Chinese Economic Reform and Labor Market Efficiency

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Abstract. The environment in which Chinese workers convert their human capital into earnings changed dramatically as a result of market-oriented economic reform. Simultaneously with labor market reforms were educational reforms that increased compulsory schooling to 10 years. We hypothesize that the change from a centrally-planned economy to a more market oriented economy substantially increased labor market efficiency. We decompose earnings and find that approximately 60 percent of the total change in earnings is the result of greater labor market efficiencies, 20 percent of earnings growth can be attributed to higher levels of human capital, and 20 percent of earnings growth can be attributed to exogenous change.

Key Words: Economic transition, earnings determinants, stochastic frontier regression

JEL Codes: P3, J3, C4

I. Introduction

The Chinese economy experienced very rapid growth between 1988 and 1995 - nominal wages tripled and average annual real wage growth was just under five percent. It is well-known that the market-oriented reform has been an important factor in the unprecedented economic growth. Less well-known are the educational reform policies that were undertaken about the same time, of which raising the compulsory education to ten years is most noteworthy. Destroyed by the Cultural Revolution, China has also witnessed a remarkable expansion of higher education institutions from 598 in 1978 to 1,984 in 1998 (Ministry of Education, 2000). Enrollment numbers in postsecondary institutions rose from 0.86 million in 1978 to 2.8 million in 1994. Full-time students enrolled in undergraduate programs also grew at an annual rate of 7.7 percent during this period. China also became more outward looking during this time period, with exports as a fraction of GDP growing from 14 percent in 1988 to 20 percent in 1997 (World Development Report, 1999).

We hypothesize that the change from a centrally-planned economy to a more market oriented labor market substantially increased labor market efficiency. In this paper we ask the question: how much of the rapid rise in earnings between 1988 and 1995 can be attributed to an increase in the labor market efficiency and how much can be attributed to the increase in the average level of human capital (education)?

We employ a stochastic frontier method to obtain a latent efficiency measure. While stochastic frontier analysis (Aigner, Lovell, and Schmidt, 1977) has not been applied to transition economies, it has been employed by labor economists to study incomplete worker information (Hofler and Polachek, 1985, among others), discrimination (Robinson and Wunnava, 1989), and immigrant's relative earnings performance (Daneshvary et al, 1992; Lang, 2005). Lovell (1995) provides a useful policy oriented review of efficiency analysis.

Our study complements the existing literature focusing on the effects of economic reform in China. Some recent examples include the effects of economic reforms on: skill differentials and market segmentation (Fleisher and Wang, 2004); returns to schooling (Zhang et al, 2005); gender discrimination (Liu et. al, 2000), manufacturing productivity (Wu, 2001); ownership reform and productivity (Xu, 2000), among other topics. However, we are the first to consider how economic reforms allow workers to more fully capture the *potential* returns to their human capital.

II. Stochastic Frontier Models

Prior to the economic reform the wage rate was determined by a rigid formula that is primarily based on seniority and, in turn, wage differences by schooling, occupation, and level of skills were very small in China. Since the economic and educational reforms the returns to schooling have remained below its contribution to productivity when compared to other transition economies. This phenomenon is intriguing, considering that the proportion of 4-year college graduates in China among the adult population was less than 1% in 1997 (National Bureau of Statistics of China, 1998) and the skilled labor is relatively scarce in China.

The labor-market monopsony theory provides a useful framework to our research.[1] Monopsony in China may rise from the immobility of urban workers, especially those who are employed by state-owned enterprises (SOE) and locked by employer-provided benefits, such as housing, medical, food, and others (Parker, 1999; Dong and Putterman, 2000). On the demand side, the compensation system used by the SOE's and collectives is unable to reflect the variations of marginal product for workers with different human capital (Fleisher and Wang, 2001). This inefficiency of labor demand stems from the fact that these firms do not have incentives to maximize profits prior to the economic reform. Given the pre-reform official wage grid,

[1] Meng (2000) provides an excellent survey of recent labor market reforms in urban China.

restrictions on wage and employment policies of collectives, and persisting limits on geographic mobility, it is plausible that wage compression by skill or schooling level has diminished to some extent. Although single industries dominated labor markets prior to the reform, the levels of their monopsony power vary in different regions due to the disparities of these industries' concentration in the local labor market. During transition a limited number of firms are likely to continue their dominance in the local labor market due to different levels of competition caused by firms of non-state ownerships. In addition, the incentive structures within SOE's were dramatically changed after the introduction of a reward system that related workers' as well as managers' wages to the profit performance of firms. This reform prompted SOE's management to abandon their politically motivated practices and pursue profit-oriented objectives. Many studies have reported that these new incentives are very effective in reducing technical inefficiency and increasing productivity (Hay et al., 1994; Hussain and Zhang, 1994; Morris, 1995). Due to the inefficiency originating from both labor demand and supply, especially during the pre-reform period, we expect to see a sizable gap between realized earnings and earnings frontiers, which is likely to diminish over time.

Using a standard labor market efficiency model:

$$L_{jk}^{D} = \theta_1^{D} + \theta_2^{D} X_{jk} + \theta_3^{D} w_{jk} - u_{jk}^{D}, u_{jk}^{D} \geq 0, \quad (1)$$

and

$$L_{ji}^{S} = \theta_1^{S} + \theta_2^{S} X_{ji} + \theta_3^{S} w_{ji} - u_{ji}^{S}, u_{ji}^{S} \geq 0, \quad (2)$$

where L_{jk}^{D} is quantity of labor demanded for employer *k* in local labor market *j* and L_{ji}^{S} is individual *i*'s labor supply choice. The deterministic parts of equations (1) and (2) are local labor demand and supply frontiers. The term u_{jk}^{D} reflects the inefficiency for employer *j* to identify the potential pool of qualified workers in locale *j*, which is partly due to the fact that state firms are not profit–maximizers; u_{ji}^{S} captures the inability of individual *i* to identify the full range of

potential employers, or to realize the full potential of worker's human capital, as well as the immobility caused by the local employers' monopsony.[2]

Suppose that there are K_j employers and N_j potential workers in locale j, with the local labor market clearing condition applied,

$$\sum_{k=1}^{K_j} L_{jk}^{D} = \sum_{i=1}^{N_j} L_{ji}^{S} . \tag{3}$$

We can derive the following reduced-form wage equation:

$$\ln(w_i) = \alpha + \beta X_i + \gamma R_i + v_i - u_i , \tag{4}$$

where $\ln(w_i)$ is log earnings, X_i is a vector of human capital measures, R_i is an indicator for geographical regions, $v_i \sim N(0,\sigma_v^2)$ is normal error, and $u_i \geq 0$ is earning inefficiency due to the joint effects of u^D and u^S. While γ's may capture the differences of living standards, they also reflect the real earning differences and disparities of the degree of monopsony prevalence in different geographical areas. The predicted wage efficiency is then given by

$$E[\exp(-u_i) \mid \ln(w_i) - (\alpha + \beta X_i + \gamma R_i)] . \tag{5}$$

Empirical model

We assume that a worker's human capital endowment is measured solely by one's education and experience (c.f., Polachek and Xiang, 2005). Other factors such as gender, occupation, industry, family status, or Communist Party membership status affect earnings indirectly by influencing how *efficiently* one is able to convert their human capital into earnings. This assumption, along with our theoretical model, suggests that we model (log) earnings as a function of experience, experience squared, years of schooling and a vector of regional indicators.

[2] Polachek and Robst (1998) address the assumption that efficiency can be measured as a residual. Using independent information they find that "stochastic frontier estimates provide a reasonable measure of a worker's incomplete wage information"p.231).

It is necessary to assume a structure for the efficiency portion of the combined error term. We follow the literature and impose an exponential form on the error term as the most robust alternative.[3] To identify the efficient frontier we use the 1995 data because it represents the outcome of a partially functioning labor market, as opposed to 1988 where wages were set by a formula based primarily on seniority. We then predict the potential earnings for both years from the 1995 frontier model. This allows us to predict the increase in overall labor market efficiency over time as well as efficiency gains for particular subgroups (males, Party members, etc). An Oaxaca type decomposition is used to analyze the contributions of various determinants to the increase in earnings. To highlight the impact of efficiency we report the decomposition results with and without the efficiency term.

III. Data and Findings

Our data source is the Chinese Household Income Projects (urban samples), 1988 and 1995. We select workers between 18 years and 59 years with positive earnings and labor market experience. We exclude workers whose primary occupation is listed as owner and those workers whose real earnings are less than one yuan per day. Our samples include 16,807 observations for 1988 and 10,747 observations for 1995. The samples contain data from 10 provinces in 1988 and 11 provinces in 1995.[4]

Table 1 presents descriptive statistics. Earnings have risen rapidly from 1848 yuan in 1988 to 2788 yuan in 1995 (in 1988 yuan). Schooling increases from 10.3 years to 11.3 years between 1988 and 1995. As both age and education are increasing over time we find a slight increase in

[3] We also used half-normal and truncated normal forms but our empirical finding regarding the contribution of schooling isn't altered.
[4] Our data includes very few foreign sector workers, which might be used to compare efficiency across sectors. Additionally, 80 percent of the sample is married workers.

experience. We have nearly equal proportion of males and females in our samples and about one-quarter of workers are Party members.

Regression Results

Table 2 reports our regression results. Standard OLS earnings equation results are similar to those cited in the literature above. We observe a sharp increase in the education coefficient (0.041 vs. 0.072) and a slight decrease in the experience coefficient.

Column 3 in Table 2 presents the frontier regression results. We note that the ratio of the standard errors for the random and inefficiency-induced disturbances is close to 1 (lambda = 0.78), suggesting that the two error terms nearly equally contribute to the total variance in earnings. Comparing the OLS results of column 2 to the frontier results we see that both the schooling and experience coefficients are smaller in the frontier model which differentiates between actual and potential returns to human capital. The last row of Table 2 presents the predicted efficiencies. As expected workers capture a larger share of their potential earnings in 1995, with overall labor market efficiency increasing from 0.7263 to 0.7915.

Table 3 shows marginal effects of Party membership, gender, family status, enterprise type, and occupation on labor market efficiency. Beginning with Party membership we find that the marginal efficiency gain declines from 2.1 percentage points in 1988 to 1.35 percentage points in 1995, suggesting the waning influence of Party membership on earnings.

The efficiency advantage of being male (relative to the omitted group, females without a child less than three) changed very little over time, in each case adding about 1.7 percentage points to efficiency. However, males with small children enjoyed a larger increase in efficiency over time, changing from no impact in 1988 to a 2.7 percentage point efficiency gain in 1995. This suggests that fathers of small children benefited most from labor market reforms. The marginal efficiency effect for females with children was negative in 1988 and not statistically significant in

1995, implying that the efficiency penalty for being female and having a child disappeared over time.[5]

Workers in SOE (state owned enterprises) enjoyed larger increases in efficiency relative to the omitted group, urban collectives, and other employment. On the other hand, public (provincial-level) enterprises experienced only a modest gain relative to urban collectives. We focus on two occupations: professional, technical, and management (PROF) and Office workers (omitted group, manual workers). In 1988, office and professional workers were less able to convert their human capital into wages than manual workers. However, by 1995 we find that office and professional workers were more efficient than manual workers. This suggests that the reforms weakened the relative advantage of manual workers.

Decomposition Results

Using a decomposition method proposed by Oaxaca (1973) we hold the regression coefficients constant and allow the levels of the independent variables to vary. Table 4 presents the decomposition results based on the pooled data set. By pooling the data we can identify a year effect as well as efficiency and human capital effects.

The first regression includes the efficiency term and the second excludes efficiency. The decomposition results clearly show that most, but not all, of the earnings gains can be contributed to an increase in labor market efficiency. In fact, we find that while 61.4 percent of the change in earnings can be attributed to an increase in efficiency nearly one-fifth (18.4 percent) is due to an increase in the average level of schooling. The final fifth can be explained by exogenous changes captured by the year dummy (18.9 percent). If we exclude the efficiency term we find that the

[5] Liu et. al (2000), among others, provide evidence that economic reforms have reduced labor market discrimination in China.

schooling effect generally remains the same (15.6 percent) while the year indicator now contributes more than 80 percent of the change in earnings.[6]

IV. Conclusion

The well-known change from a centrally-planned economy to a more market oriented labor market substantially improved Chinese labor market efficiency. Less well-known are the educational reforms that were undertaken about the same time. In this paper we address the question, how much of the rapid rise in earnings (between 1988 and 1995) can be attributed to an increase in the labor market efficiency and how much can be attributed to the increase in average level of human capital (education)?

We model the China's labor market using standard labor market monopsony theory where the monopsony arises from the lack of job mobility. This lack of mobility leads to inefficiency which we expect to decline over time as labor market reforms begin to take hold. We measure the magnitude and change in labor market inefficiency using a stochastic frontier model. This approach allows us to measure the extent to which higher earnings in China can be attributed to a more efficient job market.

Our findings suggest that most, but not all, of the earnings gains can be contributed to an increase in labor market efficiency. We attribute three-fifths of the change in earnings to an increase in efficiency, one-fifth to an increase in the average level of schooling, and the final fifth to exogenous shocks to the overall economy.

[6] We also decomposed using individual years and no year effect. In this case the efficiency term captures most of the year effect and the schooling effect remains essentially unchanged.

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Table 1. Descriptive Statistics

	1988		1995	
	mean	std.	mean	std.
Experience (years)	20.9	10.5	21.3	9.6
Schooling (years)	10.3	2.6	11.3	2.4
Male (%)	52.4	49.9	53.4	49.9
Party membership (%)	23.9	42.7	26.0	44.9
Child < 3	11.0	31.2	3.1	17.3
Male with child < 3 (%)	5.9	23.2	1.6	12.5
Female with child < 3 (%)	5.3	22.4	1.5	12.2
Age	37.1	10.5	38.6	9.6
SOE (%)	39.8	48.9	27.8	44.8
(works in) public sector (%)	39.8	48.9	55.4	49.8
(works in) collective (%)	20.0	40.0	14.3	35.0
(works in) other employment (%)	0.4	6.8	2.5	15.8
Professional employment	22.9	42.0	35.9	48.0
Office employment	24.1	42.8	21.5	41.0
Earnings, 1988 Yuan	1847	961	2788	1621
Sample Size (N)	16807		10747	

Table 2. Human capital regression results.
(dependent variable: log earnings)

	OLS		Frontier
	1988	1995	1995
Experience	0.0435	0.0389	0.0333
	(.0009)***	(.0017)***	(.0016)***
Experience²	-0.00055	-0.00047	-0.00036
	(.00002)***	(.00004)***	(.00004)***
Schooling	0.0410	0.0720	0.0654
	(.0010)***	(.0018)***	(.0018)***
Province indicators	yes	yes	yes
R^2/LL	0.389	0.355	-5927
N	16807	10747	10747
Lambda	--	--	0.78
			(0.10)
Mean Predicted Efficiency	0.7263	0.7915	--
	(.0008)	(.0010)	

Notes: Standard errors in parenthesis; *** indicate that the estimated coefficients are statistically significant at the 1% level. Mean predicted efficiency is computed using parameters of the frontier model (third column) estimated on 1995 data.

Table 3. Determinants of efficiency.
(dependent variable: predicted efficiency)

	1988	1995
Party membership	0.0210	0.0135
	(.0022)***	(.0025)***
Male	0.0176	0.0169
	(.0018)***	(.0021)***
Male with child	0.0021	0.0270
	(.0037)	(.0082)***
Female with child	-0.0151	0.0088
	(.0038)***	(.0084)
SOE	0.0434	0.0609
	(.0021)***	(.0032)***
Public	0.0232	0.0287
	(.0023)***	(.0029)***
Professional	-0.0208	0.0207
	(.0022)***	(.0029)***
Office	-0.0106	0.0058
	(.0021)***	(.0028)***
Constant	0.6936	0.7369
	(.0020)***	(.0027)***
Province indicators	no	no
R^2	0.044	0.069
N	16807	10747

Notes: standard errors in parenthesis; *** indicate that the estimated coefficients are statistically significant at the 1% level.

Table 4. Decomposition of the increase in log earnings between 1988 and 1995. (dependent variable: log earnings)

		Contribution		Contribution
Experience	0.0302	3.5%	0.0411	4.8%
	(.0003)***		(.0008)***	
Experience²	-0.0003	-0.1%	-0.0005	-0.2%
	(.0000)***		(.00002)***	
Schooling	0.0616	18.4%	0.0523	15.6%
	(.0003)***		(.0009)***	
Efficiency	3.392	61.4%	--	--
(predicted)	(.0072)***			
Year 1995 dummy	0.0678	18.9%	0.2933	81.6%
	(.0017)***		(.0049)***	
Province indicators	yes	--	yes	--
R^2	0.938	--	0.431	--
N	27494	--	27494	--

Notes: standard errors in parenthesis; *** indicate that the estimated coefficients are statistically significant at the 1% level.