Decomposing Earnings Growth in China:
The Role of Implicit Labor Taxes

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Abstract: China's economic reforms in the 1990's caused a dramatic increase in earnings. We hypothesize that a significant source of the earnings growth is the reduction in implicit taxes paid by the workers. Using the frontier model to estimate potential earnings we find that three-fifths of the change in earnings between 1988 and 1995 can be attributed to the reduction in implicit taxes, one-fifth to an increase in average level of human capital, and the final fifth to exogenous shocks to the overall economy. We find differential reductions in implicit taxes by age, occupation, and region, consistent with China's development policy of letting "some grow richer sooner."

I. Introduction

A major event in any economic transition to a market economy involves labor market reforms. A prominent example of labor market reforms is China. The Chinese economy experienced very rapid growth between 1988 and 1995 - nominal wages tripled and average annual real wage growth was nearly five percent. It is well-known that the market-oriented reform has been an important factor in the unprecedented economic growth. We hypothesize that a significant source of this earnings growth is the reduction in implicit taxes paid by workers under a socialist system.

Dong and Putterman (2000) characterize pre-reform China as similar to the Soviet Union under Stalin: The Chinese Communist Party's leadership priority goal was rapid industrialization. To obtain the resources for capital investment that fueled industrialization "the monopsonist state [paid] its workers less than the value of their marginal product (p.35)". Kornai (1992, p. 2270) suggests that "central management normally seeks to counteract the wage pressure in order to spare the resources intended for other purposes (investment, defense spending)." Imai (2000) concurs with this analysis, arguing that the government channeled "resources from households to the state in lieu of an explicit personal income tax system (p. 525)". His approach is to treat wage controls as implicit labor income taxation. His estimate of the implicit labor tax rate for the period 1970 to 1978 is 27.9 percent of labor income.

We view the reform period after 1988 as characterized by a weakening of the state's monopsony power (see Dong and Putterman, 2002). To finance capital investment, the government increasingly turned to foreign investment; foreign direct investment in China increased from 6.2 billion $US in 1988 to 111.4 billion in 1993 (Ministry of Foreign Trade and

Economic Cooperation). Thus, the ability and necessity of raising funds through implicit taxes on labor has fallen during the reform period.

We use stochastic frontier analysis to estimate the gap between actual earnings under a socialist system and those earned after a reduction in implicit taxes. The stochastic frontier method (Aigner, Lovell, and Schmidt, 1977; Lovell, 1995) has been employed by labor economists to study incomplete worker information (Hofler and Polachek, 1985; Holfler and Murphy, 1992, among others), discrimination (Robinson and Wunnava, 1989; Robinson, 1993), and immigrant's relative earnings performance (Daneshvary et al, 1992; Lang, 2005). We assign the shortfall between the actual pre-reform earnings and those potentially earned under reform conditions as Imai's "implicit tax."

The goal of this paper is to decompose earnings growth and identify the major factors responsible for the more than fifty percent increase in earnings between 1988 and 1995. Our earnings decomposition assigns about three fifths of the increase in earnings to a reduction in implicit taxes, about one fifth to increases in human capital, and about one–fifth to exogenous changes.[1] To support our overall findings we analyze earnings growth by province and find that the reductions in implicit taxes track closely to what we know about regional growth in China. We find that younger, better educated, professional workers experience a dramatic improvement in economic status over this time period, as their implicit taxes were rapidly reduced. The finding of differential reductions in implicit taxes by age, occupation, and region is consistent with China's well-known development policy of letting "some grow richer sooner."

II.   Estimating Potential Earnings with Stochastic Frontier Models

This paper follows a small, but growing labor economics literature that employs the stochastic frontier approach to describe the highest potential earnings associated with a given human capital stock. Under fully efficient conditions, (i.e., in the absence of incomplete information, discrimination, monopsony, or implicit taxation) a worker will have the same potential and actual earnings.   In the incomplete information examples, frontier analysis is used to estimate the "degree of shortfall between the wages workers earn and what they could earn assuming perfect or costless information in the labor market (Hofler and Murphy, 1992, p. 511)." In the discrimination examples, frontier analysis is used to find the "true" wage regression for both males and females. The stochastic frontier approach eliminates the need to assume "that the non-discriminatory wage is either the male or female wage (Robinson, 1993, p.45)." Lang (2005) argues that immigrants are inefficient at converting their human capital into earnings hence their actual earnings fall below their potential earnings. Generically, the gap between actual and potential earnings is known as "*earnings inefficiency,*" or alternatively, the degree to which an individual captures his potential earnings as "*earnings efficiency*."

An important source of earnings inefficiency in China in 1988 is due to implicit taxation by the Chinese government. Following Dong and Putterman (2002) and Imai (2000) we note that this implicit taxation was dramatically reduced as part of the economic reforms of the early 1990's. Thus to identify the effective frontier we use the 1995 data because it represents the outcome of a labor market with lower implicit taxes, as opposed to 1988 where wages were set by a formula based primarily on seniority and implicit taxes were a major feature of the centralized wage-setting scheme. We then predict the potential earnings for both years from the

1995 frontier model. This allows us to measure the effect of reductions in implicit taxes on earnings over time.

Clearly, in a socialist labor market there are alternative sources of earnings inefficiencies. Our approach is to measure the change in efficiency over time. We note that our data is before the major restructuring of China's state owned industries, which generated alternative sources of earnings efficiencies. It is therefore unlikely that other sources of efficiency gains such as increased labor mobility significantly contributed to earnings growth. For a thorough discussion China's labor market reforms and their timing, see Meng (2000).

The Stochastic Frontier Model

The stochastic frontier model is can be written as:

$$\ln(w_i) = \alpha + \beta X_i + \gamma R_i + v_i - u_i, \tag{1}$$

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 incomplete information, discrimination, or in our case, implicit taxation. While γ's may capture the differences of living standards, they also reflect the real earnings differences and disparities of the degree of implicit taxation in different geographical areas. The predicted wage efficiency is given by

$$EFF = E[\exp(-u_i) \mid \ln(w_i) - (\alpha + \beta X_i + \gamma R_i)]. \tag{2}$$

To estimate earnings potential 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

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capital into earnings.   This assumption suggests that in order to estimate potential earnings we model (log) earnings as a function of experience, experience squared, years of schooling and a vector of regional indicators. As noted above in equations (1) and (2), the stochastic frontier regression introduces heterogeneity in a worker's earnings equation by estimating the degree to which the employee can capture his potential earnings. Finally, it is necessary to assume a structure for the nonrandom portion of the combined error term in equation (1). We follow the literature and impose an exponential form on the error term as the most robust alternative.

Like discrimination, worker incomplete information, and immigrants' disadvantage, implicit taxation is observable only as a residual. 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)." This suggests that changes in earnings efficiencies can be a proxy for changes in implicit taxation.

Finally, we estimate an earnings equation with includes efficiency using pooled data. The model is:

$$\ln(w_i) = \alpha + \beta X_i + \gamma R_i + a_1 * I(1995)_i + a_2 * EFF_i + e_i, \qquad (3)$$

where $I(1995)$ equals 1 of the observation is from year 1995 and 0 otherwise, EFF is efficiency computed in (2) for every individual (using 1995 frontier model in 1988 data), and e(i) is the random disturbance.

Equation (3) allows us to decompose the growth of log earnings into the contribution of the changes in human capital variables and efficiency, given any exogenous changes that happen between years 1988 and 1995 which are independent of changes in our observed variables. We compute each variable's contribution as [(coefficient*variable)/ $\Delta(\log(w_i)$]100%.

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. We define earnings as the sum of regular wages, floating wages, all kinds of bonuses, subsidies, cash income and allowances.[2] 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. We note that our data contains very few workers employed by foreign firms and nearly 80 percent of our sample is made up of married workers.

Table 1 presents descriptive statistics. Earnings have risen rapidly from 1847 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, primarily due to an increase in the level of compulsory education to ten years. As both age and education are increasing over time we find a slight increase in experience. We have nearly equal proportion of males and females in our samples and about one-quarter of workers are Party members.

Table 1 also shows that the share of workers employed at State-Owned Enterprises (SOE) and in urban collectives both fell at the expenses of provincially-owned enterprises.   In both years nearly all individuals in our sample are employed in the public sector. However, there were some changes in employment patterns; for example, professional employment rises from 22.9 percent to 35.9 percent.   Finally, the percent of workers with a child less than three (3) falls rapidly between 1988 and 1995.

Regression Results

Our goal is to decompose earnings growth and identify the major factors responsible for the more than fifty percent increase in earnings between 1988 and 1995. We first estimate the frontier model and obtain measurements of efficiency. Columns 1 and 2 in table 2 report our regression results for each year separately. Standard OLS earnings equation results for 1988 and 1995 are similar to those cited in the literature (see for example, Zhang, et. al, 2005, among others). 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 in year 1995 (equation 1). 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, which further validates the use of the frontier model. The last row of Table 2 presents the predicted earnings efficiencies. Using the 1995 frontier as our benchmark, we find that labor market efficiency increased from 0.7263 to 0.7915.

Table 3 presents earnings efficiencies for overall sample and selected sub-groups in 1988 and 1995. The results show that males, Party members, and workers in State Owned Enterprises (SOE) have higher earnings efficiencies in both time periods. In contrast, professionals and those with above average schooling have smaller earnings efficiencies in 1988 and a larger than average earnings efficiencies in 1995. We interpret that groups with relatively low earnings

efficiencies have relatively high rates of implicit labor taxation. More experienced (older) workers experienced a relative decline in their earnings efficiency; older individuals have higher than average earnings efficiencies in 1988 and approximately average earnings efficiencies in 1995. Likewise, we interpret these findings as evidence that older workers received relatively smaller reductions in implicit taxes. Overall, our results suggest that: 1) implicit tax policy is now more favorable to younger, better educated workers, 2) workers employed in State Owned Enterprises enjoyed larger reductions in implicit taxes than workers employed in provincial enterprises or urban collectives, 3) Party members did not suffer any ill effects due to changes in implicit tax policy, and 4) while some groups enjoyed larger reductions in implicit taxes, we find that even older, lower educated, non-Party, and nonprofessional workers faced lower implicit tax rates in 1995 than in 1988.

Decomposition Results

Using a simplified decomposition method proposed by Oaxaca (1973) we hold the regression coefficients constant and only allow the levels of the independent variables to vary. Table 4 presents the decomposition results from estimating equation (3) which is 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, i.e., reductions in implicit labor taxes. In fact, we find that while 61.4 percent of the change in earnings can be attributed to reductions in implicit labor taxes, 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 schooling effect generally remains the same (15.6 percent) while the year indicator now contributes more than 80 percent of the change in earnings.[3]

While the above results show that policy changes have varying effects on different workers, we also have reason to believe that there are regional differences in implicit tax rates. Table 5 provides average earnings efficiencies and its contribution to earnings growth by province. In 1988, earnings efficiency varies by province from 62.6 percent to 78.8 percent; however, every province experienced an increase in earnings efficiency over time, varying by province from 77.5 percent to 80.5 percent in 1995.

Consider the coastal, high growth, high income provinces, Guangdong, Beijing, and Jiangsu. In each case the average earnings efficiency in these provinces is well below average in 1988; in Guangdong's case nearly 10 percentage points below the average and 16 percentage points below Gansu Province. It appears that higher income provinces faced higher implicit tax rates in 1988, which is consistent with the notion that pre-reform China extracted wages from regions with higher productivity to finance the policy of equality.

Examining changes in earnings efficiencies over time we find that the rich coastal provinces experienced large increases in both actual and potential earnings; of the three provinces only Guangdong has an earnings efficiency below the average for all of China in 1995. In each of these high growth provinces, the share of earnings growth being explained by the changes in earnings efficiency is larger than China as a whole. For example, in Guangdong Province, the increase in earnings efficiency explains nearly three-quarters of the earnings

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growth. This suggests that while Guangdong still faced higher than average implicit tax rates in 1995, it also enjoyed the largest net reduction in implicit tax rates.[4]

In contrast, the northeastern province, Liaoning, a center of heavy industry, was more favored in pre-reform China than in post-reform China. Table 5 shows that Liaoning had a relatively high earnings efficiency (relatively low implicit tax rates) in 1988, and slow growth, which results in a small (36.5 percent) contribution of implicit tax rate reductions to earnings growth. The poor, central interior province, Anhui, which also enjoyed a relatively high earnings efficiency (low implicit tax rates) in 1988, experienced slow growth, and the change implicit tax rats contributes less than half (43.4 percent) of the total change in earnings between 1988 and 1995. In sum, changes in implicit tax rates (earnings efficiencies), and their contributions to the change in total earnings, track closely to what we know about regional growth in China over this time period (Démurger, 2001; Cai et al., 2002).

IV. Conclusion

The purpose of this paper is to advance our understanding of the causes and sources of earnings growth in China during a period of rapid growth and reform. To accomplish this task this paper connects two disparate threads in the literature. The first thread is the observation that socialist economies contain a large degree of implicit labor taxation (Kornai, 1992; Imail, 2000; Dong and Putterman, 2000, 2002) in the form of below market wages. The second thread is the use of stochastic frontier analysis (Aigner, Lovell, and Schmidt, 1977), originally developed for production analysis, and adapted by labor economists to measure the highest potential earnings associated with any given human capital stock.

Using the frontier model to identify latent implicit taxes we find that a significant source of earnings growth in China is the closing of the gap between actual and potential earnings, which represents a reduction in the implicit tax on labor. We attribute three-fifths of the change in earnings between 1988 and 1995 to a reduction in implicit labor taxes, one-fifth to an increase in the average level of human capital (schooling and experience), and the final fifth to exogenous shocks to the overall economy.

In addition to decomposing the overall earnings growth in China, we also decompose earnings growth by province. The effect of reducing implicit taxes on earnings growth varies widely by province as well, ranging from a high of 73.3 percent (Guangdong) to a low of 36.5 percent (Liaoning). Before the reforms (1988) the poorer provinces were generally able to capture a much larger share of their potential earnings than the richer provinces; i.e., faced lower rates of implicit taxation. However, the fast growing, richer provinces attribute a larger fraction of their earnings growth to a reduction in implicit taxes. Also, younger, better educated, professional workers experience a dramatic improvement in economic status over this time period, as their implicit taxes were rapidly reduced. The finding of differential reductions in implicit taxes by age, occupation, and region is consistent with China's well-known development policy of letting "some grow richer sooner."

Finally, we note that several previous studies argue that an increase in the returns to education is the source of earnings growth over the years 1988 and 1995 (see Park et al., 2004 and Zhang et al. 2005). Indeed, standard decomposition results indicate that the major source of change in earnings is attributed to the higher returns to education, but when the efficiency is included in the year-specific earnings equations, the effect of schooling is less pronounced (results not reported). One interpretation of the result is that the returns to schooling in 1988 may

be underestimated due the high implicit taxes on educated workers. However, we acknowledge that this is an open question and subject to future research, where one needs to address possible shifts in both supply and demand for labor in China, as well as address the issue of properly identifying the components of latent efficiency.

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Table 1. Descriptive Statistics

	1988		1995	
	mean	std.dev.	mean	std.dev.
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
(works in) state-owned enterprise—SOE, (%)	39.8	48.9	27.8	44.8
(works in) provincially owned (%)	39.8	48.9	55.4	49.8
(works in) urban collective (%)	20.0	40.0	14.3	35.0
(works in) other employment (%)	0.4	6.8	2.5	15.8
Professional worker (%)	22.9	42.0	35.9	48.0
Office worker (%)	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
R²/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

**Predicted Share of
Potential Earnings**

	1989	**1995**
Overall	.7263	.7915
	(.0008)	(.0011)
Male	.7391	.8038
	(.0011)	(.0013)
Female	.7122	.7775
	(.0013)	(.0017)
Party member	.7454	.8132
	(.0014)	(.0015)
State-Owned Enterprise	.7443	.8229
	(.0013)	(.0016)
Professional	.7150	.8080
	(.0019)	(.0017)
Greater than mean schooling	.7078	.7997
	(.0012)	(.0014)
Greater than mean experience	.7341	.7930
	(.0011)	(.0014)

Note: Standard deviations are in parentheses.

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

	With Efficiency	Contribution	Without Efficiency	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 (predicted)	3.392	61.4%	--	--
	(.0072)***			
Year 1995 dummy	0.0678	18.9%	0.2933	81.6%
	(.0017)***		(.0049)***	
Province indicators	yes	--	Yes	--
R²	0.938	--	0.431	--
N	27494	--	27494	--

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

Table 5

Retained Share of Earnings and Its Contribution of
Earnings Growth, By Province

	Sample mean log earnings			Mean retained share of potential earnings		Contribution of change in retained share of potential earnings
	Year 1988	Year 1995	Change	Year 1988	Year 1995	
Beijing	7.52	8.15	0.63	.6536	.7934	69.8%
Liaoning	7.45	7.71	0.26	.7602	.7875	36.5%
Henan	7.25	7.35	0.30	.7409	.7865	51.3%
Jiangsu	7.42	7.90	0.48	.6960	.7922	64.4%
Anhui	7.36	7.61	0.25	.7643	.7939	43.4%
Hubei	7.39	7.78	0.39	.7274	.7947	58.9%
Guangdong	7.77	8.40	0.63	.6263	.7747	73.3%
Shanxi	7.30	7.58	0.28	.7415	.7900	60.7%
Gansu	7.42	7.53	0.11	.7882	.7998	38.0%
Yunnan	7.50	7.78	0.28	.7654	.8053	52.1%
China	7.43	7.79	0.36	.7263	.7915	61.1%