Forest commons, rural saving and investment: Evidence from Ethiopian villages

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Abstract

In this paper, we evaluate the impact of Joint Forest Management (JFM) on precautionary saving, investment in child education and participation in off-farm self-employment activities among forest-using households in Ethiopia. We instrumented endogenous program participation by exogenous variation in customary rights experience within communities eligible for the JFM intervention. We also employed alternative identification strategies, including propensity score matching and difference-in-difference (DID) to test the robustness of our results. The analysis was based on the data collected from selected villages in the Gimbo district, in south-western Ethiopia. Our results show strong evidence that participation in the program deters livestock asset holding, suggesting a decrease in demand for precautionary saving. Moreover, we found that the program has spurred investment in child education and participation in off-farm self-employment. Policy implications discussed.

Keywords: *Forest commons, tenure reform, treatment effects, precautionary saving, child education, off-farm employment*

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1. Introduction

Across tropical countries, recent years have seen a wave of devolution of natural forest management to local communities to counteract deforestation and deal with its effects. Essentially, decentralization policies are intended to halt deforestation through investment in the form of stewardship of the existing forest stock, by restricting excessive forest harvesting and giving up agricultural land expansion. Spurring this type of investment by community organizations requires incentives, one of which is economic benefits provided by forests themselves through the decentralization reform. In the wake of these institutional shocks to forest commons management, the literature has mainly focused on examining the effects of such reform on the resource base (i.e., the forest) and the attendant welfare and distributional outcomes. Empirical evidence emerging from this class of literature suggests that devolution, particularly in the form of Joint Forest Management (JFM), has reduced deforestation (Nagendra, 2002; Kassa et al., 2009; Blomley et al., 2008; Gobeze et al., 2009; Klooster and Masera, 2000; Edmonds, 2002; Yadev et al., 2000 and Bluffstone, 2008) and yielded mixed welfare and distributional outcomes (Jumbe and Angelsen, 2006; Cooper, 2008 and Gelo and Koch, 2013).

However, uncertainty remains regarding the implications of these reforms for household saving and investment behaviours. Specifically, the effects on various risks, coping strategies and willingness to invest in riskier activities with the potential for higher return have not been documented in the extant literature. Against this

backdrop, we studied the effect of an Ethiopian JFM program, which was augmented by marketing support for Non-timber Forest Products (NTFP), on households' precautionary saving in the form of livestock holding, investment in children's education and participation in off-farm self-employment opportunities.

Invariably, the JFM reforms have been instituted in the developing countries context, where income and health risks are pervasive phenomena among farming households, which depend on rain-fed agriculture as a large source of their income. Furthermore, these households find themselves in an economic environment in which financial markets, credit, insurance and forward markets are either poorly developed or missing altogether, making it difficult to ensure income shortfall or smooth consumption. In response, these households often have recourse to self-insurance mechanisms, which include precautionary saving in liquid or productive assets (grain stock or livestock)[3] (Fafchamps et al., 1998 and Kazianga and Udry, 2006), extraction of NTFP (Pattanayak and Sills, 2001; Delacote, 2007 and Debela et.al, 2012), leaning on reciprocal social networks (Decron and Krishina, 2004) and cutting back investment in children's schooling (Jacoby and Skoufias, 1997; Jensen, 2000 and Dillon, 2012).

Such rational portfolio behaviour in the presence of uninsured risk can help perpetuate poverty (Jallan and Ravallion, 2001). Public or market mechanisms that protect against downside shocks (income shortfall) are likely to crowd out these behaviours and consequently reduce poverty (Gertler et.al, 2012).

[3] When faced with greater income risk in the absence of functioning insurance and credit markets, a high level of risk aversion induces households to save for the future in order to smooth consumption, even if they have high discount rates. This behaviour is commonly christened precautionary saving in the literature (Deaton 1989, 1991; Rosenzweig and Binswanger, 1993).

One such mechanism is JFM, particularly when coupled with improved market linkages for non-timber forest products. By increasing NTFP prices via improved market integration and access, the institutional shock of JFM is moderated by increased returns to NTFP extraction. Moreover, the multiplicity and seasonal distribution of NTFPs means that this income accrues steadily (Pattanayak and Sills, 2001 and Arnold and Perez, 2001) and hence stabilizes overall annual income, such that it cushions the fall in total income that would occur during bad times, but increases total income during good times. Thus, by eliminating or at least minimizing the lower tail of total income distribution, the increased returns to NTFP extraction will increase the first moment (mean), but reduce the second moment (variance) of the total income distribution. It follows that increased expected income, along with reduced income risk (i.e., reduced variability), will increase current consumption, and thus reduce the demand for precautionary saving in the form of holding more productive or liquid assets (such as livestock) or reducing children's educational expenditure.

Moreover, if increased return to NTFP extractions is perceived as a secure and steady source of income over time, risk-averse households will be more willing to invest in riskier but higher-return activities. Inter alia, these include investing in children's education and entrepreneurial self-employment ventures in non-agricultural sectors.[4]

Apart from these insurance effects, increased cash income from NTFP can address liquidity constraints that exist because of limited access to credit markets and that constrain households' ability to engage in profitable investments in agricultural

[4] These are risky investments. Children's education is an irreversible investment with delayed and possibly risky and non-linear returns (Schultz, 2003). Likewise, participation in off-farm self-employment, such as engaging in agricultural products and assets trade, are subject to market risks.

production and off-farm self-employment. For example, relaxing liquidity constraints helps households afford the start-up costs associated with entrepreneurial activities. (McKenzie and Woodruff 2006) and meet liquidity demands of seasonal agricultural production. By the same token, relaxation of liquidity constraints reduces the need to save through assets such as livestock in order to self-finance production investments.

Thus far, extant literature has provided evidence that precautionary saving and investment in risky ventures respond to public programs such as public safety net programs and conditional cash transfers. Gilligan and Hoddinot (2007) found that food aid in the form of the Productive Safety Net Program (PSNP) has slowed down the growth of livestock assets in Ethiopian villages. The finding supported the hypothesis that food aid substituted for livestock as a source of *ex post* consumption insurance. In related work, Dercon and Krishnan (2004) reported that food-for-work programs have crowded out informal risk sharing. Moreover, Gertler et al. (2012) confirmed that conditional cash transfers spurred investment in ventures that were risky but offered higher returns, which helped Mexican households attain higher long-term living standards. Likewise, randomized evaluation of Karplan et al. (2014) showed that providing farmers in northern Ghana with cash to purchase rainfall index insurance led to greater agricultural investment and riskier production choices in agriculture.

However, the question remains whether the same set of conclusions will emerge from forest commons management that offers higher and more stable environmental income relative to previous centralized or open-access tenure regimes. The present study is motivated to respond to this apparent lacuna in the literature. Using survey data from

selected villages in the Gimbo district, southwestern Ethiopia, we tested the hypotheses of (i) whether a JFM program, augmented by improved market linkage for NTFP, has reduced the demand for precautionary saving in the form of livestock assets; and (ii) whether the same programs instead spurred investment in risky ventures, specifically, children's education and off-farm self-employment, in order to raise living standards. For the analysis, we used a combination of econometric methods, including propensity score matching (PSM), difference-in-difference (DID) and instrumental variable (IV) methods to identify the average treatment effect of the program. We used participation in the JFM program as the treatment variable. As outcome variables, we use livestock holding, expenditure on children's education and participation in off-farm self-employment (livestock and coffee trade, as well as transport by pack animals).

Our results show that JFM programs with complementary market access support have reduced livestock asset holding and raised investment in children's education and participation in non-farm self-employment. The findings support the hypothesis that the program deters precautionary saving and stimulates willingness to take on risk and invest in risky but profitable ventures that raise long-run living standards.

2. Common property forest management in south western Ethiopia

In recognition of the importance of forest resources and in response to decades of deforestation under the state property regime and control, Ethiopia has recently reviewed its long-standing forestry policies and begun to implement decentralization of natural forest management to the communities located near that resource (Ameha et.al., 2014b and Gelo and Koch, 2014). From that policy, a number of programs have

been implemented across the country by various bilateral donors, such as GTZ and JICA and, as well as NGOs, including FARM Africa and SOS-Sahel (Tesfaye et al., 2010 and Kubsa et al., 2003). The general objectives of these programs are to arrest deforestation while improving the welfare outcome of those who are largely dependent on the forest for their livelihoods; the latter of which is intended to be achieved through bolstering the economic benefits provided by the forests.

Against this back drop, Farm Africa/SOS-Sahel started implementing JFM programs in 2001 (Lemenih and Bekele, 2008), which has currently culminated in the management of about 34000 ha of forests in the Bonga region (Ameha, 2014b).In light of the aforementioned two-pronged objectives, Farm Africa/SOS-Sahel targeted forests with the threat of deforestation and communities that depended heavily on those forests. Once identified, forest units were demarcated in the field. Within the provisionally identified forest units, information related to available forest resources was required, as was information related to past and present management practices. Finally, it was necessary to develop an understanding of prevailing forest management problems, forest uses and forest user needs (Lemenih and Bekele, 2008).

A number of observations emerged from this multi-step process. First, forest-dependent communities had engaged in the following portfolio of livelihood options, some of which have strong implications for deforestation: crop production, livestock production, forest extraction and off-farm employment (Gobeze et al., 2011). Among them, crop production through agricultural encroachment into forests and forest extraction in the form of illegal logging, and the harvest of fuel wood, for either direct sale or charcoal production, were to blame for increased deforestation (Lemenih and

Bekele, 2008; Bekele and Bekele, 2005).

Second, it was observed that communities related to forests were heterogeneous in terms of claims of customary right to the forests. Specifically, two groups of forest using communities were identified, namely, native population and resettled population (those new settlers that arrived from outside). Across these groups, perception of property right to forests varied. In particular, the native population perceives the forest as belonging to them (as a group) and view state ownership as the government's attempt to take it over. However, new settlers see the forest resources as being open to all. Whereas the former group is construed as having customary right to forest, the latter does not qualify for such a claim because of historical reasons (Stellmacher, 2007). Moreover, from federal and local government's point of view, such perception and the consequent forest use behavior were construed as violation of forest conservation rules, but these entities have failed to enforce rules due to high transaction (monitoring and enforcement) costs coupled with a significant budget constraint. Consequently, the forest had been subjected to an institutional vacuum in which no definite and enforceable institutions regulating access to the forests existed, the outcome often being de facto open access.

In light of these observations, Farm Africa had to face a choice of criterion of targeting a particular forest for intervention. The overriding criterion though, was the potential of each observed forest to produce non-timber forest products so that the program will bolster the economic benefits provided by the forests through the marketing intervention. However, variation in perception and practice of forest's customary right structure across native and new settlers' population raised another question of

selection criterion, once the first criterion was met. In consultation with local government and communities, Farm Africa devised the second criteria; whether the community (native or settlers) are primary users of the forest, which in turn was determined by proximity to the targeted forest and frequency of use (Ameha, 2014b; Lemenih and Bekele, 2008 and Bekele and Bekele, 2005). This criterion culminated in including both native population and population and new settlers across which perception of customary right over the targeted forests differed (Stellmacher, 2007). The difference in perception of customary right, in turn, results in varying participation decisions across the two population groups.

Once intervention sites and participants in the program had identified the remaining key elements of JFM intervention–crafting common property right forest management institutions (rules) and establishing enforcement mechanisms – were put in place. The process of rule setting and establishing the attendant community organization involved a range of complex procedures. Farm Africa/SOS-Sahel began the process with negotiations and discussions with all stakeholders. However, since skepticism regarding JFM was rife within both the local government and the local communities, Farm Africa/SOS-Sahel provided JFM training for all eligible households (Bekele and Bekele, 2005).

Eligible households that chose to participate in the JFM program formed Forest User Groups (FUG), which later developed into Forest Users Cooperatives (FUC). Those choosing not to participate must revert to using the nearest non-JFM forest, which, in effect, is a forest that operates under the *status quo*; that forest is unregulated, and access is open to all. The decision to participate or not to participate was voluntary. It

is assumed that the participation decision was determined by the perceived costs and benefits of JFM, a perception that is likely affected by training. However, there are reasons to believe that the participation decisions among these households are likely to vary with whether one belongs to native population or new settlers population as well as whether one's joint forest using group is ethnically heterogeneous. In the words of Ostrom (2007), participation in collective action is low among heterogeneous groups compared to homogenous groups due to lack of trust and communication. We thus, expect that the likelihoods of a participation of household in new eligible settlers group is lower compared to that in native population. Moreover, decentralization of forest property proposed by the program, as opposed to complete control of the state, is more harmonious to the perception among native population that claims that the forest naturally belongs to them. This is likely to encourage households in this group to participate in the program compared to household in new settlers group.

The formation of FUG/FUC came into effect following the framing of rules (institutions) and the setting up of organizational components (often known as nested enterprises in the commons literature). Because JFM is a co-management system, determination of the authority for making constitutional, collective choices and operational level rules were not left to FUC collectives, alone; rather, they involved experts from Farm Africa/SOS-Sahel and local governments. At an operational level, the rules comprise of: (i) stipulations relating to quantity and the types of forest products allowed for use by members; (ii) stipulations concerning disposal procedures for commercially valuable NTFPs; (iii) enforcement rules surrounding protection from fire, vandalism (including unauthorized tree cutting) and agricultural encroachment (clearing forest for agricultural land acquisition), and (iv) forest development (management) rules regarding the planting of new trees for the enrichment of the

existing forest.

Within the bounds of this intuitional framework, each individual member enjoys two kinds of rights over forest products: (1) a private right, and (2) a collective right. Privately, the forest can be used for livestock production, collecting wood for private use (including energy and farm implement construction), harvesting medicinal plants for own consumption, and beekeeping, all subject to management committee approval. The harvest of timber, forest coffee, and spices is a collective right, belonging to the FUC, leading to benefits that must be distributed across the membership, although 30% of total income is retained by the FUC (Bekele and Bekele, 2005, Lemenih and Bekele, 2008).

In terms of the causal chain, activities of JFM intervention – program forest identification, community and personnel training, stakeholder's analysis and negotiation – gave rise to the FUC (rules and its organizational contents)[5]. The functioning of the FUC, in combination with marketing assistance, in turn, yielded a range of intended outcomes. Particularly, it has increased forest cover and NTFP productivity (Bekele and Bekele, 2005; Limenih and Bekele, 2008; Gobeze et al., 2011), reduced free grazing of livestock within the forest and cutback agricultural encroachment and forest fires (Limenih and Bekele, 2008), and slashed the extraction of forest resources for the production and sale of charcoal and firewood (Gobeze et al., 2009). Moreover, the program has improved farmer access to new, fair and sustainable market opportunities, enabling them to sell their products (coffee, honey, spices) at

[5] In describing the evaluation problem we are drawing on theory of change as it is common in program evaluation literature. This framework outlines a results chain, which sets out the sequence of program inputs, activities, and outputs that are expected to improve intermediate and final outcomes associated with the intervention (Gertler, Martinez, Premand, Rawlings & Vermeersch, 2010).

better prices. For example, program farmers, through the FUC, sell forest coffee at 87% higher prices than non-program farmers (Shumeta, Urgessa and Kebebew, 2012). Likewise, they sell honey at 70% higher prices compared to non-program farmers (SOS SAHEL, 2007). These price premiums are attributed to savings on transaction costs (searching, bargaining, etc.), as well as added value accruing from processing, at least in the case of honey. Importantly, the program has raised annual per capita NTFP revenue by ETB 252–277 (an increase in excess of 100% of the annual per capita NTFP revenue of ETB 235 for non-program farmers (Gelo and Koch, 2014)[6]. As alluded to in the forgoing section, this can yield both insurance and liquidity effects on livestock holding, child education and participation in off-farm self-employment.

3. The data

Data for the analysis was obtained from a household survey undertaken in 10 Ethiopian villages in October of 2009. The villages are located in the Gimbo District, which is in southwestern Ethiopia. Survey sites were purposive, in the sense that five JFM villages and five non-JFM villages were selected from a list developed in consultation with the local government, as well as Farm Africa/SOS Sahel. The selected non-JFM villages were the closest available to the selected JFM villages.

The selection of villages was followed by going to the lower level of local government "Kebele", where we obtained sample frames of households for the selected villages. We randomly selected 200 households from JFM villages and 177 from non-JFM village, making up a total of 377 households.

Respondents provided information on household characteristics, such as: age, education, gender, family size, household expenditures (consumption and non-consumptions) on various goods and services, household earnings from the sale of

[6] ETB is Ethiopian Birr.

various goods and services, as well as the labor allocated to harvesting forest products and to other activities. Additional information related to potential determinants of JFM participation was also collected. This information included household circumstances prevailing immediately before the inception of JFM, such as household assets; livestock holding, land holding, the household head's education and age, participation in off-farm employment, ownership of private trees, access to extension services, and experiences related to alternative collective action arrangements. We also gathered information related to the distance the household was from both JFM and alternative forests. Finally, data related to the community was gathered, including population, ethnic structure, forest status and location. Information on livestock holdings were converted into tropical livestock units (TLUs), where 1 TLU, is equivalent to 1.5 cattle, 10 sheep, 12 goats, 2 donkeys or 1 horse. The number of TLUs was used as a proxy for the households' livestock assets (Lehouerou and Hoste, 1977).

Because of absence of longitudinal data, we designed our questionnaire to collect recall data. These data included information on variables household's circumstances that prevailed immediately before the inception of JFM in relation to the distance to PFM and alternative forests, household assets including livestock holding, the household head's education and age, participation in off-farm self- employment, ownership of private trees, participation in extension services, and experience of participation in alternative collective actions arrangements. Furthermore, data on community level variables such as population size, ethnic structure, forest status and location were collected. However, we didn't collect information on income and expenditure variables through recall design as it is hardly possible to recall information on them.

4. Theoretical framework

In this section, we develop a theoretical model to derive testable hypothesis of the linkage between JFM intervention and farm household investment behavior. We build on Deaton's (1991) canonical model of the intertemporal choice problem of a household that faces a stochastic income stream but has no access to financial markets. Specifically, the consumer is assumed to solve the following decision problem;

$$Max_{c_t} \sum_{t=0}^{\infty} \beta u(c_t) \quad (1)$$

Subject to

$$x_t = A_t + y_t \quad (2)$$

$$c_t \leq x_t \quad (3)$$

$$x_{t+1} = A_t + y_t - c_t + y_{t+1} \quad (4)$$

$$A_t \geq 0, \forall t \quad (5)$$

Where the current $u(c_t)$ is assumed to follow a constant relative risk-aversion (CRRA) and hence c_t is current consumption level, A_t is the stock of asset holding at time t. Cash on hand, x_t is defined as the sum value of asset holding, A_t and current income, y_t. Note that current income represents total income accrued from all source given by $y_t = w_t + rA_t + p\bar{f}$, where p is the net price of NTFP, which is subject to rise due to program intervention of improving market access. We assume that a typical farm household earns fixed labor income, w_t, return to holding the asset, rA_t and return to NTFP extraction, $p\bar{f}$ where $\bar{f}$ is fixed quantity of NTFP, the extraction of which is limited by the JFM rules. Equation (4) represents asset dynamics where the next period's asset level is simply the difference between cash on hand and consumption. The last equation is the non-negativity restriction on assets signifying the borrowing

constraint inherent under missing financial markets. Alternatively, the problem becomes one of solving Bellman equation for dynamic optimization given by;

$$V(x_t) = Max_{s_t} u(x_t - s_t) + \beta EV(x_{t+1}) \quad (6)$$

where we use saving, s_t as a choice variable. Following Deaton (1991), the value function $V(.)$ is monotonically increasing and concave in x_t. Equation (6) yields the following first order necessary conditions for an interior solution that implies consumption smoothing;

$$u_c(x_t - s_t)(-1) + \beta EV'(x_{t+1}) = 0 \quad (7)$$

Proposition 1. *An increase in NTFP price deters asset holding for precautionary saving.*

Proof : We prove this proposition in two ways. First, we can rearrange (7) as follows:

$$u_s(x_t - s_t) = \beta EV'(x_{t+1}) \quad (8)$$

Observe that the right hand side of (8) depends on the distribution of x_{t+1}, which, in turns, depends on y_{t+1}. Suppose we have two cases; one where y_{t+1} follows a distribution with higher variance and the other where its distribution embodies lower variance. Following Deaton (1991), we assume that the value function $V(.)$ is monotonically increasing and concave in x_t making the marginal value function (right hand side term of (8)) a downward sloping convex function. By Jensen inequality, marginal value functions under high income variance scenario lie above marginal value functions under low income variance for all values of s_t. For a given left hand side function of (8), the latter solves the optimization at lower level of saving, ${s_t}^*$ than the former, which leads to higher level of saving, ${s_t}^{**}$ implying ${s_t}^* < {s_t}^{**}$. We thus regard the difference ${s_t}^* - {s_t}^{**} < 0$ as program impact, because the program is expected to reduce variance of total income via increasing NTFP price. To see how

this causal mechanism works (our second proof), we undertake comparative static analysis of the reaction of savings to a change in price of NTFP

We derive comparative static results by applying the implicit function theorem to (7) i.e. let $F = u'(x_t - s_t) + \beta EV'(x_{t+1}) = 0$ be an implicit function and its derivatives with respect to s_t and p are respectively given by;

$$F_s = u_{cc}(x_t - s_t)(-1^2) + \beta EV_{xx}(x_{t+1}) < 0 \quad (9)$$

$$F_p = u_{cc}(x_t - s_t) + \beta EV_{xx}(x_{t+1}) < 0 \quad (10)$$

Moreover, the negativity of the first terms, the second order sufficient condition is guaranteed from concavity of utility function in c_t for a risk averse consumer and concavity of value function in x_{t+t} . Armed with these assumptions, we show that the response of saving is a decreasing function of the NTFP price as follows;

$$\frac{\partial s_t}{\partial p} = -\left(\frac{F_p}{F_s}\right) < 0 \quad (11)$$

The proposition suggests that increased price of NTFP leads to lower equilibrium asset holding through reduced saving. The intuition is that increased price of NTFP amounts to increased return to NTFP extraction, which changes composition of the asset portfolio in favour of NTFP extraction. Moreover, increased return to NTFP extraction has far-reaching implications for the distribution of total income of a household. Importantly, it reduces variance (proxy for risk) of total income of a household via eliminating or at least minimizing the lower tail of total income distribution while increasing its mean. Thus, for a given location parameter; mean of total income, the assumption of risk aversion implies that reduced income variance leads to more consumption and hence less saving (diminished motive for precautionary saving). In a nutshell, proposition 1 sets the basis for the empirical models employed in this study.

5. Econometric framework

Program impact refers to the difference between the observed outcome and the counterfactual outcome – the outcome that would have obtained had the program not been taken-up (Rubin 1973; Heckman et al., 1998 and Cobb-Clark and Crossley, 2003). As is well established in the program evaluation literature, we cannot observe counterfactuals because an individual is either in one state or the other at any point in time. In this study, we follow a quasi-experimental approach to identify the appropriate counterfactual, accepting that program participation is not random. As such, appropriately controlling for participation decisions is tantamount to identifying the program impact.

Following Roy (1951), we argue that farmers choose to participate in the program, provided that the benefit of doing so outweighs that arising from the *status quo*. That choice entails not only a welfare outcome, but also a behavioral change matching that welfare gain. If farmer $i = \{1, 2, \dots, N\}$ chooses to participate $(D_i = 1)$, the relevant household outcome, in this case livestock holding, education expenditure and participation in off-farm self-employment, is L_{1i}; L_{0i} is the relevant outcome for non-participating $(D_i = 0)$ households. Therefore, in regression format, $L_i = L_{0i} + D_i(L_{1i} - L_{0i}) + \eta_i = \alpha + \tau D_i + \eta_i$. Since participation is voluntary, the outcome is not likely to be independent of the treatment choice, such that treatment is not independent of the error term in the previous regression. Therefore, additional assumptions are needed in order to estimate the treatment impact.

Assuming that the distribution of outcome variables L_{1i} and L_{0i} are independent of treatment D_i, given a vector of covariates X_i, a propensity score matching estimator for the average effect of treatment on the treated can be derived. Intuitively, the goal of

matching is to create a control group of non-JFM participants that is as similar as possible to the treatment group of JFM participants, although the groups differ in terms of their participation. Identification of the average effect of JFM on the program participants, via propensity score matching (PSM), requires both the strict ignorability of treatment, $(L_{1i,}, L_{0i}) \perp D_i|P(X_i)$.

Non-ignorable Treatment Assignment

If there are unobservable determinants of participation, meaning that treatment assignment is non-ignorable, treatment effect results based on (PSM) estimators are biased. Under non-ignorable assignment to treatment, control function method (selectivity models), DID or IV approaches are, instead, needed (Woodridge, 2002, Heckman, and Navarro-Lozano, 2004; Heckman and Vytlacil, 2005 and Todd, 2008).

In what follows, we carefully describe the causal effect of interest. The data is comprised of n observations, and two of outcome variable L_i, livestock holding and education expenditure are continuously distributed, where participation in off-farm self-employment follows binary distribution. There is a binary treatment variable, denoted by D_i, as well as an instrumental variable, Z. For concreteness, from the matching section; we can re-specify the observed outcome variable as;

$$L_i = L_{0i} + D_i(L_{1i} - L_{0i}) + \eta_i \ = \alpha + \tau D_i + \{D_i, (u_{1i} - u_{0i}) + u_{0i}\} \quad (12)$$

The average treatment effect and or treatment effect on the treated is derived from (12) as follows, after manipulation of certain algebra;

$$E(L_{1i}|D_i = 1, X) - E(L_{0i}|D_i = 0, X)$$

$$= E(\tau|X) + E\{(u_{0i}|D_i = 1, \ X) - E(u_{0i}|D_i = 0, \ X)\} \quad (13)$$

Where the first term in RHS of equation (12) is average treatment on treated (ATT). The second term in equation (12) is the difference in the untreated outcome variables

between program participant (treated) and non-participant (untreated) individuals. If this term is zero, treatment effect on treated can be estimated using propensity score matching (PSM). However, if this difference is greater than zero, it follows that those individuals who would have done well, in terms of unobservable, u_{0i}, without program participation, decided to participate in the program. In other words, cov $(u_{0i}, D_i) \neq 0$ leading to bias of PSM estimate in equation (1). Identification is then, achieved through either selection models, panel data models (DID) or IV method (Heckman and Vytlacil, 2005; and Todd, 2008).

In the interest of testing robustness of estimate to different identification assumptions, we employed PSM, DID and instrumental variable methods to identify treatment effect estimate in (13), the latter two of which are used to control for selection/endogeneity bias.

We exploited exogenous variation in ethnic composition and the associated perception of customary right across population, who were chosen eligible and were using the targeted forests before program intervention. As discussed in section 2, these variation across the group results in variation of household's participation across the groups. We use a binary variable of whether a household belongs to native population or new settlers to capture this variation in eligible set of populations.

This variable is thus, used as an indicator of the household's intention to treat, which is assumed to determine participation in the JFM program. However, because variation in group ethnic composition and the associated perception of customary right were determined by historical events, this variable is exogenous to our outcome variables

and can only impact on them through its effects on household program participation status. However, as our IV is binary and hence the problem of partial/imperfect compliance, we followed the specifications of (Angrist et al., 2000; Hirano et al., 2000; Yau and Little, 2001; Abadie, 2003 and Frolich, 2007) in our empirical strategy.

6. Result and discussion

In this, section, we present the impact of program participation on livestock holding, expenditure on education and participation in off-farm self-employments among program participants. Table 3 presents results from propensity score matching, differences-in-difference and binary-IV models. As a baseline case, we also estimated simple mean differences in outcome variables between program participants and non-participants. The mean differences estimate obtained through t-test is not statistically significant, suggesting that there is no difference in livestock holding between the two groups. However, the mean differences are statistically significant and positive for off-farm self-employment and education expenditure.

Identification based on observed controls via PSM yielded treatment effect estimates of -1.6TLU , 0.141 percentage point and ETB 67.002 respectively on livestock holding, off-farm self-employment participation and expenditure on education.

For livestock holding, when we estimate the mean difference, from a pooled baseline and follow up dataset, via single DID, average treatment effect on treated (ATT), the estimate is -0.858, which is statistically significant. Given that the mean livestock holding among non-participants (control group) is 4.50TLU (see Table 1), this vindicates that the program has reduced livestock holding by 19.06%. Moreover,

conditional mean differences estimate from DID that controls for covariates yielded a statistically significant average program effects of -0.9TLU. Moreover, an IV method estimates are respectively -1.29TLU, 0.842 percentage points and ETB52.10 respectively for livestock holding, off-farm self-employment and expenditure on education, which are statistically significant.

In terms of participation in off-farm employment, in the interest of robustness, we also implemented a standard random effect probit (RE) model, Maximum Simulated Likelihood random effects dynamic probit models (Dynamic probit-SML) with autocorrelated errors models and Hecman maximum likelihood estimator of dynamic probit (Dynamic probit-Hecman), which allows for the endogeneity of the initial conditions, but assumes no autocorrelation in the time varying component of error term. The results from these models are in accordance with those obtained from PSM and IV methods, while variation in estimates magnitude remains (see Table 4).

Overall, the analysis revealed that JFM, augmented by integration of the markets for NTFP, deters investment in livestock asset and that result is robust to a broader set of identification strategies. Our result corroborates Gilligan Hoddinott (2007), who uncovered that public insurance in the form of Safety Net Program has slowed down the growth of livestock asset in Ethiopian villages. Specifically, our finding supported the hypothesis that, via increasing secure environmental income, the JFM program considered has crowded out livestock holding as a source of *ex post* consumption insurance.

Alternative explanation lies in liquidity effect of the program. That is, through revenue from forest products, which accrues throughout the year, the programs have provided

participants households with liquidity required for investment in alternative venture, typically crop production, and thus substitute livestock as a liquid asset, the sale of which generates cash to purchase such inputs as fertilizer, pesticide and seed for crop production.

On other front, the analysis revealed that participation in JFM program considered in our study spurred investment in child education and off-farm self-employment both of which are risky ventures, but have potential to raise long-term living standards. This support the hypothesis that, via offering higher and secure environmental income, the program has encouraged households to take on risk and invest in more productive activities and human capital. These behavioral responses point to the program's potential to break poverty trap via ancillary mechanism beyond directly raising short-term welfare outcome. In nutshell, we make the observation that augmenting natural capital through increasing its product price can raise long-term living-standard, which amounts to leveraging rural poverty reduction.

7. Conclusion

In the wake of decentralization of forest commons management, previous literature has mainly focused on examining the impact of forest commons tenure reform on forest base as well as the attendant welfare and distributional outcomes. Another strand of literature analyzed whether public safety net program crowed out livestock holding as source of *ex post* consumption insurance[7].

However, we observe sizeable dearth of evidences on the linkage between forest commons tenure reform and precautionary saving and the ability to take on risk

[7] In fact, much of the literature have been commited to testing the existences of precauatinray motive among peasnt farm houeholds by investigtaing the link between livestck and income shock.

investment in productive activities that offers opportunities to raise long-term living standard. In light of this empirical uncertainty, this study set out to examine the impact of a unique Joint Forest Management on livestock holding, participation in off-farm self-employment and investment in child education in selected rural villages of Ethiopia. This program is two-pronged: a Joint Forestry Management (JFM) is developed and combined with the provision of additional support for improved market linkages for non-timber forest products.

The analysis was based on data collected in selected villages of Gimbo district southwestern Ethiopia. As a methodological basis, we drew on potential outcome framework, through which the causal link between program intervention and household's livestock holding, child education expenditure and on-farm-self-employment could be empirically investigated. We employed propensity score matching, difference-in-differences and instrumental variables models to examine the robustness of the estimated treatment effects to various identification assumptions.

The analysis revealed that average livestock holding is smaller for program participants than non-participants suggesting that the JFM intervention has deterred investment/ saving in the form of livestock among participating households in the study villages. The result supported our theoretical prediction that the program has reduced the demand for precautionary saving in the form of livestock asset. Moreover, we found that the program has spurred investment in child education and participation in off-farm self-employment.

These results point to a broader set of rural development implications of forest commons management that raises a steadily accruing environmental income. First, it raises concern about possible policy choice dilemma. On the one hand, forest commons decentralization policies are intended to save forests from deforestation

through investment in the form of stewardship of existing forest stock (restricting excessive forest harvest and giving up agricultural land expansion). Spurring this investment required providing incentive basis through increasing economic benefits afforded by decentralized forests themselves. One possibility, perhaps innovative one, is raising the value of forest products via improving their market linkage, which was shown to crowd out livestock holding. On the other hand, livestock are productive assets, in addition to being buffer stock, making it important government policy target to bolster agricultural outputs. Its depletion thus, raises concerns as much as deforestation does. These conflicting outcomes point to conservation-development policy choice dilemma underscoring the importance of careful design and implementation of either of the policies.

Perhaps, an interesting rural development implication of such programs is their ability to encourage households to take on risk and participate in risky ventures, such as off-farm self-employment as well as investment in child education, both of which have potential to raise long-term living standard.

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Table 1. Descriptive statistics of covariates used in the analysis

Variable	Description	JFM participant		Non-participant		
		Mean	SE	Mean	SE	Mean difference
Sex	Household head sex (male=1)	0.932	0.018	.943	0.016	-0.010
agea	Age of household head in years	43.916	1.019	43.244	1.023	-0.671
Hhsize	Household size (number of members)	5.899	0.165	5.7346	0.154	0.164
Tlua	Household livestock ownership converted in to TLU(in total livestock unit)	4.256	0.193	4.501	0.215	-0.244
Lndsza	Household landholding size in hectare	2.300	0.110	2.412	0.114	-0.111
Edumax	Number of households in the village	6.257	0.220	6.707	0.220	-0.450
Offrma	Whether a household participated in off-farm self-employment activities (yes=1, no=0))	0.145	0.026	0.082	0.019	0.063**
Wealth	Whether a household has a corrugated house(yes=1, no=0)	0.251	0.032	0.239	0.030	0.011
Hhedua	Education (grade attained) of household head	4.5	0.208	5.108	0.307	-0.608*
Dsttown	Household distance to the nearest town (in minute)	69.379	3.509	72.454	2.693	-3.074
Dstroad	Household distance to the nearest road(in minute)	23.639	1.935	32.295	2.614	-8.656***
Malefa	Household labor-force (men)	1.449	0.055	1.478	0.059	0.028
Femalefa	Household labor force women	1.378	0.051	1.338	0.046	0.04
crdta	Whether a household has participated in credit market (yes=1, no=0)	0.307	0.034	0.219	0.029	0.087**

Table1 2: Logit model estimates of the determinants of program participation (baseline covariates were used)

VARIABLES	coefficient	Marginal effect
Household head's age	-0.008	-0.002
	(0.011)	(0.002)
Household head's gender	-0.336	-0.083
	(0.553)	(0.137)
Household head's education	0.022	0.005
	(0.052)	(0.012)
Female labour force	0.848***	0. 208***
	(0.307)	(0. 075)
Male labour force	-0.230	-0.056
	(0.258)	(0. 063)
Land holding size in ha	0.010	0.002
	(0.085)	(0.021)
Off-farm employment	0.842*	0.207*
	(0.490)	(0. 115)
Distance to agro extension office	-0.004*	-0.001*
	(0.002)	(0.001)
Woodlot ownership	-0.511*	-0.125*
	(0.282)	(0.068)
Livestock holding size in TLU	0.122***	0.030**
	(0.049)	(0. 012)
Distance from JFM forest	-0.028***	-0.006***
	(0.005)	(0.001)
Experience of other collective action	1.400***	0.329***
	(0.509)	(0 .103)
Distance from nearest town	-0.005*	-0.001*
	(0.003)	(0 .001)
Distance from nearest road	-0.008**	-0.002**
	(0.004)	(0.001)
Constant	0.281	
	(0.761)	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 3 Average Treatment Effect on Treated (ATT) alternative estimators

Estimator	Livestock holding	off-farm self-employment	education expenditure
Simple difference	0.239	0.063**	116.550**
	(0.292)	(0.035)	(45.297)
Kernel matching	-1.624***	0.141*	67.002*
	(0.371)	(0.073)	(29.818)
DID-I	-0.858*		
	(0.452)		
DID-II	-0.900**		
	(0.418)		
IV-nonparametric	-1.291*	0.842**	52.10*
	(0.760)	(1.994)	(27.66)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 4. Panel data models estimate of program impact on self-employment

	RE-probit	Dynamic probit-SML	Dynamic probit-Hecman
VARIABLES			
partcp	0.969**	0. 445**	0.445**
	(0.494)	(0. 205)	(0.205)
hhedu	0.264***	0.0963***	0.0964***
	(0.0845)	(0. 0328)	(0.0328)
hhdstwnmin	-0.00722	-0. 00405	-0.00405*
	(0.00552)	(0. 00242)	(0.00242)
age	0.0176	0. 00703	0.00703
	(0.0198)	(0. 00886)	(0.00886)
sex	0.115	0. 0447	0.0447
	(1.042)	(0.415)	(0.415)
lndsz	-0.234	-0. 0841	-0.0841
	(0.162)	(0. 06856)	(0.0686)
tlu	-0.0793	-0. 0539	-0.0539
	(0.0712)	(0. 0368)	(0.0368)
crdt	0.761*	0. 509**	0.509**
	(0.390)	(0. 2040)	(0.204)
Constant	-4.531***	-1.660***	-1.660***
	(1.434)	(0.560)	(0.560)
Observations	540	358	358

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1