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Tenure Security, Human Capital and Soil Conservation in an Overlapping Generation Rural Economy

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ABSTRACT

We develop an overlapping generation model of rural agricultural households to examine whether tenure security and subsistence needs influence the choice between unexploited topsoil and investment in children's human capital as the mode of transfer of wealth. A unique dataset from Bangladesh finds that tenure security is associated with greater topsoil conservation and lower human capital investment. Therefore, there exists a tradeoff between these two modes of transfer. We suggest that increased public expenditure on schooling, which substitutes private expenditure, may lower the pressure on land and soil resources.

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1. Introduction

Rural areas of developing countries are highly dependent on agriculture for both income and employment (Malik, 1999). Around 70% people from low-income countries live in rural areas where agriculture is the principal economic activity, contributing around 32% of the gross domestic product and employing nearly 80% of the workforce (World Bank, 2015). Moreover, low per-capita arable land results in high incidences of poverty in those countries; only 0.22 ha of land are available per-capita and around 47% of people live below the $1.90/day poverty line in lower income countries (World Bank, 2015).[1] Hardcore poverty often forces farmers, especially smallholders, to use their limited land resources intensively to meet even subsistence consumption needs. This high dependence on land-intensive agricultural production results in increased pressures on different attributes of land quality, such as topsoil.

Topsoil, which is an important determinant of agricultural productivity, is often conserved and shared from one generation to the next (Bréchet and Lambrecht, 2011). Common soil conservation practices include stone terracing and tree plantation. However, the benefits of such conservation efforts may take years to be realized (Reardon and Vosti, 1995); and, often tenure insecurity results in overexploitation of the topsoil to maximize the immediate returns at the cost of future damages (Ray, 2005). The absence of proper land and other important markets in the rural areas of developing countries may limit the eventual financial returns to conservation. Yet, rural agricultural households devote considerable amounts of time and effort for topsoil conservation, often as a form of stewardship for future generations (Besley, 1995; Brasselle et al., 2002; Deininger and Jin, 2006; Ervin and Ervin, 1982; Reardon and Vosti, 1995). This suggests the presence of altruistic behavior within the family (e.g., Becker, 1981), and we therefore consider such intra-household altruism as the key incentive for conserving the topsoil.

The lack or improper enforcement of land tenure security often contributes to topsoil degradation through reduced incentives for conservation effort (Deininger et al., 2013; Deininger and Jin, 2006; Gebremedhin and Swinton, 2003; Kabubo-Mariara, 2007; Ray, 2005). Consequently, tenure security can play a central role in influencing the topsoil conservation decision (IFAD, 2008; UNECA, 2009). Land tenure, which refers to the social relations and institutions that govern access to and control over land and related resources, determines who can use the land resources, for how long and under what conditions (IFAD, 2008). Consistent with this definition, we empirically define tenure security in terms of owned land as proportion of total operated agricultural land by a household. In many developing countries including Bangladesh, agricultural land rental transactions are mostly informal and, therefore, represent a reasonable form of tenure insecurity (e.g., Eskander and Barbier, 2016; Ray, 2005).[2] Depending on the degree of tenure security, the altruistic current generation may be interested in

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[1] In 2012, 47% of the population of low-income countries still lived on less than US$1.90 (2011 PPP) a day per capita, and 74% lived on less than US$3.10 (2011 PPP) a day per capita (World Bank, 2015). Low-income countries are those in which 2014 GNI per capita was $1045 or less.

[2] Similarly, Ray (2005) considers share tenancy as a measure of tenure security. It identifies that the tenant-farmers might overexploit the land to maximize immediate returns even at the cost of future damages, and under-supply long-run productivity improving investments in land, than the owner-farmers.

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alternative modes of transfer to the future generation, such as investment in human capital of the future generation.

We develop an overlapping generations (OLG) model of a representative rural agricultural household to explore the linkage between intra-household altruism, tenure security and topsoil conservation. The current generation maximizes an altruistic inter-temporal utility function by making labor allocation, consumption and transfer decisions. At the beginning of the second period, the current generation allocates its total labor time between agricultural production and topsoil conservation, and allocates agricultural income between consumption and human capital investment. It transfers the agricultural land with the remaining topsoil to the future generation at the end of the second period. Thus, after meeting its production and consumption needs, the current generation may end up transferring various combination of unexploited topsoil and human capital investment to the future generation (e.g., Tomes, 1982).

Our theoretical analysis focuses on substitutability between unexploited topsoil and human capital investment as the method of transfer. Based on the theoretical findings, we hypothesize that households with greater tenure security have greater conservation investment and lower human capital investment. We use the Bangladesh Household Income and Expenditure Survey (HIES) dataset to investigate these hypotheses for the agricultural households of Bangladesh.

The impact of tenure security on topsoil and land conservation has been widely studied in the literature (Place, 2009; Gebremedhin and Swinton, 2003). Potential sources of tenure insecurity include lack of land titles (Bezabih et al., 2012), short-term tenancy contracts (Bandiera, 2007; Ray, 2005), lack of transferability (Besley, 1995), risk of expropriation (Deininger and Jin, 2006) and customary gender-biased inheritance practices (Lovo, 2016). However, the empirical relationship is inconclusive, and depends on the specific case under study (Besley and Ghatak, 2009). One possible reason is that the alternative modes of wealth transfer by households have not been considered. This is the first investigation to consider how tenure security influences the choice between unexploited topsoil and human capital investment as the mode of intergenerational transfer of wealth.

We find that a unit increase in tenure security has significant associations with a 0.54% increase in conservation investment and 0.16% decrease in human capital investment. That is, Bangladeshi agricultural households experience a tradeoff between conservation and human capital investments emerging from tenure security: given the level of tenure security, an increase (decrease) in conservation investment must be accompanied by a decrease (increase) in human capital investment, and vice-versa. Substitutability between them may lead to important implications for developing countries in terms of both private educational expenditure and land resource management. Since public and private investments on conservation and human capital investments are complementary, public policies that target the conservation and management of land and soil resources may result in higher private investment on children's human capital development. Similarly, higher public investment in education may increase conservation investment.

The content of the remainder of the article is as follows. Section II develops the OLG model of rural agricultural households and analyzes the effect of tenure security on optimal decisions. Section 3 specifies the empirical strategy. Section IV provides a brief discussion of data used for empirical analysis. Section V discusses the main empirical results. Finally, Section VI summarizes and concludes by discussing the key policy implications.

2. An OLG Model of Rural Agricultural Households

The overlapping generations (OLG) model in this paper includes two modes of transfer: unexploited topsoil and human capital investment (i.e., educational expenditure), in the context of a rural developing economy. Our interest is to determine how the choice is made between these alternative modes of transfer and to identify factors critical to this choice.

The rural economy consists of M homogeneous agricultural households, which can be represented by a single household. At any point in time, the representative household consists of two overlapping generations: *young* and *old*. The current generation, denoted by the subscript 1, is born in time t and lives two consecutive periods t (*young* age) and $t+1$ (*old* age).[3] It does not earn in time t, rather lives on the contribution from the previous generation. The current and future generations overlap in time $t+1$, when the current generation earns agricultural income, and makes consumption, labor allocation and transfer decisions.

The current generation uses its fixed endowments of land and labor for agricultural production. It inherits a fixed amount of land with a given topsoil depth and tenure security from the previous generation at the end of time t. On retirement from economic activities at the end of time $t+1$, it transfers the land to the future generation with remaining topsoil depth. The altruistic current generation may spend a part of its total labor time in topsoil conservation, which does not directly affect current agricultural production but prevents soil depletion and thus indirectly influences the production of the future generation.

Land tenure security is often missing, or not properly defined and enforced, in the rural areas of developing countries (de Janvry et al., 2015). We consider an exogenous measure of tenure security, θ, which is continuous within the range [0,1], where higher values of θ indicate greater tenure security, and vice-versa, $\forall\theta\in[0,1]$. Among the extreme cases, $\theta=1$ implies complete tenure security, and $\theta=0$ implies zero tenure security. We assume that θ is time-independent, i.e., the degree of tenure security is fixed across generations. Empirical analyses, predominantly on sub-Saharan Africa, provide mixed evidence of direction on the relationship between tenure security and soil conservation (Deininger and Jin, 2006). While secured tenure can potentially increase soil conservation investment, such investments could also lead to increased tenure security (Besley, 1995). However, empirically the direction of relationship depends on the specific type of investment and definition of tenure security (Lovo, 2016). As has been outlined in the following sections, we empirically define tenure security in terms of owned land as proportion of operated land and conservation investment in terms of money spent on compost and forest seedlings. While these types of investments are productivity-enhancing, they are not necessarily security-enhancing (e.g., Deininger and Jin, 2006). Moreover, because of the absence of a properly functioning land sales market and no apparent governmental policy on the intergenerational transfer of land in Bangladesh, user rights of agricultural land are typically transferred through inheritance, making the security-enhancing role of conservation investments less likely at least according to the empirical definitions we use in this paper.

The current generation maximizes a utility function, which incorporates Stone-Geary preferences (SGP) with respect to its subsistence consumption needs as well as altruistic concerns for the future generation. The present generation gains utility from its consumption above the subsistence level and altruistic utility from the welfare of the future generation. Let $c_{1,t+1}$ denote its consumption in time $t+1$, $\bar{c}$ the subsistence level of consumption, and U_2 the utility of the future generation. The inter-temporal utility of the current generation is:

$$U_1 = u(c_{1,t+1}-\bar{c}) + \rho U_2, \tag{1}$$

[3] Similarly, the future generation, denoted by the subscript 2, is born in time $t+1$ and lives two consecutive periods $t+1$ (young age) and $t+2$ (old age).

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