle level professional, technical or vocational school	11
Upper middle school	12
Lower middle school	9
Elementary school	6
Illiterate or semi-illiterate	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 years of schooling is missing, individuals who failed to report education level information;

(3) Keep individuals whose current status is working or employed, or re-employed after retirement;

(4) Discard individuals who are self-employed, private enterprise owners or managers;

(5) Discard individuals whose reported income is 0 or below.

3.3 CHNS

3.3.1 Income variables

Income includes wages, subsidies, other job-related income and household agricultural income. For CHNS, we use the sum of INDINC (Total net individual income, nominal), INDSUB (Individual subsidies) and individual share of HHSUB (Household subsidies) to calculate the final targeted individual income variable.

3.3.1.1 Total net individual income, nominal (INDINC)

Variable: INDINC - Total net individual income, nominal

Data files: INDBUSN - business income

INDFARM - farming income

INDFISH - fishing income

INDGARD - gardening income

INDLVST - livestock income

INDRETIRE - retirement income

INDWAGE - non-retirement wages

a) Non-Retirement Wages

Variable: INDWAGE - Total individual income from all non-retirement wages earned by individuals. Annual wage is calculated for each job record in the wages file.

Generally, annual wage income is Months Worked times Average Monthly non-Retirement Wage, annualized, plus Bonuses and Other Cash or In-Kind Income. For 1989, annualized income from piece work is calculated.

Source:

C3, months worked last year (job level), 1991 - 2006

C8, average month's wages (job level), 1991 - 2006

C6, wages per piece of completed work, 1989

C7, average number of pieces completed/work, 1989

I19, value of bonuses received last year (job level), 1989-2006

I101, other cash income (job level), 2006

I103, value of other non-cash income (job level), 2006

B2, B3B, B4, B5, B9, B10, filter questions (person level)

b) Retirement Income

Variable: INDRET - Total Individual Retirement Income

Source:

J5, retirement pensions/salaries (individual), 1989 - 2000

B2D, retirement wage from this job (job level), 2004 - 2006

c) Business Income

Variable: INDBUS - Total individual net income from all businesses operated by household that the individual participated in.

Source:

Individual proportion of net income from household businesses:

H6, Months worked in household business last year

H7, Days per week worked in household business last year

H8, Hours per day worked in household business last year

Total household net income from all household businesses:

H2, Business type

H3, Revenue from this business

H4, Expenses

d) Farming Income

Variable: INDFARM - Total individual net income from farming.

Source:

Individual proportion of net income from household farming:

E4A, months worked on farm last year

E4B, days worked on farm per week last year

E4C, hours worked on farm per day last year

E2A, worked on HH farm/orchard last year (from 2004 on)

E4, 12-month average hours worked on farm per week (1989 only)

Total household net income from farming:

E7, cash for collective farming (individual level), 1989 - 2006

E9, in-kind for collective farming (individual level), 1989 - 2006

E13B, expenses to raise crop (crop level), 1989

E15B, receipts from sale of crop (crop level), 1989

E17B, receipts if crop kept had been sold (crop level), 1989

E19B, receipts if crop given away had been sold (crop level), 1989

E13, kg of crop grown (crop level), 1991-1997

E14, kg of crop sold to government (crop level), 1991-1997

E15, government price for crop (crop level), 1991-1997

E16, kg of crop sold to free market (crop level), 1991-1997

E17, free-market price for crop (crop level), 1991-1997

E12, expenses to raise all crops (household level), 1991 - 2006

E14A, receipts from sale of all crops (household level), 1991 - 2006

E16A, value of all crops consumed (household level), 1991 - 2006

e) Fishing Income

Variable: INDFISH - Individual income from fishing.

Source:

Individual proportion of net income from household farming:

G4A, months worked on fishing last year

G4B, days worked on fishing per week last year

G4C, hours worked on fishing per day last year

G2, filter: worked on fishing last year (from 2004 on)

G4, 12-month average hours worked on fishing per week (1989 only)

Total household net income from farming:

G7, wages received from collective fishing (individual)

G9, market value of fish received in-kind from the collective (individual)

G11, revenue from fish sales (household)

G13, value of fish consumed at home (household)

G15, value of fish given as gift (household)

G16, expenses of fishing business (household)

f) Gardening Income

Variable: INDGARD - Total individual net income from gardening

Source:

Individual proportion of net income from household gardening:

D3A, months worked on gardening last year

D3B, days worked on gardening per week last year

D3C, hours worked on gardening per day last year

D2A, worked in HH garden last year (from 2004 on)

D3, 12-month average hours worked on gardening per week (1989 only)

Total household net income from household garden or orchard

D5, revenue from sale of home garden produce, 1989 - 2006

D6, market value of consumed produce, 1989 - 2006

D7, expenses to grow produce, 1991-2006

g) Livestock Income

Variable: INDLVST - Total individual net income from raising livestock.

Source:

Individual proportion of net HH income (HHLVST) from household livestock business:

F4A, months worked on raising livestock last year

F4B, days worked on raising livestock per week last year

F4C, hours worked on raising livestock per day last year

F2A, raising livestock last year (from 2004 on)

F4, 12-month average hours worked on raising livestock per week (1989 only)

Total household net income from all livestock activities:

F7, wages received from collective animal husbandry (individual)

F9, market value of livestock received in-kind from collective (individual)

F14, expenses to raise livestock (livestock level)

F15, expenses from using home-grown feed (livestock level)

F17, revenue from sale of livestock products (livestock level)

F19, value of livestock products consumed at home (livestock level)

F21, value of livestock products given as gifts (livestock level)

3.3.1.2 Subsidies

The subsidies include INDSUB (Individual subsidies) and individual share of HHSUB (Household subsidies). We distribute household subsidies equally among household individuals, the household subsidies are divided by the number of members in one household.

INDSUB=(I9+I11+I12+I13+I13A+I14+I14A+I14B)*12

HHSUB=I10A+I15A+I16A+I17A+I21+K47

Source:

ANNUAL subsidies for the following items, at the Household level:

I10A, one-child subsidy, 1991 - 2006

I15A, gas subsidy, 1993 - 2006

I16A, coal subsidy, 1993 - 2006

I17A, electricity subsidy, 1993 - 2006

I21, food/gift/discounts from work unit, 1989 - 2006

K47, childcare subsidy, 1989 - 2006

MONTHLY subsidies for the following items, at the Individual level:

I9, food subsidy, 1989 - 1997

I11, health subsidy, 1989 - 1997

I12, bath/haircut subsidy, 1989 - 1997

I13, book/newspaper subsidy, 1989 - 1997

I13A, housing subsidy, 1989 - 1997

I14, other subsidy, 1989 - 1997

I14A, average monthly subsidy from job 1, 2000 - 2006

I14B, average monthly subsidy from job 2, 2004 - 2006

3.3.2 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 for each category. Finally, we add up individual income from the four categories for each family member.

3.3.3 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

3.3.4 Selection of sample

(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.

4. Imputing parameters

4.1. Imputation method of urban parameters

4.1.1 Parameter estimates based on UHS, CHIP, CHNS

We use UHS, CHIP, CHNS data to estimate the earnings equation by gender and year. Table B.1.1-B.1.3 contain means and standard deviations of each variable for UHS, CHIP, CHNS.

4.1.2 General idea about imputation

We use UHS, CHIP and CHNS to estimate parameters of the basic Mincer equation, and get the fitted values for the intercept, return to education, and experience related terms. They are weighted by respective

sample size if more than one sample is available. Then we use the parameter estimates to fit a time trend model, and then get the fitted values of each parameter by gender for the years 1985-2009. These fitted values are the final urban imputed parameters.

4.1.3 Specifications

We treat a , b , g , d separately and use the parameters of each group as the dependent variable and use time (i.e., year) as the independent variable.

For a , b , g and d , we use the linear time trend model. The regression equation is: $Y = a0 + a1 * time + u$.

For a , b , g and d , we assume that they increase or decrease at a constant rate each year. Taking the a _male as an example, we assume that the intercept increases at the growth rate of a1 per year.

Figure B.1- Figure B.8 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 2009.

Tables and figures of appendix B

Table B.1 Micro Datasets

Year	UHS	CHIP	CHNS
1985			
1986	U		
1987	U		
1988	U	U/R	
1989	U		U/R
1990	U		
1991	U		U/R
1992	U		
1993	U		U/R
1994	U		
1995	U	U/R	
1996	U		
1997	U		U/R
1998			
1999			
2000			U/R
2001			
2002		U/R	
2003			
2004			U/R
2005			
2006			U/R
2007		U/R	
2008			
2009			U/R

Note: CHIP: Chinese Household Income Project

UHS: Urban Household Survey

CHNS: China Health and Nutrition Survey

Table B.1.1 Summary Statistics: UHS Samples

Year	Variables	Male		Female	
		Mean	S.D.	Mean	S.D.
1986	inc.	1484.83	550.33	1244.13	496.67
	e	10.48	2.92	9.77	2.79
	exp	20.47	11.06	17.80	9.50
	exp2	541.56	475.90	407.06	350.80
1987	inc.	1542.71	612.87	1292.50	496.48
	e	10.61	2.91	9.84	2.71
	exp	21.03	10.89	18.43	9.46
	exp2	560.94	471.92	429.09	353.99
1988	inc.	1973.86	860.82	1632.92	721.84
	e	10.77	2.93	9.94	2.76
	exp	20.61	10.93	17.93	9.40
	exp2	544.37	473.04	410.04	348.28
1989	inc.	2262.58	1019.21	1886.99	873.03
	e	10.92	2.96	10.10	2.69
	exp	20.80	10.96	18.26	9.36
	exp2	552.68	472.52	421.23	348.02
1990	inc.	2488.05	1094.79	2088.16	931.65
	e	11.09	2.92	10.28	2.70
	exp	21.14	10.83	18.49	9.33
	exp2	564.19	472.00	428.74	348.20
1991	inc.	2734.07	1175.66	2327.27	1015.47
	e	11.25	2.95	10.49	2.66
	exp	20.68	10.54	18.22	9.03
	exp2	538.57	458.48	413.44	337.06
1992	inc.	3204.91	1678.20	2661.58	1294.45
	e	11.34	2.81	10.56	2.65
	exp	21.66	10.96	19.63	9.63
	exp2	589.10	495.59	477.91	386.69
1993	inc.	3886.54	2471.99	3251.78	1972.98
	e	11.39	2.71	10.75	2.54
	exp	21.36	10.58	19.06	9.10
	exp2	568.01	464.42	445.89	344.57
1994	inc.	5432.23	3620.87	4455.86	2962.17
	e	11.51	2.77	10.92	2.49
	exp	21.21	10.55	18.90	9.10
	exp2	561.18	465.53	439.98	346.76
1995	inc.	6656.28	4196.61	5522.89	3497.76
	e	11.60	2.71	10.96	2.49
	exp	21.43	10.29	19.16	8.97
	exp2	564.96	452.06	447.58	342.98
1996	inc.	7354.62	5044.70	6124.44	4435.34
	e	11.64	2.69	11.07	2.43
	exp	21.76	10.30	19.51	8.99
	exp2	579.54	454.23	461.26	345.12

1997	inc.	8512.26	6050.73	7017.49	5333.35
	e	11.64	2.68	11.11	2.42
	exp	21.97	10.14	19.71	8.98
	exp2	585.36	447.17	469.00	346.25

Table B.1.2 Summary Statistics: CHIP samples

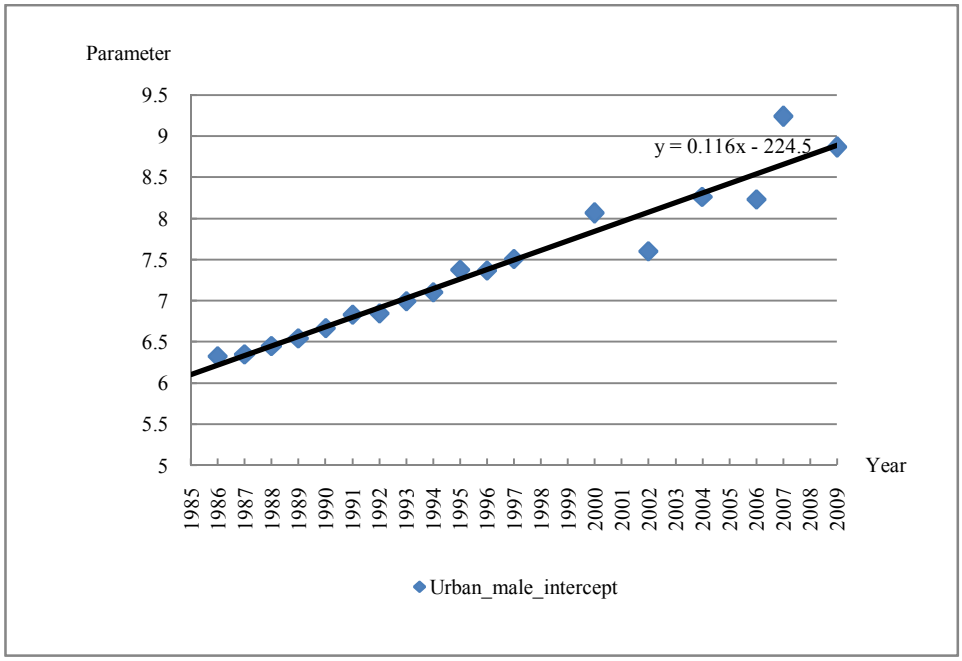
Year	Variables	Urban				Rural			
		Male		Female		Male		Female	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
1988	inc.	1929.73	948.86	1633.48	946.90	967.03	1054.63	856.77	845.65
	e	10.70	2.92	9.99	2.75	7.16	3.28	5.01	3.88
	exp	20.95	10.98	18.24	9.43	18.33	12.39	15.40	10.87
	exp2	559.21	480.24	421.77	354.84	489.62	516.15	355.40	390.61
1995	inc.	6643.41	3720.13	5486.28	3067.29	4828.23	5626.44	4601.42	4564.63
	e	11.71	2.74	11.03	2.54	7.91	2.83	6.22	3.40
	exp	22.51	10.76	20.66	9.63	21.41	11.95	20.18	11.17
	exp2	622.43	492.14	519.39	394.29	601.41	543.29	532.08	472.12
2002	inc.	12246.93	8058.56	9788.37	6920.72	5295.99	5636.03	3664.75	3998.78
	e	12.07	2.82	11.63	2.73	8.52	2.76	6.91	3.67
	exp	24.38	10.30	22.79	9.72	21.76	12.10	19.73	11.09
	exp2	700.49	489.23	613.91	421.81	619.95	543.64	512.29	443.08
2007	inc.	34207.11	31304.61	24437.88	24972.30	14310.20	13124.36	10783.55	11125.28
	e	12.48	2.98	12.19	2.92	8.20	2.39	7.55	2.52
	exp	22.67	11.50	20.88	10.94	22.43	12.79	19.45	11.36
	exp2	646.29	526.24	555.61	456.47	666.64	579.67	507.34	448.32

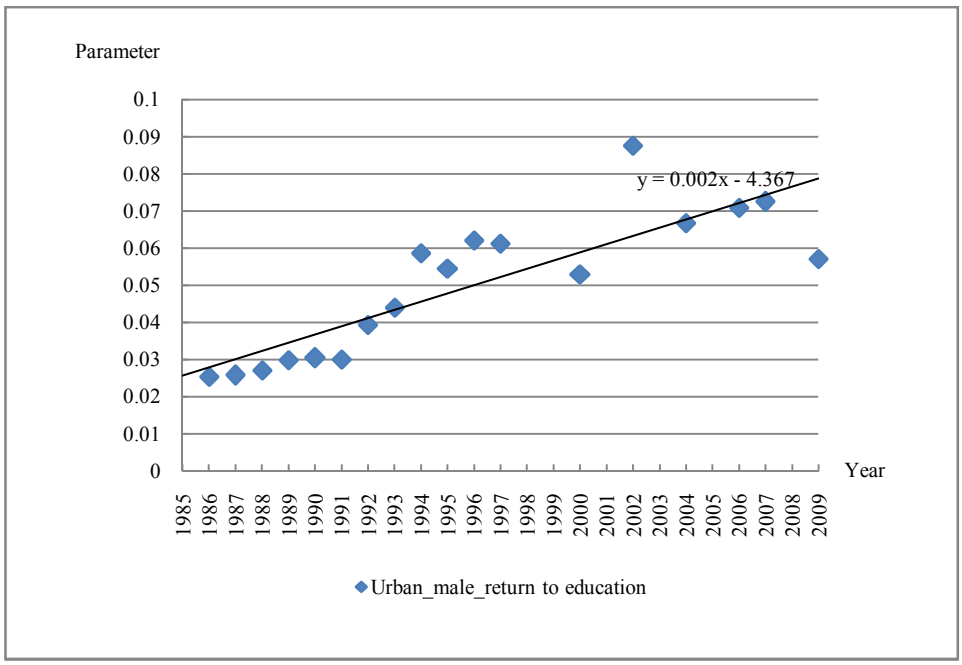
Table B.1.3 Summary Statistics: CHNS samples

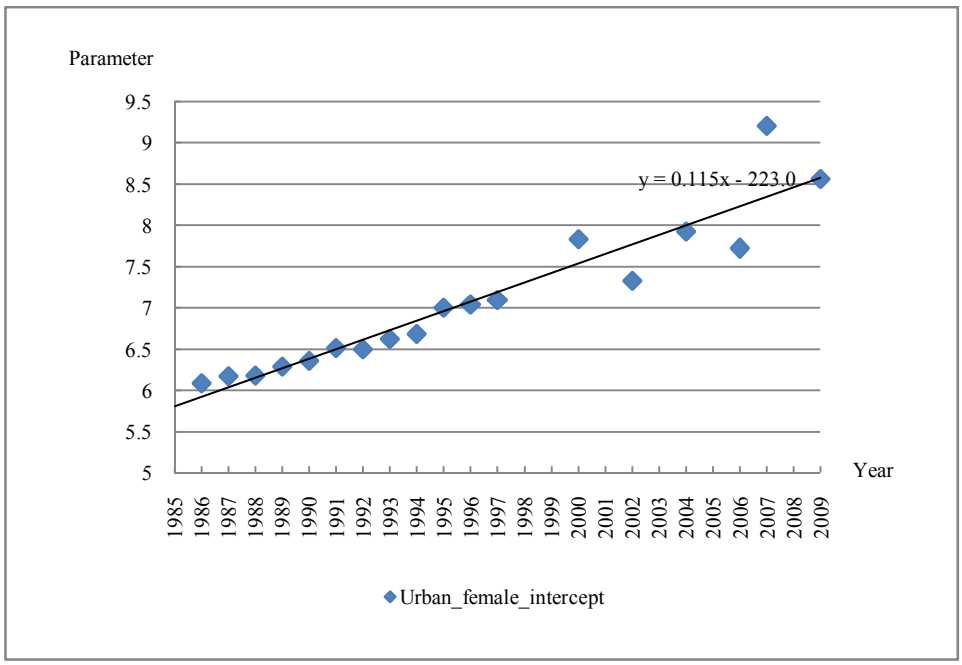
Year	Variables	Urban				Rural			
		Male		Female		Male		Female	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
1989	inc.	1798.70	2344.70	1586.70	2811.08	1528.22	4327.60	1163.61	1208.51
	e	8.97	3.99	8.48	4.03	6.30	4.07	4.62	4.35
	exp	18.83	11.28	16.22	9.52	18.58	11.19	16.49	10.18
	exp2	481.46	496.74	353.69	357.28	470.40	470.24	375.41	379.95
1991	inc.	1982.20	1166.19	1658.30	1101.16	1488.30	1536.87	1218.69	1150.49
	e	9.03	4.01	8.40	4.08	6.68	3.94	4.90	4.31
	exp	20.29	11.67	17.57	10.03	19.47	11.43	17.24	10.29
	exp2	547.69	536.04	409.28	400.77	509.78	491.39	403.10	388.17

Year	Variables	Urban				Rural			
		Male		Female		Male		Female	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
1993	inc.	3004.28	2713.91	2572.46	2350.75	2077.52	2287.98	1708.76	1725.63
	e	9.50	3.67	8.85	3.73	7.08	3.72	5.29	4.27
	exp	21.12	11.13	18.49	9.66	20.01	11.40	18.13	10.27
	exp2	569.96	519.48	435.08	383.87	530.22	492.58	433.94	394.98
1997	inc.	6736.15	5557.51	5494.90	4417.92	4510.02	4667.66	3482.20	3338.41
	e	10.17	3.36	9.65	3.48	7.33	3.54	5.59	4.17
	exp	21.75	10.76	19.00	9.46	21.26	11.56	19.58	10.55
	exp2	588.88	496.39	450.29	375.41	585.44	516.52	494.49	426.10
2000	inc.	9531.14	10001.12	7680.28	6977.01	5372.80	5953.70	4049.79	3861.85
	e	10.86	3.24	10.49	3.45	7.94	3.27	6.38	4.13
	exp	22.61	10.71	20.26	9.80	22.12	11.68	20.92	10.49
	exp2	625.58	499.59	506.24	401.96	625.85	529.18	547.67	434.83
2004	inc.	12698.23	10912.61	10486.85	9471.15	7228.57	9316.07	5497.96	6418.09
	e	11.09	3.05	10.63	3.23	8.29	3.19	6.78	4.04
	exp	25.31	10.41	23.10	9.77	25.87	10.94	23.60	9.62
	exp2	748.65	509.74	628.71	426.33	788.78	543.67	649.36	430.63
2006	inc.	17566.76	22706.18	13106.66	14583.46	10744.52	13026.88	7506.87	8592.91
	e	11.31	3.22	10.93	3.48	8.38	3.64	6.94	4.34
	exp	26.17	9.96	23.88	9.41	26.46	10.67	24.18	9.39
	exp2	784.05	497.25	658.56	424.07	813.95	540.02	672.88	425.50
2009	inc.	25380.83	31297.40	18287.02	17651.27	16781.56	25841.87	12409.02	14177.14
	e	11.07	3.23	11.05	3.33	8.26	3.39	7.29	4.13
	exp	27.02	10.40	23.94	9.83	26.78	10.81	24.16	9.57
	exp2	838.20	524.35	669.66	433.39	833.89	551.49	675.04	422.00

Figures B.1-B.4 Plotting Parameter Estimates Against Time: Urban Sample



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8
7.5
7
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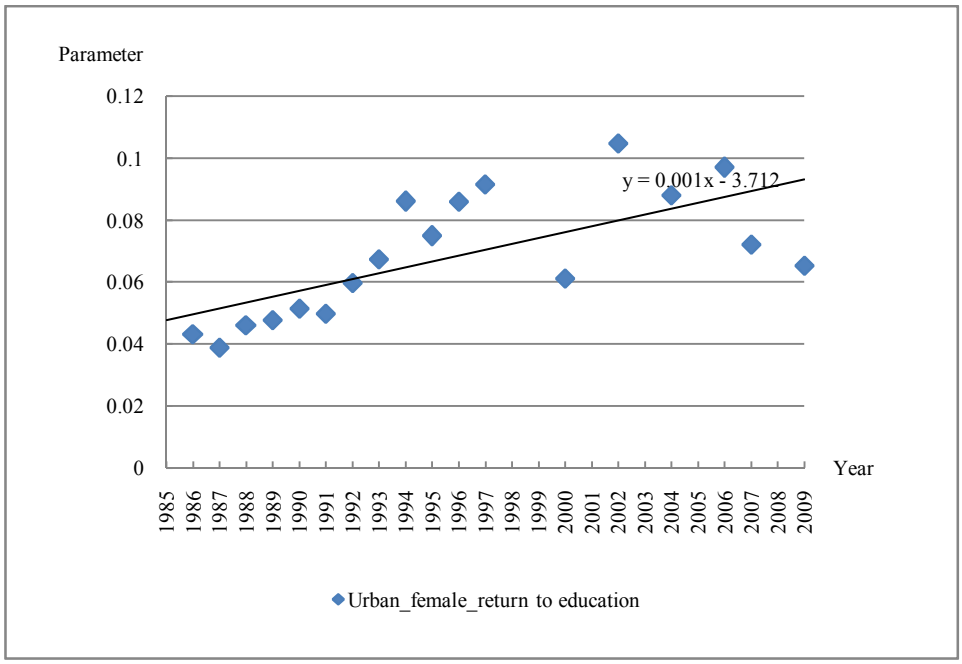
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Urban_female_intercept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0.04
0.02
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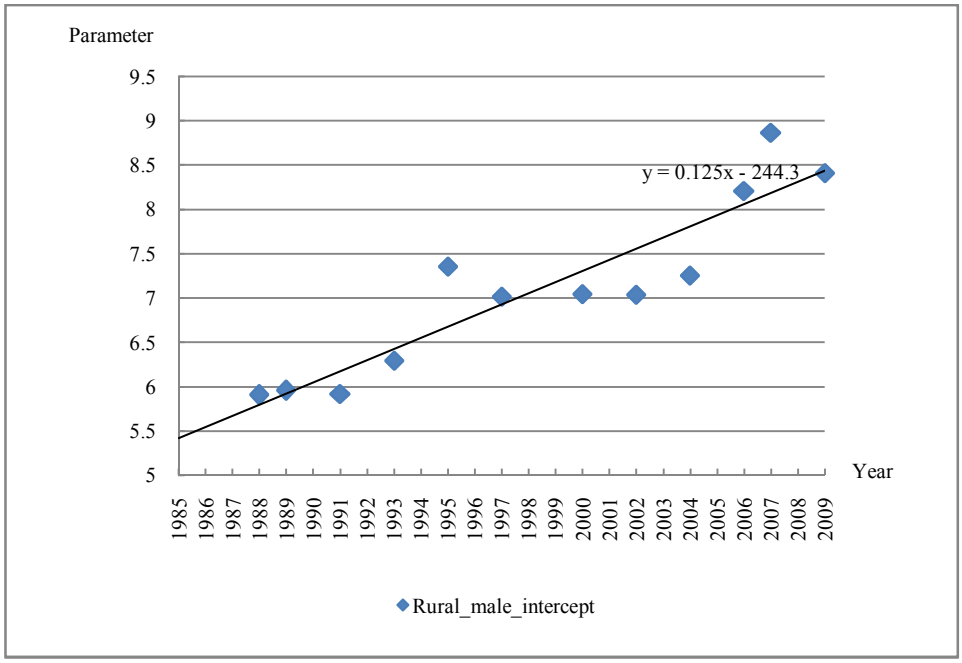
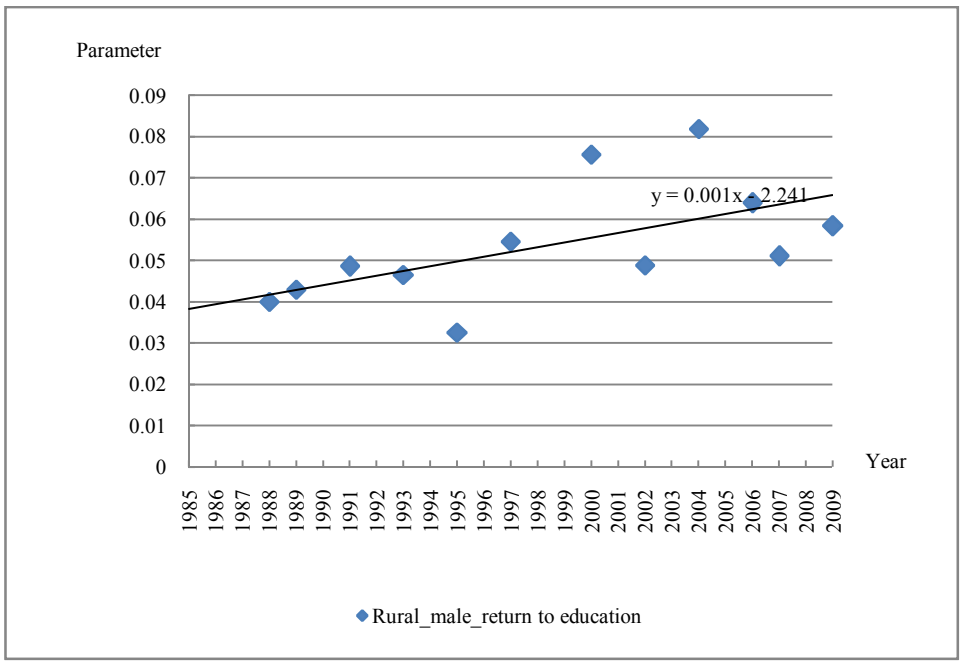
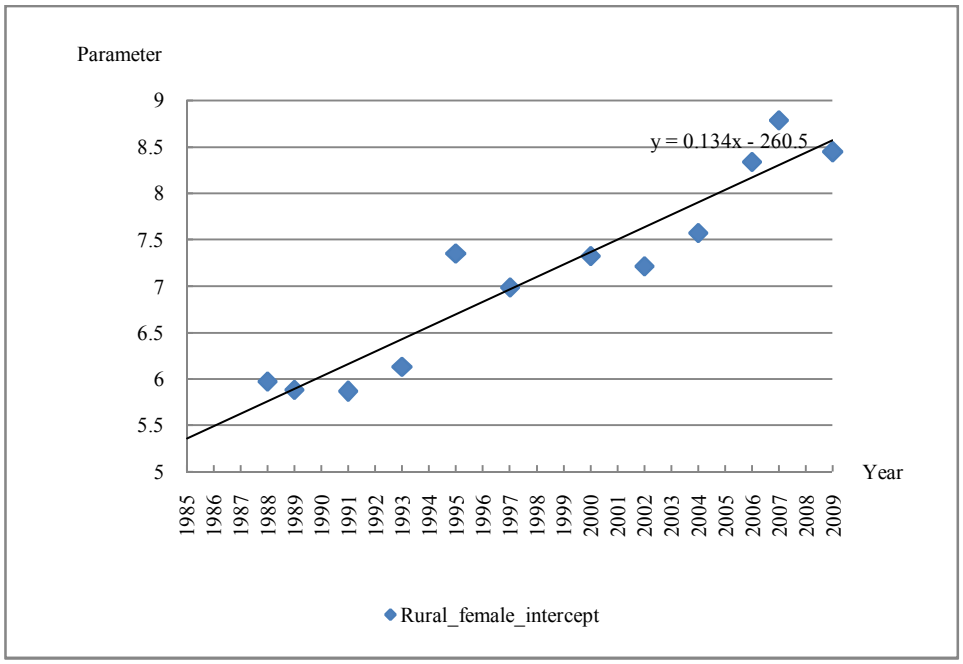
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Urban_female_return to education

Figures B.5~8 Plotting Parameter Estimates Against Time: Rural Sample



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8
7.5
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6.5
6
5.5
5
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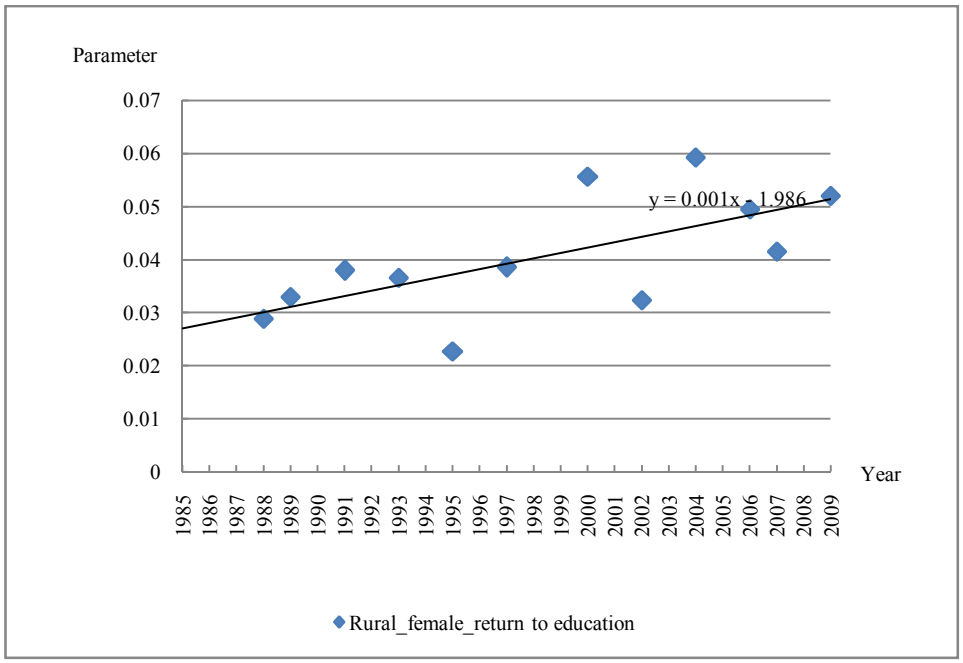
Rural_female_intercept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0.05
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0.02
0.01
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Year
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Rural_female_return to education

Appendix C: Human capital stock calculation

This section summarizes the basic methods and procedures of estimating China's human capital stock from 1985 to 2009 based on the J-F approach. In particular, it explains the necessary data estimation of the J-F approach based on China's data. We use the following notations:

y = 1980, 1981, 1982, … 2009, calendar year;

s = 1, 2, sex, male or female;

a = 0, 1, …. 60, age;

e: education level, which is described below.

For years 1985-2009 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 2000-2009 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 employed person in year y, with sex s, age a , and education level e;

empr(y,s,a,e): employment rate in year y, for persons with sex s, age a, and education level e;

mhrs(y,s,a,e): market labor time per capita in year y, for persons 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, for persons 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 share 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 population 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 people in school in year y, with sex s, age a, and education level e.

pop_nischool(y,s,a,e): the number of people 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): lifetime income for both sexes (nominal income).

v_e：share of the present value of lifetime income for the population with education level e.

$\overline{v}_e$：average share of the present value of lifetime income for the population with education level e.

$\overline{v}_s$：average share of the present value of lifetime income for the population with sex s.

ΔlnK：growth rate of the aggregate human capital stock

Poplog(y,s): the logarithmic growth rate of the population for sex s in year y.

Mitg (y): cumulated growth rate of the aggregate human capital stock

MiQ(y): total lifetime income in year y measured in the base year's prices.

1. Age categories for calculating lifetime income using 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 males and 55 for females. The legal retirement ages were 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 Settling the Retired Workers by the State Council"

(1978, No.104). In general, the legal retirement age is 60 for male and 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 males and 45 for females. For people who become disabled due to illness and other reasons, the legal retirement age is 50 for males and 45 for females.

(2) The a in the table is the upper bound of "work and school", and the lower bound of "work only". This age is determined 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 data from 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 work experience squared exp^2 by OLS.

$$\ln \text{yinc} = a + b\,e + g\,\exp + d\,\exp^2 + \text{u}$$

We use the fitted value of *ln yinc* from the equation above to obtain $\text{m}_\text{i} = e^{\ln \text{yinc}}$. We regress the yearly income observed in the survey data against m_i by OLS (without the intercept) to obtain the coefficient estimate

for m_i,α[94]. Finally, we estimate the yearly income of the employed as yinc= $a \times e^{\ln \text{yinc}}$.

Note: The yearly income used for estimating the Mincer equation is in real terms with1985 as the based year.

2.1.2 Years of schooling and work 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	
2000-2009	0	6	9	12	15	16

(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 Estimation of annual market income

When estimate the yearly income of the employed using the Mincer equation, we obtain $\text{yinc}_{y,s,a,e} = \text{whrs}_{y,s,a,e} \times \text{com}_{y,s,a,e}$.

According to

$\text{mhrs}_{y,s,a,e}=\text{whrs}_{y,s,a,e} \times \text{empr}_{y,s,a,e}$, $\text{ymi}_{y,s,a,e}=\text{whrs}_{y,s,a,e} \times \text{empr}_{y,s,a,e} \times \text{com}_{y,s,a,e}$

to the annual market income is given by:

$$\text{ymi}_{y,s,a,e}=\text{yinc}_{y,s,a,e} \times \text{empr}_{y,s,a,e}.$$

[94] Jeffrey M. Wooldridge (2005), Introductory Econometrics: A Modern Approach, 3rd edition.

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 in 1995 and 2000. We assume the employment rate for college is the same as that of university.

The formula used to calculate the employment rate is:

$$empr(y,s,a,e)=[employed(y,s,a,e)]/pop(y,s,a,e)$$

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" for each province, autonomous region and municipality directly under the central government is aggregated to the whole population employed by the actual sampling percentage of 10%.

3. Calculation of enrollment rate

Enrollment rate is the share that a group with education level e to enroll 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 enrollment number of each year by sex, age and education level is given by:

$$\text{NewEnroll}(y,s,a,e) = \text{NewEnroll}(y,s,e) * \lambda(y,s,a,e)$$

$$\sum_{a} l(y,s,a,e) = 1$$

Note: λ(y,s,a,e) refers to the age distribution of enrollment number for each education level and sex.

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:

$$\text{pop\_inschool}(y,s,a,e-n) = \text{NewEnroll}(y-n,s,a-n,e)$$

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, where "*X*" is 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 enrolling 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 who have no schooling in year y and enroll into primary school in year y+1 is 11. The upper bound of people out of school in 2007 and enrolling 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 a grade, or takes leaves for a year or more within a certain education category.

2) We could only calculate the primary school enrollment rate till 2003 for lack of data We use the same enrollment rates in 2003 for years after 2003. Likewise, for junior middle school and high school enrollment rates, we fix the enrollment rates for 2007 and 2008 at the 2006 levels.

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 an 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. We discount that income by 6 years to reflect the fact that it takes 6 years for him to reach junior middle school: senr(y,s,a,jm-pri)*mi(y,s,a+6,jm)*R^6.

(2) If an individual in the second grade of primary school can advance to the next higher education level, his life time income calculated as: senr(y,s,a,jm-pri-1)*mi(y,s,a+5,jm)*R^5 , discounted by 5 years as it takes him 5 years to reach junior middle school.

(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 an 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.- We discount that income by 3 years as it takes 3 years for him to reach senior middle school: senr(y,s,a,sm-jm)*mi(y,s,a+3,sm)*R^3

(2) If an individual in the second grade of junior middle school can advance to the next higher education level, his lifetime income is calculated as senr(y,s,a,sm-jm-1)*mi(y,s,a+2,sm)*R^2 , discounted by 5 years as it takes 2 years for hime to reach senior middle school.

(3) Similarly, we can calculate the lifetime income of the group in each

grade of junior middle school.

For the years that we do not home separate enrollments for university and college (there are five categories for education level, and the last level is college and above), we get the lifetime income of the group in the first grade of senior middle school as $senr(y,s,a,col\text{-}sm)*mi(y,s,a+3,col)*R^3$. For grade 2 and 3 students, the lifetime income are given by:

$$senr(y,s,a,col\text{-}sm\text{-}1)*mi(y,s,a+2,col)*R^2$$

and

$$senr(y,s,a,col\text{-}sm\text{-}1)*mi(y,s,a+2,col)*R$$

respectively.

For the years that separate university and college enrollments are available (there are six categories for education level, and the last level is university and above), we should use the lifetime income equation are:

$$senr(y,s,a,col\text{-}sm)*mi(y,s,a+3,col)*R^3+senr(y,s,a,uni\text{-}sm)*mi(y,s,a+3,uni)*R^3$$

as for a senior middle school students, they can go to college or university after their graduation.

For grade 2 students, the lifetime income is calculated as $senr(y,s,a,col\text{-}sm\text{-}1)*mi(y,s,\ a+2,col)*R^2+senr(y,s,a,uni\text{-}sm\text{-}1)*mi(y,s,a+2,uni)*R^2$. 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 age-specific survival rates. Accordingly, survival rate does not appear 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:

$$pop\_inschool(y,s,a,e) = \sum_{n=0}^{y(e)} pop\_inschool(y,s,a,e-n)$$

where 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 made 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 aged 5-10.

(2) Add the weighted negative out-of-school population for certain gender, age, education level to the in-school population by grades, where the weights are the proportion of population in each grade for by gender, age, and education level.

5.2 Out-of-school population's lifetime income

The out-of-school population consists of people who are working. For people below the age of 60, the formula for lifetime income is:

mi(y,s,a,e) = ymi(y,s,a,e) + sr(y+1,s)*mi((y,s,a+1,e)*R

For those who are over 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 approximate the real wage growth rate of urban and rural areas. Specifically, we use the labor productivity of the primary sector for the rural population and the labor productivity of the secondary and tertiary sectors for the urban population. The growth rates of real wage are 6.14% for the urban population and 4.33% for the rural population.

6.2 Discount rate

The discount rate we use is 4.58%, This discount rate was used in Jorgenson and Yun (1990) and Jorgenson and Fraumeni (1992a).- It is based on the rate of return on long-term investments in the private sector of the U.S. economy. This is also the rate adopted by the OECD consortium (OECD 2010).

7. Tax rate and non-market income

(1) We use the Mincer equation to estimate annual income of the employed population. 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 estimates are derived from market income only.

8. Human capital stock in China: 1985-2009

The income estimated by the Mincer equation is the real yearly income (using 1985 as the based). We use CPI and real income to obtain the nominal yearly income.

Tables C.1－C.8 report the real human capital in China with 1985 as the baseline year. Table C.9-C.16 show the labor force human capital. We create a new human capital series starting from 2000, as the reported education categories separates college from university or above.

Tables and figures of appendix C

Table C.1 Urban Real Human Capital 1985-2009, in Billions

Year	Total	Male	Female
1985	10140	6468	3672
1986	11051	7050	4001
1987	11905	7590	4315
1988	11517	7378	4139
1989	11447	7340	4107
1990	13228	8496	4732
1991	14463	9261	5202
1992	15377	9812	5565
1993	15423	9847	5576
1994	14227	9105	5122
1995	13965	8898	5067
1996	15648	9960	5688
1997	18506	11790	6716
1998	22447	14340	8107
1999	27368	17440	9928
2000	32430	20660	11770
2001	37330	23750	13580
2002	44230	28130	16100
2003	51300	32660	18640
2004	57350	36430	20920
2005	66550	41860	24690
2006	72440	46310	26130
2007	80210	51210	29000
2008	88340	56230	32110
2009	102920	65560	37360

Note: The results are based on five education categories.

Table C.2 Urban Real Human Capital 2000-2009, in Billions

Year	Total	Male	Female
2000	32710	20820	11890
2001	37680	23950	13730
2002	44690	28400	16290
2003	51870	32990	18880
2004	58020	36810	21210
2005	67690	42510	25180
2006	73370	46850	26520
2007	81320	51860	29460
2008	89690	57030	32660
2009	104590	66550	38040

Note: The results are based on six education categories.

Table C.3 Rural Real Human Capital 1985-2009, in Billions

Year	Total	Male	Female
1985	15893	9294	6599
1986	16732	9845	6887
1987	17603	10420	7183
1988	16898	10070	6828
1989	15924	9522	6402
1990	17169	10320	6849
1991	18714	11300	7414
1992	19850	12040	7810
1993	19541	11940	7601
1994	17678	10860	6818
1995	16664	10230	6434
1996	16965	10450	6515
1997	18251	11320	6931
1998	20242	12650	7592
1999	22593	14240	8353
2000	24923	15810	9113
2001	26734	16990	9744

2002	28940	18450	10490
2003	30680	19600	11080
2004	31750	20350	11400
2005	33510	21490	12020
2006	36480	23530	12950
2007	38080	24650	13430
2008	39390	25610	13780
2009	43540	28400	15140

Note: The results are based on five education categories.

Table C.4 Rural Real Human Capital 2000-2009, in Billions

Year	Total	Male	Female
2000	24706	15670	9036
2001	26503	16840	9663
2002	28700	18290	10410
2003	30410	19430	10980
2004	31440	20150	11290
2005	33140	21250	11890
2006	36080	23270	12810
2007	37630	24360	13270
2008	38920	25310	13610
2009	42940	28010	14930

Note: The results are based on six education categories.

Table C.5 Urban Per Capita Real Human Capital, 1985-2009

Unit: Thousand Yuan

Year	Total	Male	Female
1985	44.66	53.59	34.53
1986	46.50	56.09	35.74
1987	47.92	58.07	36.64
1988	44.70	54.03	34.19
1989	43.05	51.78	33.08
1990	48.58	58.16	37.50
1991	51.70	62.13	39.80

Year	Total	Male	Female
1992	53.64	64.55	41.32
1993	52.57	63.73	40.15
1994	47.35	57.63	35.95
1995	45.50	55.41	34.62
1996	47.85	58.34	36.39
1997	53.27	64.94	40.51
1998	61.10	74.32	46.48
1999	70.65	85.64	54.03
2000	79.69	96.26	61.20
2001	88.20	106.91	67.52
2002	100.43	122.44	76.43
2003	112.16	137.12	85.03
2004	122.01	148.92	92.81
2005	138.44	167.14	107.22
2006	147.63	181.03	111.26
2007	159.93	195.81	120.84
2008	172.46	210.48	131.02
2009	197.04	240.42	149.66

Note: The results are based on five education categories.

Table C.6 Urban Per Capita Real Human Capital, 2000-2009

Unit: Thousand Yuan

Year	Total	Male	Female
2000	80.39	96.99	61.86
2001	89.04	107.81	68.31
2002	101.48	123.61	77.34
2003	113.39	138.46	86.13
2004	123.44	150.50	94.09
2005	140.80	169.74	109.33
2006	149.53	183.16	112.90
2007	162.17	198.33	122.76
2008	175.09	213.46	133.27
2009	200.25	244.05	152.40

Note: The results are based on six education categories.

Table C.7 Rural Per Capita Real Human Capital, 1985-2009

Unit: Thousand Yuan

Year	Total	Male	Female
1985	21.68	24.24	18.88
1986	22.76	25.55	19.69
1987	23.86	26.88	20.51
1988	22.71	25.70	19.38
1989	21.21	24.06	18.03
1990	22.61	25.75	19.10
1991	24.56	28.11	20.59
1992	26.00	29.89	21.65
1993	25.55	29.57	21.05
1994	23.10	26.91	18.85
1995	21.78	25.44	17.73
1996	22.45	26.33	18.15
1997	24.46	28.81	19.62
1998	27.52	32.58	21.86
1999	31.24	37.16	24.56
2000	35.03	41.84	27.32
2001	38.45	46.10	29.82
2002	42.62	51.32	32.84
2003	46.34	56.01	35.48
2004	49.12	59.64	37.35
2005	53.19	64.77	40.31
2006	58.88	72.01	44.23
2007	62.74	76.80	46.95
2008	66.26	81.22	49.35
2009	74.71	91.75	55.41

Note: The results are based on five education categories.

Table C.8 Rural Per Capita Real Human Capital, 2000-2009

Unit: Thousand Yuan

Year	Total	Male	Female
2000	**35.03**	**41.85**	**27.32**
2001	**38.45**	**46.10**	**29.82**
2002	**42.62**	**51.32**	**32.84**
2003	**46.33**	**56.01**	**35.48**
2004	**49.11**	**59.64**	**37.35**
2005	**53.19**	**64.77**	**40.31**
2006	**58.88**	**72.01**	**44.23**
2007	**62.74**	**76.81**	**46.96**
2008	**66.26**	**81.22**	**49.36**
2009	**74.72**	**91.75**	**55.42**

Note: The results are based on six education categories.

Table C.9 Urban Real Labor Force Human Capital 1985-2009, in Billions

Year	Total	Male	Female
1985	4805	3094	1711
1986	5306	3407	1899
1987	5719	3668	2051
1988	5706	3675	2031
1989	5863	3791	2072
1990	6711	4368	2343
1991	7389	4787	2602
1992	7809	5041	2768
1993	7706	4971	2735
1994	6913	4450	2463
1995	6662	4273	2389
1996	7334	4725	2609
1997	8650	5599	3051
1998	10662	6936	3726
1999	13013	8492	4521

2000	15670	10280	5390
2001	17721	11600	6121
2002	20456	13370	7086
2003	23216	15170	8046
2004	25060	16380	8680
2005	28044	18330	9714
2006	31520	20740	10780
2007	33980	22400	11580
2008	36140	23850	12290
2009	41880	27730	14150

Note: The results are based on five education categories.

Table C.10 Urban Real Total Human Capital 2000-2009, in Billions

Year	Total	Male	Female
2000	**15294**	**10030**	**5264**
2001	**17393**	**11380**	**6013**
2002	**20210**	**13210**	**7000**
2003	**23117**	**15110**	**8007**
2004	**25188**	**16460**	**8728**
2005	**28205**	**18430**	**9775**
2006	**31720**	**20860**	**10860**
2007	**34210**	**22540**	**11670**
2008	**36410**	**24020**	**12390**
2009	**42220**	**27940**	**14280**

Note: The results are based on six education categories.

Table C.11 Rural Real Labor Force Human Capital 1985-2009, in Billions

Year	Total	Male	Female
1985	7922	4682	3240
1986	8451	5010	3441
1987	9092	5414	3678
1988	8874	5319	3555
1989	8491	5119	3372

Year	Total	Male	Female
1990	9276	5621	3655
1991	10251	6232	4019
1992	10958	6686	4272
1993	10774	6608	4166
1994	9613	5921	3692
1995	9041	5587	3454
1996	9234	5755	3479
1997	9996	6279	3717
1998	11230	7114	4116
1999	12509	7985	4524
2000	13831	8896	4935
2001	14837	9544	5293
2002	16071	10350	5721
2003	17229	11100	6129
2004	17547	11310	6237
2005	18433	11880	6553
2006	20588	13360	7228
2007	21980	14320	7660
2008	23026	15060	7966
2009	25628	16830	8798

Note: The results are based on five education categories.

Table C.12 Rural Real Labor Force Human Capital 2000-2009, in Billions

Year	Total	Male	Female
2000	13717	8823	4894
2001	14715	9466	5249
2002	15943	10270	5673
2003	17076	11000	6076
2004	17376	11200	6176
2005	18232	11750	6482
2006	20371	13220	7151
2007	21731	14160	7571
2008	22753	14880	7873
2009	25279	16600	8679

Note: The results are based on six education categories.

Table C.13 Urban Per Capita Real Labor Force Human Capital, 1985-2009

Unit: Thousand Yuan

Year	Total	Male	Female
1985	33.71	40.83	25.62
1986	35.24	42.94	26.66
1987	36.22	44.41	27.23
1988	34.05	41.61	25.62
1989	33.22	40.39	25.07
1990	37.11	44.98	27.98
1991	39.24	47.76	29.55
1992	40.14	49.07	30.14
1993	38.59	47.51	28.77
1994	34.13	42.26	25.33
1995	32.19	40.02	23.85
1996	33.56	41.75	24.77
1997	37.20	46.34	27.31
1998	42.71	53.35	31.16
1999	48.89	61.06	35.57
2000	55.10	68.90	39.86
2001	59.95	75.26	43.27
2002	67.00	84.50	48.18
2003	73.77	93.30	52.90
2004	78.38	99.38	56.03
2005	84.94	107.79	60.67
2006	93.05	118.52	65.84
2007	98.63	125.51	69.75
2008	103.91	131.96	73.56
2009	117.96	149.75	83.31

Note: The results are based on five education categories.

Table C.14 Urban Per Capita Real Labor Force Human Capital, 2000-2009

Unit: Thousand Yuan

Year	Total	Male	Female
2000	**54.37**	**68.07**	**39.30**
2001	**59.38**	**74.60**	**42.83**
2002	**66.62**	**84.07**	**47.87**
2003	**73.72**	**93.28**	**52.82**
2004	**78.78**	**99.86**	**56.35**
2005	**85.43**	**108.38**	**61.06**
2006	**93.64**	**119.23**	**66.30**
2007	**99.32**	**126.33**	**70.29**
2008	**104.69**	**132.89**	**74.18**
2009	**118.92**	**150.90**	**84.08**

Note: The results are based on six education categories.

Table C.15 Rural Per Capita Real Labor Force Human Capital, 1985-2009

Unit: Thousand Yuan

Year	Total	Male	Female
1985	18.50	20.78	15.97
1986	19.48	21.99	16.71
1987	20.54	23.30	17.48
1988	19.60	22.34	16.57
1989	18.37	20.98	15.44
1990	19.62	22.50	16.39
1991	21.28	24.53	17.65
1992	22.49	26.06	18.51
1993	21.94	25.62	17.87
1994	19.58	23.02	15.79
1995	18.37	21.72	14.70
1996	18.92	22.49	14.98
1997	20.56	24.57	16.12
1998	23.12	27.80	17.92
1999	25.97	31.34	19.94

2000	28.89	35.01	21.96
2001	31.39	38.22	23.75
2002	34.56	42.29	25.97
2003	37.50	46.07	28.06
2004	39.17	48.31	29.16
2005	42.17	52.16	31.30
2006	47.26	58.71	34.73
2007	50.83	63.18	37.23
2008	53.86	66.96	39.33
2009	60.96	75.91	44.28

Note: The results are based on five education categories.

Table C.16 Rural Per Capita Real Labor Force Human Capital, 2000-2009

Unit: Thousand Yuan

Year	Total	Male	Female
2000	**28.89**	**35.01**	**21.96**
2001	**31.40**	**38.22**	**23.75**
2002	**34.56**	**42.30**	**25.97**
2003	**37.51**	**46.08**	**28.06**
2004	**39.17**	**48.32**	**29.16**
2005	**42.17**	**52.17**	**31.30**
2006	**47.27**	**58.73**	**34.74**
2007	**50.84**	**63.20**	**37.24**
2008	**53.88**	**66.98**	**39.34**
2009	**60.98**	**75.94**	**44.29**

Note: The results are based on six education categories.

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.[95] 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.[96] 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 business firms of varying ownership types, including the state-

[95] 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

[96] Jorgenson, D. W. and K - Y. Yun (1990). "Tax Reform and U.S. Economic Growth", *Journal of Political Economy*98: pp.S151-193.

owned, urban collective, 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.[97] The calculation of the average growth rate of real wage is given in Table D.1. Table D.1 shows the average growth rate is 7.22% over the period of 1978 – 2009. The annual growth rates are plotted 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 sum of income from all sources deducted from the corresponding expenses'. The 'net income is equal to 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.[98] Netting out the rate of inflation, we arrive at the growth rate of net per capita income in rural areas from 1978 - 2009.

The above estimations of urban and rural income growth rates have obvious shortcomings. For urban areas, because the wage is only one of many possible sources of income, the income estimates may not be very comprehensive. For rural areas, the net income per capita includes all the family members in the household regardless their employment status. As a result, it is not an accurate measure of the growth rate of productivity.

[97] All definitions here come from National Statistical Yearbook.
[98] National Bureau of Statistics of China, China Statistical Yearbook 2008, Website: http://www.stats.gov.cn/tjsj/ndsj/2008/indexch.htm.

1.2 Growth rate of labor productivity

The Harrod-Neutral production function is:

$$Y=F(K, A(t)\cdot L(t))$$

$$A(t)=A_0e(qt)$$

$$L(t)=L_0e(nt)$$

where A(t) is the measure of technology level, A>0 and dA/dt>0. q is the growth rate of technology 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 q . Thus, under the assumption that technological changes are Harrod-Neutral, income and labor productivity grow at the same rate.[99]

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).

To calculate the rural and urban growth rate of labor productivity, we use primary industry GDP for rural areas and secondary and tertiary industries GDP for urban areas.

Labor productivity the rural sector is calculated as follows:

Labor productivity of the rural sector = Real GDP of Agriculture/Employment of Agriculture

[99] http://homepage.newschool.edu/het/essays/growth/neoclass/solowtech.htm

Labor productivity of the urban sector=Real GDP of secondary and tertiary industries/Employment of secondary and tertiary industries.

The rural and urban growth rates of labor productivity are 4.33% and 6.14%, respectively.

Some studies use the growth rate of GDP per capita as the urban growth rate of labor productivity,[100] which is far greater than our estimation. Since they use population instead of employment, their estimates are less accurate.

Figure D.1 shows the annual growth rates of labor productivity and real wage at the national level. Figure D.2 shows the annual growth rates of labor productivity for the urban and rural sectors. As shown in Figure D.1, although the mean values of the growth rate of labor productivity and real wage are close, the annual growth rate of real wage varies dramatically. In Figure D.2, we notice that the rural growth rate is mostly lower than the urban growth rate. One possible reason is that the service and industry sectors have grown faster than the agriculture sector during the past thirty years.

We choose 4.33% and 6.14% as the rates of income growth for individuals in rural and urban areas respectively. 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 rates to better reflect structural changes in the Chinese economy.

1.3 International Comparison

According to the Bureau of Labor Statistics of the United States, the estimated annual growth rates of labor productivity over the period 1979-2007

[100] Xu Xunchuan (2008), "The analysis of labor productivity's impact on employment." *Contemporary Finance & Economics* 10: pp.17-22

are 1.5% for U.S., 2.0% for Japan, and 4.3% for South Korea. OECD, using GDP per hour worked to measure labor productivity, reports estimates of 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). In addition, the labor productivity of Taiwan increased significantly from 7.38% during the period of 1953 – 1961 to 9.15% during the period of 1962 – 1971, and fell to 3.84% during the period of 1972 -1981.[101] The United States Bureau of Labor Statistics also published annual data on labor productivity in the non-agriculture sector, which indicate labor productivity grew 1.4%-1.5% per year from 1979-1995 and 2.5% per year from 1995-2008.[102]

2. Discount Rate

Discount rate reflects the time value of currency and is derived based on the return on long-term investments. The discount rate of 4.58%, used in Jorgenson and Yun (1990) and Jorgenson and Fraumeni (1992a), is based on the rate of return on long-term investments in the private sector of the U.S. economy. This is also the rate adopted by the OECD consortium (OECD 2010). We adopt it as well.

[101] Zhang Yushan(1987), "The comparison of labor productivity of Taiwan and South Korea." *Asia-pacific Economic Review* 6
[102] http://data.bls.gov/PDQ/servlet/SurveyOutputServlet and http://www.bls.gov/fls/#tables

Tables and figures of appendix D

Table D.1 Growth Rate in China, 1978-2009

Year	Nominal GDP （100 million）	Real GDP indices (1978 =100)	Real GDP （100 Million Yuan）	Employed person (10 thousand)	Labor productivity (Yuan per person)	National labor productivity growth rate	National 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	0.0660
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	-0.0120
1982	5323.35	133.15	4853.54	45295	1071.54	0.0514	0.0130
1983	5962.65	147.60	5380.29	46436	1158.65	0.0782	0.0150
1984	7208.05	170.00	6196.81	48197	1285.72	0.1041	0.1480
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	0.0820
1987	12058.62	234.27	8539.80	52783	1617.91	0.0808	0.0090
1988	15042.82	260.70	9503.13	54334	1749.02	0.0779	-0.0080
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	0.1307
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	0.1519
2002	120332.69	897.77	32725.69	73740	4437.98	0.0772	0.1545
2003	135822.76	987.78	36006.57	74432	4837.51	0.0862	0.1199

Year	Nominal GDP （100 million）	Real GDP indices (1978 =100)	Real GDP （100 Million Yuan）	Employed person (10 thousand)	Labor productivity (Yuan per person)	National labor productivity growth rate	National average real wage growth rate
2004	159878.34	1087.39	39637.85	75200	5270.99	0.0858	0.1045
2005	184937.37	1210.38	44120.90	75825	5818.78	0.0989	0.1280
2006	216314.43	1363.81	49713.90	76400	6507.06	0.1118	0.1267
2007	265810.31	1556.96	56754.58	76990	7371.68	0.1248	0.1359
2008	314045.43	1706.97	62222.70	77480	8030.81	0.0856	0.1100
2009	340506.87	1862.53	67893.10	77995	8704.80	0.0806	

Data Source：

1. Total employed person and average real wage growth rate of 1978-2009: 60-year statistic data of New China, Department of Comprehensive Statistics of National Bureau of Statistics of China, Beijing, China Statistics Press
2. Other data: National Bureau of Statistics of China, China Statistical Yearbook 2010.

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 productivity 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

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 productivity 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
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	45289.87	41855	10820.66	0.0674
2006	3624.72	32561	1113.21	0.0912	51457.34	43839	11737.80	0.0814
2007	3760.43	31444	1195.91	0.0717	59352.91	45546	13031.42	0.1046
2008	3962.68	30654	1292.71	0.0778	65311.04	46826	13947.60	0.0679
2009	4128.46	29708	1389.68	0.0723	71679.22	48287	14844.41	0.0623

Data Source:

Data Source：

3. Total employed person and average real wage growth rate of 1978-2009: 60-year statistic data of New China, Department of Comprehensive Statistics of National Bureau of Statistics of China, Beijing, China Statistics Press
4. Other data: National Bureau of Statistics of China, China Statistical Yearbook 2010.

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 exists 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.

Figures of appendix D

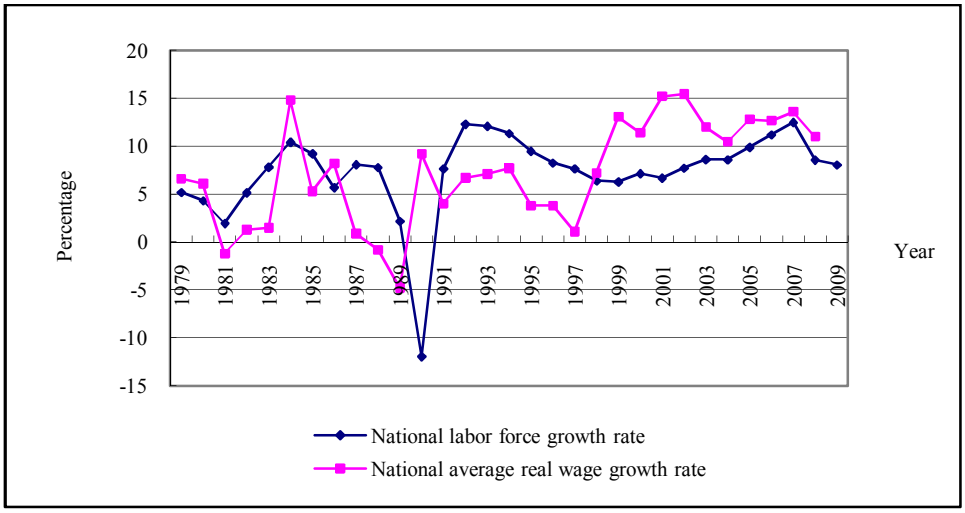

Figure D.1 Growth Rate of National Labor Productivity and Average Real Wage

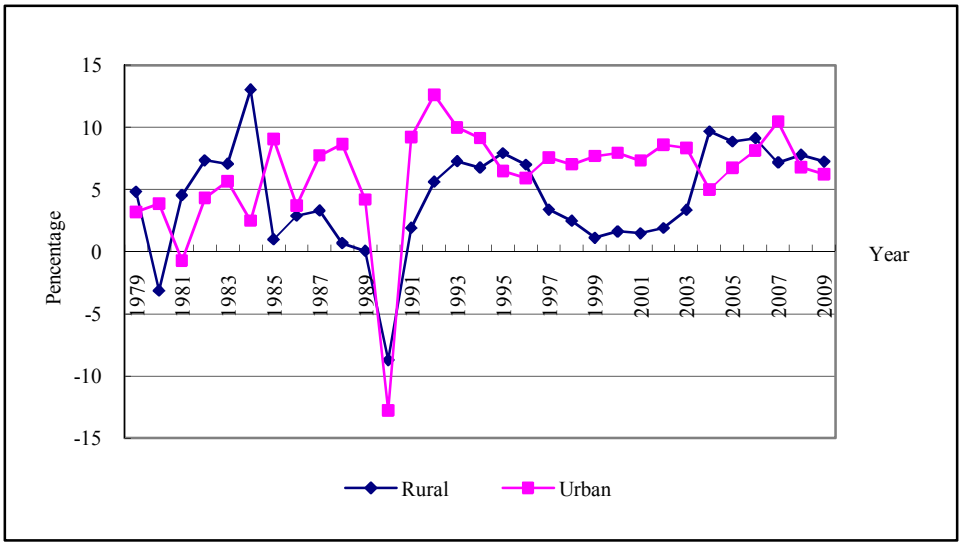

Figure D.2 Growth Rate of Labor Productivity in Urban and Rural Sectors

Appendix for provincial human capital calculation

See the Chinese version report.

Reference List

Abraham, Katharine G. June (2010), Survey of Current Business, Accounting for Investments in Formal Education, pp. 42-53.

Abraham, Katharine (2005), Beyond the Market: Designing Nonmarket Accounts for the United States, National Academies Press, Washington, D.C.

Ahlroth, Sofia, A. and Bjorklund, A. Forslund (1997), "The Output of the Swedish Education Sector", *Review of Income and Wealth* Volume 43, Number 1, pp.89-104.

Ashenfelter, Orley and Krueger, Alan (1994), "Estimates of the Economic Return to Schooling from a New Sample of Twins", *American Economic Review* 84, December, pp.1157-73.

Becker, G. (1964), *Human Capital*, 2nd edition, Columbia University Press, New York.

Brandt, Loren, Holz, Carsten (2006), Spatial price differences in China: estimates and implications. Economic Development and Cultural Change 55, 43–86.

Bureau of Statistics of China (2008), China Population Statistical Yearbook 2008, China Statistics Press, Beijing.

Cai Fang and Wang, Dewen(1999), "The Sustainability of China's Economic Growth and Labor Contributions", Economic Research (Chinese) 10, pp.62-68.

Christian, Michael (2010), "Human Capital Accounting in the United States, 1994-2006", Survey of Current Business, June 2010, pp. 31-36.

Coleman, J. (1990), Foundations of Social Theory, Belknap, 304.

Démurger, Sylvie (2001), "Infrastructure Development and Economic Growth: An Explanation for Regional Disparities in China?" Journal of Comparative Economics 19, pp.95-117.

Ederer, Peer (2006). "Innovation at Work: The European Human Capital Index", The Lisbon Council Policy Brief, in conjunction with Deutschland Denken! and Zeppelin University, Brussels, October 12.

Ederer, Peer, Philipp Schuller, and Stepham Willms (2007), "Innovation at work：The European Human Capital Index", The Lisbon Council Policy Brief, Volume 2, Number 3, Brussels.

Fleisher, Belton., and Chen, Jian (1997), "The Coast-Noncoast Income Gap, Productivity and Regional Economic Policy in China", Journal of Comparative Economics 252: pp.220-236.

Fleisher, Belton., Sabirianova, Klara., and Wang, Xiaojun (2005), "Returns to Skills and the Speed of Reforms: Evidence from Central and Eastern Europe, China, and Russia.", Journal of Comparative Economics 33, issue 2, pp.351-370.

Fleisher, Belton and Wang, Xiaojun (2004), "Skill Differentials, Return to Schooling, and Market Segmentation in a Transition Economy: the Case of Mainland China", Journal of Development Economics 73, pp.315-328.

Fleisher, Belton, Li Haizheng and Zhao Minqiang (2009), "Human Capital, Economic Growth, and Regional Inequality in China", *Journal of Development Economics*, forthcoming.

Fraumeni, Barbara M. (2006), "A Human Capital Approach to Measuring Government Education Output", presentation at the OECD/ONS/Government of Norway Workshop on the Measurement of Non-market Output and Health, London, England, UK, October 4.

Fraumeni, Barbara M. (2008a), "Human Capital and Investment in Education: A Streamlined Approach", presentation at the Fondazione Giovanni Agnelli/OECD Workshop on the Measurement of Human Capital, Turin, Italy, November 3.

Fraumeni, Barbara M. (2008b), "Human Capital: From Indicators and Indexes to Accounts," paper presented at the Fondazione Giovanni Agnelli/OECD Workshop on the Measurement of Human Capital, Turin, Italy, November 4.

Fraumeni, Barbara M. (2009), "Further Comments: Results by Country and Future Efforts" presentation at a China Center for Human Capital and Labor Market Research seminar at the Central University of Finance and Economics, Beijing, China, June 19.

Greaker, Mads and Liu, Gang (2008) "Measuring the Stock of Human Capital for Norway: A Lifetime Labour Income Approach," paper presented at the Fondazione Giovanni Agnelli/OECD Workshop on the Measurement of Human Capital, Turin, Italy, November 3.

Griliches, Zvi, "Estimating the Returns to Schooling." *Econometrica* 45, 1977, pp.1-22.

Gu, Wulong and Wong, Ambrose (2008), "Human Development and its Contribution to the Wealth Accounts in Canada," paper presented at the Fondazione Giovanni Agnelli/OECD Workshop on the Measurement of Human Capital, Turin, Italy, November 3.

Gu, Wulong and Wong Ambrose (2009), “Human Development and its Contribution to the Wealth Accounts in Canada,” paper presented at the Canadian Economic Association Annual Conference, May 29.

Heckman, James J. (2005), “China's Human Capital Investment”, China Economic Review 16, pp.50-70.

Holz, Carsten A. (2006), “New Capital Estimates for China”, China Economic Review 17, pp.142-185.

Hou,Yafei and Cao Yin(2000), ”Analysis of the Quality of Human Capital Stock”, Chinese Journal of Population Science(Chinese) 6, pp.43-48.

Hu,Angang(2002), ”From the Most Populous Country to A Country with Great Power of Human Capital:1980-2000”, Chinese Journal of Population Science(Chinese) 5, pp.1-10.

Hu,Yongyuan(2005), ”Human Capital and Economic Growth: A Co-integration Analysis”, Science and Technology Management Research(Chinese) 4, pp.88-90.

Jorgenson, Dale W. and Fraumeni, Barbara M. (1989), “The Accumulation of Human and Non-Human Capital, 1948-1984,” in R. Lipsey and H. Tice eds., ***The Measurement of Saving, Investment and Wealth***, Chicago, University of Chicago Press, NBER, pp. 227-282.

Jorgenson, Dale W. and Fraumeni, Barbara M. (1992a), “Investment in Education and U.S. Economic Growth,” ***Scandinavian Journal of Economics,*** Vol. 94, supplement, pp. S51-70.

Jorgenson, Dale W. and Fraumeni, Barbara M. (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.

Jorgenson, Dale W. and K – Y. Yun (1990),"Tax Reform and U.S. Economic Growth." Journal of Political Economy 98:pp. S151-193.

Jorgenson, Dale W. , Mun S. Ho, and Kevin J. Stiroh (2005), Information Technology and the American Growth Resurgence, volume 3 of Productivity, Harvard University Press, Cambridge, MA, 2005.

Joseph E. Stiglitz, Joseph E., Amartya Sen, and Jean-Paul Fitoussi (2009), Report by the Commission on the Measurement of Economic Performance and Social Progress, September 14.

Keeley, Brian (2007), *Human Capital, How What You Know Shapes Your Life*, OECD Insights, Paris.

Kendrick, J. (1976), The Formation and Stocks of Total Capital, NBER, Columbia University Press, New York, N.Y.

Koman, R., and Marin, D. (1997), "Human Capital and Macroeconomic Growth: Austria and Germany 1960-1997. An Update." IAS Economics Series No. 69.

Laroche, M. and Merette, M. (2000), "Measuring Human Capital in Canada." Ministry of Finance of Canada.

Le, Trinh Van Thi, Gibson, John, and Oxley, Les (2005), "Measuring the Stock of Human Capital in New Zealand," *Mathematics and Computers in Simulation*, Volume 68, Issue 5-6, May, pp. 485-98.

Le, Trinh, Gibson, John, and Oxley, Les (2003), "Cost- and Income-Based Measures of Human Capital." *Journal of Economic Surveys* 17, 3: pp.271-307.

Le, Trinh, Gibson, John, and Oxley, Les (2005), “Measures of Human Capital: A Review of the Literature.” New Zealand Treasury Working Paper 05/10.

Li, Haizheng (2003), “Economic Transition and Returns to Education in China.” *Economics of Education Review* 2 317-328.

Liu, Zhiqiang (1998), “Earnings, Education, and Economic Reforms in Urban China.” *Economic Development and Cultural Change* 46, pp.697-725.

Liu, Zhiqiang (2007), "The External Returns to Education: Evidence from Chinese Cities”, Journal of Urban Economics 61 (3), pp.542-564.

Maurer-Fazio, Maggie (1999), “Earnings and Education in China’s Transition to a Market Economy: Survey Evidence from 1989 and 1992.” China Economic Review 10, pp.17-40.

Mincer, Jacob (1974), Schooling, Experience and Earnings. Columbia University Press. New York.

Mira, M. and Liu, G. (2010), “The OECD Human Capital Project: Progress Report,” paper prepared for the 31st General Conference of the International Association for Research in Income and Wealth, St. Gallen, Switzerland, August 22-28 to the bibliography.

Mulligan, C. B., and Sala-i-Martin, X. (1997), “A Labor Income-based Measure of the Value of Human Capital: An Application to the States of the United States”. *Japan and the World Economy* 9, 2: pp.159-191.

OECD (2001), *The Well-being of Nations: The Role of Human and Social Capital*, OECD, Paris.

Qian,Xuya, and Liu,Jie(2007), ”Empirical Study of Human Capital in China”, Statistic Research(Chinese) 3, pp.39-45.

Schultz, T. (1961), “Investment in Human Capital”, *American Economic Review* 51, 1: pp.1-17.

Stroombergen, A., D. Rose and Nana, G. (2002), “Review of the Statistical Measurement of Human Capital”, Statistics New Zealand working paper.

Wang,Dejin and Xiang,Rongmei(2006), ”Estimates of Human Capital Stock in China”,Statistics and Decision (Chinese) 5, pp.100-102.

Wang, Xiaojun, Fleisher, Belton, Li, Haizheng, and Li, Shi (2009) “Access to Higher Education and Inequality: A Chinese Experiment.” IZA Discussion Paper No. 2823.

Wei, Hui (2008) “Developments in the Estimation of the Value of Human Capital in Australia,” paper presented at the Fondazione Giovanni Agnelli/OECD Workshop on the Measurement of Human Capital, Turin, Italy, November 3.

World Bank (1997), “Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development,” Environmentally Sustainable Development Studies and Monographs Series No. 17, Washington, D.C.

World Bank (2006) *Where is the Wealth of Nations, Measuring Capital for the 21st Century*, The International Bank for Reconstruction and Development/The World Bank, Washington, DC.

Yang, Dennis (2005), “Determinants of Schooling Returns during Transition: Evidence from Chinese Cities.” *Journal of Comparative Economics* 33, pp.244-264.

Yu,Shujing(2008), ”Comprehensive Evaluation and Dynamic Analysis on China's Provincial-level Regional Human Capital”, Modern Management Science(Chinese) 4, pp. 36-37.

Zhang Fan(2000), ”Estimates of Physical Capital and Human Capital in China”, Economic Research (Chinese) 8, pp.66-71.

Zhang Jun, Wu, Guiying, and Zhang Jipeng (2004), “Compilation of China’s Provincial Capital Stock Series Using Perpetual Inventory Method, 1952-2000”, Economic Research (Chinese), October.

Zhang, Junsen, Zhao, Yaohui, Park, Alberb, and Song, Xiaoqing (2005), “Economic Returns to Schooling in Urban China, 1988-2001.” Journal of Comparative Economics 33, pp.730-752.

Zhou,Delu,(2005), ”Population-based Indicators of Human Capital Accounting Theory and Empirical Study”, Chinese Journal of Population Science(Chinese) 3, pp. 56-62.

Zhou Ya(2004), “Study on the Distribution Differences of China's Human Capital”, Education & Economics(Chinese) 2, pp.17-20.

Zhu,Pingfang, and Xu,Dafeng(2007), ”Estimation of Human Capital in Chinese Cities”, Economic Research (Chinese) 8, pp.84-95.

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