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## Does computer penetration increase farmers' income? An empirical study from China

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### ABSTRACT

The diffusion and adoption of modern information technology provide new chance for China to close urban-rural income gap. This paper uses China's provincial panel data from 2002 to 2013 to investigate the effect of computer penetration on rural residents' income. A public program aiming to connect every village with broadband Internet and other rural facilities provides plausibly exogenous variation in rural residents' availability and adoption of the broadband Internet, which is used to explore the instrument variable for rural computer penetration. The results show that rural computer penetration tends to increase rural residents' income over time, but the average effect remains limited. The dynamic panel threshold effects model, which allows for both the threshold variable and other covariates to be endogenous, is further used to explore the constraints of the income-increase effect of rural computer penetration. It shows that the effect is at least doubled over the average effect estimated from instrument variables method, once the digital divide causes are removed. Our findings have important implications for the government to increase rural residents' income and reduce urban-rural income gap by encouraging rural computer usage and removing the digital divide.

### 1. Introduction

As a result of urban-biased policies, an urban-rural income gap broadly exists in developing countries and undermines social stability and sustainable development. In China, although this gap has decreased since 2009, after years of pro-rural policies at the central government level since 2004, the disposable income of urban and township residents remained 2.73 times the net income of rural residents in 2015 (NBSC, 2016). Agricultural technological progress is an important driving force of raising rural productivity, increasing rural residents' income, and narrowing the urban-rural income (Fan & Pardey, 1997; Gao, Zheng, & Bu, 2014; Huang & Rozelle, 1996). During past decades, the diffusion of the Internet and communication technology (ICT) in rural areas has provided new opportunities for rural dwellers to increase their income and thus reduce sectoral income gap. Although ICT cannot be considered as a pure agricultural technology, rural residents are using it to distribute and share information, advertise and sell agricultural products, learn new skills and knowledge, and purchase qualified agricultural inputs.

Mobile phones and computers are two terminal devices used to connect to the Internet. Compared with using a mobile phone, using a computer requires more skills and knowledge, and it is for diversified needs other than communications and amusements. If one wants to engage in e-business, he/she needs a computer. Like rural residents in Taobao villages who sell rural products through

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China's largest C2C online platform, [Taobao.com](http://Taobao.com), they need computers to distribute product information and process online orders.<sup>1</sup> This paper tries to estimate the effect of rural computer penetration on rural residents' income.

Because a computer costs on average much more than a mobile phone, for rural households purchasing a computer is more likely a real need for rural business or agricultural activities. It does not exclude, however, the reverse causality that rural households own a computer resulting from an increase in income. To address such endogeneity, this paper uses the change in Internet penetration rate caused by an exogenous policy shock, the Cuncun Tong (CT) Project, which aims to connect each village with modern facilities including broadband Internet, as the instrument variable of rural computer penetration. The two-stage least squares (2SLS) estimation with the provincial panel data finds that the income-increase effect of rural computer penetration is very small but statistically significant and increases over time. A 10% increase in rural computer penetration leads to a 0.43% increase in rural residents' income growth, which increased to 0.74% after 2007.

To further investigate the digital-divide constraints of rural computer penetration, we further use the dynamic panel threshold effects model (DPTM) which allows for both the threshold variable and other covariates to be endogenous. The two-step first-difference generalized method of moments (GMM) estimation from DPTM shows that the income promotion effect of rural computer penetration is constrained by the level of rural computer penetration itself, rural residents' education, economic development, and rural public infrastructures. Removing such constraints will increase the contribution of computer penetration to rural residents' income growth 2 to 4 times its average contribution estimated from 2SLS.

The rest of the paper is structured as follows. Section 2 provides a brief review on extant literature based on which the contribution of this paper is introduced. In section 3, we introduce the CT project and its effect on Internet penetration rate, which provide exogenous shock on rural computer penetrations. The empirical strategies are specified in section 4 where we introduce the empirical models, the variables, and the data, and test the validity of the instrument variable. Section 5 reports the empirical results, and section 6 concludes the paper.

## 2. Literature review

Our study first connects to the literature on the socioeconomic effect of Internet diffusion and adoption in the sense that computer usage is based on Internet access. The literature either examines the relationship between Internet usage and overall economic performance (Acharya, 2016; Bu & Zhan, 2011; Choi & Hoon Yi, 2009; Hwang & Shin, 2017; Ng, Lye, & Lim, 2013; Noh & Yoo, 2008; Qiang, Rosotto, & Kimura, 2009), the effect of the Internet on labour productivity and wage (Akerman, Gaarder, & Mogstad, 2015), or explores the cases of the effect of Internet diffusion on rural development (Zhao, Hao, & Banerjee, 2006; Rye, 2008; Xia, 2010). Recent literature emphasizes or examines the implication of the Internet for rural firms in developed countries (Canzian, Poy, & Schüller, 2015; Galloway, Sanders, & Deakins, 2011) as well as the effect of rural broadband diffusion on local economic growth in developed countries (Whitacre, Gallardo, & Strover, 2014a, 2014b). Although Qiang et al. (2009) exemplified programs showing that access to broadband Internet produces positive impact on rural income in developing countries like India and Burkina Faso, it lacks empirical studies on the relationship of Internet adoption through use of a computer and rural residents' income growth. In particular, the research related to the influence of the Internet usage on the income of Chinese rural residents is still blank.

The second strand of literature connecting to our study concerns the digital divide (Chinn & Fairlie, 2007; OECD, 2001; Schleife, 2010; Vigdor, Ladd, & Martinez, 2014).<sup>2</sup> People differ significantly in their abilities to access and use the Internet through a computer due to their locations, education levels, the extent of Internet diffusion, and information infrastructures. This strand of the literature has investigated the causes of the digital divide, including socioeconomic factors such as GDP per capita, population structures, education, public infrastructures (Chinn & Fairlie, 2007; Korupp & Szydluk, 2005); environmental factors such as family members' use of computer, friends' use of computer, which determines the network effects and the social capital in computer usage (Li & Shiu, 2012; Liu & San, 2006; Quibria, Ahmed, Tschang, & Reyes-Macasaquit, 2003; Schleife, 2010); and individual factors such as differences in income, education, skills, experience, and knowledge of how to use the Internet (Drouard, 2010; Hargittai, 2002; LaRose, Gregg, Strover, Straubhaar, & Carpenter, 2007; Warschauer, 2010; Whitacre, Strover, & Gallardo, 2015; van Deursen & van Dijk, 2010).

Computer penetration suffers from similar constraints because the computer is one of the terminal devices people use to connect to the Internet. Moreover, rural residents differ even more significantly in their ability to access a computer and the broadband Internet, and thus suffer the aforementioned constraints more. As a result, rural computer usage is very limited while mobile phones, which are much cheaper and more easily portable, are increasingly used to access the Internet and improve market efficiency (Aker, 2010; Jensen, 2007), and are called to replace PCs in rural areas (Samarajiva, 2009; Veeraraghavan, Yasodhar, & Toyama, 2009). In China, more than 95% of Taobao villages are located in developed eastern regions, but these constitute only a very small part of eastern villages (Ali-Research-Institute, 2015b, 2015a). Given that the diffusion and adoption of ICT in China is mainly determined by income, education, and information facilities (Li & Shiu, 2012), and that China's rural areas are much less developed than urban areas, this paper tries to examine the constraints of the main causes of the digital divide – namely income, education, and infrastructures – on the income-increase effect of rural computer penetration.

<sup>1</sup> Taobao Village is a cluster of rural e-sellers within an administrative village where residents get started in e-commerce spontaneously primarily with the use of the Taobao Marketplace, the total annual e-commerce transaction volume is at least 10 million yuan (about \$1.6 million), and at least 10% of village households actively engage in e-commerce or at least 100 active online shops have been opened by villagers. According to the Ali-Research-Institute (2016), the number of Taobao villages has jumped to 1311 at the end of 2016; Taobao villages have appeared in 18 provinces, with more than 300,000 online shops, bringing about the direct employment of 840,000 persons.

<sup>2</sup> According to OECD (2001), the "digital divide" refers to "the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities." (p. 5).

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