Determinants of Schooling Returns during Transition:

Evidence from Chinese Cities

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Abstract

This paper uses 1988 and 1995 data from a national household survey to study (a) across-region dispersions and over-time changes in returns to education for a large number of Chinese cities, and (b) the determinants of these variations in schooling returns during economic transition. On average, the estimated rates of return at city level increased from 3.1% to 5.1% over the two years, and the dispersion widened significantly. In the same period, the gender earnings gap increased, and the returns to experience and communist membership rose sharply. Individual cross-section and city-level panel data suggest that the presence of foreign and joint-venture firms, market job search channels, and information infrastructure helped raise returns to education. The size of the state sector constrained schooling returns.

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1. Introduction

Rising returns to education is a major labor market phenomenon observed in virtually all transition economies. However, the pace of the increase varies across regions as well as within regions over time. In China, for instance, low returns to schooling persisted for at least a decade after the inception of reform in 1978, but then, the estimated returns increased gradually in the 1990s (Zhang and Zhao, 2002).[1] In Eastern European countries, returns to education typically rose immediately following reform, but the speed of change shows great diversity across countries.[2] Understanding the determinants of changing returns to education is important because the changes not only reflect the progress of reform, but also affect wage structures, income distribution, and incentives for investing in human capital. Although an extensive labor literature has studied the determinants of schooling premiums for market economies (see Katz and Autor, 1999), empirical investigations into economic transition have been scant.[3] This neglect is due in part to the absence of high quality data -- data that contain rich spatial variations or a long time series in returns to schooling, which enables researchers to conduct econometric analysis.

In this paper, we investigate cross-section dispersions and over-time changes in returns to education for a large number of Chinese cities during the years 1988 and 1995, using data from the Chinese Household Income Project (CHIP). CHIP contains detailed information on personal earnings and demographic characteristics with broad geographical representation. More specifically, the first wave of CHIP covers 67 cities

and the second wave includes 62 cities.[4] Among these cities, 29 are included in both surveys. To explore the data, we use Mincer-type earnings functions to estimate city-specific rates of returns to education, shedding light on spatial dispersion as well as changes in schooling returns over time. Empirical evidence shows that on average, the rates of return to education at city level increased from 3.1% to 5.1% over the seven-year period, while the dispersion in rates of return widened significantly, with the standard deviation almost doubled from 0.011 to 0.02. Consistent with this trend, the gender earnings gap and the returns to experience and communist membership increased sharply.

The rise in the level and dispersion in schooling returns are outcomes of changing labor market conditions during economic transition. In standard labor analysis, researchers emphasize the role of supply factors (e.g., relative supply of skilled workers), demand factors (e.g., skill requirements due to technological change), as well as other environmental variables such as taxes and costs of education in explaining schooling premiums (Katz and Autor, 1999; Heckman et al., 2003). Based on the general framework, We propose several hypotheses closely related to reform that may affect the payoffs to education in changing institutional environments. These dynamic factors include the pace of restructuring enterprise ownership, the degree of openness to foreign competition, the availability of market job search channels, and the development of communication infrastructure. By aggregating individual and household data, we construct city-level measures of labor market conditions and test the proposed hypotheses using both cross-section and city-level panel data. The findings suggest that the presence of foreign/joint-venture firms, market job search channels and information infrastructure

helped raise returns to education. In contrast, the dominance of the state sector constrained schooling returns.

Other researchers have also used the CHIP surveys to examine returns to education in China. However, most studies use single-year data (Johnson and Chow, 1997; Liu, 1998; Maurer-Fazio, 1999; Li, 2003). In existing studies that analyze both waves of the data (Gustafsson and Li, 2000; Knight and Song, 2003), the primary focus is on income inequality and the gender earnings gap. Unlike this paper, these studies do not offer direct evidence on regional dispersions and changes in returns to education over time. Moreover, unlike other studies, this paper examines how reform and transition processes influence the functioning of local labor markets, and how these interactions in turn determine the rewards to education.

2. Data

The data used in this paper come from the two waves of CHIP, which collected household survey data in 1988 and 1995. These two cross-section surveys were designed and conducted by researchers from the Chinese Academy of Social Sciences and western scholars. The samples and questionnaires are broadly comparable across the two years. The 1988 survey includes 9,009 urban households, covering 10 of China's 31 provinces. The 1995 survey adds one more province (Sichuan) and includes 6,931 households. To ensure compatibility, we use data from the same 10 provinces covered in both waves, thus excluding Sichuan from empirical analysis. Although the households in CHIP were sub-samples from the annual income and expenditure surveys of the State Statistical Bureau (SSB), the CHIP questionnaires contain much more detailed information than the

SSB survey, and the data still constitute a representative sample of urban households in China (Riskin, Zhao and Li, 2001).

The sample used for analysis consists of 17,074 and 9,627 individuals for 1988 and 1995, respectively. These individuals are either permanent workers/employees of enterprises and institutions, or long-term contact workers/employees, who reported positive earnings. Individuals who received pensions or were formally designated as retired or students were excluded from the sample. we also exclude two other groups: temporary workers, and private enterprise proprietors or self-employed individuals, because the former group often has irregular hours of work, which is not reported in the survey, thus making their earnings incompatible with permanent workers. For the latter group, it is difficult to compute their labor earnings because these earnings are often entangled with the returns to household capital.

The earnings used for analysis include all types of wages (basic, floating, contract, overtime pay, and so on), bonuses, pay from second jobs, all kinds of subsidies, hardship allowances, and income in kind. The earnings records, although rich, are not ideal. In particular, they do not include the value of medical care and pension accruals. Moreover, the value of enterprise-supplied housing is not reported in the survey as earned income. Throughout the paper, we use monthly earnings as the income measure. Although wage rate is an alternative measure for studying returns to education, it is not feasible here, as information on hours of work is only available in the 1995 survey for computing wage rates. Unfortunately, there is no information on hours of work in the 1988 survey.[5]

Table 1 presents information on worker monthly earnings and sample distribution across the provinces. As noted earlier, we use the ten provinces that appear in both waves of the survey for analysis. Average real earnings measured in 1988 yuan increased from 1,972 to 2,812 over the seven-year period, a 45.9% jump.[6] There are significant variations in average worker earnings across the provinces; the differentials become noticeably higher over time. In 1988, the monthly earning per worker for the richest province (Guangdong) is about 80% higher than the poorest province (Henan), but in 1995 that gap increases to 144% (Guangdong vs. Gangsu).

It is important to this study that the survey covers a large number of cities from geographically-dispersed regions: 67 cities for 1988 and 62 for 1995. On average, there are 255 and 155 individuals surveyed in each city in each of the two years. Another important feature of the data, shown in the last column of Table 1, is that the surveys cover 29 cities in both years, thus enabling researchers to construct a two-year, city-level panel. These cities, which are rather spread out in China, can be considered as local labor markets with varying institutional environments. This rich data structure will allow the estimation of city-specific rates of return to education in order to examine their cross-section dispersion and over-time changes. The city panel will help control local time-invariant characteristics when studying regional variations in returns to education.

Table 2 presents summary statistics for key variables. The upper panel reports few familiar personal characteristics to the analysis of earnings. Completed years of schooling increase by 1.1 over the seven-year period, while labor market experience stays stable. Note that the CHIP surveys report educational attainment in seven categories based on completion levels. To estimate returns to years of education, each completion category

should be matched with years of education. Based on previous studies and education systems in China, we make the following assignment: college and above (16 years), community and vocational college (14 years), high school (12 years), lower middle school (9 years), primary school (6 years), three years or more of primary school (4 years), and less than three years of primary school (2 years). Following the convention, experience is approximated by (Age-S-7). In regard to other personal characteristics, male workers account for the majority of the labor force, ethnic minority consists of 3.7% and 4.6% of all workers for the two years, and the percentage of communist party members rises from 24% to 26.1% despite the declining role of the party in economic activities during reform.

The lower panel of Table 1 summarizing the characteristics of the cities is constructed from individual and household level data. we use these variables to measure the skill composition of the labor force, the extent of technological change in the cities, and a series of reform and environmental factors that may affect the payoffs to education in local labor markets. In later analysis, we shall propose and test hypotheses that explain why these city-level variables may influence rates of return to education.

The city characteristics reveal a few interesting features of China's labor markets over the seven-year period. The supply of skilled workers, as measured by the percentage of workers having an education higher than the lower middle school level, increases from 49.3% in 1988 to 66.2% in 1995.[7] However, the percentage of workers employed in science and technology industries,[8] which relates closely to the flow of new technology, only experiences a slight increase during this period, from 2.1% to 2.4%. In contrast, the percentage of workers employed by foreign and joint-venture firms, a measure of

openness in the labor market, is almost tripled, yet this percentage still remains at a low level. Information infrastructure, as approximated by the percentage of households with home telephones, rose from 4.9% to 41.8% representing dramatic improvements. Another variable that indicates the extent of labor market transition is whether current employees found their jobs though market channels. This variable is reported in the 1995 CHIP survey as getting jobs through non-public agencies or by workers themselves. In that year, 13% of the labor force found their current jobs through market channels. Unfortunately this variable, which is indicative of local labor market development, is missing in the 1988 survey.

3. Returns to Education over Space and Time

3.1 Empirical Specification

The Mincer-type equation has been widely used in the analysis of human capital and earnings relationship. We adopt a variant form as the basic specification for estimating returns to education:

$$LnY_i = \beta_0 + \beta_1 S_i + \beta_2 E_i + \beta_3 E_i^{\,2} + \sum_{j=1}^{3} \gamma_j X_{ij} + \mu_i, \qquad (1)$$

where Y_i is monthly earnings for worker *i*, S_i is years of schooling, E_i is potential labor market experience, E_i^2 is experience squared, and μ_i is the error term with $E(\mu_i) = 0$. The variable X_{ij} represents three other personal characteristics: gender, Communist Party membership and minority status, all of which may also affect personal earnings.

In equation (1), β_1 measures the average rate of return to an additional year of education for the individual in the sample. The human capital theory posits that schooling

may enhance the productivity of individuals, implying $\beta_1>0$. On-the-job training, which is often correlated with experience, can also have a positive effect on earnings ($\beta_2>0$), but there may be diminishing returns to experience ($\beta_3<0$). Other personal characteristics, such as gender, Communist Party membership and ethnicity, may also have their own effects on earnings independent of schooling, but if these variables are correlated with education, their insertion in equation (1) would systematically affect the estimate of β_1.

Ordinary least squares (OLS) is a procedure widely used for estimating the human capital earnings function. One problem with OLS is that the omission of one's ability in the estimation may result in a biased and inconsistent β_1 due to a positive correlation between schooling and ability. Economists have used three strategies to deal with the ability bias: the instrumental variable approach, the fixed effect method, and direct measurement of ability (see Card, 1999). However, each of these approaches has stringent data requirements. Another potential complication is that individuals may have differential rates of return to education. As Heckman and Li (forthcoming) demonstrate using 2000 Household Survey Data collected by the State Statistical Bureau, heterogeneity among people in returns to schooling is substantial in China.[9] The OLS estimates, without taking into account population heterogeneity and sorting in school attendance, tend to result in underestimation of rates of returns to education. The study by Heckman and Li with explicit modeling of heterogeneity and comparative advantage reveals that sending a randomly-selected person to college results in a 43% increase in the person's lifetime earnings, or a 10.8% increase in annualized returns, in 2000 for young people in the urban areas of six provinces in China, whereas the OLS estimator gives a 29% increase in lifetime earnings, or a 7.25% increase annualized returns.

While acknowledging these estimation issues, we choose to use the OLS procedure for the current study because (a) the CHIP surveys do not have extensive data that permit careful corrections for the ability bias; (b) an approach that takes into account sorting in educational attainment may not be crucial for the current study because many workers in the 1988 and 1995 surveys obtained their education prior to the inception of reform in 1978, when rigid policy rules, rather than self-selection and comparative advantage, influenced individual schooling attainment;[10] and (c) the OLS results would ensure compatibility of findings with existing studies on returns to education in transition economies, which in general do not control for the biases arising from omitted variables.[11]

Another issue is whether to include regional and/or occupational dummy variables in the estimation. There are noticeable differences in specification among studies using the CHIP data.[12] We choose to exclude the occupational dummies because wages and occupations are likely to be jointly determined, as part of educational returns comes from occupational choice [see Schultz (1988) for related discussions]. However, it is less clear whether one should exclude province dummies. One argument for their inclusion is the need for adjusting differences in regional cost of living. The arguments against inclusion include the fact that migration across regions is also an endogenous labor-market decision, although Johnson (2003) shows that across-province migration in China is far below the level consistent with fully-integrated labor markets. For empirical analysis, we will have specifications with and without regional dummies. The results will show that the rate-of-return estimates are not sensitive to the alternative specifications.

Equation (1) imposes the implicit assumption that rates of return to schooling are the same across all cities. Although the specification provides an average rate of return estimate for the entire sample, the restrictive assumption is strongly rejected in subsequent data analysis. To relax this restriction and allow differences in rates of return to education across the cities, we will use the following, more flexible empirical form:

$$LnY_i = \beta_0 + \sum_{k=1}^{n} \beta_k S_{ik} D_{ik} + \beta_2 E_i + \beta_3 E_i^2 + \sum_{j=1}^{3} \gamma_j X_{ij} + \mu_i, \qquad (2)$$

where β_k is a rate-of-return parameter to be estimated for city k; D_{ik} is a city-level dummy variable where $D_{ik}=1$, if worker i resides in city k, and $D_{ik}=0$, otherwise. Consequently, the estimation of (2) will generate 67 and 62 city-specific estimates of rates of return to schooling for the 1988 and 1995 sample, respectively. These estimates for individual cities will be the basis for examining schooling returns across space and over time.

3.2 Findings

Table 3 presents the results of estimating 1988 and 1995 cross-section data. Columns (1)-(3) and (6)-(8) are the results of fitting equation (1) and its variants, which show average returns to education across all cities. Columns (4)-(5) and (9)-(10) are the results of fitting equation (2), which yield city-specific rates of returns to schooling. All regressions use the OLS procedure with Huber-White robust standard errors, which correct for heteroscedasticity of an unknown form. The fact that individual samples are drawn from various groups (e.g., families or enterprises of different ownership types) may give rise to heteroscedastic errors. For all regressions, the high F-values reject the null hypotheses that all of the coefficients are jointly equal to zero.

Several noticeable results emerge from a comparison of the 1988 and 1995 estimates. First, the sample average rates of return to education increased substantially over the seven-year period, rising from a range of 3.3%--3.9% to 5.9%--7.3%. Correspondingly, there are substantial increases in the returns to experience, rising from 3.9%--4.2% to 7.1--7.6%, and the results from both years reveal the expected diminishing returns to experience. Consistent with these trends, the gender earnings gap nearly doubled in percentage terms, rising from around 9.7% to 15.5--16.7%. At the same time, the returns to communist membership also increased, from the 7%--9.3% range to 10.8%--13.2%. All of these estimates have high statistical significance. Overall, minority members receive less earning than Han Chinese, although most of the estimated differentials are not statistically significant.

These results on the rising returns to education and the widening gender earnings gap over the period 1988-1995 are broadly consistent with previous research.[13] The new findings are the rapid increases in the returns to experience and communist party membership, which to my knowledge are not documented in the earlier literature. The combined evidence on the diverging returns to worker characteristics are closely related to a previously-documented trend that since the inception of reform in 1978, China has experienced the largest increase in income inequality among all countries for which comparable data are available (e.g. World Bank, 1997). Note that wage inequality may be decomposed into changes in the distribution of worker attributes and changes in the returns to those attributes. Hence, the above findings on the diverging returns to worker characteristics point to an important source of rising income inequality during China's economic transition.[14]

For both 1988 and 1995, the estimated rates of return to schooling are lower when gender, communist party membership and ethnicity are added to the basic specification. This change is due to the correlation between educational attainment and personal characteristics: for both years, schooling is positively associated with being male and a party member;[15] for 1995, schooling is negatively associated with being a minority.[16] Provincial dummy variables are added to regressions reported in columns (3), (5), (8) and (10). Paired comparisons with results in (2), (4), (7) and (9) without regional dummy variables indicate that their inclusion does not seriously affect the estimates of various parameters.

In short, the above evidence suggests that China's wage structure became more diverse over the seven-year period: the returns to human capital variables rose, and gender and party member wage gaps increased. Moreover, a larger portion of wage variations could no longer be explained by the set of explanatory variables, as the R^2s of the regressions are reduced dramatically in value from 1988 to 1995. These findings are consistent with the arguments that the "wage grids" implemented in the central planning period to effect income equality were gradually dismantled in this important period of reform (e.g. Meng, 2000).

The estimated returns to education discussed so far, while useful in providing a general picture of nationwide changes, are based on the assumption of equal schooling returns across local labor markets. However, F-tests yield F(66,16981)=19.14 for 1988 and F(62,9550)=21.46 for 1995, which strongly reject the notion of equal returns. Hence, we adopt the more flexible empirical equation in (2) to estimate the rates of return to schooling specific to individual cities. The columns (4)-(5) and (9)-(10) of Table 3

present the coefficients of all explanatory variables other than schooling. In order to explore in detail the spatial variations in schooling returns, we use Table 4 and Figure 1 to present city-specific estimates. Because the exclusion of province dummy variables does not significantly affect the parameter estimates, we shall discuss the findings based on the results reported in columns (5) and (10) of Table 3, i.e., the regressions with province effects.[17]

Table 4 highlights the dispersion of estimated rates of return to education across the sampled Chinese cities for 1988 and 1995. Over the seven-year period, the average rate of return to education for these cities increased from 3.1% to 5.1%; a paired t-test on the equality of these rates gives t=6.2, suggesting a statistically-significant upward shift. The range of city-specific returns moved up from -0.1%--7% to 1.7%--10.3%,[18] and their spatial dispersion also rose. The standard deviations in the city-level estimates are almost doubled, rising from 1.1% to 2%, and the GINI coefficient increases from 0.195 to 0.225.[19]

To illustrate these changes, Figure 1 plots the frequency distribution of the estimated rates of return to education across the cities; this information is reported in the lower panel of Table 4. The plot for 1988 is a tight, bell-shaped frequency curve, consistent with the uniformity of wage controls across regions during that time. The frequency curve for 1995 is much flatter, and its mean has clearly shifted to the right. These changes during transition in the distribution of returns to education appear to be consistent with a gradual relaxation of the wage grid inherited from central planning.

However, a quick examination of individual cities does not help identify a set of city characteristics closely related to schooling returns. For the 1988 sample, for instance,

the three lowest rates of return are found in Nantong city of Jiangsu province, Yanbei of Shanxi, and Shantou of Guangdong; the highest returns are found in Shenzhen and Feshan of Guangdong as well as Lanzhou of Gansu. Both low and high returns are found in coastal (Guangdong and Jiangsu) and interior provinces, as well as rich and poor provinces (see Table 1).[20] Similarly, there are no specific patterns emerging from the 1995 estimates.[21]

Nevertheless, the large cross-city variations in the rates of return to schooling in China are quite striking, given the fact that the estimates are generated using uniform procedures and comparable data. For each of the two years, the highest estimates are about seven and ten times higher than the lowest estimates, respectively. These differences are very large in light of international experience. In a comparable study using microdata, Trostel et al. (2002) estimates economic returns to schooling in 28 countries worldwide. Due to differences in the data -- such as whether income is measured before or after tax, diverse market institutions, and high isolation of international labor markets-- one would expect much larger cross-country dispersions in schooling returns. But in fact, the cross-city differences in China are quite comparable with the cross-country variations. For the latter, for instance, their highest rate-of-return estimate for a country is also about ten times larger than the lowest estimate for another country.[22]

What factors have caused the large regional variation and over-time changes in returns to education in China? This is the topic to which we now turn.

4. Determinants of Schooling Returns

Ever since the seminal work of Becker (1964), theory of human capital has made a link between the rate of return to schooling and the interest rate in determining optimal educational investment. Assuming stationarity of economic environments, analysts can use the Mincer model to identify rewards to skills and rates of return to investment. Recently however, as Heckman, Lochner and Todd (2003) demonstrate with explicit empirical models, many environmental factors such as costs of schooling, taxes and uncertainty of future earnings may affect individual schooling choices and the market returns to education. These general arguments can be readily applied to transition economies in which rules and institutions are changing rapidly with reform.[23] In what follows, we propose a few hypotheses on local labor market conditions - some closely related to transition - that may affect the payoffs to education in changing institutional environments.

4.1 Hypotheses

Despite major improvements in the functioning of labor markets since the inception of reform in China, there are still serious obstacles that stand in the way of a fully-integrated national market (Fleisher and Yang, 2004). There is much evidence of city and province border effects on labor flows attributable not only to household registration restrictions, but also to local protectionism and the inability or unwillingness of the central government to enforce existing laws and regulations (Poncet, 2003). It is true that there has been increased labor migration in China. But interregional movement is much smaller than what would be expected if relocation were unrestricted by existing legal and economic barriers (Johnson, 2003). All of this evidence suggests that cities in China are

still not fully integrated, and that they can be considered as local labor markets. Therefore, the characteristics of the cities may affect the operation of the local markets, resulting in differential returns to education.

We shall start this section by discussing conventional factors influencing skill wage differentials, and then move on to consideration of determinants that are closely related to economic reforms.

The first factor is the supply of skilled workers. Education as a factor of production responds to supply and demand conditions so that its price tends to fall when the relative supply of skilled workers increases, *ceteris paribus* (see Katz and Autor, 2002). In this paper, we measure the relative supply of education by the percentage of workers who have completed an education higher than lower middle school, i.e., nine years of education, which is required by the education system in China. Table 2 shows 49.3% of skilled workers among all permanent and long-term contract workers in the 1988 sample; the ratio increases to 66.2% in 1995.

The second factor is the demand for education. It has long been recognized that the value of education is positively associated with the speed of technological change, which presents a non- neutral demand for education as opposed to capital as a factor of production. Education tends to have higher payoffs in dynamic environments with rapid flow of technology because education facilitates people's ability to interpret and decode information (Schultz, 1975; Foster and Rosenzweig, 1996). The previous literature has used different measures for technological change, including per capita expenditure on research at the U.S. state level (e.g. Welch, 1970). In absence of this and related information for the sample cities, we use the percentage of labor force employed in the

technology and science sectors as a proxy.[24] Higher labor share implies more activities related to science and innovation.

The third determinant is the size of state sector. We define this variable as the percentage of workers employed in state-owned enterprises and local public firms. This variable not only indicates the share of the labor force still under the "wage grid," but also sheds light on the pace of reform in the cities. A larger state sector would imply tighter controls in the local labor markets, thus lower returns to education.

The fourth determinant is the degree of openness in the labor market. During the transition from planning to market, inputs of production will be compensated increasingly by their marginal contributions to production. Foreign and joint-venture firms are likely to take these initiatives because they are generally not influenced by government labor rules and regulations. Therefore, openness in the labor market, as measured by the percentage of workers employed in foreign and joint-venture firms, can be a driving force for competitive wage compensation during transition (Yang, 2004b). Admittedly, however, the share of employment in foreign and joint-venture firms may also approximate another dimension of demand for educated workers, as imported technology needs to be adapted to local conditions and thus raises the demand for education. Although we cannot separate the effects of education demand from those deriving from competitive wage mechanisms, we hypothesize that labor market openness raises returns to education.

The fifth variable is market job search. Economic reform has gradually reduced the role of government labor bureaus in assigning workers to firms and enterprises. During this process, the availability of employment search channels in the market plays

an important role in matching workers to the best paying jobs. Better search mechanisms imply a larger scope through which schooling can realize its returns. For the 1995 survey, we can construct an index for each city revealing the percentage of workers finding jobs through market channels.[25] We expect this variable on labor market development to have a positive relationship with rates of return to education. Unfortunately, this variable is not available for the 1988 survey.

Finally, we consider the role of information infrastructure. Social and market infrastructure, including transportation and information channels, affect the functioning of labor markets. Better infrastructure facilitates job search, thus creating opportunities for the skilled labor force to harvest the benefits of schooling investment. In this paper, we use the percentage of households in each city who have home telephones to approximate the level of development in communication infrastructure. China experienced major improvements in this regard during the studied seven-year period: families with home telephones increased by about 37 percentage points (see Table 2).

Of course, the above variables do not constitute an exhaustive list of factors that influence returns to education in local labor markets. Other factors, such as school quality and the composition of industries, may also affect schooling returns, yet these variables are not available in the data. All of the city characteristics analyzed above are reported in the CHIP surveys at either the individual or household level. We use micro information from individual cities to construct labor market variables for each of the cities. Hence, these city-level factors are exogenous to individual decisions and behaviors, but relevant for the determination of returns to schooling in regional labor markets.

4.2 Empirical Specification

Building on equation (2) we replace the city dummy variables (D_{ik}) with the preceding city-level characteristics representing the conditions of local labor markets M_g, where the subscript refers to the gth condition. Hence, the estimation equation becomes:

$$LnY_i = \beta_0 + \beta_1 S_i + \sum_{g=1}^{m} \beta_g S_{ik} M_{ikg} + \beta_2 E_i + \beta_3 E_i^{\,2} + \sum_{j=1}^{3} \gamma_j X_{ij} + \mu_i . \qquad (3)$$

Here M_{ikg} represents the gth condition specific for person i who resides in city k. If the variables, such as labor market openness or communication infrastructure, have systematic effects on returns to education, β_g would differ significantly from zero. The implicit assumption behind this approach is that local labor market conditions are given exogenously to individual firms operating in the environment. When those conditions evolve over time, firms would respond to the changes by adjusting their compensation for education. For instance, if exogenous technological change occurs that raises the value of education as a productive input, firms would adapt to the new situation by paying a larger schooling premium. However, to the extent that there exist more fundamental factors that determine jointly the schooling premium and local labor market conditions, the estimation function would suffer from simultaneity bias, thus rendering the inference unreliable. While one cannot exclude potential simultaneity, we leave this challenging question for future research.

Equation (3) will be fitted separately to the 1988 and 1995 data. While the estimates will provide cross-section evidence on the determinants of schooling returns, the specification may potentially suffer from the omitted variable bias. In other words, when some unobserved city-level factors influence the returns to education but are correlated with M_{ikg}, β_g would be either over or under-estimated, depending on the nature

of correlation. This potential complication poses problems for interpreting the estimation results.

Panel data analysis is an effective strategy to deal with city-level fixed effects. Recall that in the CHIP data, 29 cities are included in both the 1988 and 1995 surveys (see Table 1). This rich data structure permits panel data analysis for these cities; however, the observations are limited.

Therefore, in order to provide corroborating evidence for the cross-section results, we also estimate the following first-difference equation, using the 29 cities as basic unit of observations:

$$\Delta r_k = \sum_{g=1}^{m} \delta_g \Delta M_k + \varepsilon_k, \qquad (4)$$

where Δr_k is the change in the estimated rate of return to education for city k between 1988 and 1995, obtained from columns (5) and (10) of Table 3, and ΔM_k measures the changes in labor market conditions. The main idea that needs to be emphasized is that the evolution of local market environments may cause over-time changes in returns to schooling.

4.3 Findings

Table 5 reports the results of fitting equation (3) to the 1988 and 1995 data. Since information on market channels of job search is only available in the second survey, I run an extra regression with the addition of this variable for that year. The findings reported confirm some earlier results which indicated that the returns to experience, to being male workers, and party membership all rose during the seven-year period.[26]

For 1988 and 1995, labor market openness, as measured by labor force shares in foreign and joint-venture firms, and information infrastructure, as measured by proportion of families with telephones, have positive and statistically significant effects on raising returns to education in local labor markets. The coefficient for market openness increases in size over time, suggesting an intensified effect. The coefficient for the infrastructure variable becomes smaller, which may imply a possible diminishing marginal effect. Also, as expected, the availability of market job search channels raises rates of return to education.

The estimates for other city-level characteristics reveal mixed results. For 1988, the relative supply of skilled labor and state-sector dominance reduce rates of return to education, as expected in earlier discussions. For 1995, however, the labor supply variable becomes less significant statistically, and the sign for the state-sector measure turns positive. One potential reason for the sign switch is that continued enterprise restructuring may have improved the management of state-owned firms, so that many profit-losing firms exited the market at the same time as more efficient state enterprises followed the practice of private firms by rewarding education by the middle of 1990s. In any event, the variable on the technology sector that attempts to measure the demand for education at the city level does not show significant effects on returns to education.

To mitigate the potentially significant estimation bias due to city fixed effects, and to provide supplemental evidence to the cross-section findings, Table 6 reports the results of panel data analysis of fitting equation (4) to the sample of 29 cities. Before interpreting the estimates, however, we should note that there is fair amount of correlation between the explanatory variables. For instance, the change in openness has a

correlation coefficient of -0.34 with the change in the size of the state sector, and a correlation coefficient of 0.27 with the improvement in information infrastructure. The correlation coefficient between the changes in the size of the state sector and the share of skilled labor is 0.25. Because of the concern for multicollinearity, especially when there are only 29 cities used for analysis, we first run regressions using one of the explanatory variables at a time, and then include all explanatory variables in a separate regression. The results of these specifications shed light on the explanatory power of individual variables as well as their joint significance.

Findings in columns (1)-(5) of Table 6 suggest that increases in the presence of foreign and joint-venture firms, the decline in the size of the state sector, and improvements in market infrastructure all have positive and significant effects on schooling returns.[27] For instance, a 1 percentage point increase in the labor share of foreign and joint-venture companies, either through their pressure on paying competitive wages or the increased demand for educated workers, would raise the returns to education by 0.34 percentage points in the local labor market. By comparison, a 1 percentage point increase in families with home telephones would raise schooling returns by 0.02 percentage points. Therefore, as a proxy for overall improvements in information infrastructure, the 37 percentage-point increase in this ratio over the seven-year period is responsible for 0.74 percentage points of the observed increases in returns to education. It should be noted that although the statistical significance of these variables declines in column (6) due to multicollinearity, the coefficient for labor market openness remains sizable and statistically significant.

Combining all results in Tables (5) and (6), we would conclude that the presence of foreign and joint-venture firms, the availability of market channels of job search, and information infrastructure all help raise returns to education. On the contrary, the size of the state sector constrains schooling returns.

5. Concluding Remarks

In this paper we have examined the across-section variations and over-time changes in the rates of return to education for a large number of Chinese cities during the transition period 1988-1995. Dispersion and the level of schooling returns are two central aspects of human capital theory because the market determination of these two variables has important behavioral consequences. If the rewards to schooling are lower than their true productivity effects, individuals would choose to invest in less-than-optimum education, thereby retarding economic performance and growth. Moreover, in a fully integrated labor market with adjustments for factors such as school quality and the composition of industries, returns to education should tend to equalize across regions as the educated workforce searches for and moves to jobs with the highest pay. These are established results for the fully functioning labor markets. Psacharopoulos (1994) reports that the average rate of return to education is 10.1% for the world and 9.6% for Asia; for low and middle income countries, the returns to education are in the 11.2%-11.7% range.

In comparison with other countries, China's returns to education remained low by the middle 1990s, despite significant increases since the inception of reform, and at the low level, the dispersion in schooling returns across cities was large. These findings indicate that by the middle 1990s, there was still serious segmentation across regional

labor markets in China, and individuals still had low incentives to invest in education because of this investment's low returns.[28] Consequently, an effective policy for raising returns to education would be to free up local labor markets and allow educated workers to search for better employment opportunities. Market integration and labor mobility would serve as equilibrating forces to reduce regional disparities in returns to education. As the preceding analysis suggests, creating market job search channels would be a specific mechanism in raising schooling returns. Moreover, promoting labor market competition from foreign and joint-venture firms, and improving market infrastructure, are also effective policies to restore the right incentives for human capital investment. A more educated labor force will be essential for achieving higher earnings and welfare.

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Table 1: Worker Earnings and Sample Distributions by Province

	1988			1995			Cities in 1988-95 panel
	Mean	Number of cities	Number of workers	Mean	Number of cities	Number of workers	
Whole sample	1927	67	17074	2812	62	9627	29
	(1034)			(1712)			
Beijing	2052	1	833	3797	1	802	1
	(734)			(1643)			
Shanxi	1667	8	1830	2198	8	1032	4
	(1220)			(1119)			
Liaoning	1844	4	1842	2487	4	1185	3
	(618)			(1232)			
Jiangsu	1906	8	2231	3026	9	1199	5
	(625)			(1472)			
Anhui	1758	8	1693	2195	6	792	3
	(1061)			(1098)			
Henan	1555	8	1912	2120	8	912	4
	(709)			(1061)			
Hubei	1767	9	1887	2652	7	1167	0
	(728)			(1179)			
Guangdong	2800	8	1968	5089	8	869	5
	(1598)			(3040)			
Yunnan	2027	9	1765	2563	8	1079	4
	(848)			(1082)			
Gangsu	1907	4	1113	2084	3	590	0
	(1088)			(927)			

Note: Average earnings are in 1988 Yuan with 1995 earnings deflated by urban consumer price index. Standard errors are in parentheses.

Table 2: Variable Means and Standard Deviations

Variable	1988	1995
Log Earnings (yuan)	7.5	8.6
	(0.4)	(0.7)
Personal Characteristics:		
Schooling (years)	10.7	11.8
	(2.9)	(2.6)
Experience (years)	20.5	20.9
	(11.0)	(10.1)
Sex (% of male)	52.8	53.6
	(49.9)	(49.9)
Communists (% of party members)	24.0	26.1
	(42.7)	(43.9)
Ethnicity (% of minority)	3.7	4.6
	(18.9)	(21.0)
City Characteristics:		
Skilled labor force (%, schooling level > lower middle school)	49.3	66.2
	(50.0)	(47.3)
Technology sector (%, workers in science/technology industries	2.1	2.4
	(14.3)	(15.4)
State sector (%, workers in state-owned and local public firms)	79.4	83.3
	(40.4)	(37.3)
Openness (%, workers in foreign-owned and joint-venture firms	0.3	0.8
	(5.4)	(8.9)
Job search (%, workers found jobs through market channels)	_	13.0
		(33.6)
Information infrastructure (%, households with telephones)	4.9	41.8
	(21.7)	(49.3)

Table 3: Estimated Mincer Models

Independent variable	1988 (1)	(2)	(3)	(4)	(5)	1995 (6)	(7)	(8)	(9)	(10)
Schooling	0.0389	0.0326	0.0330	_	_	0.0732	0.0617	0.0591	_	_
	(0.0011)	(0.0011)	(0.0010)			(0.0030)	(0.0032)	(0.0031)		
Schooling*Cities	no	no	no	yes	yes	no	no	no	yes	yes
Experience	0.0418	0.0416	0.0403	0.0394	0.0393	0.0756	0.0746	0.0721	0.0711	0.0709
	(0.0014)	(0.0014)	(0.0013)	(0.0013)	(0.0013)	(0.0038)	(0.0038)	(0.0037)	(0.0037)	(0.0037)
Experience squared	-0.0005	-0.0006	-0.0005	-0.0005	-0.0005	-0.0014	-0.0014	-0.0014	-0.0014	-0.0014
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Male	_	0.0970	0.0966	0.0974	0.0966	_	0.1547	0.1648	0.1671	0.1669
		(0.0063)	(0.0058)	(0.0057)	(0.0056)		(0.0145)	(0.0136)	(0.0133)	(0.0132)
Party member	_	0.0700	0.0804	0.0931	0.0916	_	0.1170	0.1082	0.1319	0.1314
		(0.0072)	(0.0065)	(0.0064)	(0.0064)		(0.0165)	(0.0154)	(0.0154)	(0.0154)
Minority	_	-0.0150	-0.0082	0.0131	0.0148	_	-0.0476	-0.0609	-0.0135	-0.0240
		(0.0137)	(0.0131)	(0.0142)	(0.0140)		(0.0307)	(0.0318)	(0.0333)	(0.0330)
Province dummies	no	no	yes	no	yes	no	no	yes	no	yes
Constant	6.4708	6.4969	6.4731	6.5391	6.7894	6.8821	6.9543	6.8151	7.1262	7.6914
	(0.0189)	(0.0197)	(0.0798)	(0.0182)	(0.0797)	(0.0528)	(0.0557)	(0.0573)	(0.0546)	(0.119)
R-squared	0.2578	0.2751	0.3904	0.4239	0.4345	0.1502	0.1682	0.2761	0.3196	0.2761
F-statistics	1479.51	896.42	517.79	141.33	131.80	391.58	243.40	208.24	66.39	61.67
Degree of freedom	(3,17060)	(6,17057)	(16,17047)	(72,16991)	(82,16981)	(3,9624)	(6,9620)	(15,9611)	(67,9559)	(76,9550)

Note: Huber-White standard errors are reported in parentheses, which correct for heteroscedasticity of an unspecified form. This note also applies to Tables (5) and (6).

Table 4: Dispersion in Estimated Rates of Return to Education across Cities

Measures of Dispersion	1988	1995
Mean	0.031	0.051
Lowest	-0.001	0.017
Highest	0.070	0.103
Standard deviation	0.011	0.020
GINI coefficient	0.195	0.225
Range of rates of return (r, %)	**Number of cities**	
$r \leq 0.5$	2	_
$0.5 < r \leq 1.0$	3	_
$1.0 < r \leq 1.5$	4	_
$1.5 < r \leq 2.0$	11	3
$2.0 < r \leq 2.5$	10	3
$2.5 < r \leq 3.0$	15	2
$3.0 < r \leq 3.5$	13	9
$3.5 < r \leq 4.0$	5	6
$4.0 < r \leq 4.5$	2	5
$4.5 < r \leq 5.0$	1	4
$5.0 < r \leq 5.5$	_	5
$5.5 < r \leq 6.0$	_	5
$6.0 < r \leq 6.5$	_	1
$6.5 < r \leq 7.0$	1	7
$7.0 < r \leq 7.5$	_	4
$7.5 < r \leq 8.0$	_	3
$8.0 < r \leq 8.5$	_	2
$8.5 < r \leq 9.0$	_	1
$9.0 < r$	_	2
All ranges	67	62

Table 5: Determinants of Schooling Returns: Evidence from Cross-section Data

	1988	1995	
Independent variable	(1)	(2)	(3)
Schooling	0.0498**	-0.0058	-0.0107
	(0.0052)	(0.0069)	(0.0069)
Schooling*skilled workers	-0.0137**	0.0120*	0.0105
	(0.0031)	(0.0065)	(0.0065)
Schooling*size of technology sector	-0.0105	0.0121	0.0172
	(0.0130)	(0.0130)	(0.0130)
Schooling*size of public sector	-0.0191**	0.0302**	0.0323**
	(0.0026)	(0.0071)	(0.0070)
Schooling*foreign/joint ventures	0.4222**	1.2782**	1.1960**
	(0.0257)	(0.0593)	(0.0613)
Schooling*market job search	_	_	0.0319**
			(0.0069)
Schooling*information infrastructure	0.0709**	0.0400**	0.0416**
	(0.0055)	(0.0030)	(0.0030)
Experience	0.0410**	0.0718**	0.0720**
	(0.0014)	(0.0037)	(0.0037)
Experience squared	-0.0005**	-0.0014**	-0.0014**
	(0.0000)	(0.0001)	(0.0001)
Male	0.0961**	0.1611**	0.1609**
	(0.0061)	(0.0138)	(0.0137)
Party member	0.0747**	0.1235**	0.1243**
	(0.0068)	(0.0158)	(0.0157)
Minority	0.0043	-0.0102	-0.0054
	(0.0137)	(0.0312)	(0.0312)
Constant	6.5039**	7.0769**	7.0718**
	(0.0194)	(0.0546)	(0.0545)
R-squared	0.3298	0.2571	0.2587
F-statistics	610.39	252.77	233.88
Degree of freedom	(11, 17009)	(11, 9615)	(12, 9614)

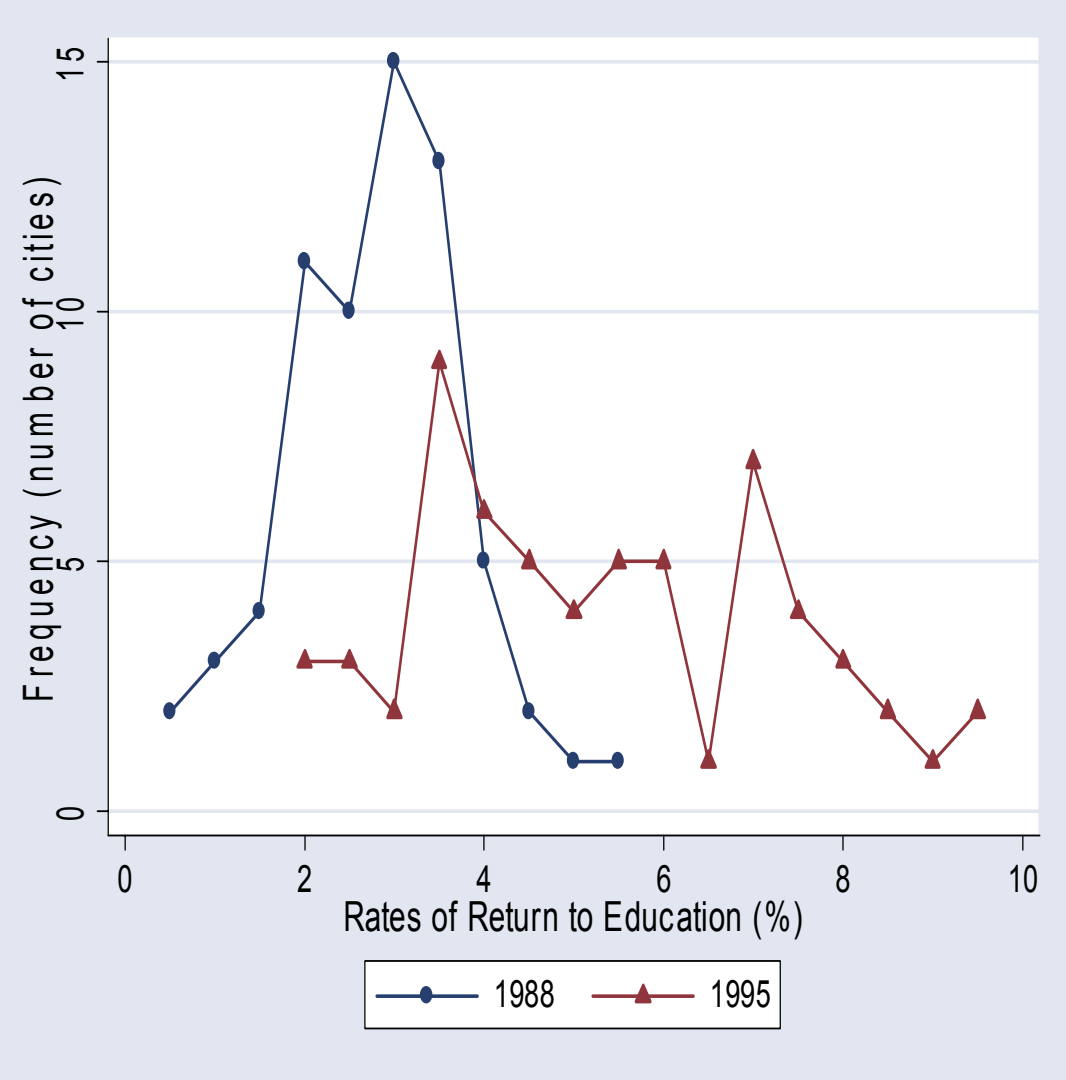
Note: * indicates significance at 10-percent level and ** at 5-percent level.

Table 6: Determinants of Schooling Returns: Evidence from City Panel Data

	Dependent variable = Δ Rates of Return to Education					
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Δ skilled labor force	-0.0089	_	_	_	_	-0.0217
	(0.0339)					(0.0268)
Δ size of technology sector	_	-0.1251	_	_	_	-0.0182
		(0.0844)				(0.0387)
Δ size of state sector	_	_	-0.0756*	_	_	-0.0939
			(0.0463)			(0.0679)
Δ foreign/joint ventures	_	_	_	0.3420**	_	0.3155**
				(0.0747)		(0.0820)
Δ information infrastructure	_	_	_	_	0.0201*	0.0090
					(0.0117)	(0.0096)
Constant	0.0257**	0.0247**	0.0266**	0.0226**	0.0150**	0.0232**
	(0.0062)	(0.0026)	(0.0030)	(0.0021)	(0.0060))	(0.0070)
R-squared	0.0025	0.0753	0.0563	0.4372	0.2571	0.5317
F-statistics	0.07	2.20	2.67	20.98	2.95	5.22
Degree of freedom	(1, 27)	(1, 27)	(1, 27)	(1, 27)	(1, 27)	(5, 23)

Note: * indicates significance at 10-percent level and ** at 5-percent level.

Figure 1: Frequency Distribution of Rates of Return
to Education across Cities, 1988 and 1995



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Footnotes:

1. They present yearly estimates of rates of return to schooling in urban China using a large nationally representative sample for the period 1988-1999. The paper also surveys previous studies on returns to education in China.

2. See Orazem and Vodopivec (1995), Rutkowski (1996), Chase (1998), Brainerd (1998), Flaganan (1998), Munich, Svejnar and Terrel (forthcoming), and Jones and Ilayperuma (2004) for estimates on changes in schooling returns during transition in Bulgaria, Czech Republic, Poland, Russia and Slovania.

3. An important exception is Fleisher, Sabirianova and Wang (2004) in which they examine how the timing of reform and macroeconomic volatility affect cross-country differences in returns to schooling. The analysis is based a metadata set constructed from 33 studies of 10 transition economies. Park et al. (2003) investigates the rising returns to education in post-reform China, but the demand and supply factors they emphasize are not necessarily related to institutional reforms.

4. These are large national representative household surveys covering 10 provinces of varying income levels with one extra province added to the 1995 survey. See Riskin, Zhao and Li (2001) for detailed descriptions of the CHIP data.

5. As Card (1999) explains, the use of earnings or wage rates in empirical estimation is common in the related literature. Li (2001) discusses the biases that might be involved in using alternative measures for the CHIP data.

6. These figures are broadly consistent with the national average monthly real earnings in 1988 yuan of formal employees, which are 1747 and 2413 yuan, respectively, for the two years (SSB, 1996), despite the fact that the definitions of earnings do not overlap completely.

7. More specifically, the percentages of workers with educational attainment at primary school or lower, lower middle school, high school, and vocational college or higher are 11.9%, 38.8%, 24.8% and 24.5%, respectively, for 1988. The percentages of workers in the corresponding categories are 4.5%, 29.3%, 24.7% and 41.5%, respectively, for 1995. These changes are associated with an increase of 1.1 years of average schooling for the sampled workers, as discussed earlier.

8. The questionnaire includes thirteen occupational sector codes for the primary work unit of each worker. These sector codes are consistent with the standard urban household survey conducted by China's State Statistical Bureau. In the original description, the science and technology sector refers to jobs in "scientific research and technical services." Jobs in "education, culture, arts and broadcasting" belong to a separate sector.

9. For instance, there is evidence that people sort into different schooling levels, which is due in part to their differential returns to education. According to Heckman and Li, the treated effect of four-year college education on lifetime earnings of the treated (TT), i.e., the returns to college education for those who actually attended college, is 51.5

percentage points. By comparison, the estimated return to college education for those who did not attend college, i.e., the treatment effect of the untreated (TUT), is 36.3 percentage points, a rate much lower than the schooling returns for college attendees.

10. In addition, although the OLS estimator was shown to have a downward-bias (Heckman and Li, forthcoming), it is unclear whether the extent of the bias is as important for analyzing the changes in rates of return overtime, an emphasis of the current paper.

11. One recent exception is Giles et al. (2004), which uses as instruments city-specific education-disruption variables related to the Cultural Revolution in China to control for unmeasured ability.

12. Johnson and Chow (1997) and Maurer-Fazio (1999) have neither province nor occupational dummies in their basic specifications. Li (2003) includes regional dummies but not occupational variables. Gustafsson and Li (2000) and Knight and Song (2003) have both province and occupational variables in their regressions. Different from all others, Liu (1998) has two types of specifications, either having both types of dummies or none of them.

13. For instance, among studies using CHIP data, the range of estimated schooling returns based on alternative functional specifications is 2.8%--3.6% for 1988 and 4.7%--6.9% for 1995 (Johnson and Chow, 1997; Liu, 1998; Li, 2003). Based on data from Urban Household Income Survey, Zhang and Zhao (2002) report slightly higher rates of returns at 4.7% for 1988 and 7.7% for 1995, with a similar rising trend. Moreover, my findings on gender earnings gap corroborate the results reported by Gustafsson and Li (2000).

14. See Park et al. (2003) for detailed decomposition analysis.

15. The effect of party membership on earnings could involve complicated factors, going beyond a simple positive correlation between schooling and party membership. Party membership could be a useful career investment that gives a positive signal to potential employers regarding the person's unobserved quality, which in turn generates higher earnings. Obviously, systematic analysis in this direction goes beyond the scope of the current paper.

16. The regressions are in linear form, with schooling as the dependent variable. The coefficients and corresponding t-values for gender, party membership and minority are: 0.32 (7.1), 1.22 (22.92) and 0.058 (0.50) in 1988; 0.24 (4.5), 1.22 (19.98) and -0.507 (-4.05) in 1995.

17. Deleting the regional dummies for each of the two years does not significantly affect the estimated city-level schooling returns, as the paired t-tests of t=-1.2843 and t=-0.5773 cannot reject the null hypotheses that there are no differences in the average estimated returns across the cities, with or without regional dummies.

18. Most of these city-level rates of return parameters are precisely estimated: 67 out of 69 estimates for 1988 and 59 out of 62 estimates for 1995 are statistically different from zero at the 5 percent significance level.

19. Previous studies that pay some attention to spatial variations in schooling returns in China are Liu (1998) and Maurer-Fazio (1999). The first research compares the returns to education between Guangdong province and all other provinces, while the second research assigns the provinces into developed coastal, northern, interior and less

developed regions in an attempt to examine whether the rates of return differ systematically across these broadly defined locations. Both studies only use the 1988 CHIP data, and none of them studies differential returns at the city level.

20. However, Shenzhen is a unique city recognized as the forefront of urban economic reforms.

21. For the 1995 sample, Suqian of Jiangsu, and Lijiang and Gejiu of Yunnan have the three lowest rates of return; Shunde of Guangdong, Yixin of Jiangsu, and Pingdingshan of Henan have the highest returns.

22. The study computes separate rates of return to education for men and women. The coefficients of variation for the international estimates are 0.589 and 0.571, which are not much higher than the cross-city variation of 0.367 and 0.401 for 1988 and 1995.

23. Yang (2004a) studies the effect of policy reform on returns to education in China's rural labor market. He shows that education captures increased payoffs during factor market liberalization within which rural families are allowed to allocate more freely their productive resources between agriculture and rural industrial production.

24. See footnote 8 for a description of the technology and science sector.

25. More specifically there is a question in the 1995 survey which asks: "How did you get the current job?" Among the answers, two indicate private search channels: (a) obtained through a non-government employment agency, and (b) found it on your own (as opposed to being assigned by government labor bureaus or inherited). These two answers help identify the availability of non-government employment search.

26. Note that the interactive terms of education, as well as the coefficient for schooling, all contribute to the estimate of overall schooling returns. The coefficient for

schooling alone does not offer direct interpretations for returns to education without joint consideration with the interaction terms.

27. Based on matched data of employees and their firms, Dong and Stargardter (2004) find that privatization raises returns to education of individual employees. Their findings corroborate with the city-level results reported here: the dominance of the state sector reduces returns to education in local labor markets.

28. These results echo the arguments made by Heckman (2003) that China spends too little on human capital investment and too much on physical capital.