The impact of China's Priority Forest Programs on rural households' income mobility

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ABSTRACT

Over the past two decades, China has undertaken unprecedented forest programs in an effort to restore damaged ecosystems and increasing farmers' income. Using survey results of 2070 rural households in 15 counties of six provinces, we estimate the effects of China's Priority Forest Programs (PFPs) on rural households' income mobility. The effects of the area enrolled in the PFPs on rural households are mixed. It appears that larger area enrolled in the Industrial Timber Plantation Program and the Sloping Land Conversion Program pushed up rural households' income mobility, whereas greater area enrolled in the Natural Forest Protection Program constrained their income mobility, and the size of enrollment in the Desertification Combating Program around Beijing and Tianjin and the Shelterbelt Development Program in the Three-North Regions and the Yangtze River Basin seem to have little effect on rural households' income mobility.

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Introduction

As a concept advanced by Friedman (1962), income mobility describes changes in the income of an individual or a set of individuals in the overall income distribution of a defined group. The focus in income mobility studies is to observe movements in income levels by employing relevant methods to estimate and analyze dynamic changes of a targeted position in the income distribution. Income mobility has already become a crucial part of income distribution analysis (Fields et al., 2002, 2003; Alesina et al., 2004; Shorrocks, 1978, 1982; Chakravarty et al., 1985; Peter and Huynh, 2006; Dragoset and Fields, 2007). For reasons of data availability, empirical studies of income mobility began with cases pertaining to developed countries (Atkinson et al., 1992; Gottschalk, 1997; Wodon, 2001; Maasoumi and Trede, 2001; Fields, 2001, 2007; Jarvis and Jenkins, 1998) and just a few developing countries (Gaiha, 1988; Kapitány and Molnár, 2004; Yitzhaki and Wodon, 2004).

China's per capita gross domestic product (GDP) has increased eightfold since 1978 (Zheng et al., 2008). Similarly, farmers' per capita income increased from 134 yuan in 1978 to 1060 yuan in 2008 (1978 constant price), or an increase of 6.9 times (China National Statistics Bureau, 2009). However, income disparity of rural households has expanded since 1978, whereas the Gini coefficient widened from 0.21 in 1978 to 0.37 by 2007 (Ministry of Agriculture, 2008). Obviously, how to further reduce rural poverty

and income inequality remains a top priority in China. Some studies related to income mobility in China have been carried out (Nee, 1996; Nee et al., 1997; Khor and Pencavel, 2006; Yin et al., 2006; Sun, 2007; Wang and Liang, 2007; Wang, 2005; Quan, 2005, 2008; Zhao, 2008), and found that income mobility contributed to income equality and urban households' income mobility appeared to be stable or changing slowly over time.

Since 1998, the Natural Forest Protection Program (NFPP), the Sloping Land Conversion Program (SLCP), the Desertification Combating Program around Beijing and Tianjin (DCBT), the Shelterbelt Development Program in the Three-North Regions and the Yangtze River Basin (SBDP), the Wildlife Conservation and Nature Reserve Program (WCNR), and the Industrial Timber Plantation Program (ITPP) have been gradually launched by the Government of China to restore degraded ecosystems (see Appendix 1 for detail). In addition to improving the environmental and natural resource conditions, the Government of China has used these PFPs to enhance the income levels of rural residents (State Forestry Administration, 2002, 2003). The number of rural households that participated in the SLCP and the DCBT in 2001 was 3,577,296 and 13,610, respectively, but the participation number jumped to 26,840,778 and 2,524,382, respectively in 2008 (State Forestry Administration, 2008). Large tracts of forestland of rural households have been enrolled under the NFPP, WCNR, ITPP and the SBDP within the PFPs program areas.

Large-scale and effective land conversion and forest ecological restoration programs have mainly taken place in developed countries, notably the Conservation Reserve Program in the United States of America (Cowan and Johnson, 2008), the Permanent Cover

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Environmental Program in Canada, and a variety of short-term set aside programs and long-term forest programs in the European Union (OECD, 1997). In many developing countries, on the other hand, rapid population growth and the associated increase in food demand have led to a continued reclamation of marginal land and deforestation (Scherr and Yadav, 1996). Many developing countries have also paid attention to forest ecological restoration (FAO, 2009). Given China's significant experience in this respect, an assessment of the impact of the PFPs on rural households' income mobility is not only useful for China, but also insightful for other countries, especially those countries that are about to embark on similar pathways of economic transitions.

The implementation of the PFPs has direct and indirect impact on rural households' income levels. From the perspective of rural households, the direct effects of these PFPs are mainly reflected in the government subsidies (under the SLCP and the DCBT), the government restrictions (under the NFPP and the WCNR), and the government incentives (under the ITPP and the SBDP). The indirect impact on rural households' income is mainly reflected in production endowment adjustments caused by these PFPs. Some rural households have participated in these PFPs while others have not. There exist numerous tradeoffs, most of which can result in changed patterns of land use and production. Induced by the land reallocation and production shift, farmers have to intensify farming and commercial forestry activities on their remaining lands, switch animal husbandry from open grazing to pen raising, or search for off-farm jobs in order to sustain their income growth. Therefore, it is expected that following their participation in the PFPs, rural households' income sources and employment structure, and production technology will undergo major transformation. To be sure, in addition to farmers' own initiatives, efforts, and inputs, the extent and trend of their income and employment changes depend critically on the availability and effectiveness of technical, financial, and personnel assistance provided by the local public agencies. Finally, the PFPs have been gradually launched in a number of counties and rural households have been enrolled in the PFPs in different years. For example, provinces such as Shaanxi, Sichuan, Hebei, Jiangxi, and Guangxi Zhuang Autonomous Region have participated in the SLCP since 1999, 1999, 2002, 2001 and 2002, respectively. In the meantime, even in a same village, rural households varied in their involvement in the SLCP and the DCBT from one year to another. Changes have taken place in the income levels of an individual or a set of individuals in terms of the overall income distribution of a defined group, i.e., income mobility.

Some studies related to the direct and indirect effects of the PFPs on rural households' income have been conducted (Zhao and Wang, 2006; Hu, 2005; Li et al., 2004; Guo and Yao, 2007; Liu and Zhang, 2006; Xu et al., 2004; Yi et al., 2006). Besides, change in income structure has also been examined (Zhu et al., 2005; Guo et al., 2005; Yi et al., 2006; Zhao and Wang, 2006; Hu, 2005; Gan et al., 2005; Xu et al., 2004). For those participating households, the area of farmland and forestland committed has varied considerably, due to different preferences and responses to market signals. It is reasonable to hypothesize that the PFPs have altered rural household income, income inequality and income mobility. The impact of the PFPs on rural households' income inequality has been explored (Liu et al., 2010) by means of dataset involving short intervals. It has been recognized that understanding income mobility is of great importance, because it helps explain entrenched nature of households' income.

To the best of our knowledge, because of data limitations and constraints of sample sizes, earlier studies used dataset covering one year or a few years and one region or a few regions. It is very difficult for those researchers to consider the impact of the implementation of the PFPs on rural households' income mobility. This paper uses a dataset of 2070 rural households collected from

15 counties in provinces including Shandong, Shaanxi, Guangxi Zhuang Autonomous Region, Sichuan, Hebei and Jiangxi from 1995 to 2008 to analyze the impact of the PFPs on income mobility of rural households, with a view to understanding whether long-term income inequality has been reduced. With the assistance of a large dataset involving a relatively long period of time, we were interested in estimating the effects of the PFPs on rural households' income mobility and, in turn, analyze changes in income distribution. Our empirical results indicate that the impacts of the PFPs on rural households' income mobility are mixed. The Government of China has made it clear that the PFPs will continue to be implemented in the 12th Five-Year National Development Plan (2011–2015) and the 13th Five-Year National Development Plan (2016–2020). Therefore, the findings of our study will be helpful to government agencies for the next phases of implementation to attain the goals of both ecological restoration and poverty reduction.

The structure of the paper is as follows: the next section describes the methodology and data; then, the empirical results are presented. The paper ends with a discussion and conclusion.

Methodology

Consider an initial vector of sample rural households' income $X = (x_1, x_2, \ldots, x_k, \ldots, x_n) \in R_+^n$, where x_k is the kth household income ranked in an ascending order of income ($k = 1, 2, 3, \ldots, n$), and $n > 1$ is the population. After t period(s), x becomes $y \in R_+^n$, where the households are ordered the same in y as in x. Suppose each household in x is allocated to one of m equally populated ranked income groups indexed by i. The households in y are grouped in groups based on y income. Let $P_{ij} \geq 0$ be the probability that a household in group i will be in group j and t periods later, and define the $m \times m$ transition matrix:

$$P := [P_{ij}], \quad \text{with} \quad \sum_{j=1}^{n} P_{ij} = \sum_{i=1}^{n} P_{ij} = 1 \tag{1}$$

If the possible values of variable X_n have m kinds of status and they are arranged into a probability matrix P after one period:

$$P = \begin{bmatrix} P_{11} & P_{12} & \cdots & P_{1m} \\ P_{21} & P_{22} & \cdots & P_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ P_{m1} & P_{m2} & \cdots & P_{mm} \end{bmatrix} \tag{2}$$

The $m \times m$ transition matrix $P := [P_{ij}]$ is called one step transition probability matrix, obviously,

$$P_{ij} \geq 0 \quad \text{and} \quad P_{ij} = P_{ji} \tag{3}$$

If variable is in state i at period T_n, but shift to state j by t steps, we then call this probability of transition t step transition probability, which is:

$$P\left(X_{n+k} = \frac{j}{X_n} = i\right) = P_{ij}(k), \quad i, j = 1, 2, \ldots, m \tag{4}$$

For $P := [P_{ij}]$ $i, j, \ldots, m$, it could be written as:

$$P_{ij}(k) = \begin{bmatrix} P_{11}(k) & P_{12}(k) & \cdots & P_{lm}(k) \\ P_{21}(k) & P_{22}(k) & \cdots & P_{2m}(k) \\ \cdots & \cdots & \cdots & \cdots \\ P_{m1}(k) & P_{m2}(k) & \cdots & P_{mm}(k) \end{bmatrix} \tag{5}$$

The element P_{ij} indicates the probability of number i rural household in the base year shifting to number j income group in the final