China Economic Review 22 (2011) 344–356

Contents lists available at ScienceDirect

China Economic Review

The impact of agricultural technology adoption on income inequality in rural China: Evidence from southern Yunnan Province

Shijun DING [a], Laura MERILUOTO [b], W. Robert REED [b,*], Dayun TAO [c], Haitao WU [a]

[a] Zhongnan University of Economics and Law, Wuhan, China
[b] University of Canterbury, Christchurch, New Zealand
[c] Yunnan Academy of Agricultural Sciences, Kunming, China

ARTICLE INFO

Article history:
Received 11 June 2010
Received in revised form 25 April 2011
Accepted 29 April 2011
Available online 14 May 2011

JEL classification:
O13
O18
O53
Q12

Keywords:
Rural economic development
Chinese economic development
Upland rice
Income inequality
Agricultural income policy

ABSTRACT

This study analyzes the impact on income inequality of government efforts to increase agricultural incomes in rural China. It collects and analyzes survey data from 473 households in Yunnan, China in 2004. In particular, it investigates the effects of government efforts to promote improved upland rice technologies. Our analysis shows that farmers who adopted these technologies had incomes approximately 15% higher than non-adopters. Despite this relatively large increase, we estimate that the impact on income inequality was relatively slight. This is primarily due to the fact that lower-income farmers adopted the improved rice technology at rates that were roughly equivalent to those of higher-income farmers.

1. Introduction

Over the last several decades, China has made unparalleled progress in increasing incomes and reducing poverty. Government policy, and changes in government policy, can rightly be credited with much of this progress. One undesirable consequence of this progress has been the widening income gap between rural and urban areas. The current rural–urban income gap is the result of a long-term trend that began in 1978 with the economic reforms of Deng Xiaoping. In 1978, rural incomes were approximately 39% of urban incomes. By 2010, they had fallen to 30% (NBS, 2009). This has occurred despite a massive reallocation of labor from rural to urban areas. Over the same period, the share of China's total population living in rural areas fell from 82% to approximately 50% (NBS, 2009).

Chinese policy-makers are keenly aware of the political ramifications associated with the widening gap between rich and poor (e.g., Jiang, 1997).[1] This has resulted in a proliferation of policy initiatives.[2] A major thrust of these initiatives has been the effort to increase rural incomes via state support of agriculture. This is evidenced by the large increases in the national government's

* Corresponding author. Tel.: +64 3 364 2846; fax: +64 3 364 2635.
E-mail addresses: dingshijun2006@yahoo.com.cn (S. Ding), laura.meriluoto@canterbury.ac.nz (L. Meriluoto), bob.reed@canterbury.ac.nz (W.R. Reed), taody12@public.km.yn.cn (D. Tao), wuhan_haitao@yahoo.com.cn (H. Wu).

[1] For example, see http://english.people.com.cn/90001/90776/90882/6911854.html.
[2] For example, CPAD (1994) initiated China's 8–7 National Poverty Reduction Program; CPG (2010) launched the West Areas Development Strategy.

1043-951X/$ – see front matter © 2011 Elsevier Inc. All rights reserved.
doi:10.1016/j.chieco.2011.04.003

agricultural budget that have occurred in recent years. For example, national budget spending on agriculture increased in real terms from 25 billion RMB Yuan in 1990, to 81 billion RMB Yuan in 2000, and to 533 billion RMB Yuan in 2009 (MOF, 2009).[3]

One key component of the government's agricultural policy has been the encouragement of productivity improvements in "marginal" agricultural land in rural areas via local extension services.[4] These areas are of particular importance because a large portion of low income households are congregated there. Improving their incomes is key to reducing rural–urban income inequality in China.

A potential problem with these efforts is that they may increase local income inequality. Indeed, a large literature, stimulated by interest in the consequences of the "green revolution," reports that agricultural technology adoptions can sometimes worsen income inequality (Freebairn, 1995; Griffin, 1974, Lipton & Longhurst, 1989; Pearse, 1980). Numerous studies have investigated income inequality in rural China (Chen & Zhang, 2009). Benjamin, Brandt, and Giles (2005) report that most rural inequality is due to local (within village) differences rather than differences across villages or provinces. While studies reach different conclusions as to the source of local income disparities, Ravallion and Chen (1999) conclude that when it comes to farm income, grain production is a major contributing factor.

Given this interest in rural income inequality, it is perhaps surprising that little is known about the distributional impacts of government-aided productivity improvements in Chinese farming communities. We are aware of only one study that directly addresses the impact of improved agricultural technology. Lin (1999) investigated the effects of F_1 hybrid rice adoption. He used data from a cross-sectional survey of 500 households in 5 counties of Hunan Province taken in December 1988 and January 1989. While he did not come to a definitive conclusion regarding income inequality, Lin found that adopters saw their rice incomes increase; and non-adopters saw their non-rice incomes increase. The latter mitigated the income inequality effects of the former.

An important difference between our study and Lin's is that his study focused on hybrid, paddy rice adoption in lowland areas. In contrast, our study focuses on hybrid rice adoption in upland areas. It is the latter which is now receiving much attention in the development literature (Conway, 1999; Fan & Hazell, 2000; Pender, 2008). Pender (2008, page 7) writes:

> During the past several decades, dramatic improvements in agricultural productivity and the reduction of poverty have been achieved in many countries of South and East Asia. …Despite this progress, hundreds of millions of rural people in less-favored environments – areas where rainfed agriculture dominates and where there are critical biophysical constraints such as low and uncertain rainfall, steep slopes and poor soil, or socio-economic constraints such as poor access to markets, infrastructure and services – have obtained much less benefit from this progress.

Gustaffson and Li's (2002) finding of substantial heterogeneity in income growth rates across counties in rural China is a reminder that one-size-fits-all generalizations should be viewed with caution. There is therefore a need for additional studies to confirm or disconfirm the findings of Lin's (1999) research. This study meets that need by analyzing the income effects of technology adoptions associated with the introduction of an improved upland rice variety. We draw on a cross-sectional survey of rural households in Yunnan province conducted in 2005. While our study differs from Lin in some important respects, it reaches a similar conclusion. We find no evidence that the adoption of improved upland rice contributes to increased income inequality.

Our study proceeds as follows. Section 2 reviews Lin's (1999) theoretical analysis of the impact of improved rice technology on household incomes. Section 3 presents some background concerning the agricultural technology adoption studied here. Section 4 discusses the data used in our empirical analyses. Section 5 reports the results of our investigations. Section 6 concludes.

2. Theory and methodology

2.1. Theory

Lin's (1999) model of the effects of improved rice technology provides a useful framework for understanding the issues associated with our empirical analysis. The starting point is a two-good, two-household general equilibrium model where comparative advantage is driven by different input endowments of the households, as well as different input requirements of the two goods. The two goods produced are rice (R) and non-rice (N). Rice is assumed to be land-intensive; and non-rice, labor-intensive. The two households are indexed by $i=\{1,2\}$, and possess endowments E_i. The production possibilities frontier of non-rice for Household i is defined as:

$$y_{Ni} = F_i(y_{Ri}, E_i).$$

It is assumed that Household 1 is land-abundant and has an endowment vector E_1 that gives it a comparative advantage in rice. It is also assumed that there are no factor markets but perfect product markets, so that all transactions take place through the product market. The income of Household i is defined as

$$I_i = y_{Ni} + \frac{p_R}{p_N} y_{Ri}.$$

[3] Expenditures are in 1990 constant Yuan.

[4] The Chinese government re-established its public agricultural extension service in the late 1970s. By the middle of the 1980s, China had established public agricultural extension service stations in every county and township, including remote regions. The system provided high-quality agricultural extension service. By the middle of the 1990s, it employed an extension staff of more than 1 million, approximately 70% of whom had graduated from technical high schools or colleges. More than 90% of these worked at public agricultural extension system stations at the county and township levels (Hu, Yang, Kelly, & Huang, 2009; Lu, 2009). Based upon a survey of 28 counties in rural China, Hu, Huang, and Li (2004) report that 40% of new agricultural technologies adopted by farmers during 1996 and 2002 were generated from public agricultural extension services.