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Cost sharing for timber stand improvements: Inducement or crowding out of private investment?

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ABSTRACT

Cost sharing has been widely used to encourage the management of privately owned forests. While there is evidence of its capacity to promote management activities, it still remains open whether cost sharing induces additional private investments or whether it substitutes public funds for private capital. This study re-examines the latter issue in the case of Finnish family forest owners' pre-commercial and restoration thinnings using data from a nation-wide survey ($n = 3801$). A two-step model of cost-share participation and stand improvements is used to account for the endogeneity of cost-share participation. Cost-share participation was related to personal assistance and clearly encouraged forest owners' engagement in and extent of stand improvements. The inducement or crowding out of private capital is analytically shown to depend on the relative magnitude of forest owners' response to cost-share incentives in each specific situation. In the present case evidence suggests that cost sharing has had an inducement effect on private investment. This is likely related to the advanced personal assistance that has promoted the knowledge of and participation in cost sharing. The findings suggest that cost sharing can be a useful component in a balanced policy mix especially when combined with informational instruments.

1. Introduction

Contemporary forest policy instruments are increasingly facing demands of cost-effectiveness and evidenced benefits to the society. The ongoing changes in forest land ownership in Europe (see Živojinović et al., 2015) call for a critical look into existing forest management incentives, especially into their performance with respect to new or emerging types of forest owners. The EU Forest Strategy (European Commission, 2013) underlines the need to strengthen sustainable forest management. Due to the current economic situation, however, EU member states may cut down on their forestry subsidies. There has also been critical discussion about whether subsidies for wood production fit with the production of market goods in the market economy (see, e.g., Hujala et al., 2014). In Finland, for example, the overhaul of forest legislation in the early 2010s has followed the principles of market liberalization. The idea has been to thin down regulation and to enhance private companies' operational environment for delivering market services to landowners. Nevertheless, forestry subsidies and cost-share programs are still widely used, and the debate on their basic justification makes the critical evaluation of their performance even more relevant.

Public cost-share and technical assistance programs have been used to encourage various management activities in private forests. In North America, where reforestation is in the landowner's discretion and further thinnings are not regularly undertaken, most cost-share programs have targeted reforestation investment to ensure a sustainable future timber supply (e.g., de Steiguer, 1984). More recent examples are cost-share and conservation easement programs for various silvicultural and conservation management activities (Song et al., 2014a, b) and cost sharing for pre-commercial thinnings to prevent insect damage (Watson et al., 2013). In Europe, subsidies are the most common financial instrument in forest policy used in some form by over 20 countries (Rametsteiner and Sotirov, 2015). In Finland, where the reforestation of cut-over land is required by law and not subsidized, most cost-share funds have been used for pre-commercial thinnings and cleaning of young stands. In the Nordic even-age forestry regime, conducting such improvements in due course is considered pivotal in avoiding growth losses and maintaining profitability over the rotation period. Despite variation in the targeted management activities across regions and programs, the basic rationale for subsidizing private forestry is to provide private forest owners with economic incentives for reforestation and other long-term investments to support long-run timber supply, to promote conservational goals, or to correct for negative externalities.

Several studies suggest that cost sharing has been successful in bringing about increased reforestation and timber stand improvements (Boyd, 1984; Hardie and Parks, 1991, 1996; Hyberg and Holthausen,

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1989; Løyland et al., 1995; Ovaskainen et al., 2006; Royer, 1987; Song et al., 2014a; Zhang and Flick, 2001). This is a satisfying outcome if the policy maker's primary concern is to ensure sufficient areas of management activities to support future timber production, be it with private or public funds. Regardless of a positive acreage response, however, it is not clear whether cost sharing truly induces additional private investments or whether it substitutes public funds for private capital. It clearly matters to the actual effectiveness of the cost-sharing instrument if cost-share funds are used for investments that would be made without public funds as well. Although the potential "capital substitution problem" (de Steiguer, 1984), or crowding out effect, has been long recognized, rather few studies have focused on this issue, and existing evidence is mixed. Boyd (1984), Zhang and Flick (2001), and Linden and Leppänen (2003) found suggestive evidence of crowding out, while de Steiguer (1984), Lee et al. (1992), and Hardie and Parks (1996) found no such effect. Sun (2007), using a time-varying parameters model, found both inducement and crowding out effects depending on the time period and region considered. In the current quest for more cost-effective forest policies, the crowding out issue obviously deserves to be revisited.

The effectiveness of voluntary policy instruments, such as cost sharing, depends on private forest owners' awareness of and participation in the program (Hardie and Parks, 1991; Romm et al., 1987). A related feature of cost sharing is the jointness of program participation and investment decisions: "*the participation decision is also an investment decision, for the qualifying owner must commit economic resources to the regeneration or improvement of a forest site*" (Hardie and Parks, 1991, p. 157). Still, it has been common in previous studies to treat program participation as a random exogenous variable (for a detailed list of references, see Song et al., 2014a).

The failure to account for the non-randomness and endogeneity of cost-share participation results in potentially biased estimates for the effects of cost sharing. For a way around the apparent endogeneity, many studies have used predetermined variables, such as awareness of cost sharing prior to the investment decision (e.g., Boyd, 1984; Hyberg and Holthausen, 1989; Royer, 1987; Zhang and Flick, 2001). Studies that explicitly model the program participation decision and account for its endogeneity when estimating the effects of cost sharing are few. Hardie and Parks (1996) examined program enrollment and acreage response to reforestation cost sharing using a two-stage switching regression with endogenous switching. Ovaskainen et al. (2006) used a two-step approach in which the predicted probability of cost-share program participation from the first-step model was used as the cost-sharing variable in the second-step model of timber stand improvements. Song et al. (2014a, b), in their analysis of cost-share and conservation easement program participation and its effect on family forest owners' management activities, used the propensity scores matching method to reduce the possible selection bias.

The present study investigates the effects of cost sharing, personal assistance and forest planning on the probability (done or not done) as well as the extent (hectares managed relative to the total area of forested land in the holding) of Finnish family forest owners' timber stand improvements. These include pre-commercial thinnings and cleaning of seedling and sapling stands as well as restoration thinnings of overstocked juvenile stands. Data from a nation-wide survey of Finnish family forest owners and their stand improvements in 2004–2008 are used. We contribute to the understanding of the effects of voluntary policy instruments as follows.

First, we allow for the endogeneity of cost sharing due to the jointness of the cost-share participation and investment decisions by using a two-step estimation approach (Murphy and Topel, 1985). Besides overcoming a potential bias, separately modeling the participation decision highlights factors affecting cost-share participation, especially the interconnection of cost sharing and personal assistance. As cost sharing is treated as the probability of cost-share participation, its realized (*ex post*) and predicted (*ex ante*) effects are analyzed through changes in the predicted performance as the probability of participation is altered. While several previous studies have employed two-step sample selection models to analyze landowners' awareness of and participation in policy programs (e.g., Creamer et al., 2012; Joshi et al., 2013; Sun et al., 2009) or the likelihood of reforestation and reforestation investment conditional on the decision to reforest (Zhang and Flick, 2001), it is worth noting that the main issue of the present study is markedly different from these studies. In modeling cost-share participation as an endogenous variable and then proceeding to estimate its effect on forest investment decisions, we rather follow Hardie and Parks (1996), Ovaskainen et al. (2006) or Song et al. (2014a).

Second, we reconsider the less frequently covered issue of the potential substitution of public funds for private capital through cost sharing. We show analytically that for cost sharing to induce private investment, its relative effect on the overall investment (i.e., private capital plus public funds) per hectare must exceed the subsidy-covered share of the management cost relative to the privately funded share of the cost. The derived formula and the estimated effects are then used to examine the empirical issue of whether inducement or crowding out of private capital occurs in the present case. The subsequent discussion informs policymakers on the aspects that need to be considered when aiming to design, modify or discontinue cost-share programs in private forestry.

2. Analytical approach

2.1. Econometric models and two-step estimation

Two frequently used models for qualitative and limited dependent variables are the probit and Tobit models (e.g., Maddala, 1983). The underlying processes can be presented by letting a continuous latent variable y_i^* denote an individual's propensity to engage in the activity in question. The latent y_i^* is assumed to be linear function of the vector of independent variables $x=(x_1,\ldots,x_n)$. It is observed as y_i, which is either a binary indicator of engagement or a censored variable. When $\beta=(\beta_1,\ldots,\beta_n)$ denotes the estimable vector of parameters and u_i is an error term, the binary probit model is characterized by

$$y_i^* = \beta' x_i + u_i, y_i = \mathbf{1}(y_i^*>0) \quad (1)$$

where $u_i \sim N[0,\sigma^2]$ and $\mathbf{1}(\cdot)$ is an indicator function which takes on the 1 value if the statement in parenthesis is true and the 0 value otherwise. The Tobit model, which is one type of censored regression models, can be written as

$$y_i^* = \beta' x_i + u_i, y_i = \max(0, y_i^*) \quad (2)$$

Unlike the case of an exogenous cost-sharing variable, allowing for the jointness of the cost-share participation and investment decisions calls for a two-equation model with two latent variables. First, let y_{i1}^* represent the propensity to participate in cost sharing, which depends on a vector of independent variables z_i and is observed as a binary indicator of whether public subsidy was used. Second, y_{i2}^* is the propensity to invest in stand improvement, which depends on the cost-share participation decision and other regressors x_i and is observed as a binary or censored variable.

In this study two-equation models were estimated using the two-step estimation method (Murphy and Topel, 1985; Greene, 2000, pp. 133–137, 432–438; Greene, 2002, Section E15.5.3). This approach is often used to allow for unobserved, yet predictable factors such as expectations. First, the probit–probit model can be written as

$$y_{i1}^* = \beta_1' z_i + u_{i1}, y_{i1} = \mathbf{1}(y_{i1}^*>0) \quad (3a)$$
$$y_{i2}^* = \gamma_2 \Phi\left(\hat{\beta_1'} z_i\right) + \beta_2' x_i + u_{i2}, y_{i2} = \mathbf{1}(y_{i2}^*>0) \quad (3b)$$