DISCUSSION PAPER SERIES

IZA DP No. 4872

Explaining Rising Returns to Education in Urban China in the 1990s

Xuejun Liu
Albert Park
Yaohui Zhao

April 2010

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

Explaining Rising Returns to Education in Urban China in the 1990s

Xuejun Liu
Beijing Normal University

Albert Park
University of Oxford
and IZA

Yaohui Zhao
Peking University
and IZA

Discussion Paper No. 4872
April 2010

IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

IZA Discussion Paper No. 4872
April 2010

ABSTRACT

Explaining Rising Returns to Education in Urban China in the 1990s*

Although theory predicts that international trade will decrease the relative demand for skilled workers in relatively skill-deficit countries, in recent decades many developing countries have experienced rising wage premiums for skilled workers. We examines this puzzle by quantifying the relative importance of different supply and demand factors in explaining the rapid increase in the returns to education experienced by China during the 1990s. Analyzing Chinese urban household survey and census data for six provinces, we find that although changes in the structure of demand did reduce the demand for skilled workers, consistent with trade theory, the magnitude of the effect was modest and more than offset by institutional reforms and technological changes that increased the relative demand for skill.

JEL Classification: F16, J24, J31, P23

Keywords: education, earnings, inequality, China

Corresponding author:

Albert Park
Department of Economics
University of Oxford
Manor Road Bldg.
Manor Road
Oxford OX1 3UQ
United Kingdom
E-mail: albert.park@economics.ox.ac.uk

* This research is supported by Key Project Fund for Key Research Base in Humanities and Social Sciences, Ministry of Education, China.

1. Introduction

An intriguing question in international economics is why globalization in recent decades is associated with widening skill premiums in both developed and developing countries (see Wood 1997, Harrison and Hanson 1999, Goldberg and Pavcnik 2007 for surveys of the literature). Standard trade theory predicts that with greater trade and specialization, the relative demand for skilled workers should increase in developed countries where skilled workers are relatively abundant and decrease in developing countries where skilled workers are relatively scarce. The direction of skill premium changes thus is expected to diverge in rich and poor countries. Foreign direct investment is another key aspect of globalization which could increase the demand for skilled workers in poor countries if FDI embodies skill-biased technologies developed in rich countries (Acemoglu 2002). There may also be other confounding factors that help explain the puzzle since many supply and demand factors may be changing over time, complicating simple before-after comparisons.

So far the evidence on the effect of globalization on inequality in developing countries comes mainly from Latin America and India (see review by Goldberg and Pavcnik 2007). Little research has been done on China, with the exceptions of Wei and Wu (2002) and Wan, Lu and Chen (2007).[1] Being the largest trading nation and most populous country in the developing world, analyzing China's experience can increase understanding of how globalization affects world inequality and influences skill premiums in developing countries. Many studies of rising wage inequality in the United States and other industrial countries since the 1980s have found skill-biased technical change to be the most important contributing factor.[2]

[1] Evidence from Hong Kong shows a large increase in the relative demand for skilled workers following China's FDI liberalization in the late 1970's (Hsieh and Woo 2005, Ho, Wei and Wong 2005).
[2] Among many studies, notable contributions include Katz and Murphy (1992), Bound and Johnson (1992), Juhn et al. (1993), Krueger (1993), Freeman (1993), Freeman and Katz (1994), Borjas and Valerie (1995), DiNardo, Fortin and Lemieux (1996), Autor, Katz and Kruger (1998), Acemoglu (2002), Card and

Wage inequality in urban China expanded rapidly in the 1990s, with rising returns to education playing an important role (Park et al., 2008). Based on repeated cross-sectional data between 1988 and 2001 drawn from urban household surveys in 6 provinces, Zhang et al. (2005) find that the returns to a year of schooling increased from only 4.0 percent in 1988 to 10.2 percent in 2001. Most of the rise in the returns to education occurred after 1992 and reflected an increase in the wage premium for higher education. The higher returns to education are observed within groups defined by sex, work experience, region, and ownership.

Many factors can influence the returns to education. In addition to international trade and skill-biased technological progress, which are general processes, in China specific features of the country's economic transition may also have played an important role. First, China witnessed a massive inflow of unskilled migrant labor from rural to urban areas which may have reduced the relative skill level of the urban labor force even as educational attainment of the total population improved.[3] Second, during the central planning and early reform periods, wage-setting in state-owned enterprises (SOEs) compressed the wage structure; later institutional reforms that decentralized wage-setting authority to individual enterprises led wages to become more market-determined over time, increasingly rewarding productivity. Third, the role of markets in determining wages was reinforced by increased competition associated with the free entry and rapid growth of the non-state sector.

Existing empirical studies that examine the relationship between globalization and inequality in China (Wei and Wu 2002, Wan, Lu and Chen 2007) examine whether regions that were more exposed to trade liberalization experienced different changes in income inequality than less-exposed regions without systematically accounting for other

---

DiNardo, 2002, and Lemieux (2007).

3 A large literature examines rural-to-urban labor migration in China (examples are Zhao 1999a, 1999b, Rozelle et al., 1999.)

factors. The results are conflicting: while Wei and Wu (2002) find a negative relationship, Wan, Lu and Chen (2007) find a positive effect.

Given the multiple possible explanations for rising returns to education in China, we adopt a unified framework to systematically evaluate the relative contributions of different demand and supply factors to changes in education premiums. We divide the factors into four groups: (1) institutional changes affecting sectoral wage rents; (2) changes in the relative supply of skilled labor in urban labor markets, including rural-urban migrants; (3) changes in labor demand associated with shifts in production structure due to greater specialization based on comparative advantage or to other product demand shifts; and (4) technological change, which is likely to be influenced by FDI. We focus on the wage differentials among workers with college education and above, senior high school education and junior high school education and below.

The remainder of the paper is organized as follows. Section 2 provides institutional background for understanding China's evolving labor market, Section 3 describes the data sources and presents the changes in wage differentials among educational groups during the 1990s. Section 4 presents the analytical framework, Section 5 reports the empirical results, and Section 6 concludes.

2. Institutional Background: China's Economic Reforms in the 1990s

Prior to the economic reforms initiated by Deng Xiaoping in the 1980s, China had a highly compressed wage structure determined by the government's centralized economic planning apparatus. Since that time, and especially since the 1990s, wage setting has become increasingly market driven, leading to significant increases in wage inequality. Two main reforms that have contributed to this outcome are the deregulation of state-owned enterprises (SOEs), and free entry and competition from the non-state sector, including foreign-invested enterprises.

The reform of the SOEs prior to the mid-1990s were incremental and focused on strengthening managerial incentives by allowing managers more autonomy, including a certain degree of freedom in employment and wage setting. Nonetheless, government pay scales still largely defined differences in compensation based on pay rank, occupation, region, and type of workplace. Leaders refrained from privatizing enterprises and prohibited managers from firing workers. However, things changed quite dramatically starting in the mid-1990s, when the Chinese government moved ahead aggressively to diversify ownership of SOEs and allow inefficient firms to reduce employment or go bankrupt. Aggressive economic restructuring led to the layoffs of at least 10 million workers by 1997 and 27 million workers from 1998 to 2004, mostly from the state sector (Cai, Park and Zhao 2008). These changes profoundly affected the functioning of the labor market in China.

The ownership conversion of SOEs in the 1990s was a government response to massive financial losses in the state sector, which in turn, were partly induced by the emergence of non-state enterprises as competitors. The first powerful burst of non-state enterprise growth came from collectively-owned rural enterprises freed by the de-collectivization of agriculture in the early- to mid-1980s. In addition, foreign direct investment from Hong Kong, Macao and Taiwan was targeted by the establishment of special economic zones in southeast coastal areas. The openness policy greatly expanded in the early 1990s, leading to a sharp rises in foreign direct investments not just from Greater China but from around the world. With no responsibilities to provide "iron-rice bowls" to workers, these new entrants offered competitive wages to attract workers, helping to loosen the previously compressed wage structure. Following the labor market retrenchment in the mid-1990s, many urban workers of all skill levels were forced to seek employment outside of the state sector. Competition from rapidly growing non-state firms eliminated monopoly rents in most sectors, and wage rents previously created by incremental reforms diminished, resulting in redistribution of wage rents across sectors.

Recent reforms of the state sector have created new mixed ownership forms, including cooperative units, joint ownership units, limited liability corporations, and shareholding corporations. Although these new ownership forms maintain some state-ownership, they provide firm managers with greater profit incentives and autonomy, especially in the area of employment and wage-setting. Until the beginning of the 1990s, the pure state sector, including government and fully-owned state enterprises, accounted for over 80 percent of urban employment. By 2005, its employment share was less than 40 percent.

The greatest source of labor supply for non-state enterprises has been rural migrant workers. As a legacy of the economic planning era, all Chinese citizens are registered either as agricultural or non-agricultural residents in a specific location (*hukou*). Agricultural residents used to be confined to farming; moving to urban areas required government approval which was quite difficult. Over time, despite the persistence of the residential registration system, many practical barriers to population mobility disappeared (e.g., difficulty of government approvals, fees, quotas), enabling many rural residents to work in cities, where there was high demand for their services. If we define a migrant as someone residing in a county or city different from his/her home of registration, migrants comprised 5.8 percent of China's total population, 12.2 percent of the urban population, and 2.5 percent of the rural population in 2000. In China's cities (excluding townships), migrants accounted for 14.6 percent of the population and 19.6 percent of employment (Cai, Park and Zhao 2008).

Because rural residents have significantly fewer years of formal schooling than their urban counterparts due to longstanding inequities in educational access in rural and urban areas, most rural migrants are relatively unskilled, with no more than a junior high school education. Thus, the inflow of rural migrants increased the relative supply of unskilled workers in cities. It should be noted that despite the large flow of labor from rural to urban areas, substantial income differentials remains between urban and rural areas even after controlling for individual differences in gender, age, and education. Despite recent reforms intended to better integrate migrants into urban communities, most migrants still lack equal treatment. They are unable to send their children to urban schools unless they pay high additional fees, and they lack access to housing, social insurance, and social protection programs afforded to registered nonagricultural residents.

With respect to external economic relations, the 1990s was the decade in which the Chinese economy became highly integrated with the global economy. Steps to liberalize international trade and attract FDI were made well in advance of China's entry into the WTO in 2000. The number of companies authorized to conduct trade transactions increased from less than 5000 in 1988 to more than 30,000 in 2000, and average statutory tariff rates fell by nearly two thirds to about 15 percent in 2000 (Lardy, 2002). New regulations on FDI established in 1986 set the stage for a rapid growth in FDI in the next decade. The results were breathtaking. Exports quadrupled from 1990 to 2000, while newly contracted FDI increased by more than 10 times, from just $660 million in 1990 to nearly $7 billion in 2000 (peaking at over $10 billion in 1993). By 2000, China's total trade was equal to more than 40 percent of GDP. FDI accounted for as much as 17 percent of national capital formation in 1994, declining to 7 percent by 2004 (Branstetter and Lardy, 2008).

3. Data and Descriptive Evidence of Rising Returns to Education in China

We use wage data from China's Urban Household Surveys (UHS) collected by the National Bureau of Statistics (NBS) from 1989 to 2001 in six provinces: Beijing, Guangdong, Liaoning, Shaanxi, Sichuan and Zhejiang. This is a period during which

China experienced very rapid growth in international trade and foreign direct investment. The six provinces are roughly representative of China's different regions. Beijing is in North-Central China, Guangdong and Zhejiang are coastal provinces, Liaoning is in the Northeast, Shaanxi is in the Northwest, and Sichuan is in the Southwest. Table 1 reports sample sizes for each year after excluding students, the disabled, and those younger than 16 or older than 60. To reduce bias caused by variations in working hours, when computing wages by educational levels we confine our sample to full-time employees, excluding individuals who are self-employed or re-employed retired workers, who together account for less than 15 percent of the labor force in 2001 (Table 1). The size of the resulting sample is 6,000-8,000 individuals in each year (Table 1). The NBS household sample surveys are provincially representative. In all calculations, we employ sampling weights to account for changes in sampling rates in different provinces over time.[4]

The wage measure is the annual wage, including base wages, bonuses, and subsidies. The UHS data does not include information on working hours, making it impossible to calculate an hourly wage. It also does not provide data on the value of non-wage benefits such as pensions, health insurance, and unemployment insurance, which are likely to be greater for the better educated (leading to underestimation of the true returns to education) and for those working in the state sector. All wages are in 1988 yuan, deflated using provincial CPIs. One limitation of the UHS data is that it does not sample migrant households living in urban areas without a local household registration (*hukou*). Because migrant workers account for an increasingly large share of the workforce, especially of low-skill workers, the UHS samples become less representative over time.

Because of the weaknesses of the UHS data, throughout the paper we focus on the years 1990, 1995 and 2000, for which we have more complete employment data from

[4] The provincial sampling weights are proportional to the non-agricultural population divided by UHS sample size in each province.

China's 1990 and 2000 population censuses and 1995 mini-census of one percent of the population.[5] Unfortunately, the census data do not include information on wages. The year 1995 roughly coincides with the end of the first spurt in rapidly rising returns to education (Park et al. 2008). For each year of data, we also include the adjacent two years of data in order to increase sample size and smooth out short-run fluctuations. Except where explicitly noted, in the analysis below employment numbers are from the census and mini-census data, while wages are from the UHS data. In combining these data, we implicitly assume that migrant labor and local resident labor are perfectly substitutable. In fact, migrant workers often face discrimination, earning lower wages than local workers (Meng and Zhang 2001). Since migrants tend to be less educated, the lack of wage data for migrants thus is likely to lead to downward bias in the estimated returns to education.

To carry out the supply and demand analysis, the total labor force as measured by the census and mini-census data must be disaggregated into a discrete number of educational groups. We classify education levels into three groups: "college" refers to college-educated and above, including three- or two-year vocational colleges and post-graduate education, "senior high" includes graduates of senior high school and three- or two-year vocational and technical high schools, and "junior high" includes those completing junior high school and below.[6] One concern about these categories is that

[5] Table A1 in appendix compares descriptive statistics for the UHS sample and the census data. The UHS sample from the six provinces tend to be older, female, and more educated, compared to the census samples in the same provinces and in the whole country. But the changes in age, sex, education composition and employment distribution across industries show similar pattern between the UHS and census samples.

[6] The issues arising in disaggregating the labor force have been discussed by Hamermesh (1993) and Katz and Autor (1999). One simple approach is to break up the work force into two groups of particular interest, such as "high" and "low" education (equivalents), or "young" and "old", or men and women. This approach was used by Katz and Murphy (1992), Baldwin and Cain (1997), and Autor et al. (1998), etc. The advantage of this approach is it is simple to implement and the estimates are easy to interpret, but much information is lost. Another approach is to divide the labor force into a large number of cells, typically by sex, education, age/experience groups. The advantage of this approach is that it uses much more information on the nature of changes in wage structure; however it requires strong assumptions about functional form and substitutability of different groups. Bound and Johnson (1992) adopt the latter approach to classify the labor force into 32 groups defined by gender, experience and educational level.

they aggregate different subcategories of educational attainment, so that changes in group composition could bias estimates of changes in the returns to education. In Appendix Table A2, we present tabulations of how the composition of each education group changes over time. For the UHS data used to calculate the wage differentials (columns 1-3), the "quality" of junior high and below clearly increases, the composition of senior high school changes little, and the "quality" of college and above falls, as 2- and 3-year colleges become more prevalent. This suggests that our estimates of increasing wage differentials over time are likely to be downward biased.

Table 2 presents mean log wages by educational level. The wages of all three educational levels increased over the period, with the college-educated gaining the most, followed by senior high school graduates; those with junior high school education and below gained the least. To control for other factors influencing wages, we run regressions of wages on education levels and other personal characteristics (including dummy variables for sex, four potential experience groups, six provinces, and dummy variables for the two adjacent years). The resultant wage differentials by educational level in different years and their changes from 1990 to 1995 and from 1995 to 2000 are reported in Table 3.

As can be seen from Table 3, the wage differentials between college education and senior high school education and between senior high school education and junior high school education both experienced dramatic increases in the 1990s. However, there were some notable differences between 1990-95 and 1995-2000 and with respect to the levels of education being compared. First, the wage differential widened faster between senior high school and junior high than between college and senior high school in both periods. Secondly, wage differentials widened faster from 1995 to 2000 than from 1990 to 1995. The wage differential between senior high school and junior high school graduates was only 14.9% in 1990, increasing to 22.9% in 1995 and rising rapidly to 34.7% in 2000. In comparison, the wage differential between college and senior high school graduates started at a slightly higher level of 17.7% in 1990, and increased to 25.2% in 1995 and 35.6% in 2000. The goal of this paper is to explain these patterns and trends.

4. Conceptual Framework

The aggregate labor force is composed of *I* educational groups employed in *S* sectors of employment defined by industry and ownership categories. As in Bound and Johnson (1992), W_{is} is the wage of education group *i* (i=college, senior high, or junior high) in sector *s,* and is the product of a competitive wage W_{ic} for each education group and a relative wage rent R_{is} for working in sector *s*:

$$W_{is} = W_{ic} R_{is} \tag{1}$$

If the non-pecuniary attributes of employment in all sectors are identical and nothing causes wages to deviate from their competitive norm, the wage rents (R_{is}'s) will all be identically equal to one. However, in general wage differentials do exist across sectors (Krueger and Summers, 1988; Healwege, 1992; Zhao, 2002). Taking the logarithm of both sides of equation (1) and denoting logs with lower case letters, the log wage of group *i* in sector *s* can be decomposed into two additive parts:

$$w_{is} = w_{ic} + r_{is} . \tag{1'}$$

Averaging both sides of equation (1') across all sectors, we get:

$$w_i = w_{ic} + r_i = w_{ic} + \sum_s r_{is} \phi_{is} \tag{2}$$

where w_i is the average log wage of group *i* and $r_i = \sum_s r_{is} \phi_{is}$ is the wage rent enjoyed by group *i*, where ϕ_{is} is the employment share of group *i* in sector *s* ($\phi_{is} = N_{is}/N_i$ where N_{is} is the number of workers in demographic group *i* in sector *s* and N_i is the total number of workers in group *i*).

Totally differentiating equation (2), we get the following:

$$dw_i = dw_{ic} + dr_i \tag{3}$$

Thus, any change in wage differentials between educational groups is caused either by changes in wage rents or by changes in competitive wages. The change in wage rent can be written as follows:

$$dr_i = \sum_s (\phi_{is} dr_{is} + r_{is} d\phi_{is}) = \sum_s \phi_{is} dr_{is} + \sum_s r_{is} d\phi_{is} .$$

This decomposition has two elements: changes in relative wages of economic sectors, $\sum_s \phi_{is} dr_{is}$, or "wage effects", and changes in the distribution of employment across economic sectors, $\sum_s r_{is} d\phi_{is}$, or "weight effects".

Assuming that the wage rent in sector *s* is identical for each educational group ($r_{is} = r_s$), we consider the two dimensions of industry and ownership type. Thus, we can decompose the wage rent into industrial wage rents and ownership wage rents as follows:[7]

$$\begin{aligned} r_i &= \sum_{s=1}^{S} r_s \phi_{is} = \sum_{j=1}^{J} \sum_{o=1}^{O} r_{jo} \phi_{ijo} = \sum_{j=1}^{J} \sum_{o=1}^{O} (r_{jo} - r_j + r_j) \phi_{ijo} \\ &= \sum_{o=1}^{O} \sum_{j=1}^{J} (r_{jo} - r_j) \phi_{ijo} + \sum_{j=1}^{J} r_j \phi_{ij} = r_i^O + r_i^J \end{aligned}$$

Here, subscript *j* indexes industry and subscript *o* indexes ownership type; r_{jo} is the wage rent rate for industry *j* and ownership type *o*, r_j is the average wage rent in industry *j*, ϕ_{ijo} is the fraction of group *i* in industry *j* and ownership type *o*, ϕ_{ij} is the fraction of education group *i* in industry *j*, $r_i^O = \sum_{o=1}^{O} \sum_{j=1}^{J} (r_{jo} - r_j) \phi_{ijo}$ is the ownership

[7] This assumption implies that wage rents are only related to characteristics of sector s and not workers' education levels, in other words that they do not reflect selection effects.

wage rent, and $r_i^J = \sum_{j=1}^{J} r_j \phi_{ij}$ is the average industry wage rent enjoyed by group *i*.

Assuming that the industrial wage rent rate r_j and ownership wage rent rate r_o are determined independently, namely that $r_{jo} = r_j + r_o$, then the ownership wage rent enjoyed by group *i* can be defined as $r_i^O = \sum_{o=1}^{O} r_o \phi_{io}$. The definition of sectoral wage rent enjoyed by group *i* then can be simplified as follows:

$$r_i = \sum_{o=1}^{O} r_o \phi_{io} + \sum_{j=1}^{J} r_j \phi_{ij} = r_i^O + r_i^J .$$

Totally differentiating this equation yields the following expression:

$$dr_i = dr_i^O + dr_i^J = (\sum_{o=1}^{O} \phi_{io} dr_o + \sum_{o=1}^{O} r_o d\phi_{io}) + (\sum_{j=1}^{J} \phi_{ij} dr_j + \sum_{j=1}^{J} r_j d\phi_{ij}) \qquad (4)$$

Using equation (4), we can separately calculate changes in industrial wage rents dr_i^J and changes in ownership wage rents dr_i^O, and each of these can be further decomposed into a wage effect and weight effect.

Following Bound and Johnson (1992), we can use the following expression derived from a fully specified demand and supply system to decompose the change in competitive wages for group *i*:

$$dw_{ic} = (1 - 1/\sigma) d(\ln b_i) + (1/\sigma) d(\ln D_i) - (1/\sigma) d(\ln N_i) , \qquad (5)$$

where dw_{ic} is the change in the competitive wage of group *i*, $dlnN_i$ is the change in relative supply of workers in group *i*, $dlnD_i$ is the change in relative demand for workers in group *i* due to shifts in product demand across industries, $dln(b_i)$ is the change in relative general technical efficiency of group *i*, and σ is the constant elasticity of substitution among educational groups (which can range from 0 to positive infinity).

Equation (5) states that changes in the relative competitive wage of group *i* workers depend positively on the change in relative technical efficiency $d(lnb_i)$, negatively on the relative supply change $d(ln N_i)$, and positively on the change in the demand for products that use group *i* workers more intensively in their production $d(lnD_i)$. The impact of each factor on wages depends upon the elasticity of intrafactor substitution.

Plugging equations (4) and (5) into equation (3), we present the final equation for decomposing changes in the relative wage of each educational group:

$$dw_i = (1-1/\sigma)d(\ln b_i) + (1/\sigma)d(\ln D_i) - (1/\sigma)d(\ln N_i) + (dr_i^O + dr_i^J) \qquad (6)$$

This equation states that a change in the wages of group *i* relative to the mean wage or the wage of another educational group can be decomposed into four sources: changes in wage rents, changes in relative labor supply, changes in relative labor demand due to shifts in product demand, and changes in relative technological efficiency.

5. Results

5.1. Wage Rents

We can use a discrete form of equation (4) to calculate changes in wage rents over time. As noted above, these changes include changes in relative wage levels across industries or ownership types, i.e., wage effects, and changes in the educational composition of employment in high- and low-wage industries and ownership types, i.e., weight effects. The share of group *i* in industry *j* or in ownership type *o* in each year can be computed directly from the data, but we need to estimate the wage rents. Assuming that the industrial and ownership wage rents are determined independently, we can use the following regression to estimate the wage rents of group *i* in industry *j* or ownership type *o* (the r_j and r_o):

$$\ln W_k = \alpha_0 + \sum_i \alpha_i G_{ki} + \sum_j \gamma_j S_{kj} + \sum_o \gamma_o S_{ko} + \sum_p \beta_p P_{kp} + \sum_t \beta_t T_{kt} + \varepsilon_k \qquad (7)$$

Here, $\ln W_k$ is the log real wage of individual *k*, G_{ki} are a set of dummy variables capturing individual characteristics i, e.g., sex, experience, and education, S_{kj} are dummy variables for industries j, S_{ko} are dummy variables for ownership types o, P_{kp} are dummy variables for provinces p, T_t are dummy variables for years t,[8] and ε_k is the error term. The estimated coefficients on the dummies for industries (γ_j), capture the industrial wage premium relative to the reference group, and the deviation of the estimated γ_j's from their mean value $\bar{\gamma}$ in each period is the wage rent associated with industry j ($r_j = \gamma_j - \bar{\gamma}$).[9] Ownership wage rents are calculated in analogous fashion.

Categorization of industries in the NBS urban household survey varies in different years. We aggregate the industries into 10 categories that can be consistently defined over all years. Estimated wage rents for industrial sectors are reported in columns 1 to 3 of Table 4. Not surprisingly, monopoly industries such as finance and insurance, transportation, and postal and telecommunications services consistently enjoyed above average wage rents while decentralized and competitive industries such as manufacturing, retail trade and food catering had below-average wages. The data also confirm anecdotal observations that government agencies and semi-governmental social service sectors (education; research; culture, mass media, and health care; and sports and social welfare) have enjoyed considerable gains in wages over time.

The distributions of employment by educational group among industries are reported in columns 4 to 12 of Table 4.[10] It is easy to see that workers with less education tend to work in low-wage industries. Nearly half of all workers with junior high school education or below were in manufacturing, and another 19 percent worked in the retail and catering industry. Over time, these workers increasingly worked in the social

8 To smooth out time effects, we define years as moving averages, for example, data for year 1990 includes 1989, 1990 and 1991.

9 $\bar{\gamma}$ is the weighted average of the estimated coefficients on industry dummy variables: $\bar{\gamma} = \sum_{j=0}^{J-1} \phi_j \gamma_j$, where J=10 is the total number of industrial categories; γ_0 of the base industry is set to zero.

10 In estimating wage rents, we use employment numbers calculated from the UHS data from which the wage data are taken. The census data does not provide information on ownership type.

service industry, reaching 10 percent in 2000. Although these three industries also absorbed a large share of senior high school graduates, the percentages were relatively lower. Senior high school graduates increasingly entered into high-paying sectors such as post and telecom services, finance and insurance, and government or semi-government agencies. For college graduates, although nearly one quarter were employed in manufacturing, nearly 40 percent worked in educational institutions and government or semi-governmental agencies that enjoyed relatively high wage rents.

It is not obvious at first sight whether high-wage industries expanded or contracted, or whether workers with less education left or entered low-wage industries with increasing frequency over time. In columns 2 to 4 of Table 5, we calculate the total effects of changes in industrial wage rents on wage differentials by educational groups and decompose the effects into wage and weight effects.

The total effect of changes in relative industrial wage rents is to increase the returns to education. In both periods and for both college versus high school graduates and high school versus junior high school, wage effects dominate weight effects. Inspecting the results more carefully yields some interesting observations. From 1990 to 1995, the effect of changes in industry wage rents was similarly positive for the college-senior high and senior-junior high wage differentials while weight effects were inconsequential. However, from 1995 to 2000, changes in industry wage rents strongly favored the college-educated, and this was caused mainly by intensified selection of the college-educated into high-wage industries, or weight effects. This change in inequality dynamics in the latter period could reflect the fact that college graduates increasingly looked for jobs on their own instead of relying on government assignment. It could also reflect the increasing prevalence of "jumping into the sea," whereby those working in the government and state sectors left for more lucrative jobs in the financial or private sectors.

An important part of the economic transition in China has been liberalization of wage setting in the state sector, including state-owned enterprises (SOEs) as well as government and semi-government institutions. It is thus of interest to examine whether state sector rents existed independently of industry rents and how changes in such rents influenced wage differentials across educational groups. The estimated r_o's are reported in columns 1 to 3 in Panel B of Table 4. The employment distribution of the three educational groups across ownership types are described in columns 4 to 12. It is immediately obvious that the state-owned sector has enjoyed large, positive wage rents, and that these rents have changed little from 1990 to 2000.

As for the industry wage rents, we calculate the effect of changes in ownership wage rents on the relative wage of different education groups, and decompose it into wage effects and weight effects. Results are reported in columns 5 to 7 of Table 5. They show that changes in ownership wage rents were positive but very small from 1990 to 1995. Interestingly, wage effects were positive, indicating a growing wage premium from being employed in the state sector, but weight effects were actually negative as more educated workers left the state-owned sector (see Table 4). From 1995 to 2000, however, the wage effect became negative, indicating that wage differentials associated with ownership types shrank. The weight effect remained negative for the wage of senior high relative to junior high and below, but turned positive for the wage of college relative to senior high school graduates. The latter result suggests that college-educated workers returned to the state-sector or were less likely to leave or be let go during the process of state-sector restructuring that occurred during the late 1990s.

5.2. Labor supply

A natural index for capturing the changes in relative labor supply of different education groups is the labor-supply-shift index, SUP_i, the proportionate change in group *i*'s share of aggregate labor force, measured as the change in the logarithm of the shares:

$$SUP_i = \Delta(\ln \phi_i^{\,s}). \tag{8}$$

Here, $\phi_i^s = N_i^s / N^s$ is the fraction of education group *i* in the total labor force.

The educational composition of the labor force from the UHS data is reported in columns 1 to 3 of Table 7. One major limitation of the UHS data is that the surveys sample only registered urban residents, excluding migrants who lack permanent resident status even though migrants increasingly compete with local residents in urban labor markets. Using 1990 and 2000 census data and 1995 mini-census data from the same provinces, which do include migrants, we recalculate the relative shares of urban labor in different education groups as well as the fraction of migrants in the labor force for the years 1990, 1995, and 2000. As reported in Table 6, the estimated fraction of migrants in the urban labor force was 7.83% in 1990, 15.75% in 1995 and 33.19% in 2000.[11] The composition of migrants by education level is reported in columns 4 to 6 of Table 7. The labor supply composition by education group after including migrants are reported in columns 7 to 9 of Table 7. Then the change in the relative supply of each group *i* (SUP_i) is calculated using equation (8) and the results are reported in column 1 of Table 9.

As seen in Table 7, if we consider only local permanent residents, the rise in educational attainment has been very rapid. However, if we include migrants, the rise is much less dramatic. From 1995 to 2000, the decline in the share of junior high school graduates among local urban residents is almost completely offset by the inflow of migrants with junior high school education or lower. The SUP index, reported in Table 9,

[11] We assume that migrants and local residents with the same level of educational attainment are perfect substitutes. To the extent that the two are not substitutes, we may underestimate changes in the relative supply of skilled labor (since local residents show a sharper increase in educational attainment), and so underestimate the negative impact of changes in relative supply on the returns to education.

reveals that from 1990 to 1995, the relative supply of senior high school to junior school graduates and that of the college to senior high school graduates went up by 14.5 percent and 30 percent, respectively. However, from 1995 to 2000, the situation changed dramatically due to the surge of migration, which led to a decline of 13.5 percent in the relative supply of senior high school graduates to junior high school graduates or below. Over the same period, the supply of the college educated relative to senior high school graduates increased by 12.6 percent.

5.3. Shifts in Product Demand

Changes in the structure of output lead to changes in the structure of inputs, in particular the skill composition of labor demand. Under the assumptions that relative labor productivity across industries remains constant and the labor market clears in each period, changes in the employment distribution across industries must reflect shifts in the structure of product demand. Following Freeman (1975) and Katz and Murphy (1992), we use the average employment growth by industry weighted by the initial employment share of each educational group to define an index EMP_i to measure the effect of product demand shifts on relative labor demand:

$$EMP_i = \sum_j \Delta(\ln \phi_j)\phi_{ij} \ . \tag{9}$$

Here, ϕ_j is the share of employment in industry *j* and $\Delta(\ln \phi_j)$ is the proportionate change in the employment share in industry *j*.

Table 8 describes the changes in the structure of industries over time. The distribution of employment across industries, ϕ_j, computed from the UHS data which includes only local permanent residents is reported in columns 1 to 3. As before, we adjust the industrial employment shares using the share of migrants and their distribution across industries according to the census data in 1990 and 2000. The migrant shares of the urban work force are presented in Table 6, the employment distribution of migrants across industries are described in columns 4 to 6 of Table 8, and the adjusted employment distributions of all urban workers are reported in columns 7 to 9. The change in industrial employment shares ($\Delta(\ln \phi_j)$) are in columns 10 and 11.

Industries such as education and media, and semi-government organizations, which employ college-educated workers more intensively experienced a relative contraction, especially from 1995 to 2000. The index EMP_i, the values of which are reported in column 2 of Table 9, can be taken as a proxy for the change in the structure of labor demand, $d(lnD_i)$. The values of this index are positive but close to zero for 1990-1995 and negative and large (-0.075 and -0.101) for 1995-2000, suggesting that shifts in product demand increased the relative demand for unskilled workers in the later period. However, changes in relative employment growth rates among industries also could be *caused* by changes in labor supply structure, which would lead to bias in the decomposition of relative wage changes.

An alternative approach that can avoid this bias is to estimate a discrete version of product-demand-shift index, DEM_i:

$$DEM_i = \Delta(\ln D_i) = \sum_j \phi_{ij} \Delta(\ln x_j) \tag{10}$$

where x_j is the true relative demand for products produced by industry-j based on consumer preferences (Bound and Johnson, 1992). Unfortunately, these x_j are unobserved. However, the unknown $\Delta(\ln x_j)$ can be estimated as coefficients $d\ln x_j$ in the following equation:

$$d(\ln \phi_{ij}) = (1-\phi_{ij}) d(\ln x_j) - \sum_{k \neq j} \phi_{ik} d(\ln x_k) + (\sigma - 1)[d(\ln(b_{ij} / b_i))], \tag{11}$$

where the subscript i indexes educational groups (i=1, 2, 3), j indexes industries, b_{ij} is an index of the technical efficiency of group i in industry j; b_i is the average technical efficiency of group *i* across all industries; and $d(\ln b_{ij}/\ln b_i)$ is the deviation of the growth rate of technical efficiency of group *i* in industry *j* from the average growth rate of technical efficiency for group *i*. If we assume that technical changes are the same across industries for all the groups, the mean of $d(\ln b_{ij}/\ln b_i)$ will equal to 0, and the last term in equation (11) can be treated as a random error with mean zero. Under this assumption, which we justify below, we can obtain unbiased estimates for $d\ln x_j$ by estimating equation (11) using OLS.

The results of this estimation are presented in columns 12 and 13 of Table 8. Based on these estimates for $\Delta(\ln x_j)$, the product-demand-shift indices DEM_i's are calculated using equation (10) and reported in column 3 of Table 9. All of the values for *DEM* are negative, providing evidence that changes in product demand across industries caused the relative demand for unskilled labor to increase. This shift is consistent with the expansion of international trade. Since China has a more abundant supply of less-educated workers, comparative advantage dictates that China should specialize in producing goods that use low-skilled labor more intensively. This structural transition in China is aided by the rise of market-driven and export-oriented foreign-invested and private enterprises, which faced market-determined wages and lacked access to subsidized credit, leading to employment decisions more in line with China's comparative advantage.

5.4. Skill-Biased Technical Change

Generally speaking, technological progress can occur in a particular industry or in all industries; thus, skill-biased technical changes that affect the relative demand for workers with different skill levels can be industry-specific or general. In the estimation of $\Delta(\ln x_j)$ above, we treated the effect of industry-specific technical change (the last term in equation (11)) as a random error. If this assumption about the error term does not hold, the estimation of $d\ln x_j$ could be biased because faster technological progress in some industries could cause a larger increase in the demand for labor in those industries. In the U.S., it has been suggested that the effects of spurts of innovation on the relative demand for different groups could vary across industries (Bound and Johnson, 1992).

To test whether technical change actually varies across industries, we follow Bound and Johnson (1992) and decompose the growth rate of technology efficiency of group *i* in industry *j* as follows:

$$d(\ln b_{ij}) = \begin{cases} c_{i0} + c_{i1} & \text{if } j \text{ in } J' \\ c_{i0} & \text{otherwise} \end{cases} . \quad (12)$$

Here J' is the subset of industries hypothesized to have a different rate of growth than a comparison set of industries, c_{i0} is the average growth rate in technical efficiency of group *i* in the comparison industries, and c_{i1} is the difference between the growth rate of technical efficiency in the two groups . If there is no significant influence of industry-specific technical efficiency change, then the average growth rate of technology efficiency for the two groups should be the same, equal to c_{i0}.

The average growth rate of technology efficiency for group *i* can thus be expressed as follows:

$$d(\ln b_i) = \begin{cases} c_{i0} + \sum_j \phi_{ij} c_{i1} = c_{i0} + \Phi_{iJ'} c_{i1} & \text{if j in J'} \\ c_{i0} & \text{if j not in J'} \end{cases} \quad (13)$$

where $\Phi_{iJ'} = \sum_{j \in J'} \phi_{ij}$ is the proportion of education group i's employment in the subset of industries J'. The industry-specific technical efficiency change of group i in industry j is:

$$d[\ln(b_{ij} / b_i)] = \begin{cases} c_{i1}(1 - \Phi_{iJ'}) & \text{if j in J'} \\ 0 & \text{if j not in J'} \end{cases} = c_{i1}(D_{J'} - \Phi_{iJ'}) , \quad (14)$$

where $D_{J'}$ is a vector of dummy variables for whether each industry is part of J'. Substituting equation (14) into equation (11), we get:

$$d(\ln\phi_{ij}) = (1-\phi_{ij})d(\ln x_j) - \sum_{k\neq j}\phi_{ik}d(\ln x_k) + (\sigma-1)c_{i1}(D_{J'} - \Phi_{iJ'}) \qquad (11')$$

By choosing a specific industry set J' and one or more educational groups, we can estimate this equation using OLS, and estimate values for $(\sigma-1)c_{i1}$. If those values are not significantly different from zero, we cannot reject the null hypothesis that there are no industry-specific technical changes.[12]

We test a wide range of industries and educational groups in this way. For example, we first test whether the manufacturing industry enjoyed a rate of technological change that was different than other industries. We find that there are no educational groups for which this is the case. The p-value for the joint exclusion test that none of the three educational groups exhibits a different rate of technological change in manufacturing is 0.567 for the period 1990 to 1995 and 0.339 for the period 1995 to 2000. Similarly, we tried other industries such as construction; transportation, post, and telecom services; wholesale and retail trade & catering services; public utility management and social services, both individually and jointly. All the results fail to show that there is any significant industry-specific technology effect for any educational group.

We take this as evidence that all three educational groups have the same growth rate of technological efficiency across industries. One possible explanation for the lack of industry-specific technical change is that economic reforms and institutional changes in the 1990s promoted efficiency similarly in all sectors of the economy rather than in specific industries. Another possibility is that our classification of industries is too broad to capture industry-specific technical change well. Given these findings, we conclude that

[12] Given $\sigma>1$, the term $(\sigma -1)c_{i1}$ should be different from zero if group *i* has different growth rate of technological efficiency (namely, $c_{i1}\neq 0$). Theoretically, it is also possible that $\sigma =1$, however, the likelihood that this equality holds exactly is vanishingly small.

the previous estimates of *d(lnx_j)* are unbiased when estimating equation (11') using OLS.

Given the lack of evidence of industry-specific technical change, we focus attention exclusively on estimating the contribution of general technical change, captured by the term $(1-1/\sigma)d(\ln b_i)$. The difficulty, of course, is that b_i is unobservable. However, the effect of general technical change on the relative wage of an educational group can be approximated by the difference between the change in competitive wage dw_{ic} and the effects of changes in relative supply and relative demand (see equation (5)).

As seen in equation (5), estimating the impact of relative demand and relative supply on relative wages requires an estimate of the elasticity of substitution $\hat{\sigma}$. One approach is to estimate this parameter directly from the data.[13] We adopt a strategy similar to that of Katz and Murphy (1992), estimating the following time series regression:

$$\ln[W_i(t)/W_{i-1}(t)] = \alpha_0 + \alpha_1 \ln[N_i(t)/N_{i-1}(t)] + \alpha_2 t + \alpha_3 \cdot D_1 \cdot t + \varepsilon . \qquad (15)$$

Here *i* refers to senior high school (college), and *i-1* refers to junior high school and below (senior high school); $\ln[W_i(t)/W_{i-1}(t)]$ is the relative wage of educational group *i* compared to education group *i-1* in year *t*; $\ln[N_i(t)/N_{i-1}(t)]$ is the relative supply of educational group *i* compared to education group *i-1* in year *t*; D_1 is a dummy variable which equals 1 if the comparison group is senior vs. junior high school, and 0 if otherwise; $\alpha_1 = -1/\sigma$, and $\alpha_2 + \alpha_3 \cdot D_1$ captures relative changes over time in the demand for each comparison group[14]. The estimate for elasticity of intrafactor

[13] Bound and Johnson (1992) estimate a second-differenced equation for the market wage. Because of our focus on three skill groups (college educated and above, senior high school, and junior high school and below), there are only 3 observations and there is no way of running regressions.

[14] Katz and Murphy (1992) estimate the elasticity of the substitution between college and senior high school by running the following linear regression on time series data: $\ln[w_2(t)/w_1(t)] = \alpha_0 + \alpha_1 \ln[N_2(t)/N_1(t)] + \alpha_2 t + \varepsilon$, where $w_2(t)/w_1(t)$, $N_2(t)/N_1(t)$ are the relative wage of college and high school graduates and the relative supply of college to high school labor; $a_1 = -1/\sigma$, and a_2 captures the time trend of relative demand shifts. This regression specification is based on a simple CES technology with two factors (college and high school labor) with changes in relative demand for college versus high school labor being a simple linear time trend.

substitution $\hat{\sigma}$ can be simply computed from the estimated coefficient $\hat{\alpha}_1 = 1/\hat{\sigma}$.

For our sample, time t ranges from 1989 to 2001. The OLS estimates for equation (15) are the following:

$$\ln[W_i(t)/W_{i-1}(t)] = \underset{(5.385)}{-59.62} - \underset{(0.0922)}{0.475}\ln[N_i(t)/N_{i-1}(t)] + \underset{(0.00269)}{0.0299}t - \underset{(0.0000268)}{0.000118} \cdot D_1 \cdot t$$

$$N = 26,\ R^2 = 0.861$$

The results yield an estimate for the elasticity of intra-factor substitution of 2.11, which appears to be on the high side in comparison to studies of the U.S. In the decomposition section, we use this estimate but also test the sensitivity of results to different assumptions about the elasticity of intra-factor substitution, given the large potential for error in estimation of this type of time-series specification.

5.5. Decomposition Results

Using the estimates from previous sections, we can fully decompose the sources of changes in the returns to education in urban China during the 1990s into four components: changes in wage rents (including industry wage rents and ownership wage rents), changes in relative labor supply, changes in relative demand resulting from changes in production structure, and general technical change. The latter is computed from the residual relative wage changes not explained by relative demand and supply changes, as well as our estimate of the elasticity of substitution among different education groups.

In Table 10, decomposition results are reported separately for the early and late 1990s, and for changes in the relative wages of college versus high school graduates and of high school graduates versus those completing junior high school and below. The results yield a number of interesting findings. First, changes in relative technical change are by far the most important source of rising returns to skill in all time periods and regardless of which education groups are being compared, accounting for between 58 and 287 percent of relative wage increases. Bound and Johnson (1992) also found general technical change to be by far the most important contributing factor to rising returns to college education in the 1980s. However, because the effects of technical change are calculated as residual effects, one must interpret this result carefully. Although skill-biased technical change is likely to be an important part of the story, as evidenced by rapid improvements in technology in China brought about at least partly by inward foreign direct investment, other factors are at play as well. Perhaps most importantly, the institutional transition towards a market economy may have caused wages to increasingly reflect differences in the productivity of workers and also provided incentives for more educated workers to become more productive (Zhang et al., 2005).

Second, for three of the four decompositions, changes in wage rents are the second most important contributor to relative wage increases, accounting for 32 percent of increasing relative wages of high school graduates versus those with less than high school education in the early 1990s and 27 and 38 percent of increasing relative wages of college versus high school graduates in the early and late 1990s. These contributions of wage rents to rising wage differentials reflects growing specialization of more educated workers in higher rent sectors relative to less educated workers. These contributions are greater in the late 1990s, when rural-urban migration accelerated.

Third, changes in relative labor supply and relative labor demand associated with shifts in production structure generally reduced the relative wages of better educated workers. The only exception is the change in relative supply of high school graduates versus those without high school degrees from 1995 to 2000, when China witnessed a large-scale migration of poorly educated rural workers to the cities. During this period, the falling relative supply of high school graduates accounted for 54.4 percent of rising relative wages of high school graduates compared to those without high school degrees.

For all other periods and education group comparisons, the relative supply of better educated workers increased. The negative effects of these increases were much greater than the negative effects due to shifts in product demand. As a share of relative wage increases of college versus high school graduates, relative supply changes contributed -190 and -57.6 percent in the early and late 1990s, compared to -24.1 and -30.2 percent contributions from changes in relative demand associated with changing production structure. In the early 1990s, relative supply changes reduced the relative wage of high school graduates versus those without high school degrees by 85 percent, compared to a 4.7 percent reduction due to changes in relative demand. As noted earlier, the negative contribution of demand changes to rising returns to education is consistent with expanding international trade. This negative effect appears to have been even greater in the late 1990s than the early 1990s, perhaps due to significant trade liberalization and growing trade in the late 1990s as China prepared for WTO accession.

Our final exercise is to examine the sensitivity of our results to the magnitude of the elasticity of substitution of workers from different education groups. As noted earlier, our estimated value of 2.11 is on the high side of estimates for the U.S. (Freeman, 1986), even though many recent studies generally accept that the elasticity of substitution between high-skill and low-skill workers is greater than one in the U.S. (Katz and Murphy, 1992; Bound and Johnson,1992; Autor, Katz, and Kruger, 1998; Katz, and Autor, 1999). In China, one might expect an even lower elasticity of substitution given remaining rigidities in the labor market associated with regulated wage and employment policies in the state sector and policy barriers to spatial mobility. On the other hand, China has a very high literacy rate and production sophistication may be relatively low compared to developed countries, reducing the set of tasks that can only be completed by better educated workers.

In Table 11, we report decomposition results varying the elasticity of substitution from 1.1 to 3. The first thing to note is that the contribution of wage rents is invariant to assumptions about the elasticity of substitution. Second, increases in the elasticity of substitution increase the contributions of relative supply and demand changes multiplicatively, with the contribution of general technical change adjusting to ensure that the total changes add up to actual changes in relative wages. In our case, as the elasticity of substitution increases, the negative effects of relative supply and demand changes both become smaller (less negative) and the estimated positive contribution of technical change falls as well but by proportionately less than the reduced negative effects. As an example, comparing the case of σ=1.1 with the baseline estimates reported in Table 10, the negative contribution of relative supply changes to the relative wage increase of high school graduates versus those without high school degrees from 1990 to 1995 falls in magnitude from -163 percent to -60 percent, the contribution of relative demand changes falls from -9 percent to -3 percent, and the contribution of technical change falls from 240 to 131 percent. Even at the lowest elasticity of substitution, the positive impact of general technical change on relative wages outweighs the negative effects of changes in relative supply and relative demand. Thus, the main conclusions of the decomposition exercise are robust to changing assumptions about the elasticity of substitution.

6. Conclusion

In this paper, we analyze the extent to which recent rapid increases in the returns to education can be explained by four factors: changes in industrial wage rents, changes in relative labor supply, shifts in product demand due to international trade, and the changes in relative technical efficiency. We find that skill-biased technical progress accounts for most of the rise in returns to education, which we interpret broadly to include changes in available technologies (including those transferred through FDI and imports) as well as institutional changes associated with economic transition and maturation of China's urban labor market. Changes in industrial wage rents are the second most important contributing factor, while changes in ownership wage rents contribute only slightly to rising wage premiums for education. The relative supply of highly educated groups increased over time, reducing education premiums, except for a reduction in the relative supply of high school graduates compared to those completing junior high school and below in the late 1990s when rural migration increased significantly. Finally, shifts in production structure also mitigated growth in the premium to education premium, consistent with international trade favoring production of less skill-intensive products, but this effect was less important than relative supply increases.

We consider three skill groups: junior high school and below, senior high school, and college and above. In both periods, the growth in the returns to high school compared to junior high and below outpaced growth in the returns to higher education compared to high school. This was due to faster expansion of higher education which increased the relative supply of college graduates combined with greater increases in migration of rural workers with lower levels of education to urban areas, as well as shifts in product demand towards low skill-intensive products, which reduced the relative demand for college graduates.

Another distinctive pattern is that increases in the relative wage of high school graduates compared to those not graduating from high school was much faster during 1995-2000 than during 1990-1995. The most important reason for this acceleration was the slowdown in the growth of relative supply of senior versus junior school graduates, again caused by the larger increase in migration in the late 1990s and the greater likelihood that senior high school graduates would go on to college.

One important limitation of the data used in this study is that it only permits industry classifications that are highly aggregated. This may lead to downward bias in the estimated effects of changes in industrial wage rents and of shifts in product demand due to international trade, and upward bias in the effect of general technical change.

Our study contribute to understanding the motivating puzzle that although trade theory predicts a decline in the relative demand for skilled workers in developing countries, many countries in the developing world experienced rising wage premiums for skilled workers during the recent period of rapid globalization. Our results show that shifts in production structure did indeed reduce the demand for skilled workers in China, technological change and institutional reforms favoring skilled workers were powerful enough to more than offset this effect. Consistent with the existing literature, the magnitude of the effect of international trade is found to be relatively small. Because many new technologies favoring skilled workers could have been transferred through foreign direct investment or imports, and because competition from foreign-invested enterprises played a key role in institutional reforms that liberalized wage setting, on balance, globalization likely played a positive role in increasing skill premiums in urban China.

References

Acemoglu, D. (2002), "Technical Change, Inequality, and the Labor Market," *Journal of Economic Literature*, 40(1), pp7-22.

Autor, D., Katz, L., and Kruger, A. (1998), "Computing Inequality: Have computers changed the Labor market?" *Quarterly Journal of Economics*, 113, pp.1169-1213.

Baldwin, Robert E. and Glenn G. Cain (1997), "Shifts in relative wages: the role of trade, technology and factor endowments", Working paper no. 5934 (NBER, Cambridge, MA).

Borjas, G. and Valerie A. (1995), "Foreign Competition, Market Power, and Wage Inequality" , *Quarterly Journal of Economics*, 110, pp.1075-1110

Bound, J., and Johnson G. (1992), "Changes in the Structure of Wages in the 1980s: An Evaluation of Alternative Explanations," *American Economic Review* 82: 371-392.

Branstetter, Lee, and Nicholas Lardy (2008), "China's Embrace of Globalization," in Loren Brandt and Thomas Rawski, eds., *China's Great Economic Transformation* (Cambridge: Cambridge University Press).

Cai, Fang, Albert Park, and Yaohui Zhao (2008), "The Chinese Labor Market in the Reform Era," in Loren Brandt and Thomas Rawski, eds., *China's Great Economic Transformation* (Cambridge: Cambridge University Press).

Card, D. and DiNardo, J. (2002), Skill Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles, NBER Working Paper No. 8769, http://www.nber.org/papers/w8769 .

DiNardo, J., Fortin N. and Lemieux T. (1996), "Labor Market Institutions and Distribution of Wages, 1973-1992: A Semiparametric Approach", *Econometrica*, 64(5):1001-46

Freeman, R. (1975), "Overinvestment in College Training?" *Journal of Human Resources* 10:287 311.

Freeman, R. (1986), "Demand for Education", in: O. Ashenfelter and R. Layard, eds., *Handbook of Labor Economics*, Vol. 1 (North-Holland, Amsterdam).

Freeman, R. (1993), "How much has de-unionization contributed to the rise in male earnings inequality?" in: S. Danziger and P. Gottschalk, eds., Uneven tides (RusseLl Sage, New York).

Freeman, R. and Katz L. (1994), "Rising wage inequality: the United States vs. other advanced countries", in: R. Freeman, ed., Working under different rules (Russell Sage

Foundation, New York).

Goldberg, Pinelopi Koujianou, and Nina Pavcnik. 2007. "Distributional Effects of Globalization in Developing Countries." *Journal of Economic Literature*, 45(1): 39–82.

Hamermesh, Daniel (1993), Labor demand (Princeton University Press, Princeton, NJ).

Harrison, Ann and Hanson, Gordon. 1999. "Who gains from trade reform? Some remaining puzzles," *Journal of Development Economics*, vol. 59(1), pages 125-154, June.

Healwege, Jean (1992). "Sectoral shift and Inter-industry wage Differentials", *Journal of Labor Economics*, Vol. 10, No.1 (Jan 1992), 55-84.

Ho, Lok Sang, Xiangdong Wei Wai Chung Wong (2005), "The effect of outward processing trade on wage inequality: the Hong Kong case," *Journal of International Economics*, vol. 67, issue 1, pages 241-257.

Hsieh, Chang-Tai and Keong T. Woo (2005), "The Impact of Outsourcing to China on Hong Kong's Labor Market," *The American Economic Review*, Vol. 95, No. 5, Dec., pp. 1673-1687

Juhn, Chinhui, Kevin M. Murphy, and Brooks Pierce (1993). "Wage Inequality and the Rise in Returns to Skill," *Journal of Political Economy* 101(3): 410-442.

Katz, Lawrence and Kevin M. Murphy (1992). "Changes in Relative Wages, 1963-1987: Supply and Demand Factors," *Quarterly Journal of Economics*, 107: 35-78

Katz, Lawrence F. and David H. Autor, (1999), "Changes In The Wage Structure And Earnings Inequality", in O. Ashenfelter and D. Card, eds., *Handbook of Labor Economics*, vol. 3A, North-Holland, 1999, 1463-1555.

Krueger, A.(1993), "How Computers Have Changed the Wage Structure: Evidence from Mcrodata,1984-1989", *Quarterly Journal of Economics*, 110,pp.33-60.

Krueger, Alan B. and Summers, Lawrence H. (1988), "Efficiency Wages and the Inter-Industry Wage Structure", *Econometrica*, March 1988, 56, 259-93.

Lardy, Nicholas (2002). *Integrating China into the Global Economy* (Washington, D.C.: Brookings Institution).

Lemieux, T. (2007), "The changing nature of wage inequality", NBER working paper, No.13523, http://www.nber.org/papers/w13523 .

Meng, Xin and Junsen Zhang (2001), "The Two-Tier Labor Market in Urban China: Occupational Segregation and Wage Differentials between Urban Residents and Rural Migrants in Shanghai," *Journal of Comparative Economics*. 29.3, pp. 485–504.

Park, Albert, Xiaoqing Song, Junsen Zhang, and Yaohui Zhao (2008), "Rising Returns to Skill, Labor Market Transition, and the Growth of Wage Inequality in China", working paper.

Rozelle, Scott, Li Guo, Minggao Shen, Amelia Hughart and John Giles (1999), "Leaving China's Farms: Survey Results of New Paths and Remaining Hurdles to Rural Migration," *The China Quarterly*, No. 158, Jun., pp. 367-393

Wan, Guanghua, Ming Lu and Zhao Chen (2007), "Globalization and Regional Income Inequality: Empirical Evidence from Within China," *Review of Income and Wealth*, Series 53, Number 1, March, pp. 35-59

Wei, Shang-jin., and Yi Wu (2002), "Globalization and Inequality Without Differences in Data Definitions, Legal System, and Other Institutions," International Monetary Fund mimeo.

Wood, Adrian (1997), "Openness and Wage Inequality in Developing Countries: The Latin American Challenge to East Asian Conventional Wisdom," *The World Bank Economic Review*, Vol. 11, No. 1, Jan., pp. 33-57

Zhang, Junsen, Yaohui Zhao, Albert Park, Xiaoqing Song (2005), "Economic returns to schooling in urban China,1988 to 2001", *Journal of Comparative Economics*, Aug 2005.

Zhao, Yaohui (1999a), "Leaving the Countryside: Rural-to-Urban Migration Decisions in China." *American Economic Review (papers and proceedings)*. 89.2, pp. 281–286.

Zhao, Yaohui (1999b), "Migration and Earnings Differences: The Case of Rural China." *Economic Development and Cultural Change*. 47, pp. 767–782.

Zhao, Yaohui (2002), "Earnings Differentials between State and Non-State Enterprises in Urban China," *Pacific Economic Review*, Vol. 7, No. 1, 181-197.

Table 1. Urban Household Survey Sample Size in Six Provinces

Year	Labor-force	workers		
		Full-time wage workers	Self-employed	Retired-workers
	(1)	(2)	(3)	(4)
1989	6006	5721	66	71
1990	6573	6249	72	93
1991	6574	6239	79	82
1992	8350	7936	84	153
1993	7472	7083	91	116
1994	7267	6831	87	160
1995	7353	6930	96	129
1996	7219	6759	100	162
1997	7373	6841	148	162
1998	7146	6519	173	155
1999	7037	6314	198	201
2000	7350	6444	254	199
2001	6618	5612	271	211

Note: (i) To focus on the labor market in urban area, farmers are excluded from all the samples used in the paper. (ii) The full-time wage worker sample in column 2 is used in calculation of wage measures.

Table 2. Mean Log Wages by Education Group, 1990, 1995 and 2000 (1988 yuan)

	1990	1995	2000
Junior high school and below	7.40	7.70	7.85
Senior high school	7.43	7.88	8.22
College and above	7.64	8.16	8.48

Table 3. Wage Differentials and Changes in Relative Wage, 1990, 1995, 2000

	Wage Differentials			Changes	
	1990	1995	2000	1990-1995	1995-2000
Senior high vs. junior high and below	0.149	0.229	0.347	0.081	0.118
College and above vs. senior high	0.177	0.252	0.356	0.075	0.104

Table 4. Wage Rents and Employment Distribution by Industry and Ownership

	Wage rent			Employment distribution(%)								
				Junior high and below			Senior high			College and above		
	1990	1995	2000	1990	1995	2000	1990	1995	2000	1990	1995	2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
A. Industry												
Manufacturing	-0.002	-0.047	-0.075	50.81	49.51	44.53	37.88	35.06	35.21	28.62	27.14	23.91
Construction	0.075	0.078	-0.024	3.67	5.00	4.44	2.22	3.97	3.58	1.54	3.01	4.17
Transportation, post and telecom services	0.075	0.122	0.130	8.73	7.09	8.75	6.52	6.90	7.95	3.51	3.54	4.49
Wholesale/retail trade & catering services	-0.022	-0.098	-0.116	18.55	19.06	18.53	15.13	17.16	17.42	6.18	8.41	9.11
Public utility management and social services	-0.009	0.092	-0.029	4.69	6.22	10.46	3.87	4.94	9.39	1.34	2.84	5.47
Health care, sports and social selfare	0.038	0.078	0.166	1.96	1.96	2.04	6.61	6.35	5.23	7.52	6.82	5.94
Education, research, culture and mass media,	-0.012	0.046	0.148	2.95	3.34	2.96	10.41	9.06	7.07	26.97	20.33	17.27
Finance and insurance	0.076	0.244	0.185	0.54	0.47	0.78	2.51	3.74	3.11	2.22	3.16	6.40
Government agencies and social organizations	-0.021	0.059	0.118	4.88	5.19	4.00	12.46	11.32	8.23	19.97	23.02	21.28
Geological exploration and other industries	-0.106	-0.163	-0.135	3.22	2.15	3.52	2.37	1.50	2.80	2.14	1.74	1.95
B. Ownership												
Non-SOEs	-0.119	-0.136	-0.117	34.22	36.78	46.48	17.76	22.10	32.43	5.05	10.64	18.51
Government and SOEs	0.034	0.040	0.046	65.78	63.22	53.52	82.24	77.90	67.57	94.95	89.36	81.49

Table 5. Changes in Relative Wage and Wage Rents, 1990 to 1995 and 1995 to 2000

	Δ Rel. wage	Industrial wage rent: Wage effect	Industrial wage rent: Weight effect	Industrial wage rent: Total	Ownership wage rent: Wage effect	Ownership wage rent: Weight effect	Ownership wage rent: Total	Total wage rent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1990-1995								
Senior vs. junior	0.081	0.023	0.003	0.025	0.004	-0.003	0.001	0.026
College vs. senior	0.075	0.023	-0.003	0.020	0.003	-0.002	0.001	0.020
1995-2000								
Senior vs. junior	0.118	0.018	-0.014	0.004	-0.002	-0.001	-0.003	0.001
College vs. senior	0.104	0.026	0.011	0.037	-0.002	0.004	0.002	0.040

Note: "Senior-junior" denotes senior high school vs. junior high school and below, and "College-senior" denotes college and above vs. senior high school.

Table 6. Share of Migrants in the Labor Force and Employment in Urban Areas in 6 Provinces

	1990	1995*	2000
	(1)	(2)	(3)
Residents	4.81	8.48	16.56
Labor force	7.83	15.75	33.19
Employment	8.00	16.56	35.40

Note: * The fraction of migrants among residents in 1995 is computed directly by the statistics that are summarized by NBS from the 1 percent population survey in 1995. The fractions of migrants among labor force and employment in 1995 are figured out by the pattern of the change in fractions of migrant among residents. Under the assumption that in urban area, the fractions of migrants in labor force and employment changed by the same paces as that of migrants in residents during 1990-2000, the fractions of migrants in 1995 can be figured out by the following equation: Fmig1995=Fmig1990+(Fmig2000-Fmig1990)*(Fpop1995-Fpop1990)/(Fpop2000-Fpop1990), where Fmig1990, Fmig1995 and Fmig2000 respectively stand for the fraction of migrants among labor force and employment in 1990,1995 and 2000; similarly, Fpop1990, Fpop1995 and Fpop2000 respectively stand for the fractions of migrants among population in 1990,1995 and 2000.

Table 7. Educational Composition of Labor Force in Urban China

	Local residents			Migrants			All		
	1990	1995	2000	1990	1995*	2000	1990	1995	2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Junior high and below	48.37	38.41	31.99	82.41	82.02	79.07	51.03	45.28	47.62
Senior high	38.28	41.52	43.00	15.80	15.90	17.16	36.52	37.48	34.43
College and above	13.35	20.07	25.00	1.79	2.15	3.77	12.44	17.24	17.96

Note: The educational composition of migrants in 1995 is figured out by that of all residents in 1995, according to the statistics on the educational distribution of all residents in 1995, which are summarized by NBS from 1 percent population survey in 1995, and assuming that the changes in educational distribution of migrants have the same pace as that of all residents.

Table 8. Adjusted Relative Labor Supply and Derived Demand Indexes by Industry, 1990-1995 and 1995-2000

	Local Urban Resident Workers			Migrant Workers			Employed in urban area			$\Delta(\ln \phi_j)$		$\Delta(\ln x_j)$	
Industry	1990	1995	2000	1990	1995*	2000	1990	1995	2000	1990-1995	1995-2000	1990-1995	1995-2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Manufacturing	42.87	38.92	35.17	48.42	50.39	63.47	43.32	40.82	45.19	-0.059	0.102	-0.042	-0.053
Construction	2.83	4.17	4.00	17.24	14.96	7.39	3.98	5.95	5.20	0.402	-0.135	0.421	-0.034
Transportation, post and telecom. services	7.18	6.28	7.30	4.39	2.82	2.36	6.96	5.71	5.55	-0.198	-0.028	-0.099	0.197
Wholesale/retail trade & catering services	15.56	16.08	15.60	16.52	17.16	17.66	15.64	16.26	16.33	0.039	0.004	0.083	0.019
Public utility management and social services	3.92	4.99	8.70	5.97	6.18	6.54	4.09	5.19	7.94	0.239	0.425	0.294	0.602
Health care, sports and social welfare	4.48	4.78	4.42	0.92	0.72	0.51	4.20	4.11	3.04	-0.022	-0.302	-0.046	-0.145
Education, research, culture and mass media	9.06	9.20	8.45	4.29	6.27	1.22	8.68	8.72	5.89	0.004	-0.392	-0.161	-0.206
Finance and insurance	1.52	2.38	3.24	0.11	0.17	0.21	1.41	2.01	2.17	0.360	0.074	0.297	0.106
Government agencies and social organizations	9.82	11.39	10.32	1.88	1.20	0.52	9.18	9.70	6.85	0.055	-0.348	0.006	-0.219
Geological exploration and other industries	2.75	1.80	2.81	0.26	0.21	0.12	2.55	1.53	1.86	-0.508	0.190	-0.397	0.474
Total	100	100	100	100	100	100	100	100	100	-	-	-	-

Note: The industrial distribution of migrants in 1995 is figured out by the statistics on the industrial distribution of all workers, which are summarized by NBS from 1 percent population survey in 1995, and assuming that the changes of migrants in industrial distribution from 1990 to 2000 have the same paces as that of all residents.

Table 9. Changes in Relative Supply and Relative Labor Demand Due to Shifts in Product Demand across Industries

Years and education groups	SUP (1)	EMP (2)	DEM (3)
1990-1995			
Senior high vs. junior high and below	0.145	0.018	-0.008
College and above vs. senior high	0.300	0.004	-0.038
1995-2000			
Senior high vs. junior high and below	-0.135	-0.075	-0.032
College and above vs. senior high	0.126	-0.101	-0.066

Table 10. Decomposition of Change in Relative Wages, 1990-1995 and 1995-2000

	ΔRel. wage (1)	Δ Wage rents All (2)	Industry (3)	Owner. (4)	SUP (5)	DEM (6)	Δ Tech (7)
A. Change in relative wage							
1990-1995							
Senior-junior	0.081	0.026	0.025	0.001	-0.069	-0.004	0.128
College-senior	0.075	0.02	0.02	0.001	-0.143	-0.018	0.216
1995-2000							
Senior-junior	0.118	0.001	0.004	-0.003	0.064	-0.015	0.068
College-senior	0.104	0.04	0.037	0.002	-0.060	-0.031	0.155
B. Percentage of change in relative wage							
1990-1995							
Senior-junior	100	32.10	30.86	1.23	-85.04	-4.69	157.63
College-senior	100	26.67	26.67	1.33	-190.02	-24.07	287.43
1995-2000							
Senior-junior	100	0.85	3.39	-2.54	54.35	-12.88	57.69
College-senior	100	38.46	35.58	1.92	-57.56	-30.15	149.24

Note: "Senior-junior" denotes senior high school vs. junior high school and below, and "College-senior" denotes college and above vs. senior high school.

Table 11. Sensitivity of Decomposition Results to the Elasticity of Substitution (% of Change in Relative Wage)

σ and years	Comparison groups	Δ Wage premium	Δ Wage rents	Effect of SUP	Effect of DEM	Effect of Δ tech.
		(1)	(2)	(3)	(4)	(5)
σ=1.1						
1990-1995	Senior- junior	100	32.10	-162.74	-8.98	239.62
	College- senior	100	26.67	-363.64	-46.06	483.03
1995-2000	Senior- junior	100	0.85	104.01	-24.65	19.80
	College- senior	100	38.46	-110.14	-57.69	229.37
σ=1.5						
1990-1995	Senior- junior	100	32.10	-119.34	-6.58	193.83
	College- senior	100	26.67	-266.67	-33.78	373.78
1995-2000	Senior- junior	100	0.85	76.27	-18.08	40.96
	College- senior	100	38.46	-80.77	-42.31	184.62
σ=2						
1990-1995	Senior- junior	100	32.10	-89.51	-4.94	162.35
	College- senior	100	26.67	-200.00	-25.33	298.67
1995-2000	Senior- junior	100	0.85	57.20	-13.56	55.51
	College- senior	100	38.46	-60.58	-31.73	153.85
σ=2.5						
1990-1995	Senior- junior	100	32.10	-71.60	-3.95	143.46
	College- senior	100	26.67	-160.00	-20.27	253.60
1995-2000	Senior- junior	100	0.85	45.76	-10.85	64.24
	College- senior	100	38.46	-48.46	-25.38	135.38
σ=3						
1990-1995	Senior- junior	100	32.10	-59.67	-3.29	130.86
	College- senior	100	26.67	-133.33	-16.89	223.56
1995-2000	Senior- junior	100	0.85	38.14	-9.04	70.06
	College- senior	100	38.46	-40.38	-21.15	123.08

Note: "Senior-junior" denotes senior high school vs. junior high school and below, and "College-senior" denotes college and above vs. senior high school.

Appendix

Table A1. Comparison of Labor Force Samples from UHS and Census

Variables	UHS- labor force in Six provinces			Census-local labor force			
				Six provinces		Country	
	1990	1995	2000	1990	2000	1990	2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age (years)	37.41	38.31	39.50	33.67	35.55	33.39	35.15
Male (%)	51.60	51.50	52.02	56.36	56.92	57.75	58.34
Average Years of Schooling:	10.76	11.19	11.57	9.85	10.28	9.84	10.43
Education distribution (%):							
Junior high and below	48.37	38.41	31.99	60.41	55.88	59.82	53.26
Senior high	38.28	41.52	43.00	29.67	28.52	31.33	31.04
College and above	13.35	20.07	25.00	9.92	15.60	8.85	15.70
Employment distribution:							
A. Across Industries(%):							
Manufacturing	42.87	38.92	35.17	51.02	38.99	51.10	39.37
Construction	2.83	4.17	4.00	7.15	6.85	6.50	6.81
Transportation, post and telecom. services	7.18	6.28	7.30	6.61	7.46	7.91	7.89
Wholesale/retail trade & catering services	15.56	16.08	15.60	12.19	18.57	12.20	17.21
Public utility management and social services	3.92	4.99	8.70	4.51	8.15	3.85	7.29
Health care, sports and social welfare	4.48	4.78	4.42	2.91	3.09	2.64	3.22
Education, research, culture and mass media	9.06	9.20	8.45	8.84	7.74	7.89	7.95
Finance and insurance	1.52	2.38	3.24	0.98	2.16	1.11	2.06
Government agencies and social organizations	9.82	11.39	10.32	5.67	6.19	6.21	6.98
Geological exploration and other industries	2.75	1.80	2.81	0.12	0.82	0.58	1.21
B. Across Ownerships(%):							
Non-SOEs	25.91	27.51	37.49	–	–	–	–
Government and SOEs	74.09	72.49	62.51	–	–	–	–

Note: For the sample from census, the ownership of the work units did not be reported by the employed.

Table A2. Changes in Education Composition of Labor Force

Composition	UHS-labor force in six provinces			Census-local labor force			
				Six provinces		Country	
	1990	1995	2000	1990	2000	1990	2000
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Junior high and below(%):							
Illiterate	1.05	0.54	0.22	2.67	1.66	3.27	1.52
Primary School	19.16	14.44	11.98	26.45	23.70	24.53	18.43
Junior High School	79.79	85.02	87.80	70.88	74.64	72.20	78.04
B. Senior high(%):							
Senior High School	68.94	68.48	70.27	76.97	71.34	76.43	69.62
Middle Technique School	31.06	31.52	29.73	23.03	28.66	23.58	33.86
C. College and above(%):							
3- or 2-year-college	–	67.52	70.75	55.54	64.65	60.42	69.32
University and above	–	32.48	29.25	44.46	35.35	39.58	32.20

Note: For the 1990 sample from UHS, the composition of the College-and-above group can not be identified, because the sub-categories were not designed into the questionnaire in 1990.