Economic Reforms and the Rate of Returns to Schooling in China's transition period

by

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Abstract

This paper replicates Li (2003)'s work on the rates of returns to education in urban China based on the data from the second cycle of the Chinese Household Income Project (CHIP-95). This data set is released by "The Inter-university Consortium for Political and Social Research (ICPSR)". This study aims to investigate whether the returns to education have been significantly affected by using different model specifications in the estimation and whether the returns have indicated an increasing trend over the course of economic reforms in China. Three factors contribute the differences in model specifications: i) the use of hourly wages or annual earnings, ii) the use of estimated or actual years of schooling, iii) the use of estimated or actual work experience.

The empirical results of this study conclude that the rates of returns to education are underestimated when the hourly wages are used in the equations as opposed to the annual earnings. This conclusion applies to all cases regardless the use of estimated or actual years of schooling and the use of estimated or actual work experience. Further results indicate that the returns to education would be underestimated when estimated years of schooling are used and would be overestimated when estimated work experience are used. Other findings pertaining to the trend of the returns are: the overall rate of return is higher for junior workers; the private sector, such as the joint-venture and foreign-owned enterprises, has higher rates of return than the state-owned sector; the years of education are rewarded more in a less-developed province than in a relatively developed province. All these findings show an upward trend of rates of returns to education in China during the transition period.

I. Introduction

From the inception of economic reform in the late 1970s, China has experienced rapid economic growth and has gradually become one of the largest economic entities in the world. Economic reforms have brought China into a transition period in which China has been moving from a centrally-planned system to a market-oriented system. How this rapid growth in the economy would affect the rate of returns to education in China has attracted many economists' attention. Returns to education are important for the labor market because they provide critical information about the incentives for human capital accumulation, the efficiency of resource allocation, and the distributional consequences of differences in human capital. Therefore, comprehending the knowledge of the relationship between economic growth and the return to education in China plays a significant role in the economic and human development of a transitional economy and will have important implications for China's sustainable economic growth. One well-known hypothesis concerning about the relationship, advanced by Nelson, Phelps (1996), and by Schults (1975), is that economic growth triggered by technological changes increases the return to education.

Most previous studies have given support to this hypothesis after they found a rising trend of rate of returns to education in China during its rapid economic growth. Nevertheless, the rates they found are relatively low compared with those from other countries experiencing transitions. In general, there are three factors that might affect the estimation of returns to education estimated by Mincerian equations. First, earnings are highly related to the individual working hours. However, since the working hour data are not available for China, most prior studies rely on the annual earnings instead of hourly wages in estimating returns to education. This ignores the fact that individuals with different educational levels work for different hours, and that

working hours could vary from one sector to another as well. Thus, the reliance on annual earnings will impart an omitted variable bias on the rates of return to schooling.

Second, previous studies based on Chinese data rely on estimating an individual's job experiences based on age and years of schooling instead of actual work experiences. A number of reasons, such as varying times spent to pursue a certain educational degree, and time spent waiting for a new job, could distort the estimated work experiences. Since the years of work experience are highly related to an individual's earnings, this sort of measurement error in the estimated work experiences will have an impact on the estimated returns to education and on the estimated returns to experience.

Third, as opposed to the actual years of schooling, the estimated years of schooling based on an individual's highest level of education are widely used by previous Chinese studies due to the data limitations. Some potential problems associated with this estimation would undermine the confidence in estimates obtained based on the use of the estimated years of schooling. For example, the same number of years is assigned to three different degrees in the category "college or above". In addition, some individuals may study in the high school for more than 3 years in order to gain admission to the college.

This study will use the data from the second cycle of the Chinese Household Income Project (CHIP-95) to duplicate Li's study (2003) to investigate whether and how the above-mentioned factors affect the rates of return to education in China; and whether the returns to education have increased as a result of the economic growth occurring over the transition period.

The second section of the paper is a literature review of six well-known articles on related studies. Section 3 investigates and compares the results based on different specifications for variables for wages, work experience, and years of schooling. Section 4 analyzes the trends of

returns to education. Section 5 is a comparison of Wan (2004)'s paper and this paper. Section 6 consists of the overall conclusion.

II. Literature Review

Byron and Manaloto (1990)

This section contains an analytical review of a series of previous studies on the estimated rate of return to education in China. The review begins with a widely cited article published by Byron and Manaloto (1990). The objective of the paper was to estimate empirical earnings functions according to a variety of linear and non-linear specifications. The significance of sex and marital status on the level of income earned by workers was also examined.

This paper differed from other articles in the literature in three respects. First of all, a relatively detailed interpretation of the Mincer-type earnings equations directly followed the introduction. In most of the subsequent literature, the interpretation of the Mincer model was not illustrated in a systematic and intuitive way again. Starting with the simplest form of Mincer equation, $\log Y = \alpha + \beta_1 S + \beta_2 E + u$ [1], the paper pointed out that the equation has a rather inflexible parametric form. If $\beta_1 = \frac{1}{Y}\frac{\partial Y}{\partial S}$ and $\beta_2 = \frac{1}{Y}\frac{\partial Y}{\partial E}$ are modeled as two constants, as Y increases, $\frac{\partial Y}{\partial S}$ and $\frac{\partial Y}{\partial E}$ must also increase. The problem of this simplest form was that it failed to reflect the concave relationship of the dependent and independent variables, which showed diminishing returns to education and experience. Nevertheless, this problem may be solved by adding higher order terms S^2 and E^2 to the simplest version of the equation. In the diagnostic analysis of the data, a scatter-plot showed a high degree of collinearity between the variables of

[1] Y=earnings, S=years of schooling, E=years of experience.

experience squared and education squared. Thus, the education squared variable was dropped from the regression model.

Some disadvantages of the Mincer model were addressed in the model interpretation part, such as the omission of the ability factor and the statistical issue of the endogeneity of the schooling decision and subsequent income earned. The technique for addressing endogeneity is to create instrumental variables for schooling. However, these problems were not seriously treated and solved in the latter part of the article. Instead, the authors concentrated on tackling other problems, such as heteroskedasticity of the disturbances, arising from the OLS regression results of their extended Mincer equation. Second, the Weighted Least Squared (WLS) was performed to correct the heteroskedasticity. The value of R-squared increased significantly from 0.4 to 0.99, and the standard errors of the coefficient estimates largely improved as well after applying the WLS regression method. However, WLS provided only a "descriptive" rather than an "analytical" treatment of heteroskedasticity. In addition, Byron and Manaloto found that the inclusion of the interaction term between education and experience in the equation was insignificant.

Third, the authors conducted their empirical study by using a data set that they called "unique" in their paper. The data set was different from those generally used, such as the Chinese Household Income Project (CHIP), which will be introduced in detail below. The data is a survey of 800 adults in Nanjing, the capital city of Jiangsu Province in the South-east of China. The survey conducted by the International Wool Secretariat in 1986 provides sufficient information about the respondent's age, occupation, income and education level, which are all essential to undertake a study on returns to education, while the original intention of the survey was to do market research on brand recognition. Compared with the CHIP, this data set lacks

both demographic and geographic representativeness due to its smaller sample size and narrower regional coverage. Moreover, this data set was not originally designed in an ideal way for a study on the response of earnings to education or experience. For instance, the income and age variables are recorded categorically. Byron and Manaloto (1990) drew some conclusions regarding the values of the return to education and experience in China and on the relationship between them. They concluded that the estimated return to education, 3.7%, was much lower in China than in many other countries. Experience and education were "highly elastic substitutes", and the former played a more important role in determining the income level. In addition, the effect of marital status was statistically insignificant, and males earned more than females. These conclusions, however, did not explicitly pertain to the issue of interest mentioned earlier in the article. That issue was to see whether workers in China made similar educational investment decisions to those in other countries. Implicitly, the authors might suggest that due to the low returns to education, members of work force in China were less likely to invest in their own education, and tended to begin their working lives earlier than those in other countries.

Liu (1998)

The second reviewed article is by Liu (1998), who estimated the rate of return to education at 3.6% in urban China for the year 1988. The result was generally in line with the figure of 3.7% obtained by Byron and Manaloto (1990) for year 1986. However, Liu's objectives were not only to investigate the rate of return to education, but also to investigate the effects of the economic reforms of the 1980s in China both on the level of individual earnings and on the rate of return to education. To estimate the rate of return to education, Liu (1998) used the Mincer-Becker human capital model and the data from the urban individual sample of the Chinese Household Income

Project (CHIP)-88. The basic specification of the earnings equation adopted by Liu was exactly the same as that used by Byron and Manaloto. Moreover, Liu also estimated an expanded Mincer equation with dummy variables for educational level, ownership status of the employer, occupation, industry and region. Note that when dummy variables for educational level are added to the estimated equation, the variable for years of schooling would be dropped from equation.

The CHIP-88 survey was funded by the Ford Foundation and a number of other institutions, and was conducted by researchers from the Institute of Economics of the Chinese Academy of Social Science and a group of western economists. The principal investigators of the survey were Griffin and Renwei. The data set consists of 31,827 individuals belonging to 9,009 urban households, and 51,352 individuals belonging to 10,258 rural households. These two distinct samples of the urban and rural population residing in 10 of China's 29 provinces were selected from significantly larger samples (67,186 rural households and 34,945 urban households) drawn by the State Statistical Bureau. To ensure a good geographic representation, the data were selected from various provinces and cities across the whole country to cover different regions and local labor markets. To ensure an adequate demographic representation, the respondents of the survey were chosen randomly among a broad range of ages, levels of education, economic sectors of employment, occupations, sources of income, employment status, and so on. The main purpose of the project was to measure and estimate the distribution of income in both rural and urban areas of China. Liu selected 16,952 urban individuals out of total 31,827 who were all between the ages of 14 and 70 and currently employed. Individuals who were self-employed and temporary job holders and who failed to report wage income or education level were excluded from the sample.

Compared with the results from Byron and Manaloto, the return to education estimated by Liu was lower by a slight 0.1%, and individual earnings were estimated to peak at 38.4 years of experience rather than at 50 years. Males' earnings are 10.6% higher than females', which was very close to the 9% discrepancy found by Byron and Manaloto. With the inclusion of dummy variables for the levels of education, Liu's estimates suggested that the rate of return to education increased with the level of education, meaning that people with higher education levels earned more than those with lower education levels. After adding the sector ownership, occupation, industry and regional dummy variables to the basic equation, Liu obtained a lower rate of return to education of 2.83%. Most of the added dummy variables were statistically significant in the expanded equation and had substantial explanatory power, as measured by the increased value of the overall R-squared. Individuals working in the foreign sector earned more than those in any other sectors.

In regards to the occupation and industry effects, managers were paid the highest incomes, and individuals in the mining industry received a premium, perhaps associated with their risky working environments. In addition, Liu estimated the earnings equation separately for each of the 14 economic sectors in the survey. He found that the skill-intensive sectors, such as personal and consulting services, education, and health, had higher rates of return to education; while, the labor-intensive sectors, such as agriculture and forestry, had lower rates of return. Interestingly, some government-owned entities, such as labor unions and geological prospecting, had the lowest rates of return. This finding might owe to the fact that pre-reform China had a different wage structure in which wage level was based on seniority and connection rather than on productivity or quality of human capital, as asserted by Chow and Johnson (1997).

Liu divided the second part of his article into two sections in order to analyze the effects of economic reforms on the rate of return to education and earnings. Among the general economic reforms, the author was most interested in their impact on the labor market. China's economic transition is a process of moving the country's economy from a centrally-planned one to a market-orientated one. Labor market reforms are thought to increase labor mobility and to promote employees' work incentives. Two major reforms were implemented that affected the wage determination process: changes in the labor contract system and adoption of a floating wage system. The reformed labor contract system offered increased discretionary powers to managers for firms' operations and administrative decisions. Under the floating wage system, a portion of workers' wages are paid on the basis of their job performance. This linkage between the rewards and productivity considerably reinforced the work incentive, which had been consistently low in the pre-reform period.

The methodology used by Liu to examine the effects of the labor reform programs was first to create an index called "Ref", calculated as "a ratio of contractual wage (floating wage) to total earnings". Thus, "Ref" measured the impact of reform programs on earnings. Second, he generated two interaction terms: Education-"Ref" and Experience-"Ref". The coefficients of Education-"Ref" and Experience-"Ref" reflected the effects of labor market reform on the rate of return to education and on the rate of return to experince, respectively. Third, all three newly created terms were added to the expanded equation and then estimated by OLS method.

The regression results of the effects of floating wage system were consistent with Liu's initial conjecture. Coefficients of Education-"Ref" under the floating wage system were all positive and statistically significant at the 1% level. However, coefficients of Experience-"Ref" were negative. This implied that the floating wage system had the effect of raising the rate of return to education

but lowering the rate of return to experience. The results of the effects of the labor contract system were, to some extent, contrary to Liu's expectations. T statistics showed that the values of coefficients of both Education-"Ref" and Experience-"Ref" were not statistically different from zero. Even though he did not provide an explanation for this outcome, I would suggest that it might be attributed to low shares of workers on contracts in state-owned and collective enterprises at that time, which were 10.1% and 5.8% of the labor force, respectively.

In the second section, Liu conducted a regional study by comparing the rate of return to education between a costal province, Guangdong, and the rest of the provinces. As a "pioneer" in the front line of China's economic reform, Guangdong is certainly representative of the rapid changes in economy brought by the reforms. Accordingly, the difference in the rate of return to education between Guangdong and all other provinces should reflect the impact of the economic reform on return to education. The results showed higher rates of return to education in Guangdong than in other provinces. However, this only applied to junior workers with experience of less than 10 years and to younger workers under 30 years of age. This result is not surprising given the fact that most beneficiaries of the reform programs were those new workers who entered the labor force during the reform period.

Li (2003)

Although acknowledged at the time by many economists as a well-designed data set for the research on the rate of return to education, the CHIP-88 still contained some shortcomings that were later investigated in the third article in my survey by Li (2003). Li's study was dedicated to justifying whether the returns to education had been underestimated because of the flaws associated with the data from 1988, and whether the returns had increased during the economic

reforms. The first shortcoming was that the annual earnings of workers, rather than hourly wages, were recorded in the CHIP-88 survey. Since working-hour data were not available in the survey, previous studies that used the CHIP-88 had to rely on annual earnings in their estimations. Li argued that working hours were negatively correlated with the level of education. In other words, individuals with higher levels of education tended to work less than those with lower levels of education. In his sample, annual earnings of those who had a college degree earned 44% more than those who had a lower middle school diploma, but in terms of hourly wages, the difference increased to 53%. This suggests an income effect: as hourly wages increase, workers respond by purchasing more leisure, which implies fewer hours of work. Therefore, using annual earnings would underestimate the average rate of return to education of the highly educated group and result in a lower overall estimated return to education. Furthermore, it could overestimate the differences in returns to education between sectors and between men and women.

Second, survey respondents were not asked to report their actual years of work experience for the CHIP-88 questionnaire. Thus, all previous studies had to calculate the estimated work experience based on the age and years of schooling for all individuals in their samples. The widely applied formula in this calculation was age minus years of schooling minus six. Because the estimated work experience failed to take into account some factors, such as varying time spent by different individuals to pursue a degree and time spent on job search, it generally overestimated years of job experience and thus underestimated returns to experience. Moreover, according to the human capital theory, work experience gained through on the job training is highly related to an individual's earnings, so that these measurement issues for work experience will lead to biases in the estimation of the returns to education.

The emergence of the second cycle of the Chinese Household Income Project (CHIP-95) provided a great source of data for Li to investigate the effects of the two flaws in CHIP-88. Not only does CHIP-95 contain information on actual working hours, but also information on actual work experience. The CHIP-95 survey, conducted in 1996, surveyed 6,928 households and 21,688 individuals in urban China. It covers a total of 11 provinces across the country. Except for the addition of a new province, Sichuan, the remaining 10 provinces remain the same as those covered in CHIP-88.

The specifications of Li's earnings equation were comparable to those of Liu's. A series of dummy variables, representing different types of firm ownership, industries, provinces and education levels, were added to the basic Mincerian equation. In addition, two new variables were included: an ethnic minority dummy variable and a dummy variable for youth "re-education". For the latter, respondents were classified as re-educated youth if they were ever sent back to rural areas to accept "re-education" during the Cultural Revolution. Li's regression results showed that when hourly wages (as opposed to annual earnings) and actual experience (as opposed to imputed experience) were inserted into the equation, the returns to education and the returns to experience were 5.4% and 5.6%, respectively. Those results indicate that in the previous studies, the return to education was underestimated by 0.7 percentage points, and the return to experience was overestimated by 1.3 percentage points when annual earnings and estimated work experience were used. These results generally meet the author's anticipations.

To examine the trend in the rate of return to education in China from the 1980s to mid 1990s, Li divided his sample in to three cohorts of workers based on the time they started to work: pre-reform period (before 1980), the early stage of urban reform (1980-1987), and the advancing stage of urban reform (1988-1995). His estimated output across the three cohorts indicated that

returns to education increased in every education category over time, and differentials in wages among those categories went up as well. Other findings were consistent with Liu's. For example, the private sector awarded highest rate of return to education among all sectors, and women generally earned less than men. Interestingly, however, in Li's regional study, the rates of return to education were higher in a less-developed province, Gansu, than in a high-income province, Guangdong. This result contrasts with the one reported by Liu using the CHIP-88. Li explained that the higher returns to education in less-developed areas were potentially due to the fact that the unskilled labor was in ample supply, but educated workers were scarce. His interpretation gained empirical support from a latter study on returns to schooling by Zhang and three other co-authors (2005). Nevertheless, Maurer-Fazio (1999) and Yang (2005) did not support that conjecture since their studies produced no clear evidence in support of either Li's or Liu's finding on this issue. All three articles just mentioned will be reviewed shortly in this section, and more comments on Li's article will also be made in the following section.

Yang (2005)

Note that Li and Liu have done the analysis for effects of economic reforms on the return to education in China's transition period by using CHIP survey from only one year. Yang (2005), the author of the fourth reviewed article, used both CHIP-88 and CHIP-95 data in order to compare the returns between these two years and drew a conclusion regarding the trend of the returns during this transition period. In his study, Yang investigated cross-sectional disparities and changes in schooling returns over time for a large number of Chinese cities in those two years. His second objective was to examine how the economic reform influences the conditions of the local labor markets and how these interactions in turn, affect the return to education.

Yang's sample consisted of 17,074 and 9,627 individuals for 1988 and 1995, respectively. CHIP-88 covers 67 cities, and CHIP-95 includes 62 cities, with 29 cites included in both surveys. The estimated Mincerian equation had the following form:

$$\ln Y_i = \beta_0 + \sum_{k=1}^{n} \beta_k S_{ik} D_{ik} + \beta_2 E_i + \beta_3 E_i^2 + \sum_{j=1}^{3} \gamma_j X_{ij} + u ,$$

where S_{ik}, E_i, Y_i are monthly earnings for worker i, estimated experience, and years of schooling, respectively. The years of experience were estimated by the same formula that was used by Li and Liu. D_{ik} is a city-level dummy variable such that D_{ik}=1, if worker i resides in city k, and D_{ik}=0, otherwise. The matrix, X_{ij}, includes three personal characters: gender, Communist Party membership, and minority status. Yang excluded the occupational dummies from the equation because wages and occupations were likely to be jointly determined. In other words, a portion of educational returns were subject to occupational choices.

The OLS estimation of the equation produced 67 and 62 city-specific estimated returns to schooling for Yang's 1988 and 1995 sample, respectively. The lowest and highest rates of return to education were -0.1% and 7% for 1988 and 1.7% and 10.3% for 1995. The mean value of the rates for these cities increased from 3.1% to 5.1% over the two periods. In addition, large increases in returns to experience, rising from 3.9% in 1988 to 7.1% in 1995, were found, and the negative estimated values of β_3 implied the diminishing returns to experience for both years. Consistent with Li's findings, the returns rose for workers who were Communist Party members and fell for the ethnic minority group members over time. There was one point of inconsistency; Yang's results showed an increased gender earnings gap, while Li found a narrowed earnings gap between the two groups.

In order to investigate the effects of the economic reform on returns to education, Yang first introduced five determinants of the returns that would be tied to reform: the supply of skilled workers, the demand for educated workers, the degree of openness in the labor market, the availability of employment search channels in the market, and the information infrastructure in the market. These are a number of determinants that can be used to reflect the labor market changes associated with the economic reform. He then selected five proxies to represent the changes in those five determinants: the percentage of skilled workers with an education higher than the lower-middle-school education, the percentage of the labor force employed in the technology and science sectors, the percentage of workers employed in foreign and joint-venture firms, the percentage of workers finding the current job through market channels, and the percentage of households with home phone services. These proxies were all measured at the city level. Third, he replaced the city dummy variables, D_{ik}, in the previous equation with the five factor dummy variables described just above (labeled M_{ikg}) and estimated the modified equation separately to the 1988 and 1995 data set to show the change over time.

The empirical results exhibited that labor market openness, information infrastructure and the availability of job search channels in the market had a statistically significant effect of raising the returns to education. The effects of the supply of the skilled workers became less significant statistically in 1995 than in 1988, and the variable for the technology sector used to measure the demand for educated workers had no substantial impact on returns to education in either year. Notice that the factors mentioned above constitute only a portion of all the factors that reflect the economic reforms and influence the returns to education. School quality, taxes, and the composition of industries are examples of other factors. Also, the estimating equation may suffer

from simultaneity bias due to the fact that some factors might not be totally exogenous to earnings.

Maurer-Fazio (1999)

The fifth reviewed article is a study similar to Yang's done by Maurer-Fazio (1999) in which two data sets from different sources were used. To document the changes in rates of returns to schooling over five years, Margaret Maurer-Fazio compared the rates in year 1988 with those in year 1992. Based on the results from the comparison, she assessed the permeation of market forces into China's urban work environment.

The data set for 1988 was, once again, the well-known CHIP-88. The data set for 1992 was gathered by the Chinese Labor Market Research Project (CLMRP), a survey project carried out by the Economics Institute of the Chinese Academy of Social Science and the Labor Science Research institute of the Ministry of Labor. The survey consists of 9,397 individuals working in 438 different commercial and industrial enterprises under different forms of ownership located in 26 cities and 12 provinces. Maurer-Fazio selected 4,113 males and 3,314 females from CLMRP, and 9,174 males and 8,370 females from CHIP-88 for his study.

The estimating equation was the basic form of the Mincerian equation including a number of control variables. All of the control variables were analogous to Yang's specification, except for the employment tenure variable. In Maurer-Fazio's samples, both short-term and temporary employees were included. Estimated experience levels were calculated for both years, and annual earnings were included in the 1988 specification, while monthly earnings were used for the 1992 specification. Overall rates of return to education in 1988 were estimated to be 2.9% for males and 4.5% for females. These rates increased to 3.7% for males and 4.9% for females in 1992.

Regardless of gender, the under-30 age group attained the highest returns to education among all age groups in the study. These estimated outcomes suggested that returns for women were higher than men, but the gap between these groups was getting smaller, and new labor force entrants enjoyed higher returns for their educational investments.

In the sectoral analysis, in 1988 the average rates of return to education for the three sectors, state-owned, collective and joint venture, were estimated to be 2.6%, 4.1% and 9.6% for males for all ages, respectively. In 1992, the corresponding estimated rates were 3.5%, 3.8% and 3.5%. The finding of the same estimated rate of return to education for the state sector and the joint ventures sector in 1992 was unexpected and contrary to the belief that the joint-venture sector provides a work environment with more flexibility and less administrative control. It should thus have relatively higher returns for education. This red flag in the results, however, was not discussed further by Maurer-Fazio in her article. One of the possible reasons was that the low average estimated rate of 3.5% for joint ventures for all ages was dragged down by the strikingly low rates of 1.3% and 1.9% reported for the age groups over 30 in 1992, even though the highest rate of 6.0% was reported for the under-30 age group.

In the regional analysis, Maurer-Fazio found that the differences in the rates of return by region were statistically insignificant for both males and females. This is inconsistent with Li's findings discussed above. Similarly, in the city-level study, she concluded that the differences across regions from most of his 40 cases were small over time, and only in a few cases were the differences statistically significant. This conclusion contradicts the findings obtained by Yang. Nevertheless, Yang was comparing year 1988 with year 1995, while Maurer-Fazio was focusing on 1988 and 1992. Furthermore, as mentioned earlier, the channel of job entry is one of the determinants of the returns to education. Yang proved in his study that workers who found their

jobs through a market mechanism rather than through the assignment of government were able to achieve positive returns for education. On the contrary, Maurer-Fazio obtained totally opposite results by using the CLMRP data in1992. Although not addressed in Maurer-Fazio's paper, the cause of the inconsistent results may be partially attributable to the differences in sample characteristics between the two studies.

Zhang, Park and Song (2005)

Most of the articles that have been reviewed so far rely on cross-sectional data to analyze the trend of returns to education in China during the economic transition period. Because CHIP has only made two data sets available for public research, the analysis of those publications using CHIP surveys is restricted to one or two years. This is not the case for the sixth reviewed article by Zhang, Park and Song (2005), who chose to use different data sets to do their trend studies. The data were comprised of fourteen consecutive annual surveys of urban households conducted by China's National Bureau of Statistics from 1988 to 2001. Given the new data, Zhang estimated the Mincerian earnings equation separately for each of the 14 years to demonstrate the trend of returns to education in that period and explained some potential factors that might cause the trend.

The average sample size of the 14-year period was 6,420 urban individuals coming from six provinces. Annual earnings instead of hourly wages were used due to the lack of information on working hours in the data. Facing the potential problems caused by this data limitation, Zhang argued that there was evidence from the CHIP data suggesting that no significant increase in the estimated returns to education emerged as hourly wages were used, compared to the results when annual earnings were used. The discrepancies arising from the hourly compensation versus the

annual compensation appear to be stable over time. However, based on the evidence from Li's study, we cannot totally support this argument. In addition, some non-wage benefits, such as medical care, the rental value of enterprise-supplied housing, and pensions, were not included in the total wages in the data. The omission problem that mismeasured wages in CHIP and other data sets would lead to underestimates in the total wages and also to the overall return to education.

Zhang, Park and Song's regression results indicated that the returns to education had increased from 4.0% in 1988 to 10.2% in 2001, an increase of more than 100% over the 14 year period. In the test of robustness of the results, Zhang, Park and Song added ownership, occupation and industry dummy variables to the basic Mincerian equation and observed the same upward trend over time for returns, albeit in reduced magnitude. The returns to schooling were higher for females than males throughout the period, while this gender disparity decreased over time and was nearly nil in 2001. In the regional study, large differences across provinces were found. The provincial gap in returns to education during the early period was large, with higher returns discerned in less-developed provinces, and lower ones in more developed provinces. These differences declined over time, and the situation was partially reversed by 2001. To explain the rising trend, Zhang, Park and Song provided empirical evidence to show that the massive increase in the relative demand of educated workers in the labor markets raised the returns to education in spite of the increase in relative supply. His chart illustrated that the relative supply had increased faster than relative wages. Thus, he asserted that the relative demand labor must outgrow the relative supply of labor in order to achieve higher rates of return to education. This finding, however, is not in line with that of Yang, who found that the demand for education had no significant effect on returns to education in either year of 1988 or 1995.

Johnson and Chow (1997)

The authors of the seventh reviewed article, Johnson and Chow (1997), differentiated their study on the rates of return to schooling in China from prior studies by adding a new group to their sample. Instead of only including urban households and individuals, they included subjects from rural areas in the study. The sample data selected from CHIP-88 contained 17,261 urban observations and 1,677 rural observations. Individuals who worked part-time were dropped from the samples for the purpose of reducing the estimation bias from not using the hourly wages. In order to examine the differences in rates of the return to education across the urban and rural areas, Johnson and Chow (1997) created an interaction term, rural*schooling, and added it to the Mincerian equation along with other control variables on gender, Communist Party status, and ethnicity.

A sample that pooled the urban and rural samples was estimated first. The OLS results showed that the rate of returns to education was 4.82% in the rural areas and 3.2% in the urban areas. The coefficient of the interaction term was positive and statistically significant. In the subsequent separate estimations, the rate of return from the urban sample was lower than that from the rural sample by 0.7%. Both pooled sample and sub-sample estimated under the same specifications reached a similar result. Johnson and Chow presented two possible explanations for the lower rate that was discerned in the urban areas. On the one hand, there were differences in the definitions of wage used for the two groups. In other words, wages were not reported the same way for the two groups. Additional benefits received by rural individuals were included in the calculation of their wages. Consequently, the average wage of rural individuals was calculated to be six yuan higher than that of urban individuals, which could have repercussions for the estimates of the returns to education. On the other hand, a majority of urban workers

chose to work in the publicly owned sector, where wages was less likely to be affected by education and productivity. A majority of rural workers chose to work in the individual and cooperative enterprises, where the influence of market forces was greater in the late 1980s. Therefore, the education of rural individuals was rewarded to a greater degree than that of urban individuals because of the sector which they work in.

III. Empirical models and data

As reviewed earlier in the first section, Li (2003)'s article had done an investigation on two potential problems associated with previous studies: the use of annual earnings and of estimated years of work experience. In this section, a replication study is conducted to reexamine the critical results and conclusions drawn by Li's study pertaining to these two issues. In addition, a third problem arising from the use of estimated years of schooling, as opposed to actual schooling, is also investigated empirically, a longstanding problem that was either ignored by most of the prior studies or barely discussed in Li's study. Up to now, the study has conducted all of its empirical analysis by using the estimated years of schooling in the earnings equations for the comparison purpose with prior studies. In CHIP-95 survey, the educational level is divided in to seven categories based on degrees. Then, a particular number of years are assigned to each education category in order to estimate the returns to schooling. By convention, the number of years is assigned as follows: college and above (Daxue, 16 years), professional school (Dazhuan, three-year college, 15 years), middle level professional, technical or vocational school (zhongzhuan, 3 years, 12 years), upper middle school (Gaozhong, 12 years), lower middle school (Chuzhong, 9 years), elementary school (Xiaoxue, 6 years), and below elementary school (2

years). Since the number of observations below elementary school is only 17 for the last case, I combine the last two categories in my estimation when education dummies are used.

This empirical study will separately estimate four cases: i) estimated years of schooling and estimated experience, ii) estimated years of schooling and actual experience, iii) actual years of schooling and estimated experience, iv) and actual years of schooling and actual experience. Furthermore, hourly wages and annual earnings will be estimated within each of the four cases. This makes total of eight combinations.

The empirical model and data used to conduct the replication study are the Mincer-type equations and the CHIP-95 survey, respectively. To ensure comparability of the results, the Mincerian equations are estimated using the same extended form used by Li, in which a series of control variables, such as binary variables for provincial, industry, and type of ownership, are added to the basic form. Some studies also include occupation variables in the earnings function. Nevertheless, wages and occupations are likely to be jointly determined because some portions of educational returns are attributable to occupation choices, as pointed out by (Yang, 2005). Thus, the occupational choice variables might be endogenous. Furthermore, there is a high degree of multicollinearity existing between school and occupation (Li, 2003).

Ordinary least squares (OLS) is applied to estimate the earnings function. The OLS specification, however, may result in a biased and inconsistent estimate of the return to education due to the omission of the ability variables. This is premised on the positive correlation between schooling and ability. Even though there exists some strategies, as pointed out by Yang (2005), such as the instrumental variable approach, the fixed effect method, and the direct measurement of ability, which can be used to tackle this ability bias, the OLS procedure with omitted ability variables is still implemented for two reasons. One is that the CHIP surveys do not contain

extensive enough data to allow for careful corrections. Second, traditionally, previous works on returns to education in transition economies tend not to control for the biases stemming from this omitted variable. Therefore, to ensure the compatibility of the results, this study also ignores this issue and assumes that ability is not correlated with education

Table 1
Variable definition and descriptive statistics

Variable	Definition	Mean
Actual schooling	Years of school	10.820
Estimated schooling	Years of school	11.614
Annual earnings	Yuan (Chinese dollar)	5795.5
Hourly wages	Yuan (Chinese dollar)	2.997
College	College (Daxue) or above	0.080
Professional school	Professional school (Dazhuan)	0.158
Middle professional	Middle level professional (Zhongzhuan)	0.170
Upper middle	Upper middle school	0.246
Lower middle	Lower middle school	0.295
Elementary	Elementary school or below	0.054
Actual experience	Years	19.315
Estimated experience	Years	20.789
Sex	1 for male, 0 for female	0.529
Ethnic Minority	1 yes, 0 no	0.043
Party	1 for communist party member, 0 other	0.253
Re-educated youth	1 yes, 0 no	0.220
State-owned	State-owned sector	0.268
Local-public	Local publicly-owned sector	0.546
Collective	Urban collective sector	0.150
Non-public	Non-publicly owned sector	0.019
Agriculture	Agriculture, forestry, etc. industry	0.016
Manufacturing	Manufacturing industry	0.407
Mining	Mining and geological survey industry	0.010
Construction	Construction industry	0.028
Transportation	Transportation and communication industry	0.049
Commerce	Commerce and trade	0.138
Service	Health, education, research, finance, etc.	0.334

N = 11,160.

A sample consisting of 11,160 workers is used in this study. The sample is selected from the CHIP-95 survey and based on urban individuals aged 18-60. It only includes workers who are currently employed with positive monthly working hours and wages. Temporary job holders

are excluded because their earnings are not compatible with those of permanent workers, given the fact that temporary workers often work irregular hours that are not reported in the survey and thus make measurement of wages nearly impossible. Workers who failed to report work experience, level of education, and years of schooling are also excluded. Furthermore, owners of private or individual enterprises are dropped from the sample, since it is difficult to distinguish their wages from their profit income.

Wages are defined to include a variety of subsidies, bonuses, and allowances on top of the basic wage. Although rich, the wage records are not ideal. In particular, the values of benefits, such as medical care, pension accruals, and enterprise-supplied housing or rental allowances, are not reported in the survey as earned wages (Yang, 2005). This is likely to underestimate returns to education to the extent that more educated workers receive higher benefits.

Table 1 presents the definitions of variables and the descriptive statistics. 52.9% of the sample is male. About 4.3% of the individuals in the sample belong to the ethnic minority group. 8% of the sample has a university education, 15.8% have a college degree, 41% have finished high school, 29.5% have completed middle school, and 5.4% have only a primary education. The remaining 3% individuals have no formal education at all. Approximately 25.3% of the samples are communist party members. A dummy variable for party membership is added to see if party members are compensated differently from other non-members. 22% are re-educated youth, who were sent to rural areas for years of "re-education". About 27% of the sample works in the state sector, 54.6% in the local-public sector, about 15% in the collective sector, and 1.9% work in foreign-owned and other sectors.

Annual earnings Vs. Hourly wages

One distinction of the CHIP-95 survey from others is the provision of the actual number of work hours on an average day and the average number of work days per week in 1995. Hourly wages could be calculated through this formula: $\frac{\text{Annual earnings}}{\text{Hours per day} \times \text{Days per week} \times 48}$. As shown in table 1, the means of the calculated hourly wage and annual earnings are 2.99 yuan and 5,795 yuan, respectively. Li and Zax (2000) find that individuals with a higher level of education tend to work less than those with a lower level of education. Using annual earnings would underestimate the wage differences among educational groups. For instance, workers who have a college degree or above earn 39% more than those who only have a middle school diploma in terms of annual earnings, while in terms of hourly wage, the difference becomes 48%. Moreover, the use of annual earnings overestimates the earnings between the state-owned sector and private sector. In terms of annual earnings, workers in private sectors earn 12.27% more than those in state sector, but in terms of hourly wage, the former group earns 1.17% less than the latter one.

To compare the effects of the use of hourly wages and annual earnings, earnings equations are estimated separately for these two types of earnings measures while holding all other variables constant, and the results are shown in Tables 2, 3, 4 and 5. Note that two measures of schooling, years of schooling and dummy variables for educational levels, are included in the equations but in separate specifications. As mentioned above, annual earnings are directly related with annual working hours, and working hours are negatively correlated with education. The estimated returns to education based on annual earnings ignore the effect of working hours on hourly wages and therefore are underestimated due to this omitted variable bias.

With no exceptions, the results from all tables clearly show that the return to education is underestimated as annual earnings are used. The discrepancies in the overall return to education

vary from the highest value of 0.63 percentage points in table 3 (estimated with both estimated years of schooling and work experience) to the lowest value of 0.3 percentage points in table 4 (estimated with both actual schooling and work experience). The differences of 0.63 percentage points and 0.3 percentage points indicate underestimations of 12.7% and 10.3%, respectively. The overall rate of return to education from column 2 of table 3 is 4.93%. This number is close to the value of 4.7% reported by Li (2003) and is higher than the value of 4.3% from Zhang (2005). Note that 4.93% is much higher than the rate obtained from previous studies that used CHIP-88. Johnson and Chow (1997) find returns ranging from 2.78% to 3.29%, and Liu (1998) reports returns in the 2.8% to 3.6% range. As hourly wages are used, the rate of return increases to 5.56%, as shown in the column 1 of table 3. However, the return drops to 4.06% when actual experience is used, as shown in the column 1 of table 2. This result is contradicted by that reported by Li, who finds an increased value of 5.4%.

Among other implications, the earnings differential between men and women is overestimated, as well as between party and non-party members, because men and party members tend to work longer than women and non-party members. The earnings difference for minorities and re-educated youth is underestimated by approximately 2% and 0.6%, and the difference between the state-owned sector and private sector is underestimated by about 5%, as shown in table 2 and 3. Qualitatively, these findings are in line with those from Li (2003). One inconsistency, however, arises when the rate of return to experience is examined. A sizable overestimation of the return to experience is reported by Li when the hourly wages are used. Nevertheless, only a slight difference on the return to experience is found by this study, and the difference is so insignificant that it can be totally ignored.

Results that are more consistent with Li's are obtained when school dummies are included. At each education level above elementary school, income returns are higher when using the hourly wages compared to annual earnings. In table 3, graduates from college or above earn 77% more than those from elementary school, graduates from professional school earn 60% more, and graduates from upper middle school earn 32% more. Quantitatively, however, these values are much higher than those from some prior studies, but lower than those obtained by Li (2003). For example, Liu (1998) reports that university graduates earn only 45% more than those with primary education in 1988, and Song and Knight (1991) report an even lower value of 10%. Nevertheless, Li (2003) finds that a college graduate earns 93% more income than someone with an elementary school education or less.

Estimated work experience Vs. Actual work experience

According to human capital theory, an individual's earnings can be viewed as output from a personal production function, while education, experience, and on-the-job training can be viewed as the inputs of the personal production function (Mincer, 1974). Thus, a change in work experience will have direct impact on an individual's earnings so as to affect that individual's estimated returns to education. In most of the previous studies, work experience is overestimated when a formula based on age and years of schooling is applied. The estimated years of work experience of the sample in this study is 20.78, and the actual work experience is 19.31. Comparing the rates of return to schooling in table 2 with those in table 3, we see that the rates derived from actual experience are 1.4 percentage points lower than those from estimated experience. This result indicates that the returns to schooling are overestimated as the estimated experience is used. Correspondingly, coefficients of all other variables, except for experience

and collective sector, decrease no matter what type of earnings measurements is used. The same outcomes are obtained when earnings equations are estimated with dummy variables for education levels. Unlike Li's study, this study does not find that the returns to work experience increase when actual work experience is used. In contrast, the change in the measure of work experience which is included does not have a significant impact on the returns to experience (All values of the results are listed in table 2 and 3).

Estimated years of schooling Vs. Actual years of schooling

As mentioned in the review section, some potential problems associated with the use of estimated year of schooling could affect the estimates of return to education. The first category, college and above, could involve a number of degrees, such as a bachelor's degree, master's degree, or doctoral degree. Each of the degrees requires a different number of years to complete. Thus, assigning a same number of years to all degrees would underestimate the total years of schooling for individuals who fall in the first category. Also, the number of years required to finish the middle-level professional school and the upper level middle may vary from province to province. The variance could range from 1 to 3 years. This phenomenon will cause errors in estimating the years of schooling, and this in turn will cause attenuation bias of the coefficient for the effect of schooling on earnings. From table 1, we see that the estimated and the actual years of schooling for the sample of this study are 11.61 and 10.82 on average, respectively.

The results of the estimations based on these two measurements of years of schooling are listed in table 4 and 5. The overall rate of return to education decreases by 0.8 percentage points from 4.06% to 3.21% when both actual years of schooling and work experience are used. After replacing the actual work experience with the estimated one, the rate increases to 4.66%. This is

Table 2

Rates of returns to education (estimated years of schooling and actual work experience)

Variables	Hourly wages	Annual earnings	Hourly wages	Annual earnings
Estimated schooling	0.0406 (19.84)	0.0357 (19.25)		
College			0.459 (15.49)	0.403 (14.96)
Professional school			0.340 (12.69)	0.307 (12.58)
Middle professional			0.291 (11.16)	0.259 (10.93)
Upper middle			0.200 (7.959)	0.183 (8.009)
Lower middle			0.119 (4.869)	0.111 (5.003)
Actual experience	0.0456 (22.36)	0.0456 (24.46)	0.0467 (22.85)	0.0465 (25.05)
Experience squared	-0.000627 (-12.55)	-0.000648 (-14.28)	-0.000663 (-13.21)	-0.000678 (-14.86)
Sex	0.0689 (6.725)	0.0869 (9.348)	0.0701 (6.844)	0.0880 (9.461)
Ethnic Minority	-0.0736 (-2.954)	-0.0542 (-2.394)	-0.0747 (-3.003)	-0.0550 (-2.432)
Party	0.0552 (4.357)	0.0662 (5.757)	0.0510 (4.027)	0.0629 (5.460)
Re-educated youth	0.0253 (2.005)	0.0194 (1.694)	0.0272 (2.153)	0.0206 (1.794)
State-owned	0.0720 (2.539)	0.0211 (0.8217)	0.0678 (2.396)	0.0178 (0.6929)
Local-public	-0.108 (-3.97)	-0.141 (-5.702)	-0.108 (-3.991)	-0.141 (-5.724)
Collective	-0.28704 (-9.76)	-0.317 (-11.88)	-0.284 (-9.674)	-0.314 (-11.80)
Summary Statistics	R^2=0.348	R^2=0.3821	R^2=0.351	R^2=0.3841
	F=63.187	F=74.586	F=185	F=196.396
	N=11,160	N=11,160	N=11,160	N=11,160

T-statistics are in parentheses. The estimated coefficients of the provincial dummy variables and industry dummy variables are not reported. F-statistics are derived from the F-test that all of the coefficients are jointly equal to zero.

Table 3

Rates of returns to education (estimated years of schooling and estimated work experience)

Variables	Hourly wages	Annual earnings	Hourly wages	Annual earnings
Estimated schooling	0.0556 (24.63)	0.0493 (24.01)		
College			0.571 (17.99)	0.499 (17.27)
Professional school			0.473 (15.96)	0.423 (15.66)
Middle professional			0.365 (13.05)	0.319 (12.54)
Upper middle			0.275 (10.03)	0.244 (9.751)
Lower middle			0.147 (5.717)	0.129 (5.518)
Estimated experience	0.0448 (22.34)	0.0451 (24.68)	0.0460 (22.64)	0.0461 (24.92)
Experience squared	-0.000612 (-13.26)	-0.000645 (-15.34)	-0.0006513 (-13.78)	-0.000678 (-15.77)
Sex	0.0766 (7.428)	0.0953 (10.15)	0.0784 (7.612)	0.0969 (10.33)
Ethnic Minority	-0.0793 (-3.158)	-0.0599 (-2.618)	-0.0806 (-3.213)	-0.0610 (-2.669)
Party	0.0660 (5.173)	0.0789 (6.79)	0.0626 (4.905)	0.0760 (5.538)
Re-educated youth	0.0413 (3.225)	0.0347 (3.009)	0.0430 (3.387)	0.0360 (3.113)
State-owned	0.0995 (3.486)	0.0487 (1.877)	0.0963 (3.38)	0.0462 (1.782)
Local-public	-0.0819 (-2.98)	-0.1153 (-4.609)	-0.0821 (-2.991)	-0.115 (-4.618)
Collective	-0.279 (-9.427)	-0.309 (-11.47)	-0.276 (-9.331)	-0.307 (-11.39)
Summary Statistics	R^2=0.3377	R^2=0.3687	R^2=0.3397	R^2=0.3702
	F=84.72	F=99.02	F=257.40	F=264.50
	N=11,160	N=11,160	N=11,160	N=11,160

T-statistics are in parentheses. Provincial dummy variables and industry dummy variables are not reported. F-statistics are derived from the F-test that all of the coefficients are jointly equal to zero.

Table 4

Rates of returns to education (actual years of schooling and actual work experience)

Variables	Hourly wages	Annual earnings	Hourly wages	Annual earnings
Actual schooling	0.0321 (17.30)	0.0291 (17.32)		
College			0.459 (15.49)	0.403 (14.96)
Professional school			0.340 (12.67)	0.307 (12.58)
Middle professional			0.291 (11.16)	0.259 (10.93)
Upper middle			0.200 (7.959)	0.183 (8.009)
Lower middle			0.119 (4.869)	0.111 (5.003)
Actual experience	0.0464 (22.59)	0.0464 (24.92)	0.0467 (22.85)	0.0465 (25.05)
Experience squared	-0.000666 (-13.25)	-0.000684 (-14.99)	-0.000663 (-13.21)	-0.000678 (-14.86)
Sex	0.0719 (6.995)	0.0893 (9.578)	0.0701 (6.844)	0.0880 (9.461)
Ethnic Minority	-0.0858 (-3.431)	-0.0647 (-2.851)	-0.0747 (-3.003)	-0.0550 (-2.432)
Party	0.0667 (5.262)	0.0753 (6.549)	0.0510 (4.027)	0.0629 (5.460)
Re-educated youth	0.0413 (3.225)	0.0192 (1.675)	0.0272 (2.153)	0.0206 (1.794)
State-owned	0.0715 (2.509)	0.0202 (0.782)	0.0678 (2.396)	0.0178 (0.692)
Local-public	-0.107 (-3.936)	-0.141 (-5.677)	-0.0108 (-3.991)	-0.141 (-5.724)
Collective	-0.299 (-10.15)	-0.327 (-12.24)	-0.284 (-9.674)	-0.314 (-11.08)
Summary Statistics	R^2=0.3429	R^2=0.3783	R^2=0.3510	R^2=0.3841
	F=57.244	F=68.67	F=185.60	F=196.39
	N=11,160	N=11,160	N=11,160	N=11,160

T-statistics are in parentheses. Provincial dummy variables and industry dummy variables are not reported. F-statistics are derived from the F-test that all of the coefficients are jointly equal to zero.

Table 5
Rates of returns to education (actual years of schooling and estimated work experience)

Variables	Hourly wages	Annual earnings	Hourly wages	Annual earnings
Actual schooling	0.0466 (22.88)	0.0425 (22.93)		
College			0.552 (17.46)	0.480 (16.66)
Professional school			0.445 (15.14)	0.394 (14.74)
Middle professional			0.367 (13.15)	0.320 (12.61)
Upper middle			0.254 (9.337)	0.222 (8.971)
Lower middle			0.143 (5.565)	0.124 (5.329)
Estimated experience	0.0458 (22.54)	0.0461 (24.92)	0.0451 (21.99)	0.0453 (24.23)
Experience squared	-0.000635 (-14.01)	-0.000663 (-16.08)	-0.000625 (-13.47)	-0.000655 (-15.49)
Sex	0.0766 (7.695)	0.0976 (10.38)	0.0807 (7.818)	0.0993 (10.55)
Ethnic Minority	-0.0901 (-3.576)	-0.0689 (-3.005)	-0.0773 (-3.076)	-0.0579 (-2.528)
Party	0.0769 (6.028)	0.0872 (7.516)	0.0683 (5.351)	0.0819 (7.041)
Re-educated youth	0.0425 (3.349)	0.0362 (3.139)	0.0472 (3.722)	0.0403 (3.489)
State-owned	0.0989 (3.45)	0.0478 (1.834)	0.100 (3.514)	0.0502 (1.930)
Local-public	-0.0828 (-3.001)	-0.116 (-4.640)	-0.0809 (-2.942)	-0.114 (-4.561)
Collective	-0.290 (-9.769)	-0.318 (-11.77)	-0.273 (-9.210)	-0.304 (-11.25)
Summary Statistics	R^2=0.3326	R^2=0.3652	R^2=0.3373	R^2=0.3672
	F=77.91	F=92.605	F=250.25	F=255.83
	N=11,160	N=11,160	N=11,160	N=11,160

T-statistics are in parentheses. Provincial dummy variables and industry dummy variables are not reported. F-statistics are derived from the F-test that all of the coefficients are jointly equal to zero.

still 0.9% lower than the one obtained by applying both estimated years of schooling and work experience. Interestingly, the estimated rates of return to work experience and the coefficient of

the state-owned sector remain the same, but the values of coefficients for all other variables go up when earnings equations are estimated by the actual years of schooling.

IV Trends of returns to education

The previous section has shown that the overall return to education based on estimated annual earnings and estimated work experience in China is approximately 4.93%. This estimated rate of return to education is considerably higher than those based on data from the 1980s. Therefore, it is natural to speculate that this increased rate of return is partly a result of the country's economic reforms initiated in the early 1980s. As an economy in transition, economic reforms have moved China from a system of government-set wages, which compressed wage scales, to a more market-orientated system. In this section, I will further examine the trend of the returns to education during the course of China's economic transition to investigate the effect of the economic reforms on the returns.

An ideal way to conduct this test is to divide the data into two periods, before and after economic reforms, and then to estimate separate earnings functions for the two subsamples. Results showing differences in the estimated returns to education between the two periods would suggest that economic reforms have, in fact, affected the rate of return to education. However, this empirical strategy is not applicable for this study due to the data limitation. Instead, I conduct a cross-sectional comparison by dividing the data in three groups based on the time they started to work: prior to economic reform (Exp>15), the early stage of reform ($8<Exp\leq 15$), and the advancing stage of reform (Exp<8). The division of the sample is carried out according to the reported length of labor force experience, which is used as a proxy for the period during which they commenced working. Differences in the estimated returns to education among the three

Table 6
Trend of returns to education

Variables	Most experienced (Exp>15)		Mid-range experiences (8<Exp≤15)		Least experienced (Exp<8)	
Schooling	0.031 (14.36)		0.054 (10.85)		0.064 (9.135)	
College		0.37 (11.81)		0.61 (7.56)		0.79 (6.038)
Professional school		0.27 (9.71)		0.46 (6.26)		0.63 (5.24)
Middle professional		0.26 (9.44)		0.40 (5.40)		0.53 (4.410)
Upper middle		0.18 (6.76)		0.24 (3.46)		0.41 (3.566)
Lower middle		0.11 (4.58)		0.14 (1.96)		0.28 (2.409)
Experience	0.015 (2.429)	0.012 (1.942)	0.11 (1.361)	0.104 (1.263)	0.243 (7.588)	0.244 (7.610)
Experience squared	-0.000072 (-0.588)	-0.000028 (-0.23)	-0.0037 (-1.115)	-0.0033 (-0.991)	-0.019 (-5.642)	-0.019 (-5.627)
Sex	0.064 (5.495)	0.066 (5.656)	0.050 (2.130)	0.047 (1.989)	0.077 (2.461)	0.080 (2.545)
Ethnic Minority	-0.052 (-1.863)	-0.050 (-1.78)	-0.170 (-2.894)	-0.180 (-3.084)	-0.068 (-0.898)	-0.071 (-0.938)
Re-educated youth	0.036 (2.954)	0.038 (3.12)	0.095 (1.819)	0.0877 (1.683)	0.307 (1.775)	0.292 (1.685)
Party	0.072 (5.564)	0.073 (5.422)	0.028 (0.86)	0.015 (0.469)	0.098 (1.419)	0.087 (1.253)
Summary Statistics	R^2=0.29	R^2=0.29	R^2=0.268	R^2=0.27	R^2=0.28	R^2=0.28
	F=27.71	F=96.78	F=31.46	F=62.62	F=14.96	F=33.52
	N=7143	N=7143	N=2245	N=2245	N=1774	N=1774

T-statistics are in parentheses. F-statistics are derived from the F-test that all of the coefficients are jointly equal to zero. Dummy variables for ownership sector, industry, and province are not reported.

groups also provide some evidence regarding the existence of the effect of economic reforms on the rate of return to education. This comparison is feasible based on the hypothesis that many reforms, such as the labor market reform and wage system reform, are more likely to be applied to the new workers first and to the existing workers subsequently.

As shown in table 6, the estimated returns to education for these three groups are 3.1%, 5.4% and 6.4%, respectively. This result presents a rising trend of returns, and the difference is statistically significant. Similar results can be found when school dummies are included in the estimating equation. Rising returns to education between the two periods are discerned for every education level. For example, the coefficients of the College variables for the three groups are 37%, 61% and 79%[2], respectively. Therefore, the wage differentials between graduates holding a college degree or above and those from elementary school for the three groups are 45%, 84% and 120%, respectively. These observed higher returns to schooling for the younger labor force is consistent with the previous hypothesis that the economic reforms are more likely to affect the younger cohorts of workers. Among other findings, party membership and re-education are only significant for the senior workers (Exp>15). Minorities earn less only for the mid-range group ($8<\text{Exp}\leq 15$).

According to some studies in the literature, the upward trend of the overall return to education is found to parallel the growth of foreign direct investment (FDI) in China. The annual flows of FDI reached 1.3 billion US dollars are decade after the legalization for foreign direct investment in 1979. Some empirical evidence provided by Zhao (2001) shows that the growth of FDI is positively correlated with relative wages of skilled labor by using data from Mexico. Later on in his study, Zhao obtains the same positive correlation by examining the data from China. The argument is that unskilled workers are abundant in unprivileged sectors, sectors with limited government support, while skilled workers are concentrated in the privileged sector—the state-owned sector. Therefore, foreign enterprises can easily hire unskilled workers at relatively low costs, but have to offer extra bonuses or compensations on top of the basic wages to attract

[2] The formula used to calculate the percentage change in wage d_i for group i relative to the base group is $d_i = e^{\beta_i} - 1$, where β_i is the coefficient for the dummy variable for group is i.

skilled workers from the privileged sector. Obviously, this would raise the relative wages of skilled labor and affect the rate of return to education.

The sectoral pattern is shown in Table 7. At every education level, except for middle professional school category, the returns to education are the highest in the joint-venture and foreign-owned sector. The wage differences between the college graduates and the elementary school graduates for the state-owned, local public and urban collective sector are 62%, 60% and 69%. Notice that the percentage difference is relatively small as compared with the 107% in the joint-venture and the foreign-owned sector. This finding is in line with Zhao (2000). Among other findings, the wage inequality between female and male workers is only statistically significant in the state-owned, local public and urban collective sector, while ethnic minorities earn considerably less in the joint-venture and foreign-owned sector. Party membership is not statistically significant in the joint-venture and foreign-owned sector, but significant in the other three sectors.

Lastly, I will conduct a regional analysis to investigate how economic development affects returns to education in China. The regional disparity in economic development has been one of the distinctive features of China's economic reforms. Coastal provinces, such as Guangdong, have been given considerable autonomy in drafting and implementing special economic and political policies to expedite their economic development and to experiment with new reform measures. The Chinese government chose the coastal regions for two main reasons: first, the geographical advantage allows the coastal regions to trade merchandise and advanced technology with foreign companies in much lower transportation costs; second, some of these regions have strong commercial connections with overseas Chinese communities, which provide a great source of capital and technology for homeland.

In this study, I will focus my regional analysis on two provinces: Guangdong and Gansu. Guangdong has been a pioneer in China's economic reforms and can be used to represent the developed region. In the transition period from 1978 to 1988, the percentage of the state-owned sectors among all sectors in Guangdong shrank dramatically from 67.82% to 35.03%, a very significant decrease, compared with the decline from 77.63% to 56.8% at national level. Furthermore, Guangdong leads all other provinces in attracting foreign direct investment (FDI). In 1995, the total annual FDI in Guangdong reached 10.18 billion yuan, representing 27% of the total China's national annual FDI of 37.7 billion yuan (China Statistical Yearbook, 1995). The share decreased slightly to 20% in 2005, while it still took the lead over all other provinces. With less active support from the government, Gansu has developed in a much slower pace and can be used to represent less-developed areas in China. In 2005, the amount of FDI in Gansu was only 20 million yuan, which was a drop of 42% from 2004, and represented merely 0.003% of the national FDI (China Statistical Yearbook, 2005).

As illustrated in Table 8, the overall return to education is estimated to be 4.5% in Guangdong and 6.2% in Gansu. This is sensible because less-developed areas lack skilled labor, and therefore reward more for an additional year of schooling. For example, according to Psacharopoulos's latest study in 2004, the mean rate of return to education in high-income countries is 7.4%, while in low-income countries, the mean rate of return increases to 10.9%. At every educational level, the relative returns are all higher in Gansu, ranging from 80% to 28%, than in Guangdong, ranging from 45% to 13.9%, as indicated in Table 8. Notice that the rate of return for college graduates in Gansu is almost twice as high as that in Guangdong, and the rate for lower middle school in Gansu is even more than twice that in Guangdong. Other findings include: the earnings gap between genders is not so different in the two provinces; the maximum

wage is reached at 26 years of job experience in Guangdong, but as high as 40 years in Gansu; ethnic minorities earn considerably less in Guangdong, and re-education and party membership are greatly rewarded in Guangdong, while make no significant difference in Gansu.

V A comparison of Wan (2004)'s paper and this paper

Wan (2004) is an alumna of mine who wrote her paper on a similar topic in 2004. Even though the two papers use the same dataset, CHIP-95, and have a similar topic, the main focuses are different. Wan (2004) concentrates her analyses on the wage determination, the effects of important characteristics, such as marital status, communist party membership, on earnings, and the rates of returns to schooling for different age cohorts, ownership sectors and regional groups. In her study, she does apply actual years of schooling and actual work experience in the estimation and take into account the effect of the working hour on earnings. However, she does not consider all the cases and undertake a thorough comparison, as this paper does, to investigate the effects of the use of actual or estimated numbers, hourly wage or annual earnings on the returns to education. Furthermore, this paper conducts a trend study to examine the effects of the economic reforms on the returns through analyses for different experience cohorts, sectors and regions.

The returns to schooling obtained from the extended Mincerian model of the two papers are 2.974% and 2.91%, respectively. These are very close results, although there are some specification distinctions between the two extended models[3]. Moreover, most other findings of the two papers are also qualitatively consistent: i) Wan (2004) reports that "using estimated work experience leads to higher rates of return to education for all cases, but it does not have much

[3] The major distinction is that Wan (2004) includes additional control variables for marital status, working hours and nature of employment; whereas, my paper includes control variables for Re-education.

effect on the rates of return to work experience itself"; ii) an increase in rates of returns to education is detected for the period from 1988 to 1995, which indicates an upward trend; iii) people who earn lower hourly wages spent more time working on an annual basis, which explains the underestimation of the returns to schooling when annual earnings are used; iv) wage premiums for communist party members, males and Han Chinese are higher than those for non-party members, females and ethnic minority; v) new labour force entrants with less work experience enjoys higher returns to education than senior workers; vi) the rates of returns to education are higher in poor regions than in the rich regions;vii) the private sector ends up with a higher returns than the state-owned sector.

VI Conclusion

Using various data sets, economists have estimated Mincer-type earnings equations to investigate the rates of returns to education during China's economic transition. Byron and Manaloto (1990) estimate a low rate of return of 3.7% by using data from a 1986 survey of 800 state industrial workers in Nanjing. This result is in line with Liu (1998)'s estimated value of 3.7% by using the most widely-used household data—CHIP 1988. Both studies find that male workers earn more than female workers. Liu (1998) also considers differences in the returns to education among difference experience groups and across different provinces. He concludes that junior workers with less work experience had higher returns to schooling, and that Guangdong had higher returns than other provinces.

Li (2003) conducts his studies based on a more recent data set—CHIP 1995. His empirical study finds that the return to education is underestimated by 0.7 percentage points and the return to experience is overestimated by 1.3 percentage points when annual earnings and estimated

years of work experience are used. His result of an overall rate of return to education of 5.4% in 1995 shows an upward trend of returns since 1988. Li (2003) makes some between-group comparisons in the returns to schooling. From the comparisons, he obtains a similar result to Liu (1998), which indicates that the annual rates of return to college education were higher for junior workers and lower for senior workers. Nevertheless, his rates of return were higher in a less-developed province, Gansu, than in a high-income province, Guangdong. This result contrasts with the one reported by Liu (1998).

Yang (2005) and Maurer-Fazio (1999) are studies that include two data sets in their empirical analyses. Yang (2005) used CHIP-95 and CHIP-88, while Maurer-Fazio (1999) used CHIP-88 and CLMRP-92. Yang (2005) concentrates his study on cross-sectional disparities at the city level. He finds that the mean value of the rates of returns to education for the cities in his estimation increased from 1988 to 1995, as well as the returns to experience. This result is consistent with that from Maurer-Fazio (1999), which reports an increase in overall rates of return to education in 1992. However, these two studies disagree with each other on the sectoral analysis. Yang (2005) asserts that workers who found jobs through a market mechanism rather than through the assignment of government end up having higher returns for education; whereas, Maurer-Fazio (1999) obtains a totally opposite result showing that the returns for education for those assigned their jobs are higher than for those who found their jobs through competitive labor markets.

Zhang (2005) is the only one of all six articles that are reviewed in the literature that uses time-series data. The data consist of fourteen annual surveys of urban households done by China's National Bureau of Statistics from 1988 to 2001. Zhang's results show an increase of more than 100% in the returns to education over the 14 years. This finding of the increasing

trend of returns is one of the major consensuses and is supported by most of the existing literature. His result also indicates that the provincial and gender gap in returns to education narrows over time. Finally, Johnson and Chow (1997) include households and individuals residing in the rural areas as well as those in the urban areas. Their study reports a higher rate of returns to schooling in rural areas than in urban areas.

This study replicates Li's work and finds that with similar specifications, the rates of returns to education are considerably higher than the estimates from previous studies. The overall rate of return has gone up to 4.93%. This rate becomes 5.6% when the hourly wages are used in the equations as opposed to the annual earnings. This underestimation of the overall returns can be found in all four cases of model specifications: estimated years of schooling and estimated work experience, estimated years of schooling and actual experience, actual years of schooling and estimated work experience, and actual years of schooling and actual work experience. The empirical results of the cases indicate that the use of estimated years of schooling would underestimate the rates of returns to education, and the use of estimated work experience would overestimate the rates. Moreover, in all cases, no significant difference is detected for the returns to experience, a result that contradicts Li's (2003).

In the subsequent trend study, all samples selected from CHIP-95 are classified into three cohorts depending on when they started working prior to economic reform (Exp>15), in the early stage of urban reforms ($8<Exp\leq 15$), and during the advanced stage of the reform (Exp<8). The overall rate of return to education is higher for junior workers, and the average rates of return to college education are 3.7% for the most experienced cohort, 6.1% for the mid-range experienced cohort, and 7.9% for the least experienced cohort. Finally, the sectoral analysis shows that joint-venture and foreign-owned enterprises have higher rates of return to schooling than state-owned

enterprises, and the returns are higher in less-developed province, Gansu, than in relatively developed province, Guangdong. All these findings, which are qualitatively consistent with Li's (2003), conclude that the rates of return to education in China have experienced an upward trend along with its growing economy in the transition period.

Table 7
Sectoral pattern of returns to education

Variable	State-owned	Local public	Urban collective	Joint-venture & Foreign-owned
College	0.487 (9.496)	0.474 (11.47)	0.527 (3.617)	0.731 (2.236)
Professional school	0.357 (7.021)	0.415 (10.71)	0.437 (5.630)	0.672 (2.407)
Middle professional	0.289 (5.930)	0.298 (8.036)	0.326 (4.724)	0.286 (1.011)
Upper middle	0.239 (4.848)	0.173 (4.685)	0.229 (4.113)	0.379 (1.484)
Lower middle	0.144 (3.072)	0.073 (2.053)	0.0776 (1.582)	0.282 (1.123)
Experience	0.0455 (13.79)	0.0444 (17.81)	0.0586 (10.38)	0.0359 (1.699)
Experience squared	-0.00063 (-8.446)	-0.00061 (-10.42)	-0.0010 (-8.434)	-0.00026 (-0.3871)
Sex	0.080 (4.804)	0.0734 (5.894)	0.159 (5.707)	0.070 (0.683)
Ethnic Minority	0.0559 (1.298)	-0.0326 (-1.155)	0.0355 (0.533)	-4.988 (-2.017)
Re-educated youth	0.0538 (2.538)	0.0325 (2.133)	0.0327 (0.964)	0.108 (0.614)
Party	0.0513 (2.635)	0.0995 (6.709)	0.118 (2.708)	-0.199 (-0.954)
Summary Statistics	R^2 =0.30	R^2 =0.35	R^2 =0.32	R^2 =0.37
	F=131.06	F=245.60	F=114.31	F=7.695
	N=2995	N=6102	N=1674	N=139

T-statistics are in parentheses. Provincial dummy variables and industry dummy variables are not reported. F-statistics are derived from the F-test that all of the coefficients are jointly equal to zero.

Table 8
Regional pattern of returns to education

Variable	Guanddong	Gansu
Schooling	0.0449 (6.327)	0.0628 (7.716)
College	0.435 (4.605)	0.809 (7.399)
Professional school	0.482 (6.050)	0.552 (5.200)
Middle professional	0.351 (4.501)	0.460 (4.542)
Upper middle	0.132 (1.909)	0.351 (3.72)
Lower middle	0.139 (2.027)	0.281 (3.076)
Experience	0.0427 (5.429)	0.0486 (6.123)
Experience squared	-0.000808 (-4.030)	-0.00060 (-2.508)
Sex	0.0868 (2.273)	0.0765 (1.950)
Ethnic Minority	-0.278 (-3.140)	-0.0896 (-0.947)
Re-educated youth	0.102 (2.164)	-0.0243 (-0.466)
Party	0.197 (4.320)	-0.0180 (-0.358)
Average earnings	10295	4302
Summary Statistics	R^2 =0.259	R^2 =0.454
	F=5.57	F=12.42
	N=936	N=633

T-statistics are in parentheses. Industry dummy variables and ownership dummy variables are not reported. F-statistics are derived from the F-test that all of the coefficients are jointly equal to zero.

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