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Land tenure security and adoption of modern rice technology in Odisha, Eastern India: Revisiting Besley's hypothesis

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ABSTRACT

This paper examines the Besley's hypothesis in agriculture of Odisha, Eastern India which says that land tenure security induces farm investment, i.e., adoption of improved/modern rice technology. A simple portfolio model has been developed which incorporates three different specifications of tenurial status that defines land tenure security. The model hypothesizes a positive effect of secured land tenure on technology adoption. Empirical estimations of that hypothesis with the help of tobit regression confirm that secured land tenure significantly augments both probability as well as intensity of adoption. In the first specification, it is observed that the owner operators, whose tenurial rights are more secured, are more likely to adopt MVs than the tenant cultivators (both partial tenants and pure tenants). In the second specification, tenants having long duration tenure are assumed to be relatively secured and they are found to be better adopters of MVs as compared to others. In the third specification, where fixed renters are assumed to be relatively secured tenants are not found to be significantly different from share croppers so far as adoption of MVs is concerned. The empirical evidences support Besley's 'security effect' hypothesis that secured land tenure enhances adoption of improved technology. The policy implication of the study suggests lifting of the legal ban on tenancy in the agriculture of Odisha and bringing a reform in the agricultural tenancy system.

1. Introduction

Land tenure plays a vital role in shaping the land use decision of farmers (Rasul et al., 2004). It has significant implications for food security and poverty alleviation, especially in regions where more than half of the population is engaged in farming. Moreover, it affects their decision to invest in agriculture (Besley, 1995; De Soto, 2000; Aha and Ayitey, 2017). As explicated in the literature that a secured tenurial status encourages farm investments and augments farm productivity, thereby alleviates poverty and accelerates economic development (Abdulai et al., 2011; Koirala et al., 2016; Zeng et al., 2018). However, farmers' investment decision is adversely affected if they are uncertain about their land tenure rights or their claim on the produce (Place, 2009; Tenaw et al., 2009). The tenant cultivators would be reluctant to make investments in land management if they do not have secured land tenure rights that make them vulnerable to eviction by landlords or land owners (Rasul et al., 2004; Tenaw et al., 2009; Zeng et al., 2018). Therefore, a secured land tenure is the base on which the farm investment is undertaken by the farmers. Because, a secured tenurial status strengthens the claim on the produce after initiating farm investments (Place, 2009), safeguards cash flows over time, facilitates asset liquidation given transferable land rights and enhances access to credit (Feder and Nishio, 1998; Zeng et al., 2018). So, all these factors incentivize adoption of improved/modern technologies that requires farm investments. Besley (1995) quite lucidly demonstrated three channels through which tenure security can possibly enhance farm investments and thereby adoption of modern technology. The first one is the '*security effect*' which says that a farmer perceiving a higher risk of losing his/her tenurial right to land and seizure of the fruits of the investment would be hugely disincentivized to invest in lands. In fact, a secured tenancy enhances the possibility of more investment in land by the tenants. The second channel is called '*collateral effect*' which points out that a secured land right makes it easier to use the land as collateral to fund land based investment. The third channel is the '*gains from trade*' which tells that investments may be encouraged if transfer rights enable individuals to rent or sell their lands easily. Though, these propositions are theoretically convincing but empirical evidences have been diverse and inconclusive.[1]

However, in Indian context, there is a dearth of research to test the security effect of land tenure on farm investment and thereby farm productivity. Further, no particular attention has been paid to analyze the role of land tenure security in deciding the proportion of land to be allotted to

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[1] Place (2009) has comprehensively surveyed the studies endorsing both divergence and convergence of land tenure and agricultural productivity while Aha and Ayitey (2017) reviewed studies in Africa and showed that results vary considerably.

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the adoption of modern technology and traditional technology. In other words, it has not been checked whether the same security effect advocated by Besley (1995) is valid when it comes to adoption of modern technology like improved paddy varieties[2] by marginal and small tenant cultivators. Though empirically tenancy as one of the determinants of technology adoption has been studied extensively in India and also other parts of the world, the role of land tenurial security is one that has been grossly ignored.[3] Adoption of modern technology like MVs of paddy is one form of farm investment, given the risks attached with it. More secured land tenure acts as an incentive for the farmers to go for MVs adoption. In fact, the security effect may work in two directions. First, it may enhance the probability of MVs adoption by new adopters. This is because a secured tenurial status ensures less risk of losing the claim on land and thereby the produce. So, it may incentivize the farmers to adopt more yield enhancing technology like MVs of paddy and reap more profits. Second, at the same time, it may also lead to allocation of more land by existing adopters to that particular technology. So it augments intensity of technology adoption. Thus, secured land tenure may augment the probability of adoption as well as intensity of adoption. The first one is termed here as probability effect of secured land tenure on adoption and the second one is termed as intensity effect of land tenure on adoption. This paper attempts to fill this gap in the literature by empirically examining the Besley's security effect thesis of land tenure on modern technology adoption in Indian agriculture. It examines empirically the role of land tenure security in their decision to adopt the modern technology and also two hypothesized channels that it may influence the adoption behaviour. Taking the use of improved paddy varieties as the modern agricultural technology, the adoption behaviour of paddy growers in Odisha is studied here in this paper. The two specific objectives pursued in this paper are: (i) to examine specifically the impact of secured land tenurial status on adoption of improved paddy varieties, and (ii) to check the probability effect and intensity effect of land tenure security on MVs adoption.

The paper is organized in this manner: after the introduction and the statement of objectives in the first section, a simple theoritical model is developed in the second section. The third section deals with study region, data collection and variable construction. Presentation of empirical results and subsequent discussions take place in the fourth section and finally the paper concludes with some policy implications.

2. The model

To motivate our empirical work and demonstrate the likely impact of tenurial status on adoption decision of improved paddy varieties (MVs), a theoretical model namely 'portfolio selection model' is developed here in this section.[4]

The adoption of modern technology like MVs is a portfolio selection problem. The sole aim of the farmer is to maximize his utility from adoption of MVs. Thus, two things that matter to the farmer are the mean income and variance of his income. Let the farmer having two alternative technologies of same crop rice, i.e., the improved/modern varieties (MVs) and traditional varieties (TVs). TVs are assumed to have low yields but stable and certain to each farmer.[5] However, the difference in output level across the farmers can be attributed to the difference in the characteristics specific to farmers. At the same time adoption of MVs yields higher output but uncertain to each of them.

Jamison and Lau (1982) showed that if all land of i^{th} farmer is devoted to TVs, then farmer's income can be written as:

$$Y_{it} = \phi_t(E) + \varepsilon_{it} \tag{1}$$

where E represents a vector of independent variables like quantity of seeds, farm size, fertilizer used, labour hours used and so on. The disturbance term ε_{it} shows the farmer's specific capacity to produce TVs. Using the same convention we can write the mean income if all lands are devoted to MVs as:

$$Y_{im} = \phi_m(E) + \varepsilon_{im} \tag{2}$$

The variables ε_{it} and ε_{im} cannot be directly observed, but their joint distribution over the whole population can be described by a probability density function. The term $\phi_j(.)$ represents the functional relationship between the mean incomes from the adoption of j^{th} technology and those independent variables, where j being either TVs or MVs.

So with r_i proportion of land being devoted to MVs, the mean income can be expressed as:

$$\begin{aligned} Y_i &= Y_{it} + r_i\,(Y_{im} - Y_{it}) \\ &= \phi_t(E) + \varepsilon_{it} + r_i\,[D(E) + (\varepsilon_{im} - \varepsilon_{it})] \end{aligned} \tag{3}$$

where $D(E) = \phi_m(E) - \phi_t(E)$. There will be no variance of income if entire land is devoted to TVs. But, adoption of MVs involves some risk of uncertain yields (Anderson, 1995; Saha, 2001; Samal and Pandey, 2005; Goyari and Sharma, 2008) and it leads to variance of income that assumes the following functional form as:

$$V_i = V_{im}(s_i,\ Z_i,\ E) \tag{4}$$

Where s_i is the i^{th} farmer's tenurial status and Z_i is the vector of other characteristics such as farming experience, education, credit availability to farmer, extension services accessed by the farmer and so on. If r_i proportion of land is allotted to MVs, the variance of income will be as follows:

$$V_i = r_i^2\, V_{im}(s_i, Z_i, E) \tag{5}$$

Here r_i is positively related to variance of income and it augments the variance if greater proportion of land is allotted to MVs. For the convenience of easy interpretation, the utility function is assumed to be separable one and takes the following form as:

$$\begin{aligned} U_i &= Y_i - L(V_i) \\ &= Y_i - L(r_i,\ s_i,\ Z_i,\ E) \end{aligned} \tag{6}$$

where $L_1 > 0$, $L_{11} > 0$ and $L_{12} < 0$ and $L(0, T_i, Z_i, E) = 0$.

The term L (.) shows the loss of utility and it increases at an increasing rate if r_i increases. But, a secured tenurial status of the farmer is assumed to reduce the utility loss emanating from MVs adoption due to variance of mean income (Y_i). Because, if the tenurial status is a secured one, then the farmer will put more efforts to reduce the risk of income loss and try to maximize the benefits from MVs adoption. Further, it is also assumed that utility loss will be zero if no land is allocated to MVs as the variance of income (Y_i) will be zero. Therefore,

[2] Here improved varieties include the new generation of high yielding varieties, hybrid and various stress tolerant varieties.

[3] Many empirical studies in India modeled this variable and got mixed results. Studies like Parthasarathy and Prasad (1978) found the evidence that tenants had a lower tendency to adopt technology than owner operators. But, fertilizer adoption intensity was same for both owners as well as tenants. Vyas (1975) showed a completely contradictory result that tenants are not only as innovative as land owners but, also use more fertilizers sometimes per acres than do the owners. However, Sarap and Vashist (1994) concluded that tenancy discourages adoption behaviour. They concluded that this relationship differs in different socio-cultural environments. Some studies in Bangladesh like Shahid and Herdt (1982) and Bhuiyan (1987) found the evidence of adverse impact of tenancy system on adoption of improved crop varieties (MVs) while Rahman (1998) and Rahman (2002) found no significant influence of tenurial arrangement on adoption of HYVs. Bandiera (2007) in Nicaragua found that owner operators are more likely to invest more on the plots they own rather than the plots being rented in.

[4] The portfolio selection model here in this paper is developed in line with the model developed by Lin (1991). Out of many varieties of theoretical models explaining the adoption of modern agricultural technologies, portfolio selection model is one that assumes that farmers are risk averse. So they try to minimize the risk by allocating some land to traditional technology even though modern technology is profitable. For more details, see Smale et al. (1994). Another type of model called two-periods model is also being developed by Soule et al. (2000) and Zeng et al. (2018) and so on.

[5] Traditional varieties (TVs) are also grown by many farmers not because of stable and certain yield only but also due to the reasons that it is preferred over MVs on the basis of peoples' taste and preferences. In certain local festivals, TVs are also preferred.