Rural-Urban Education and Health Disparities in China: A Structural Approach

Team

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1. Introduction

1.1. Background and Objective

Rural-urban income and socio-welfare disparity is a persistent social problem in China. Over the past two and a half decades, China has experienced a remarkable economic growth rate in the wake of national reforms. The beginning of the reformation in the late 1970s that aimed at rural non-farm activities, including the Household Responsibility System and rapid development of Township and Village Enterprises, improved the well-being of farmers and narrowed the rural-urban gap. But the subsequent reforms of privatization and marketizaton greatly favored urban people and exacerbated the economic disparity between rural and urban sectors. After a decade-long decrease, rural-urban inequality has been widening steadily since the 1990s (Knight and Song 1999).

The sharply increasing disparity between rural and urban sectors in recent years has restricted China’s long-run economic development. Several questions are currently very relevant: How to design better policies to increase the welfare of farmers and decrease the rural-urban economic gap? What kinds of aid programs can broadly and effectively enhance rural economic growth? How to improve the size and efficiency of public services in rural areas? How to restructure the agricultural sector, modernize rural areas, and improve farmers' income pursuant to China’s entrance to WTO? These issues, targeting rural poverty reduction, are pressing and important during China’s current rapid period of globalization and industrialization.

The role of education in poverty reduction has received confirmation from the experiences of the developing world regarding its importance both in raising income and in contributing to social equality. In recent years, health as an important determinant of the quality of life has started to get much more attention. A good example is that several key international organizations, including the World Bank, and the World Health Organization, have stated the improvement of health as their primary objective of poverty reduction, and they have devised prominent assistance programs in rural China for the improvement of health. The growing interest in improving the health of low-income groups reflects the broader interpretation of welfare in multidimensional terms. Life expectancy, as well as educational achievement and income, is an important indicator of welfare.

We plan to investigate the influences of isolation of rural communities, urban bias policy, and the availability of public services on the decisions to pursue further education and invest in health care for rural and urban dwellers in China. We have established an estimate structural model of education and health, which is based on individual rational decisions. We plan to apply the model to China's rural and urban survey data. The data include household income, education, and health status over several years. Moreover, we plan to apply the estimated parameters from the model to analyze the individual's behaviors under different policy regimes and the subsequent effects on his welfare.

The reason for us adopting the structural approach, as opposed to the widely used reduced-form approach, is based on the fact that the structural approach has been verified as a rigorous analytical method for examining people's choices (Eckstein and Wolpin 1989, Rust 1994). To evaluate the success and effectiveness of poverty reduction policies, we need to understand fully people's behaviors under the current regime and their reactions to the new policies. The primary problem with the reduced-form approach, as stated by Lucas (1976), is that changes in policy will cause people to reoptimize their choices, which are generally different from the historical prediction of the previous policy regime. With its disregard of the innate connection of economic elements, the reduced-form approach is limited in its ability to interpret the estimated parameters. For example, it generally treats education and health status as isolated elements. Furthermore, the structural approach is not only superior in regards to policy forecasts, but also allows welfare analysis. We can analyze the differences in the lifetime wealth distributions for rural and urban people caused by the changes in policies and environments.

The paper will include two parts. The first part is the structural estimation of a dynamic joint model of health and education choices. The second part will apply the estimated parameters to analyze the effectiveness of series of poverty reduction policies, including access to public finance, provision of the health-care system, price subsidization, and rural-urban migration of labor, etc.

1.2. Relationship Between Education and Health

The linkage between health and education has been comprehensively studied. Classical growth theory attributes health improvement to progress in economic condition, such as gains in income. It is well established that schooling will improve health and nutrition by raising the income (see a review in Adler et al. 1994). Also, the existing empirical evidence strongly suggests that improvement in health can significantly increase with improvement in education (Livi-Bacci 1997 and Matthews, Feinstein and Odling-Smee 1982).

However, until recently current literature has paid little attention to the interaction between education and health, and its role in determining rural-urban welfare inequality. Most research attributes the low education attainment in rural sectors to the lesser education opportunity caused by supply constraints, such as the urban bias in government policies or the lower benefits of financing education in poorer rural areas. Some research has investigated the demand constraint resulting from the lower return on investment in education and the higher opportunity cost of schooling in the rural sector. But the extent of their demand constraint was only limited to the social discrimination against rural workers, or restriction to rural-urban migration. The fact that the higher opportunity cost of schooling may reflect the shorter life expectancy of rural people has been neglected. Higher mortality risks will lower the individual return to education and, therefore, might result in fewer years of schooling. Given the clear evidence that a high level of education increases health, and a good health induces a high level of education, it is necessary to have a model that endogenizes both health and education. Yet, because of the complexity of modeling, as far as we know, few theoretical models integrate both health and education into individual's choices. We plan to fill this gap with a dynamic model integrating individual's education and health choices.

Understanding the role of education and health in rural-urban welfare disparity has important policy implications. If education and health do interact and are joint investments, the most effective investment we can make in education quality maybe is to improve the rural health care system. Similarly, one of the most effective investments we can make in rural people's health is to improve the quality of education.

2. Model Setup and Estimation Method

Based on the work of Gan and Gong (2003), we developed a dynamic structural model of education attainment and health expenditure choice decisions. Our starting point is that education and health are joint investment decisions and strongly related. More specifically, improving health reduces the rate of depreciation of investment in education and increases the return to it. Also, higher education enhances the capability of lifesaving investment in health. The rural-urban spatial divide in China results in crucial differences in people's life opportunities. People in rural areas are at a disadvantage in provision of education, perceived return of schooling, and access to health services. The structural estimation framework that we adopted fully imposes location effects and permits an investigation of whether predicted data from the structural model can fit the observed data on school attendance, incomes, and health expenditure.

We assume that each individual has a finite horizon beginning from age 10 to 65. At any age, he, or his parents if he is a minor, has two mutually exclusive alternatives: go to work or attend school. The reward for working at period *t,* based on the individual's human capital and the place where he works, is given by

$$R_1(t) = f\left(g_1, m, s_t, x_t, \chi; \alpha_1\right)e^{\varepsilon_{1t}},$$

where g_1 is the fixed working skill endowment (low or high); *m* is the location (rural or urban); χ is sex; s_t and x_t are the schooling years and the experience at period *t*, respectively; α_1 is a parameter vector associated with the working reward; ε_{1t} is random shocks to skill level. The current-period reward for school attendance depends on the individual's study ability, the place where he lives, and the cost of tuition, which is given by

$$R_2(t) = f_2\left(g_2, m, s_t, \chi; \alpha_2\right)e^{\varepsilon_{2t}}$$

where g_2 is the fixed schooling ability endowment (low or high: g_{2l} or g_{2h}), and α_2 is a parameter vector associated with the schooling reward; ε_{2t} is random shocks to consumption value of school attendance.

At any age a, the individual's objective is to maximize the expected present value of remaining lifetime net rewards.

$$\max_{\{d_i(t),J_i(t)\}_{i=1,2}} E_t\left\{\sum_{t=a}^{65}\delta^{t-a}\left[\sum_{i=1}^{2}\left(R_i(t)-J_i(t)\right)d_i(t)Q_i(t)\right]\right\} \tag{1}$$

where δ is discount factor, and $d_i(t)$ is an indicator function of alternative i. (if i =1, going to work is chosen; if i = 2, attending school is chosen). $J_i(t)$ is the health expenditure associated with alternative choice i at period t. $Q(t)$ is the probability that the individual will be alive at period t, which is assumed to be a function of health expenditure.

With the limitation of the data, the individual's survival rate could not be observed. What we may observe is just the individual's health status or the population's health status. We assume that the individual's expectation about the future status of his health coincides with the population health status within the same sociodemographic stratum. The evolution of the population's health status in a specific area can be represented by an estimated transition probability matrix.

We assume that health, h, takes on one of four values, $\{1,2,3,4\}$ denoting good, poor, bad, and dead health status, respectively. Dead is an absorb state. Each health status corresponds to different survival rate. Transitions probability between heath status 1, 2, and 3 has the form

$$\pi_1\left(h(t+1)\middle|h(t),J(t),a(t),d(t),m,z(t),\chi;\theta_1\right), \tag{2}$$

which gives the probability of health next period as a function of health this period together with age a, location m, alternative choice d, health expenditure J, sex χ, and health services z. Provision of health services, z, includes series of index of health care, such as hospital bed, doctors, and admission rate to a hospital in terms of per 1,000 people. θ is a vector of parameters. The transition probability π_1 can be taken to have a trinomial logit form, with separate coefficients for each of independent variables and their interactions. A separate binomial logit probability function will also be used to capture the stochastic process of mortality assessment:

$$\pi_2\left(dead \middle| alive, J(t), a(t), d(t), m, z(t), \chi; \theta_2\right). \tag{3}$$

Applying functions π_1 and π_2 to the population data, we can get the estimated values of the parameter vectors θ_1 and θ_2.

Define the random shock vector at period t as $\varepsilon_t = \{\varepsilon_{1t}, \varepsilon_{2t}\}$, and the state space at period t as $S(t) = \{g_1, g_2, s_t, x_t, h_t, \varepsilon_t\}$. Also for convenience, we denote $\bar{S}(t)$ as the predetermined elements of the state space, i.e, $\bar{S}(t) = \{g_1, g_2, s_t, x_t, h_t, \varepsilon_t\}$. The experience and education in the state space evolve according to

$$x_{t+1} = x_t + d_1(t),$$

$$s_{t+1} = s_t + d_2(t),$$

and the health status evolves according to the transition probabilities functions (2) and (3).

We can rewrite maximization of (1) as

$$\begin{aligned} V\left(S(a), a\right) &= \max_{\{d_i(t), J_i(t)\}_{i=1,2}} E\left\{ \sum_{t=a}^{65} \delta^{t-a} \left[\sum_{i=1}^{2} \left(R_i(t) - J_i(t)\right) d_i(t) Q_i(h(t)) \right] \middle| S(a) \right\} \\ &= \max_{k \in K} \left\{ V_k\left(S(a), a\right) \right\}, \end{aligned}$$

where K is the set of possible choices. At each period t, K consists of two alternative choices: going to work or attending to school, each associated with discretized health expenditures. $V_k\left(S(a), a\right)$, the alternative-specific value functions, obeys the Bellman equation

$$V_k\left(S(a), a\right) = \left[R_k\left(S(a), a\right) - J_k\left(S(a), a\right)\right] Q_k\left(h(a)\right)$$
$$+ \delta E\left[V\left(S(a+1), a+1\right) \middle| S(a), \text{alternative } k \text{ is chosen}\right], \qquad a < 65,$$
$$V_k\left(S(65), 65\right) = \left[R_k\left(S(65), 65\right) - J_k\left(S(65), 65\right)\right] Q_k\left(h(65)\right).$$

The standard numerical solution for such a discrete dynamical program is backward recursion. In addition, we assume the random shocks, ε_t, are serial independent and are unobserved by the econometrician. To understand the connection between the solution of the model and estimation, consider having data on a sample of individual's choices on going to work or attending school, his reward (observed only when going to wok is chosen) and health expenditure in each of periods $t = 10, 11, \ldots, T$. Then, the probability that alternative k was chosen is

$$\Pr\left(\text{alternative } k \middle| \bar{S}(t)\right) = \Pr\left\{k = \arg\max_{l \in K}\left[V_l\left(S(t), t\right)\right]\right\}$$

Our model allows individual's endowments of working skill and study ability heterogeneous. We assume that while the endowment heterogeneity is unobserved by us, we do know there to be 4 types (high working skill, high study ability; high working skill, low study ability; low working skill, high study ability; low working skill, low study ability). Denote μ_η as the proportion of the ηth type in the population. The likelihood contribution for the nth individual is thus

$$L_n = \sum_{\eta=1}^{4} \mu_\eta \prod_{t=10}^{T} \Pr\left(\text{alternative } k \middle| \bar{S}(t),\ \text{type} = \eta\right)$$

Estimation can be conducted using simulated maximum likelihood developed and analyzed in Macfadden (1989) and Keane and Wolpin (1994).

3. Data

We plan to apply the **China's Household Survey** data from 1985 to 2000 to estimate the model. This data set, carried out by the National Bureau of Statistics of China, includes two separate programs for the urban and rural areas respectively. The survey was longitudinal, returning to the same households over time.

Two other data sets could be used to study the health status between rural and urban: **1990 Chinese Census** and **World Bank's *World Development Indicators*: health capital**

4. Budget and Timetable

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